User Manual

Allen-Bradley

Dynamix -1444 Series Monitoring System

Catalog Numbers 1444-DYN04-01RA, 1444-TSCX02-02RB, 1444-RELX00-04RB, and 1444-AOFX00-04RB

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Allen-Bradley, Dynamix, Rockwell Software, and Rockwell Automation are trademarks of Rockwell Automation, Inc.

Trademarks not belonging to Rockwell Automation are property of their respective companies.

This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the major changes made to this revision.

Topic	Page
Ethernet Cable Information	15
Filters	109
Decimation Menu Selections	114
Tracking Filter Information	118
Normal Thrust Selection	135
Concluding Transient Events	177
Time Management	183
Transducer Fault Detection	189
Tachometer Signal Condition Input Fault Detection	189
Sampling Control	306

Notes:

Table of Contents

Chapter 3

Configure the 1444 Dynamic Measurement Module

Chapter 4
Measurement Definition

Chapter 5
Configure the Tachometer Expansion Module

Chapter 6
Configure Analog Outputs

Chapter 7
Configure Relays

Chapter 7
Configure Alarms

Chapter 8

Trend and Transient Capture

Chapter 9

Operate the Module

Appendix A

Status

Appendix B

CIP Objects

Notes:

This manual describes the Dynamix™ 1444 Series dynamic measurement module. The information in the following chapters discusses installation, configuration, and operation of the module.

The module measures dynamic inputs such as vibration, pressure, and static inputs such as thrust, eccentricity, and rod drop. The 1444-DYN04-01RA module is designed specifically for integration with Allen-Bradley Logix controllers connected across an industrial Ethernet network.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications Website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.
Dynamix 1444 Series Monitoring System Specifications Technical Data, publication 1444-TD001	Provides system specifications for the Dynamix 1444 Series Monitoring System.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley Distributor or Rockwell Automation sales representative.

Notes:

Chapter **1**

About the Dynamix 1444 Series Dynamic Measurement Module

Applications

The Dynamix™ 1444 Series dynamic measurement module is a four-channel, general-purpose monitor that can serve almost any industrial machinery protection or condition monitoring application. The module supports measurements of dynamic inputs such as vibration, pressure, and static inputs such as thrust, eccentricity, and rod drop. The module can be used for monitoring shaft, casing, and pedestal vibration, shaft and rod position, casing expansion and other critical dynamic and position measurements on rotating machinery.

To achieve this degree of adaptability the module marries an extraordinarily flexible firmware and an incredibly powerful multi-processor hardware platform.

The 1444-DYN04-01RA module is designed specifically for integration with Allen-Bradley Logix controllers connected across an industrial Ethernet network. This makes the 1444 Series unequaled in its ability to serve as a synergetic member of larger total facility control and information management systems.

The 1444 Series includes the main module (1444-DYN04-01RA) plus three optional expansion modules. The expansion modules, a tachometer signal conditioner, a relay module and an analog output module, are configured and managed from their host "main" module. Therefore configuration of these capabilities is included in the AOP for the main dynamic measurement module.

The main module also manages errors that are associated with any expansion module. The behavior of the expansion modules themselves on the failure of its host main module, or loss of communication to the main module, can also be defined.

The module supports the EtherNet/IP communication protocol and includes two RJ45 Ethernet ports. These ports can be applied as either standard Ethernet connections, where modules are daisy chained one to the next, or implemented by using Device Level Ring (DLR).

Main Features

The DYN module offers the following major features:

- Distributed vibration module with direct EtherNet/IP network connectivity
- Multifunction: configurable for eddy current probes, accelerometers, velocimeters, and all common dynamic measurement sensors that output voltages from -24V to +24V DC.
- Four measurement channels and two tacho (TTL) circuits
- Transducer supply configurable per channel, as one of:
  - Constant Current Mode: +24 V/4 mA
  - Constant Voltage Mode: +24 V/25 mA
  - Constant Voltage Mode: -24 V/25 mA
- Buffered signal outputs (output current limited)
- Measurement bandwidth up to 18 kHz (4-channels), 40 kHz (2-channels)
- Digital filtering and signal analysis, including integration
- Supports Spike Energy (gSE) measurements
- Implements HP and LP filters (4-pole Butterworth), with infinitely variable -3 dB points
- Sophisticated and flexible alarm logic
- Protection alarm checking, typically every 40 ms
- Relay output (SPDT) rated for 30V DC and 250V AC
- FFT analysis capability

- Configurable for specialist measurements such as:
  - Rod drop
  - Ramp or complementary differential expansion
  - Eccentricity
  - Absolute shaft vibration
- Over 20 different measurement parameters per measurement channel, such as RMS, peak, FFT band RMS, order magnitudes, phase, and speed
- Onboard storage of:
  - Trend data (discrete and dynamic data records)
  - Alarm/Event data (discrete and dynamic data records)
  - Transient data (discrete and dynamic data records)
- Expansion modules available to enhance system capabilities:
  - 4-channel Relay output module (up to three per each DYN module)
  - 2-channel Tacho Signal Conditioning module
  - 4-channel 4…20 mA output module

Product Description/System Overview

The Dynamix series consists of just six core part numbers and various accessories for connectors and cables.

A minimum Dynamix 1444 Series monitoring system consists of the following:

- One DYN module, which is comprised of a terminal base, a module, and either spring or screw clamp removable plug connectors for both the module and terminal base.
- Appropriate enclosure
- Sensors
- Power supply unit

Expansion modules provide enhanced or optional I/O capabilities that are application-dependent:

- 4-channel relay output modules (RELX)
- 4-channel 4…20 mA output module (AOFX)
- 2-channel Tacho Signal Conditioning module (TSCX)

Up to three RELX modules and one each AOFX and TSCX module can be connected to one DYN module. Interconnections between a DYN module and its Expansion module (and to extend the tacho bus from one such group to further DYN modules) are by ribbon cable assembly:

The following parts listings conform to this hierarchical structure:

- Assembly level (of module and base excluding connectors)
  - Connector level (choice of screw or spring clamp type)
  - Component level (module or base as spare/replacement item)

Table 1 - 1444 Series Catalog Numbers

Type	Module	Catalog Number
Measurement modules	Dynamic measurement module	1444-DYN04-01RA
Speed modules	Tachometer signal conditioner expansion module	1444-TSCX02-02RB
Relay modules	Relay expansion module	1444-RELX00-04RB
Analog output modules	4…20 mA expansion module	1444-AOFX00-04RB
Terminal bases	Dynamic measurement module terminal base	1444-TB-A
	Expansion module terminal base	1444-TB-B

Table 2 - Removable Plug Connector Sets

Module	Spring Connector	Screw Connector
1444-DYN04-01RA	1444-DYN-RPC-SPR-01	1444-DYN-RPC-SCW-01
1444-TSCX02-02RB	1444-TSC-RPC-SPR-01	1444-TSC-RPC-SCW-01
1444-RELX00-04RB	1444-REL-RPC-SPR-01	1444-REL-RPC-SCW-01
1444-AOFX00-04RB	1444-AOF-RPC-SPR-01	1444-AOF-RPC-SCW-01
Terminal Base	**Spring Connector**	**Screw Connector**
1444-TB-A	1444-TBA-RPC-SPR-01	1444-TBA-RPC-SCW-01
1444-TB-B	1444-TBB-RPC-SPR-01	1444-TBB-RPC-SCW-01

Table 3 - 1444 Series Interconnect Cable Accessories

Catalog Number	Description
1444-LBIC-04	Local bus interconnect cable (qty 4)
1444-LBXC-0M3-01	Local bus extender cable, 0.3m (11.8 in.)
1444-LBXC-1M0-01	Local bus extender cable, 1.0 m (39.4 in.)

Each main and expansion module terminal base includes one standard ribbon cable connector. This connector is sufficient to interconnect all main and expansion modules in a system.

System Enclosure

An IP54 weatherproof enclosure is recommended for general applications and required for use in hazardous area locations.

Use of a metal enclosure is recommended to enhance EMC and thermal system performance.

Cable, Connector, and Mounting Accessories

Local Bus (module to module, interconnect cables)

1444 series modules are connected through a local bus that is implemented by the use of a simple ribbon cable that spans one module to the next. The packaging for each terminal base includes a cable that is designed to the exact length necessary to connect two adjacent modules.

The extended interconnect cables provide a means to extend the local bus between terminal bases on different DIN rails or in different areas of a cabinet.

Extended interconnect cables are rated to 300V and from -40…105 °C (-40…221 °F).

The accessory list also includes a package of four standard length interconnect cables (catalog number 1444-LBIC-04). These cables can be used to replace the cable included with each terminal base.

Ethernet Cables

The 1444 products are designed to operate in harsh industrial environments and possibly close to electrically noisy or high-voltage devices and wiring. You must consider the environment, over the entire run of the cable, when determining an appropriate cable for the application.

Channel Class and Category

Dynamix 1444 Series monitors can be used with shielded or un-shielded Ethernet media. Shielded cable or entirely enclosing the cable within a shielded environment, such as an electrical enclosure or metal conduit, must be considered for cables longer than 3 m (9.8 ft.) to help ensure EMC compliance.

See Rockwell Automation documents 1585-BR001B-EN-P Industrial Ethernet Media and ENET-RM002C-EN-P Ethernet design considerations for information on selecting appropriate Ethernet media for your application.

Recommended Cables

Only straight connectors are recommended for use with the 1444 products. Verify that the temperature rating of the selected cable is appropriate to the environment in which the 1444 product is installed, up to and including 70 °C (158 °F).

Compatible Sensors

The following types of sensors that can be connected to a DYN module:

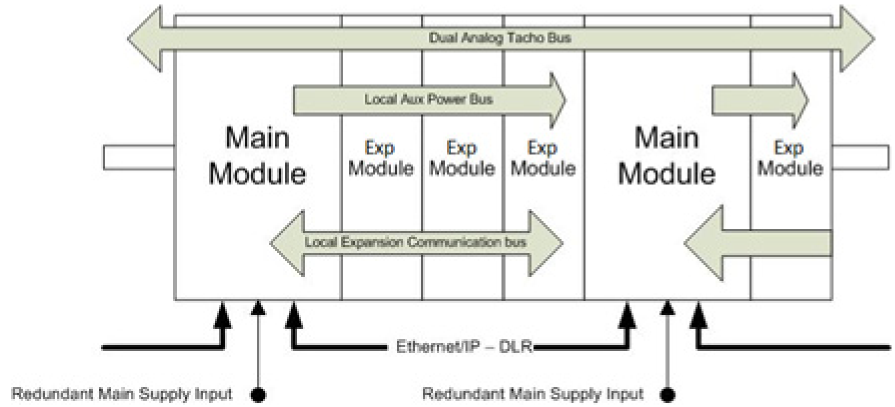
- 2-wire piezoelectric acceleration sensor
- 3-wire piezoelectric acceleration sensor with temperature sensing
- 2-wire piezoelectric dynamic pressure sensor
- 2-wire piezoelectric velocity sensors
- 2-wire self-generating velocity sensors
- 3-wire piezoelectric acceleration sensor
- 3-wire eddy current probe (ECP) systems
- Buffered voltage outputs
- Process proportional voltage signals (such as temperature, pressure, and flow)

There is a transducer supply available for each channel that can be independently enabled and configured negative or positive operation (25 mA at 24V) or as a positive constant current source at 4 mA, 24V. The transducer power supply output is made available at a separate terminal so that, by appropriate wiring, it is possible to connect either two or three wire transducers.

System Components

The Dynamix 1444 series is a machinery protection system comprising at least one DYN module that has four channels for vibration or related measurements, two TTL speed inputs, and one relay output.

Expansion modules then provide more output and input capacity that cannot be accommodated within that DYN module. The use of expansion modules is entirely optional and dependent on the specific application requirements.



For critical applications, the DYN modules support EtherNet/IP communication, including Device Level Ring (DLR) configurations and accept wide ranging (18...32 V, 24V nominal) redundant power inputs.

When expansion modules are used, the following apply:

- Any expansion modules are fitted to the right of their host DYN module.
- Expansion modules provide more relays, 4…20 mA outputs, and tachometer signal conditioning facilities.
- A local bus (ribbon cable) connects the main to its expansion modules, providing:
  - Current limited (fuse protected) power for the expansion modules
  - Local communication (main with expansion)
  - A dual tacho bus that distributes the TSCX modules TTL outputs
- The tacho bus can be extended to other DYN modules by fitting a bus cable from the end of the expansion module group or from the left side of the associated DYN module, as required.

The expansion relay module can initiate an alarm or placing the machine in a safe state if it detects the DYN module is no longer responding correctly or in a timely manner.

Network Connectivity and Considerations

Within the system, the DYN module uses an RS-485 proprietary local bus for communication with its Expansion modules. The DYN module interfaces to the EtherNet/IP network as an adapter device using single-node addressing.

Given presence of two Ethernet RJ45 ports and integrated network switch, the system can be used in different network topologies:

- Linear
- Star
- DLR

Given available internal switch, a linear module-to-module Ethernet connection can be established without the need for a local Ethernet router/switch. A linear topology is not considered to be a preferred solution, given that any module or cable failure results in loss of communication to that part of the network, downstream of the fault.

The star topology uses a multi-port Ethernet router/switch to establish point-to-point connections to DYN modules in the network. This topology increases network reliability, although it doesn't offer point-to-point connection redundancy.

IMPORTANT	As the Dynamix 1444 Series is basically a one port device with a two-port switch, the normal star topology redundancy using the Spanning Tree Protocol (STP – IEEE 802.1D or its newer and faster recovery variant RSTP – IEEE 802.1w) does not work for this EtherNet/IP application.

Most preferred from the perspective of performance, support, and ease of installation is the use of the DLR redundancy method. The Device Level Ring (DLR) redundancy mode lets you make a simple ring-based module-to-module connection to achieve a network with excellent reliability and fast recovery in the presence of one failure. This is the recommended topology for machine protection applications.

Under control of one of the ring devices configured to act as ring supervisor, a network disruption (cable or module) can be detected and communication flow direction reversed in a few 100 ms to become a star connection of two linear connections.

IMPORTANT	The Dynamix DYN module cannot provide the required Ring Supervisor capability; therefore, an EtherNet/IP controller interface with DLR functionality is required (direct interface to Controller system), or for downstream networks a separate 1783-ETAP (3-port EtherNet/IP tap) can be used to act as Ring Supervisor for multiple EtherNet/IP adapters and provide connection to the higher-level EtherNet/IP network.

Multiple rings can either be part of a further ring topology or connected with a star topology. In the latter case, the trunking method can be used where multiple parallel cables can be connected between switches such to increase bandwidth. For supported products, the redundancy level is increased.

Notes:

Install the Dynamix 1444 Series Monitoring System

Environment and Enclosure

ATTENTION: This equipment is intended for use in a Pollution Degree 2 industrial environment, in Overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and will not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment for indoor use. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that are present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication contain more information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures

Prevent Electrostatic Discharge

ATTENTION: This equipment is sensitive to Electrostatic Discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

Electrical Safety Considerations

WARNING: To comply with the CE Low Voltage Directive (LVD), all power connections to this equipment must be powered from a source compliant with the following:

- Safety Extra Low Voltage (SELV), or
- Protected Extra Low Voltage (PELV)

To comply with UL/CUL requirements, this equipment must be powered from a source compliant with the following:

- Limited Voltage Supply

If the input power supply is restricted to 8A, no additional protection is necessary. However, for supplies with higher current ratings that serve multiple groups of main modules, the first module of the daisy chain requires an 8A current limiting fuse for protection.

WARNING: All wiring must comply with applicable electrical installation requirements (for example, N.E.C. article 501-4(b)).

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations:	Informations sur l'utilisation de cet équipement en environnements dangereux:
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, hazardous locations, and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) can be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
WARNING: **Explosion Hazard -** • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means that are provided with this product. • Substitution of components may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area that is known to be nonhazardous.	**AVERTISSEMENT:** **Risque d'Explosion -** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

Do not replace components or disconnect equipment unless power has been switched off or the area is known to be free of ignitable concentrations.

WARNING: Consider the following:

- If you insert or remove the module while Backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

  Be sure that power is removed or the area is nonhazardous before proceeding.
- When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This arc could cause an explosion in hazardous location installations.

  Be sure that power is removed or the area is nonhazardous before proceeding.
- If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This arc could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- Exposure to some chemicals will degrade the sealing properties of materials that are used in the following devices:
- Relay RL1, Epoxy.

  We recommend that you periodically inspect these devices for any degradation of properties and replace the module if degradation is found.

ATTENTION: If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Before installing, configuring, operating, or maintaining this product, read this document and the documents listed in the additional resources section for installing, configuring, or operating equipment. Users should familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Installation, adjustments, putting into service, use, assembly, disassembly, and maintenance shall be carried out by suitably trained personnel in accordance with applicable code of practice. In case of malfunction or damage, no attempts at repair should be made. The module should be returned to the manufacturer for repair. Do not dismantle the module.

This equipment is certified for use only within the surrounding air temperature range of -25…70 °C (-13…158 °F). The equipment must not be used outside of this range.

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Controls, publication SGI-1.1, available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature, describes some important differences between solid-state equipment and hard-wired electromechanical devices.

WARNING: This equipment is not resistant to sunlight or other sources of UV radiation.

Exposure to some chemicals can degrade the sealing properties of materials used in the following devices:

- DYN module – Relay RL1, Epoxy
- Expansion Relay Module – Relay RL1 through RL4, Epoxy

European/IECex Hazardous Location Approval

The following applies to products marked II 3 G. Such modules:

- Are Equipment Group II, Equipment Category 3, and comply with the Essential Health and Safety Requirements
- relating to the design and construction of such equipment given in Annex II to Directive 94/9/EC. See the EC Declaration of Conformity at http://www.rockwellautomation.com/products/certification for details.
- The type of protection is Ex nA IIC T4 Gc according to EN 60079-15.
- Comply to Standards: EN 60079-0:2012+A11:2013, EN 60079-15:2010, reference certificate number DEMKO14ATEX1365X.
- Are intended for use in areas in which explosive atmospheres caused by gases, vapors, mists, or air are unlikely to occur, or are likely to occur only infrequently and for short periods. Such locations correspond to Zone 2 classification according to ATEX directive 1999/92/EC.

The following applies to products with IECEx certification. Such modules:

- Are intended for use in areas in which explosive atmospheres caused by gases, vapors, mists, or air are unlikely to occur, or are likely to occur only infrequently and for short periods. Such locations correspond to Zone 2 classification to IEC 60079-0.
- The type of protection is Ex nA IIC T4 Gc according to IEC 60079-15.
- Such modules comply to Standards IEC 60079-0:2011, IEC-60079-15:2010, reference IECEx certificate number IECExUL14.0082X.

WARNING: Special Conditions for Safe Use

- This equipment is not resistant to sunlight or other sources of UV radiation.
- This equipment shall be mounted in an ATEX/IECEx Zone 2 certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in EN/IEC 60529) and used in an environment of not more than Pollution Degree 2 (as defined in EN/IEC 60664-1) when applied in Zone 2 environments. The enclosure must be accessible only by the use of a tool.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 140% of the rated voltage when applied in Zone 2 environments.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

API-670 Compliance

The 1444 series is designed in accordance with the relevant sections of the 5th Edition of the American Petroleum Institutes (API) standard 670,(1) "Machinery Protection Systems".

(1) Whether or not a system complies is dependent on the specific components provided, the various optional elements of the standard that the user requires, and the configuration of the installed system.

Removal or Insertion Under Power (RIUP)

Removal or Insertion Under Power (RIUP) of any 1444 series main or expansion module is permitted only in a nonhazardous area.

ATTENTION:
- In a hazardous area, the module must be powered down before removal.
- Always consider the consequences for the system and the monitored machine before powering down or removing any module from service.

Design Considerations

The Dynamix modules must be placed in a protective metal enclosure with a minimum recommended protection class of IP54.

Multiple modules can be placed in one housing, providing proper consideration has been given to the following:
- System design and planning
- Mounting
- Module and connection accessibility
- Wiring, cabling, and routing
- System operating temperature and reliability

Electro Magnetic Compatibility (EMC) Precautions

While the module has been thoroughly tested for EMC compliance, performance in real world situations depends on the care that is taken during system design and installation. Follow the preferred practices listed.

Table 4 - EMC Precautions

Verify metal parts are well grounded.	• Connect all inactive metal parts, like cabinet walls and doors, to ground. • Verify that the entire surface area is grounded and the connection to ground is low impedance. • Applies to the enclosure and any additional cable junction boxes. • Avoid using aluminum parts whenever possible for grounding. Aluminum oxidizes easily, which causes its resistance to vary.
Route cables with care.	• Divide the wiring into categories (power supply, sensors, and control signals). • Use sufficient separation between the wire groups. • Always run any high current/high-voltage lines and signal/data lines in separate conduits or bundles. • Run the signal lines as closely as possible to the ground areas (for example, bus bar, metal rails and cabinet metal). • Further details about wiring category and routing are provided in the following sections, as well as wiring category identifications in the applicable specifications section.

Table 4 - EMC Precautions

Use shielded/screened cables	• Use shielded cables for all lines: signal, control, and module power. • For the analog sensor input, each channel must be separately shielded (one shield for each channel in a multi-core cable).
Properly terminating the shield wires	• Keep the unshielded part of the cables as short as possible. It is ideal if only the last 100 mm of the cable is unshielded. • Preferably, use an EMC cable gland to obtain a 360 ° ground connection to the enclosure. Alternatively, connect the shielded wire directly after entering the cabinet or the enclosure on a grounded bus bar and fix it with a cable clamp. – The modules provide SHIELD terminals that can be used for shield wire termination. However, from a performance perspective, the previously described methods are preferred. Note that the SHIELD terminals are connected together, but otherwise isolated from all module circuitry and the DIN rail. The installer uses one or more of the SHIELD terminals to connect to a ground of their choosing • Use a direct connection from the cable shield to the protective conductor. • Connect only one end of the shield to ground; for hazardous area systems, preferably at the field end. For known EMI hot-spots, use of overall conduit or double-shielded cabling with shield grounded at both ends is preferred. • When an additional junction box is used for dividing a multi-core cable into separate cables, verify that the cable shields are isolated from the metal enclosure of the distribution box. (The distribution box must be made of metal.)
Make a uniform reference potential (reference ground)	Avoid ground loops by connecting the installations and cabinets to a central ground conductor

Wiring Categories and Routing

The following wiring categories are defined to help with proper segregation of all wires and cables as part of the planning process for system layout and installation such to promote noise immunity.

Category	Group Description	Examples
1	Control and AC Power – High-power conductors that are more tolerant of electrical noise than category 2 conductors and can also cause more noise to be picked up by adjacent conductors.	• AC power lines for power supplies and I/O circuits • High-power digital AC I/O lines • High-power digital DC I/O lines
2	Signal and Communication – Low-power conductors that are less tolerant of electrical noise than category 2 conductors. They also cause less noise to be picked up by adjacent conductors (they connect to sensors and actuators relatively close to the I/O modules).	• Analog I/O lines and DC power lines for analog circuits • Low-power digital AC/DC I/O lines • Low-power digital DC lines • Communication cables
3	Intra-enclosure – Interconnect the system components within an enclosure.	• Low voltage DC power cables • Communication cables

To guard against coupling noise from one conductor to another, the following general guidelines when routing wires and cables (both inside and outside of an enclosure) apply.

Category	Routing Guidelines
1	These conductors can be routed in the same cable tray or raceway with machine power conductors of up to 600V AC.
2	If it must cross power cabling, cross at right angles. • Route at least 1.5 m/5 ft. from high-voltage enclosures or sources of RF/microwave radiation. • If the conductor is in a metal wireway or conduit, each segment of that wireway or conduit must be bonded to each adjacent segment so that it has electrical continuity along its entire length and must be bonded to the enclosure at the entry point. • Properly shield where applicable and route in a raceway separate from category 1 conductors. • If in a continuous metallic wireway or conduit, route at least 0.08 m/3 in. from category 1 conductors of less than 20 A; 0.3 m/1 ft. from AC power lines of 20 A or more, but only up to 100 kVA; 0.6 m/2 ft. from AC power lines of greater than 100 kVA. • If not in a continuous metallic wireway or conduit, route at least 0.15 m/6 in. from category 1 conductors of less than 20A; 0.3 m/1 ft. from AC power lines of 20 A or more, but only up to 100 kVA; 0.6 m/2 ft. from AC power lines of greater than 100 kVA.
3	Route conductors external to all raceways in the enclosure or in a raceway separate from any category 1 conductors with the same spacing as listed for category 2 conductors, where possible.

Use the spacing that is given in these general guidelines with the following exceptions:

- Where connection points (for conductors of different categories) on a device are closer together than the specified spacing
- Application-specific configuration for which the spacing is described in a publication for that specific application

These guidelines are for noise immunity only. Follow all local codes for safety requirements.

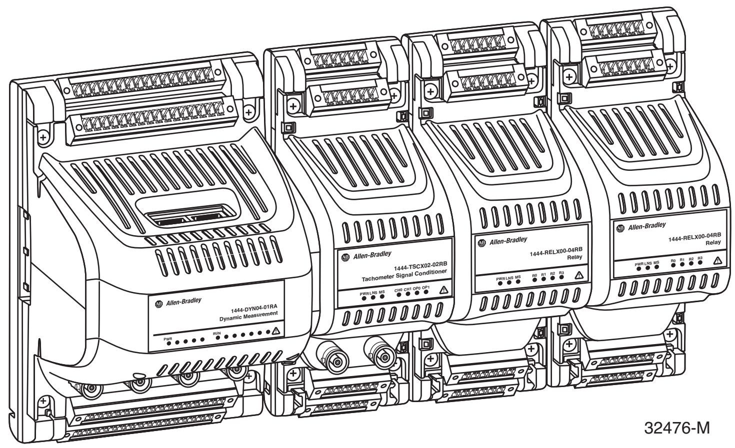
Given the Dynamix 1444 series system component top and bottom I/O access, we recommend that you use cable ducts to organize and provide separation of I/O wiring.

In the case of high-voltage relay contact wiring (120/250V AC) and/or high current load, assign top or bottom relay contacts or use Expansion bus extension cables to position applicable relay modules in a more suitable location within the overall system.

Temperature Considerations

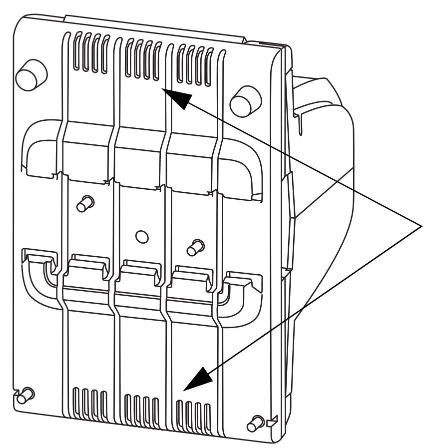
While the 1444 series modules operate at rated temperature when mounted vertically or horizontally, the system components have been designed for natural convection cooling based on a horizontal orientation. Therefore to assure optimal heat dissipation the recommended mounting orientation is horizontal (in an upright / vertical position) as shown in Figure 1.

Figure 1 - Module Mounting Position



The module plastics design enables natural convection or unducted airflow by its ventilation slots on both sides of the module such to support a "chimney effect" from bottom to top.

IMPORTANT As where the terminal base of Expansion modules has a fully passive nature, some electronics are present within the DYN module terminal base. Despite low-power dissipation, the main terminal base is also equipped with ventilation slots and some level of internal airflow ducting from bottom to top. We recommend that you verify these ventilation slots are not blocked.



Based on maximum current load models, including internal module power dissipation of its DC power and externally connected power sources, an estimate can be made of total internal power dissipation within the enclosure to provide guidance to select an enclosure or plan for required temperature control measures inside your enclosure.

Module Type	Maximum Power Dissipation
Main	9.0 W
Relay	2.3 W
4…20 mA	3.6 W
Tacho Signal Conditioning	3.0 W

Together with known (maximum) system heat dissipation from all used components that are planned for your enclosure, the following approximate equations. They are based on using no active method of heat dissipation control (like fans or air conditioning), can be used to calculate either cooling surface requirement for enclosure and/or internal cabinet temperature rise.

Metric	English
$A := \frac{0.38 \cdot Q}{1.8 \cdot T - 1.1}$	$A := \frac{4.08 \cdot Q}{T - 1.1}$
$T := \frac{0.21 \cdot Q}{A} + 0.61$	$T := \frac{4.08 \cdot Q}{A} + 1.1$
Where: • T is the temperature difference between inside air and outside ambient (°C) • Q is heat generated in enclosure (W) • A is enclosure surface area (m2) The exterior surface of all six sides of an enclosure is calculated as follows. A = 2dw + 2dh +2wh Where d (depth), w (width) and h (height) are in meters.	Where: • T is the temperature difference between inside air and outside ambient (oF) • Q is heat generated in enclosure (W) • A is enclosure surface area (ft2) The exterior surface of all six sides of an enclosure is calculated as follows. A = (2dw + 2dh +2wh)/144 Where d (depth), w (width) and h (height) are in inches.

The system components are designed for internal enclosure surrounding air temperatures of up to a maximum of 70 °C (158 °F) (measured 1 in. below the main module) based on natural convection cooling and specified air space clearances around the Dynamix 1444 series system.

Outcome of calculations can show that it is can be more efficient to provide a means of cooling rather than increase of cabinet size. Contact your cabinet manufacturer for options available to cool your cabinet.

All system components can measure and monitor internal operating temperatures, a feature that is highly recommended to be used to control overall system operating temperature during normal use.

Module specifications indicate a maximum-internal operating temperature reference for each module type.

Despite that the amount of (maximum) heat dissipation remains unchanged, use of slightly assisted cooling, also called unducted airflow, have a considerable impact (5…10 °C) (9…18 °F) on internal operating temperatures of system components.

There is one configuration aspect that can reduce the dissipation load of each DYN module by about 0.8 W, despite that typ typically the maximum heat dissipation is fixed (and actual dissipation heat dependent on module configuration and operating state.)

When powered, the buffered outputs consume a significant amount of quiescent operating power (approximately 0.8W), which also imparts more heat. Because the buffered outputs are infrequently used in most applications, it is recommended that the buffered outputs not be powered during routine operation.

See Buffered Outputs on page 60 for information on how to enable/disable the outputs.

Reliability Considerations

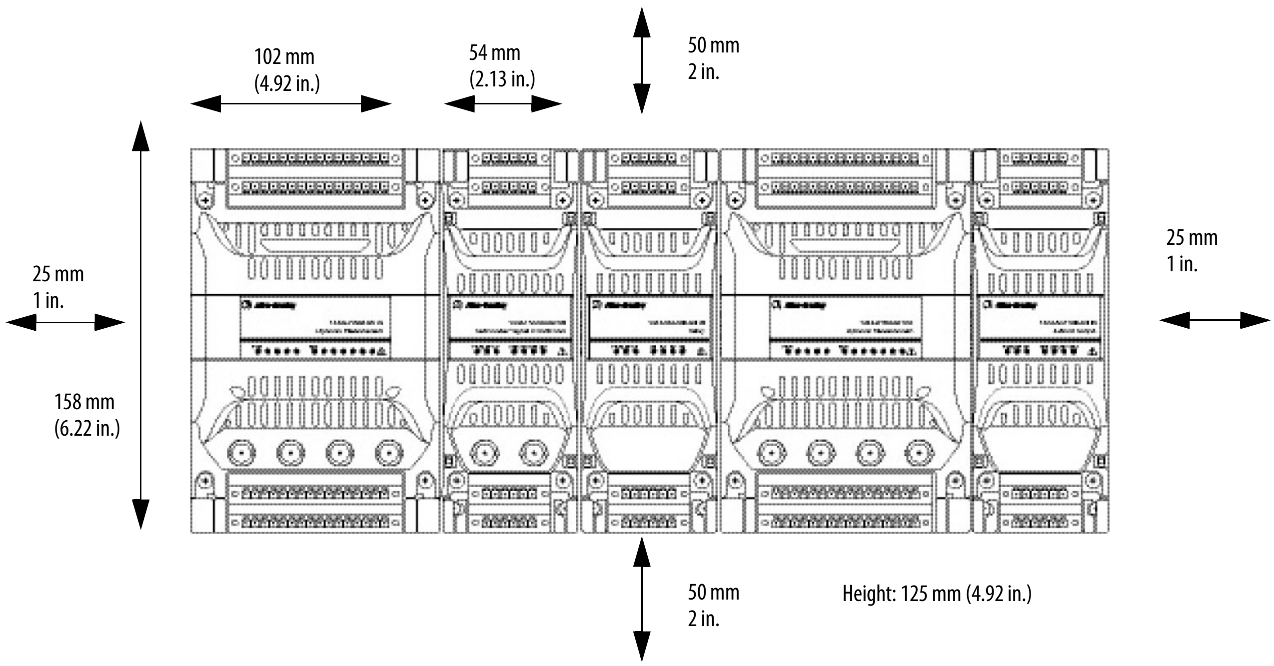
Closely related to the previous section, overall system reliability is greatly affected by operating temperatures. Therefore, it is highly recommended to minimize the internal operating temperatures of the modules.

System Space and Clearance Requirements

Design and layout of the system enclosures is a key consideration in any installation. Verify that there is sufficient space for access to (and fitting/removal of) the top and bottom connectors, and a wiring/cable ducting scheme that maintains appropriate separations.

For proper airflow and installation of the module, the following minimum-air spacing must be maintained around the system.

Figure 2 - Clearance Requirements



The 50 mm/2 in. clearance above and below the modules, in combination with 45 ° angled, pluggable connections, provides for:

- Use of tooling to make/remove electrical connections
- Visible wire identification
- Sufficient physical space to insert/remove pluggable connections
- Optimized air volume per module in relation to thermal performance

Wiring Requirements

WARNING: All wiring must comply with applicable electrical installation requirements (for example, N.E.C. article 501-4(b)).

All modules (whether main or Expansion) have four removable connectors where the field wiring is made. They come in a choice of spring cage or screw connection. Both types benefit from the following:

- Screwdriver axis parallel to conductor axis
- Positive connector retention (captive screws)
- Test connections for 1.2 mm (0.047 in.) diameter test pins or 1 mm (0.039 in.) test plugs

The DYN module connectors are 16 way and the Expansion module connectors are 6 way. Each is keyed appropriate to location and module type.

Manufacturer technical data for these connectors is as follows.

Attribute	Value
Tightening torque, mon- max (screw type only)	0.22…0.25 N•m (0.16…0.18 ft·lbf)
Normal cross-section	1.5 mm^2 (0.002in^2)
Stripping length	9 mm (0.35in)
Conductor cross-section solid or stranded min- max	0.14…1.5 mm^2 (0.0002…0.002in^2)
Conductor cross-section stranded with ferrule without plastic sleeve min- max	0.25…1.5 mm^2(0.0003…0.002in^2)
Conductor cross-section stranded with ferrule with plastic sleeve min- max	0.25…0.5 mm^2 (0.0003…0.0007in^2)
Conductor cross-section AWG/kcmil min- max - screw clamp type	28…16 mm^2
Conductor cross-section AWG/kcmil min- max - spring clamp type	26…16 mm^2
AWG according to ULL/CUL min- max -screw clamp type	30…16 mm^2
AWG according to ULL/CUL min- max -spring clamp type	28…16 mm^2

Use solid or stranded wire. All wiring must meet the following specifications:

- Minimum insulating rating of 300V
- Soldering the conductor is not allowed
- Wire ferrules can be used with stranded conductors; copper ferrules recommended
- Single wire per connection

Module Power Supply Requirements

The Dynamix 1444 series system must be powered by single or redundant, 18…32V DC supplies as follows:

- To comply with the CE Low Voltage Directive (LVD), all power connections to this equipment must be powered from a source compliant with the following:
  - Safety Extra Low Voltage (SELV), or
  - Protected Extra Low Voltage (PELV)
- To comply with UL/CUL requirements, this equipment must be powered from a source compliant with the following:
  - Limited Voltage Supply

If the input power supply is restricted to 8A, no additional protection is necessary. However, for supplies with higher current ratings that serve multiple groups of main modules, the first module of the daisy chain requires an 8A current limiting fuse for protection.

Power return line of the main-system power supply must be grounded for electrical safety reasons.

The required power supply rating can be calculated based on the following (per module) allowances.

Module Type	Power Load	18V Supply	24V Supply	32V Supply
Main	11.5 W	640 mA	480 mA	360 mA
Expansion relay	1.6 W	90 mA	70 mA	50 mA
Expansion 4…20 mA	0.76 W	40 mA	30 mA	22 mA
Expansion TSC	4 W	225 mA	170 mA	125 mA

Each redundant supply must be able to provide the full load, no facility for load sharing is provided, and the higher of the two applied voltages powers the module.

There are internal protective (non-replaceable) fuses on each of the power inputs and on the bus supply to the Expansion modules. In addition, there is similar protection on each of the (main and Expansion) modules.

The Expansion modules are only powered by the bus and from a main module base. Removal of any module (main or Expansion) does not affect power distribution to any other module in a system.

Grounding Scheme

The system is isolated from ground and to maintain isolation between multiple interconnected modules, whether they are main or Expansion modules.

Shield connections are common to one another for each module and its terminal base, but otherwise isolated from the module circuitry. These connections are provided as a termination point for cable screens/shields and, where applicable, for protective ground connections to accessible metal part. One or more must be used to connect the Shield bus to a local ground as the base module is not grounded to the DIN rail.

Use these grounding requirements to verify the safest electrical operating circumstances and to help avoid EMI and ground noise that can cause unfavorable operating conditions for the Dynamix 1444 series system:

- Module Grounding - Provide AWG 16 connection to ground for each Dynamix 1444 Series system module to an available Shield connection terminal.
- 24V Common Grounding - Given that module power supplies are galvanically isolated, it is recommended that the DC voltage supply return line to the Dynamix modules is grounded.
- Transducers – verify that transducers are electrically isolated from ground. Cable shields must be grounded at one end of the cable and the other end not connected. It is recommended, where possible, to ground the cable shield at the instrument side (PE terminals, protective earth ground bar, or cable glands) and not at the transducer end.

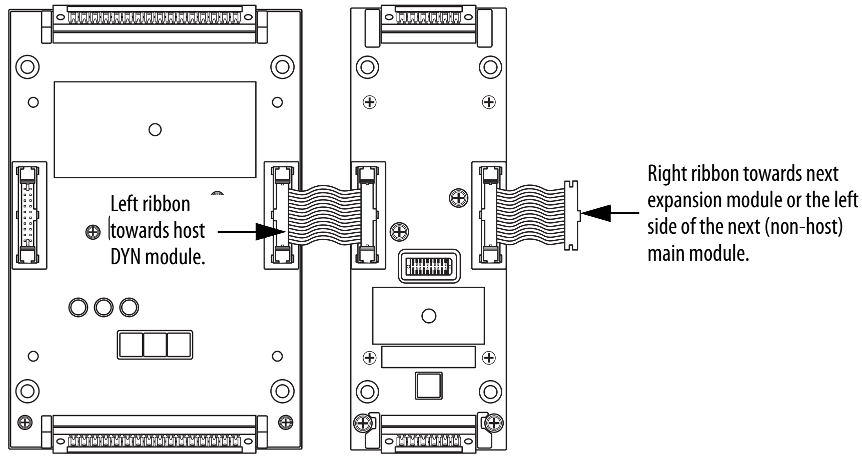
Local Bus Connection (main/expansion)

A Common-bus runs along the base parts of the main and its associated Expansion modules, which interconnect with ribbon cable. It integrates the following:

- Serial (communication) bus - between the main and its associated Expansion modules
- Power bus - Expansion modules are powered from the module base
- Tacho bus - the TSC provides up to two tacho signal outputs(1)

The system is installed with an associated Expansion module fitted to the right side of the module. The base-mounted headers are latched and, for additional security, cannot be removed (or inserted) while there is a module in place on that base.

Figure 3 - Expansion Base Part with Left and Right Ribbon Cable Fitted



The DIP switch towards the bottom of Figure 3 contributes to the expansion module bus address so that a like-for-like Expansion module replacement retains the earlier address.

Only the Relay Expansion module uses the DIP switch address. Up to three relay modules can be used per main (host) module.

To install, join the bases of a module and its associated Expansion modules by connecting the right side of one to the left side of the next by using the supplied ribbon cables. These cables are included with each main and expansion module terminal base. Continue these interconnections across all modules that are intended to share the tacho bus of a TSC module, and note the following:

- One tacho bus can support a maximum of six main modules
- One (and only one) TSC Expansion module can be used per tacho bus

(1) While the serial and power buses are specific to one DYN module and its associated Expansion modules, the tacho bus extends to serve tacho signals to multiple main modules.

Using Local Bus Extension Cables

The Dynamix 1444 series implements a Local Bus that connects modules to:

- Provide power and communication between an Expansion Module and its Host module.
- Pass the Speed Signals (TTL) from a Tachometer Signal Conditioner Module to other main modules on a network.

If no expansion modules are used in a system, then the modules do not need connected.

In cases where it is necessary to separate modules, two extension cables are provided:

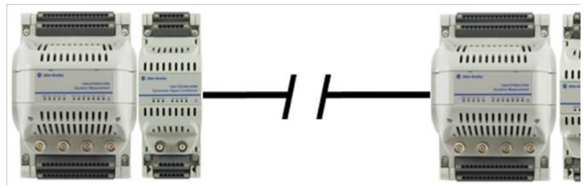
1444-LBXC-0M3-01	Local Bus Extender Cable (0.3 m)
1444-LBXC-1M0-01	Local Bus Extender Cable (1.0 m)

IMPORTANT The extension cables are intended for IN CABINET use only. The ribbon cables are only minimally shielded. Consequently, care must be taken to assure that cables are not routed across or near to high voltage or other cables that can induce noise into the network.

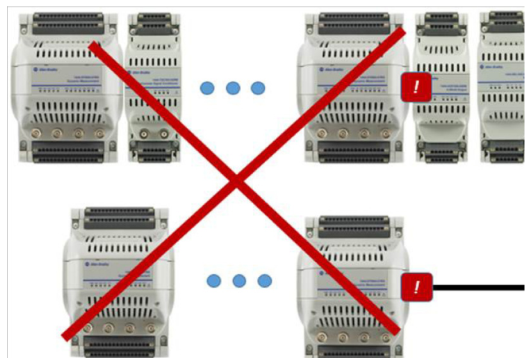
When connecting modules, be sure that the right sides of two main modules are never connected. While the connectors are keyed to prevent this, it is possible to defeat the keying by twisting the cable or by removing the keys.

WARNING: Connecting the RIGHT sides of two main modules could result in damage to the modules and unexpected or improper operation of any connected expansion modules.

The Local Bus Extension cables are designed (keyed) to allow connection of the RIGHT side of any main module to the LEFT side of any main or expansion module, as illustrated below:



Any other connection that results in the RIGHT sides of two MAIN MODULES (1444-DYN02-01RA) being connected is not allowed, including when one or more expansion modules are between them.



Connects the right sides of two main modules.

Relay Contact Protection

Measures to limit contact wear and arcing across the contacts of a mechanical relay are highly dependent on the following:

- The current and voltage being switched and whether AC or DC
- The load type (resistive or inductive)
- System factors such as wiring

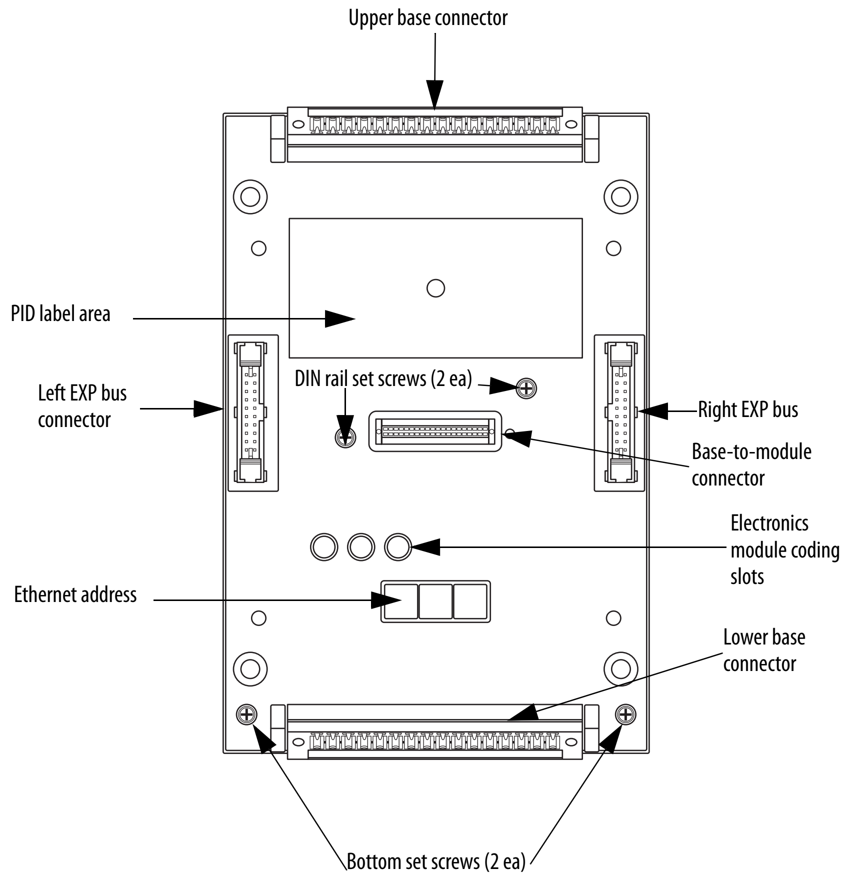
Due to this application dependency, it is not possible to integrate contact protection circuitry within the Dynamix hardware. It remains the system designer's/installer's responsibility to take appropriate external measures to mitigate these risks that are based on the reliability and functional safety requirements that can apply. Commercial surge suppressors (often DIN rail mounting) can be based on RC, MOV, or Diode protection methods. In general, it is recommended to provide protection equipment close to its originating source.

Installation Overview

Installation of the Dynamix 1444 Series system is based on one or more main modules and associated Expansion modules. The mounting arrangement, from left to right, can be summarized as follows:

- Main module
  - Expansion modules
- Main module
  - Expansion modules

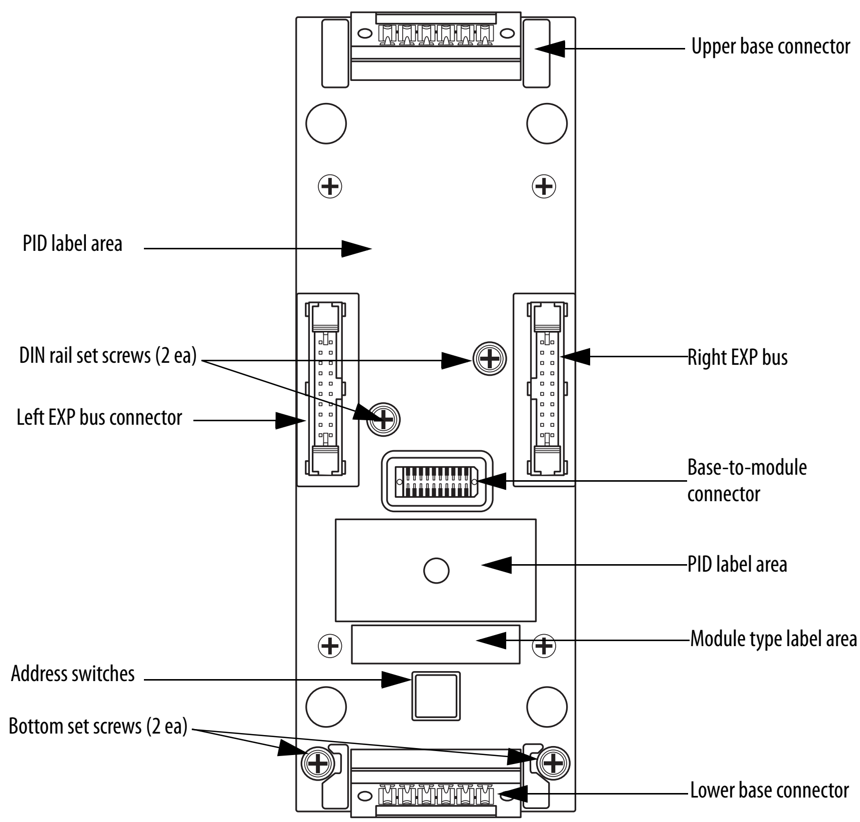
Figure 4 - Main Terminal Base – Overview



When installing the system, follow these instructions and install/configure the components in the following order.

1. Review the safety instructions.
2. Review the network connectivity considerations.
3. Review the system design guidelines, considerations, and requirements.
4. Mount the terminal base.
5. Establish expansion bus connections between modules.
6. Configure the main terminal base.
7. Configure the Auxiliary relay terminal base.
8. Configure the Auxiliary 4…20 mA terminal base.
9. Configure the Auxiliary TSC terminal base.
10. Install the module.
11. Configure the main module connectors.
12. Configure the main module transducers.
13. Configure the Expansion module connectors.
14. Start the module and perform a Self-test.

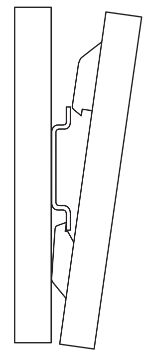
Figure 5 - Expansion Terminal Base – Overview



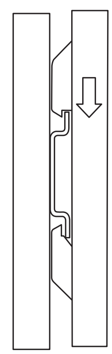
Mount the Terminal Base Unit

The following generic DIN rail mounting scheme applies to all terminal base mounting.

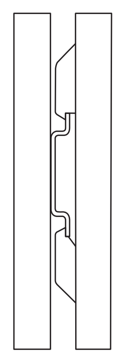
1. Hook the base assembly from the bottom under the DIN rail. The presence of coding switches identifies the bottom side of the terminal base.



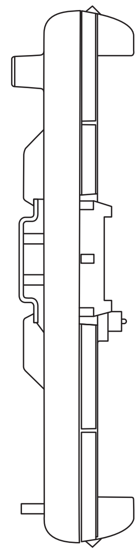
2. Hook over the top and let gravity drop the terminal base into place.



3. The terminal base is in the center position to the DIN rail. Once hooked, fasten the two center (set) screws to secure the base to the rail.



4. Tighten the two bottom set screws to secure the terminal base to the base plate such to prevent rocking effect while applying mechanical pressure to the base.



Reverse the process to remove a base. Loosen the screws to create sufficient clearance for removal of the terminal base.

Establish Bus Connections

Before configuring the terminal base and installing the main module, establish the Expansion bus connections between modules. The Expansion bus provides power and communication from a DYN module to associated Expansion modules positioned to the right and distributes the tacho bus to up to six main modules. These modules include the TSCX modules host, and mounted to the left or right of the TSCX module.

Based on system design, the required module-to-module connections can be made with interconnect cables (refer to the Local Bus (module to module, interconnect cables) section in Local Bus Connection (main/expansion) on page 40). These ribbon cable assemblies can then be fitted between various module types.

We recommend that you combine the installation of the ribbon interconnect cables with the process of mounting the terminal bases. This way, the bases can be clamped to the DIN rail and the interconnect cable can easily be fitted without subjecting it to excessive mechanical stress.

1. Install and secure the first terminal base.
2. Install the interconnection cable to the first module (right side).
3. Install the second terminal base.
4. Connect the interconnection cable to the second module (left side).
5. Secure the second terminal base.

Verify that the ribbon cable interfaces are properly locked down in the headers. Access to the connector interfaces is further protected once the main modules are installed.

Configure the Terminal Bases

The following configuration settings must be made or validated on the terminal bases before installation of the designated modules.

Configure the Main Terminal Base

The module terminal base provides three decimal coding switches used to define the last octet of the TCP/IP address of the module.

The IP address of the main module is composed of four suboctets that are separated by dots to conform to the IPv4 structure. Each suboctet can be configured with a number from 1 to 254. As shipped from the factory, the default IP address of a module is aaa.bbb.ccc.ddd.

These switches can be used for automatic configuration or definition of the last octet of a static (Class C) IP address.

These settings, from left to right, are on the bottom:

- 000 – Automatic address assignment (default)
- 001…254 – Static IP address setting (for example, 192.168.1.xxx)
- 255...887, 889...999 - Invalid address
  If set to any of these values the module powers up in Module Fault.
- 888 - Reset.
  When set, after power-up, the module immediately executes an out-of-box reset. See Resetting the Module on page 197 for further information.

The rotary switches can be adjusted by using a small flathead screwdriver.

Configure the Relay Terminal Base

The two pole dip-switch setting on the Expansion Relay terminal base is used to define the Expansion Relay module offset address. Given that up to three Relay modules can be fitted per main module, the following configurations can be defined.

These settings, from left to right, are on the bottom:

- 00: Not allowed
- 01: Relay Module 1
- 10: Relay Module 2
- 11: Relay Module 3

IMPORTANT	A base switch address setting of (00) is illegal for a relay module and causes the relay module to display a critical error (solid red Module Status Indicator).

Configure the 4…20 mA Terminal Base

The two pole dip-switch setting on the Expansion 4...20 mA terminal base is used to define the Expansion bus address for the single 4…20 mA module that can be fitted per main module.

These settings, from left to right, are on the bottom:

- 00: 4…20 mA Analog Expansion Module
- 01…11: Not used

Settings for the AOFX module include**:**

- The AOFX module applies a fixed (internal) address that requires the terminal base switch to be set to 00.
- A DYN module can only host one AOFX module.

Configure the Tacho Signal Conditioning Terminal Base

The two pole dip-switch setting on the Expansion TSC terminal base is used to define the Expansion bus address for the single TSC module that can be fitted per main module.

These settings, from left to right, are on the bottom:

- 00: Tacho Signal Conditioner Expansion (TSCX) Module
- 01…11: Not used

TSCX:

- The TSCX module applies a fixed (internal) address that requires the terminal base switch to be set to 00.
- A DYN module can only host one TSCX module.
- Only one TSCX module can be connected to the same 1444 Series Expansion bus.

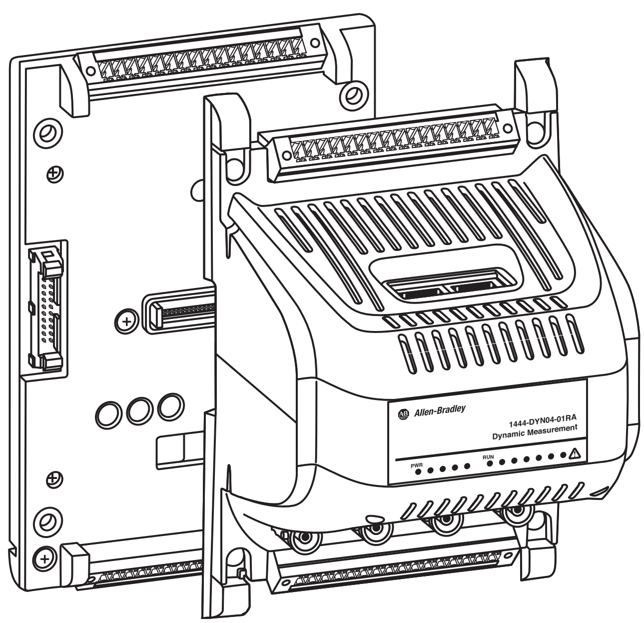
Install the Module

Main and expansion modules are readily fitted to their respective bases, with correct alignment, and connector engagement being supported by the following features:

- Module coding pin (main module only)
- Base module upper and lower connector guidance
- Module to base connector guidance and alignment

Before installing the module, check that there is no damage (bent pins) on the main/Expansion module to base connector.

Figure 6 - Module-to-Base Position



Once the main module is fitted onto the base, use the four captive quarter-turn screws, one in each corner, to secure the module to its base.

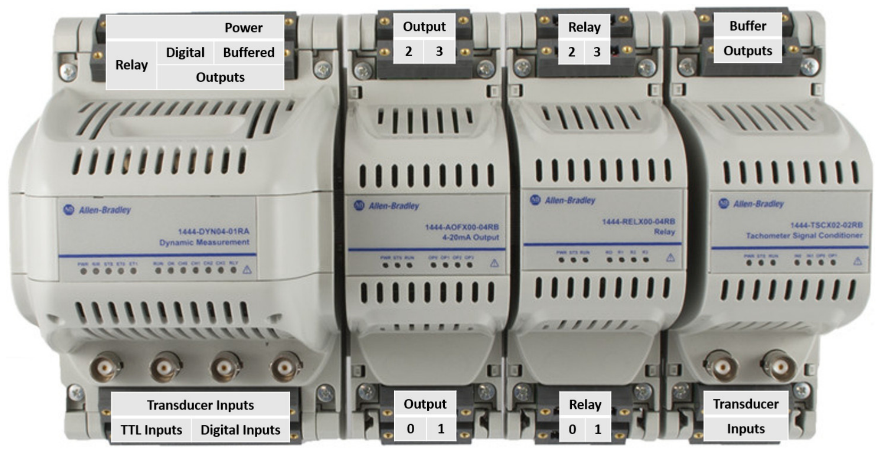
Wiring Overview

General Module Connecter Arrangements

The 1444 series requires that wiring is routed to both above and below the modules. So particular attention and planning of cabinet wire routing is essential for an efficient, well-organized, and therefore maintainable, cabinet.

Use the following figure when planning cabinet wire routing. The figure provides an overview of the locations of the connectors that are associated with the significant function of each module.

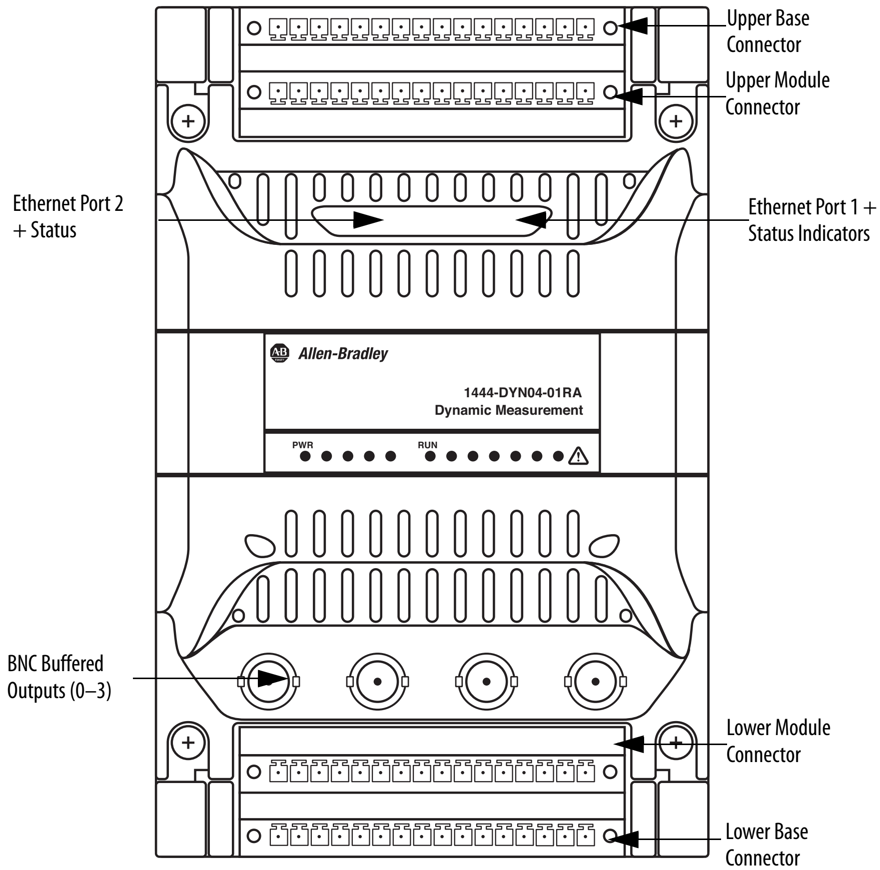
Figure 7 - General Module



Wiring the Main Module

An installed system has four removable 16-way terminal connectors, two interfacing directly to the removable module, and two to the terminal base. The base and module-mounted headers are able to accept either a screw or spring terminal connector.

Figure 8 - Main Module Connectors



Allocations to the base or module are broadly based on the following functional requirements:

- Wide-ranging 24V DC power connections are direct to the base so that they are unaffected by module removal.
- Main signal inputs/outputs and relay connections are direct to the module to minimize connection length and number of interfaces.

Each connector is keyed to its respective mating header (two per connector) and each of the terminals is uniquely numbered. Some external links can be made between terminals, depending on application requirements, to enable, for example, a transducer power supply for a 2-wire transducer connection.

Upper Base Connector

Terminal	Name	Application	Description
49	RET_1	Module Power	Supply 1 Return
50	RET_1		
51	+24V_1		Supply 1 +24V
52	+24V_1		
53	RET_0		Supply 0 Return
54	RET_0		
55	+24V_0		Supply 0 +24V
56	+24V_0		
57	OVR	Buffered Outputs	Override High
58	OVR		Override Low
59	Shield	Shield	Cable shield connection points
60	Shield		
61	Shield		
62	Shield		
63	Shield		
64	Shield		

Main Module Connectors

These connections provide duplicate terminals for twin, wide ranging DC supplies (24V nominal).

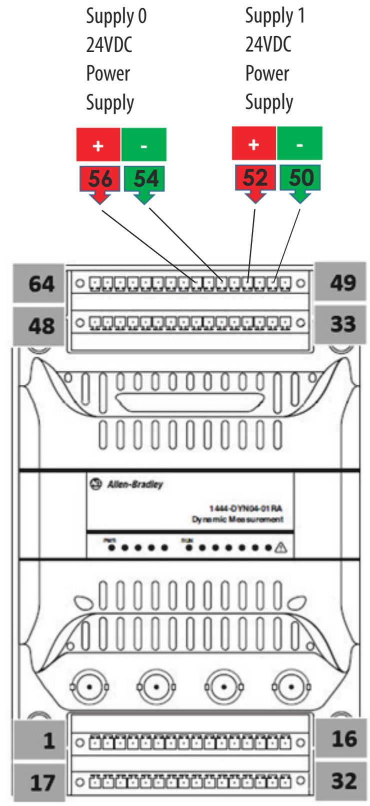
56	55	54	53	52	51	50	49
+24V-0	+24V-0	RET_0	RET_0	+24V-1	+24V-1	RET_1	RET_1

The duplicate terminals provide a means for daisy chaining power from one base to the next (subject to an overall current limit and knowing a star connection approach is preferred to avoid excessive voltage drop.) There is internal diode protection against reverse polarity and for the purposes of automatic supply selection when redundant sources are connected to inputs 0 and 1. The supply side connections are isolated from the remainder of the module circuitry.

Wiring Power

Figure 9 connects positive and negative power to the first (from left) of two identical connectors for each. See Main Module Connectors on page 52 for the complete list of power connections.

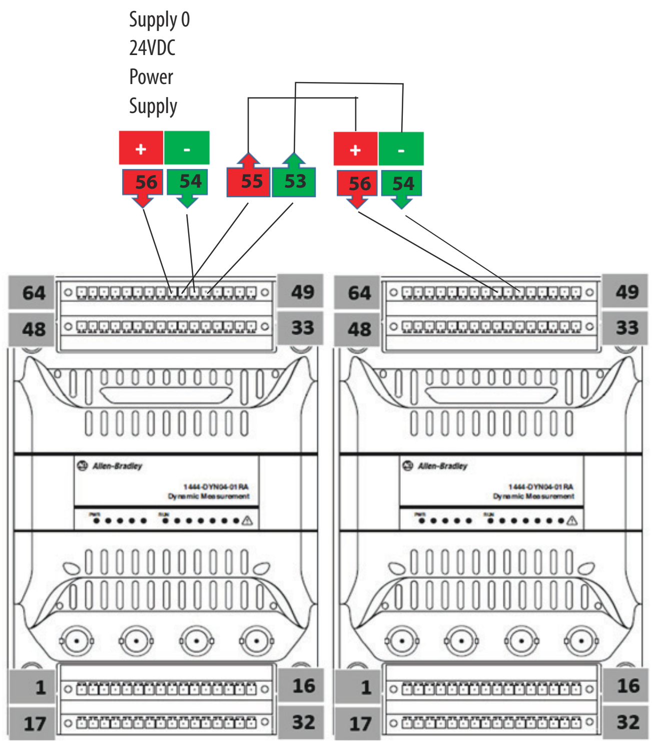
Figure 9 - Typical Wiring for Single and Redundant Power Solutions



Wiring Power to Multiple Modules

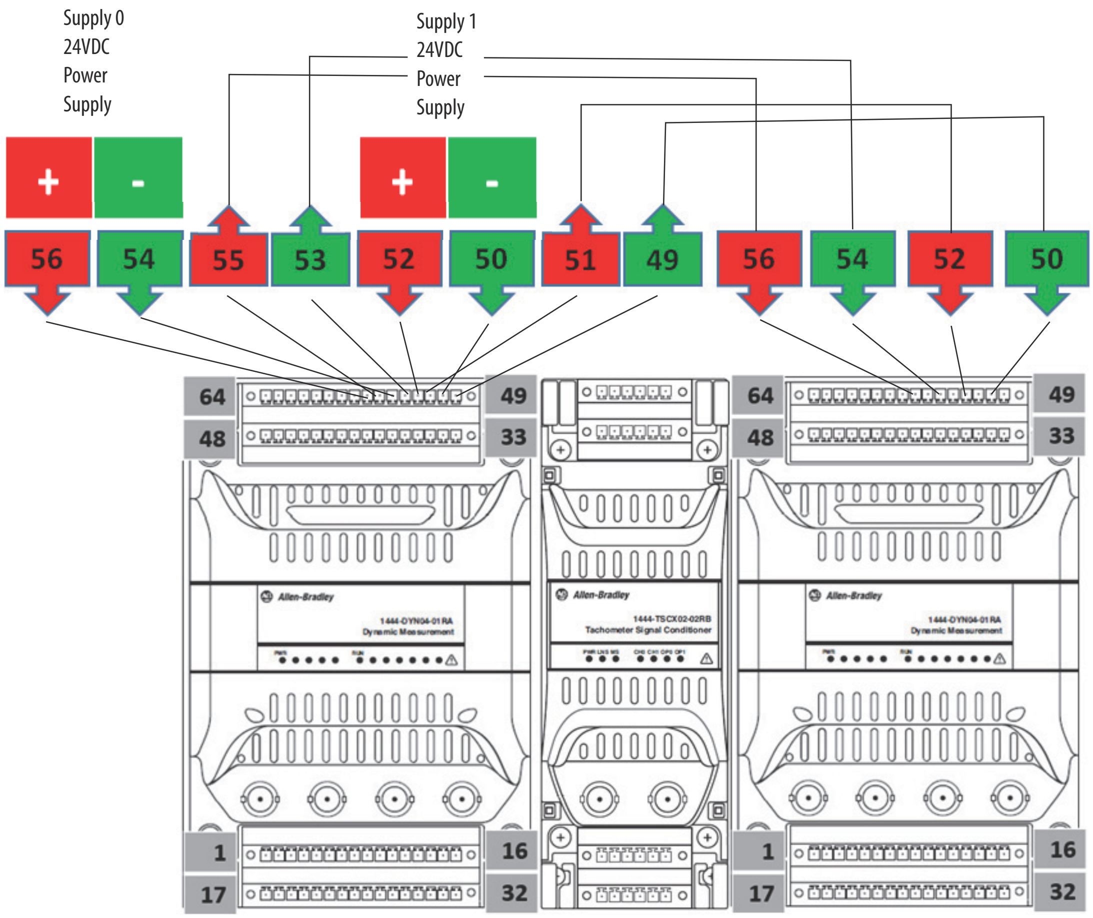
Figure 10 shows positive and negative power IN connected to the first of two identical connectors for each, and power OUT from the second of two identical connectors. See Upper Base Connector on page 52 for the complete list of power connections.

Figure 10 - Typical Wiring for Single Power Solutions to Multiple Module



[Figure 11](#) shows positive and negative power IN connections to the first of two identical connectors for each, and power OUT from the second of two identical connectors. See [Upper Base Connector on page 52](#) for the complete list of power connections.

Figure 11 - Typical Wiring for Redundant Power Solutions to Multiple Modules



Buffered Output Override

The Buffered Output 'Override' connections, pins 57 and 58 on the 1444-TB-A terminal base, are used to enable/disable the buffered outputs.

58	57
OVR	OVR

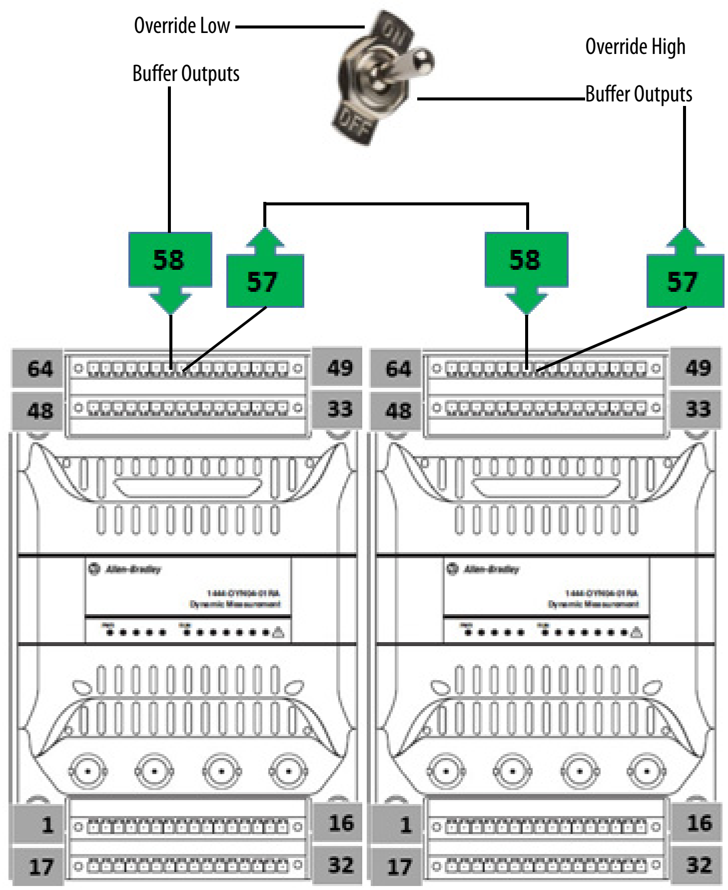
The buffered outputs are enabled (powered) when no connection is present between pins 57 and 58.

The buffered outputs are disabled (not powered) when a connection is present between pins 57 and 58.

In applications where the buffered outputs are infrequently used a switch can be installed between pins 57 and 58. When installed, opening the switch enables the buffered outputs, and closing the switch disables the outputs.

It is possible to use a common switch to manage the buffered outputs of multiple modules as the override pins are Opto-isolated from the module circuitry. When a common switch is required, wire one contact to pin 57 of the module nearest the switch and the other to pin 58 of each module to be managed.

Figure 12 - Wiring Buffer Outputs Override



Consider the following with the module:

- The module ships with a jumper installed between pins 57 and 58, which disables the buffered outputs.
- When connecting pin 58 from multiple modules to a single module's pin 57, allow for a maximum 3 mA current sink for each connected override input.
- See Temperature Considerations on page 33 for further information.

Shield Connections

The module is, by design, isolated from ground. All shield connections on this and the lower base connector are common to one another (a "shield bus"), but otherwise isolated.

64	63	62	61	60	59
Shield	Shield	Shield	Shield	Shield	Shield

Shield connections are provided as a termination point for cable screens/shields, one or more can be used to connect the shield bus to a local ground of the user's choosing.

IMPORTANT When working with the shield bus remember the following:

- The shield bus of each main and expansion module must be individually connected to ground by at least one shield pin wired directly to ground.
- For installations where EMI issues are anticipated, or when EMI is found to be a problem, wire cable shields directly to ground rather than to the shield bus of the module.

Upper Module Connector

Terminal	Name	Application	Description
33	NO	Relay Outputs	Normally Open
34	C		Common
35	NC		Normally Closed
36	SPARE	Do not connect	
37	O1L	Opto-isolated Outputs	Digital Output 1 Low
38	O1H		Digital Output 1 High
39	O0L		Digital Output 0 Low
40	O0H		Digital Output 0 High
41	RET	Buffered Outputs	Channel 3 Return
42	BUFF3		Channel 3 Signal
43	RET		Channel 2 Return
44	BUFF2		Channel 2 Signal
45	RET		Channel 1 Return
46	BUFF1		Channel 1 Signal
47	RET		Channel 0 Return
48	BUFF0		Channel 0 Signal

Relay Output

There is one SPDT relay included in the DYN module with the three contact connections being made available at the terminals. A typical purpose for this module relay is to signal module status.

35	34	33
NC	C	NO

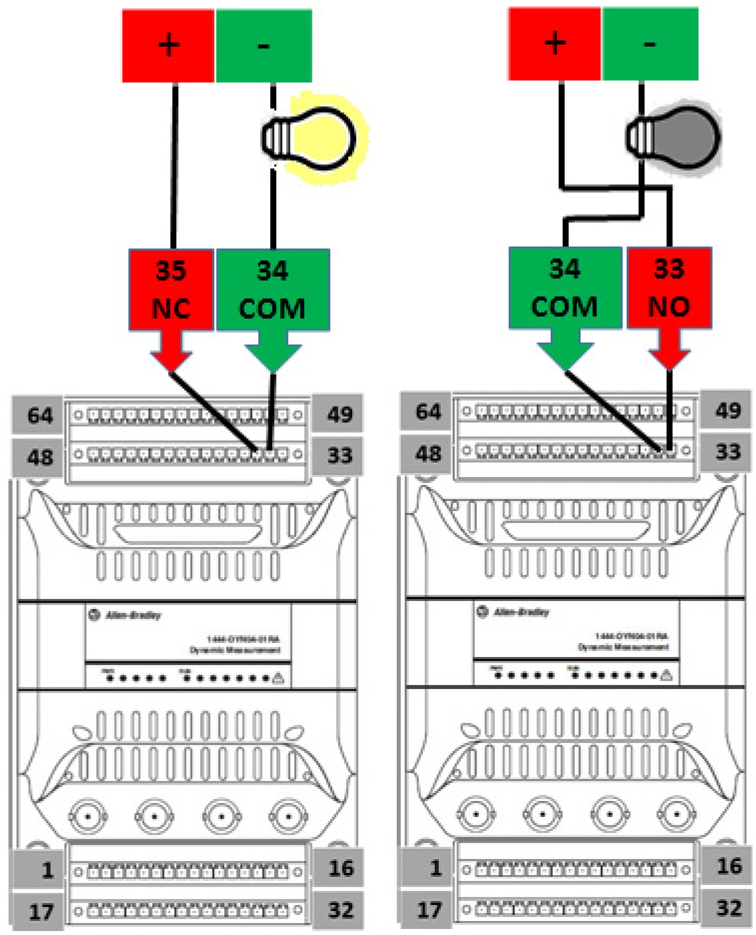
NC – Normally closed

C – Common

NO– Normally open

'Normal' is the relay contact state when un-powered.

Figure 13 - Wiring Relays



Spare

Terminal 36 is left unused for isolation reasons. Do not make any connections to this terminal.

Opto-isolated (Open Collector) Outputs

The DYN module includes two Opto-isolated outputs, 0 and 1.

40	39	38	37
00H	00L	01H	01L

The connections are functionally polarity sensitive and are designated H (High) and L (Low). As the name suggests, these connections are isolated from any others on the module. These Opto-isolated outputs support reverse connection protection within defined current load specifications.

Buffered Outputs

In addition to the BNC outputs, a buffered output is provided for each channel (0…3) on the upper module connector.

48	47	46	45	44	43	42	41
BUFF0	RET	BUFF1	RET	BUFF2	RET	BUFF3	RET

Although having independent resistive current limiting, the buffered and BNC outputs of any one channel share the same drive circuitry. All signal-related inputs and outputs, unless otherwise indicated, share the same analog ground/return.

IMPORTANT	By default the buffered outputs are not powered and no signal is available. See Buffered Output Override on page 55 for more on how to enable the Buffered Outputs.

Lower Module Connector

The following are functions of the lower module connector.

Sensor Connections

The lower module connector is where the sensor connections are made.

Terminal	Name	Application	Description
1	TXP0	Sensor 0	Transducer 0 Power
2	SIG0		Transducer 0 Signal
3	SIG0		
4	RET0		Transducer 0 Return
5	TXP1	Sensor 1	Transducer 1 Power
6	SIG1		Transducer 1 Signal
7	SIG1		
8	RET1		Transducer 1 Return
9	TXP2	Sensor 2	Transducer 2 Power
10	SIG2		Transducer 2 Signal
11	SIG2		
12	RET2		Transducer 2 Return
13	TXP3	Sensor 3	Transducer 3 Power
14	SIG3		Transducer 3 Signal
15	SIG3		
16	RET3		Transducer 3 Return

For each channel (0…3), there is a set of four connections:

- Transducer power (configurable per channel for negative or positive supply, or constant current)
- Duplicate signal input connections
- Signal return connection

Providing duplicated input signal connections accommodates various both 2-wire and 3-wire transducers. For 2-wire constant current sensors, the appropriate supply is configured and an external link is made to connect signal and power output connections. A further signal connection and associated return lets the sensor be connected without placing multiple wires in one terminal.

All signal inputs are single-ended with a ±24V range and designed for transducers that provide an output voltage proportional to the measured physical parameter. The transducer power is individually configurable per channel for one of the three following outputs: +24V, 4 mA constant current or +24V or -24V at up to 25 mA. Besides these functional operating modes, the transducer power output can also be configured as disabled.

Lower Base Connector

Terminal	Name	Application	Description
17	T0SIG	Tach 0	Tach 0 Signal
18	T0RET		Tach 0 Return
19	Shield	Shield	Shields
20	Shield		
21	T1SIG	Tach 1	Tach 1 Signal
22	T1RET		Tach 1 Return
23	Shield	Shield	Shields
24	Shield		
25	L0SIG	Logical Input	Input 0 Signal
26	L0RET		Input 0 Return
27	Shield	Shield	Shields
28	Shield		
29	L1SIG	Logical Input	Input 1 Signal
30	L1RET		Input 1 Return
31	Shield	Shield	Shields
32	Shield		

Shield

Shield connections are provided as a termination point for cable screens/shields; one or more can be used to connect Shield to a local ground of the user's choosing.

IMPORTANT	There is no internal connection between the Shield Bus and ground. A separate connection must be made between one terminal shield pin and a suitable ground location.

Logic Inputs

The DYN module includes two logic inputs, 0 and 1.

25	26	27	28	29	30
L0SIG	L0RET			L1SIG	L1RET

These are not isolated from other module circuitry; the signal input has a resistive pull-up to 5V and the return connection is analog ground/return. Logic inputs have various possible uses (configuration-dependent), including alarm gating and SPM controls.

Tacho Inputs

The DYN module includes two local tacho inputs, 0 and 1.

17	18	19	20	21	22
T0SIG	T0RET			T1SIG	T1RET

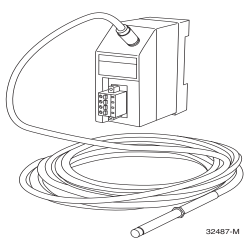
These are not isolated from other module circuitry; the signal input has a resistive pull-up to 5V and the return connection is analog ground/return. These local inputs are designed for situations where there is a TTL level tacho signal available, a tacho sensor with an open collector output (such as NPN type), a connection to an Opto output on another Dynamix module, or the TTL output from an XM-220 Dual Speed module (1440-SPD02-01RB). In most situations, the preferred method of providing tacho signals to the module is through the TSC Expansion module.

DYN Module Transducers

Proximity Probes

The following are examples of proximity probes.

Figure 14 - ECP Connections

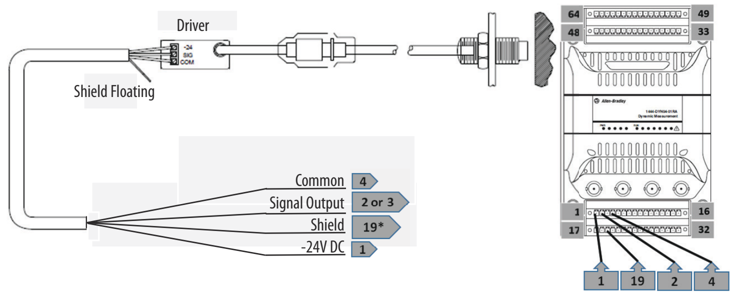


ECP Driver	Module Channel			
	0	1	2	3
Output	2 or 3	6 or 7	10 or 11	14 or 15
Common	4	8	12	16
-24V	1	5	9	13
Shield	any terminal base shield pin upper: 59…64 lower: 19, 20, 23, 24, 27, 28, 31, 32			

The channel must be configured for a negative 24V supply and either of the two signal connections can be used as in Figure 14.

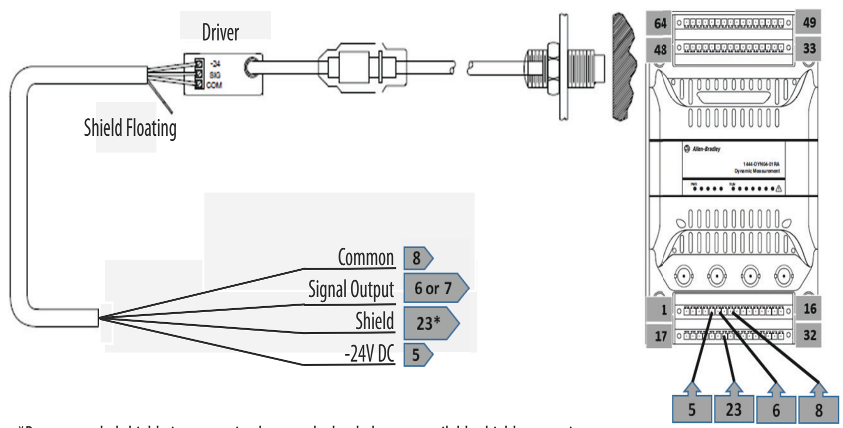
Figures 15...18 show typical wiring diagrams for channels 0...3 of an eddy current probe sensor.

Figure 15 - Channel 0 Wiring



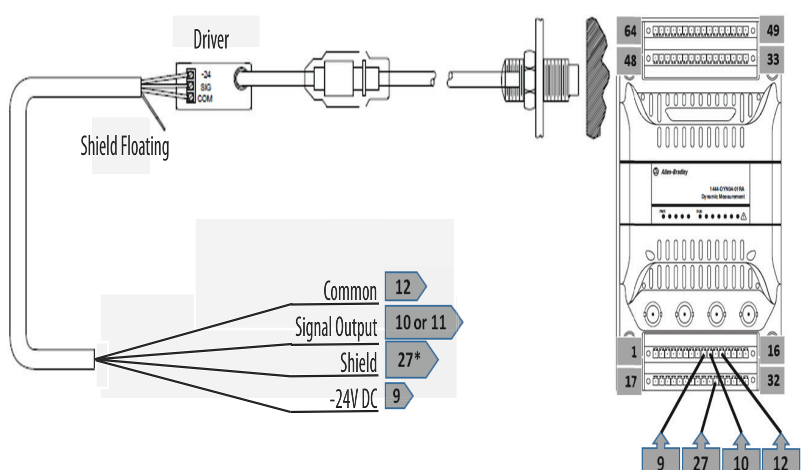
*Recommended shield pin connection but may be landed to any available shield connection.

Figure 16 - Channel 1 Wiring



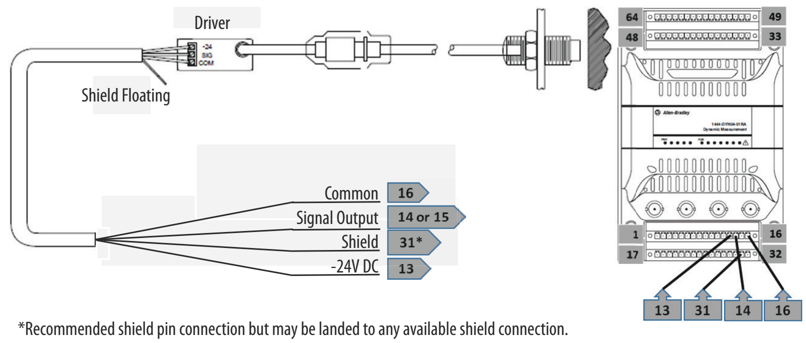
*Recommended shield pin connection but may be landed to any available shield connection.

Figure 17 - Channel 2 Wiring



*Recommended shield pin connection but may be landed to any available shield connection.

Figure 18 - Channel 3 Wiring



*Recommended shield pin connection but may be landed to any available shield connection.

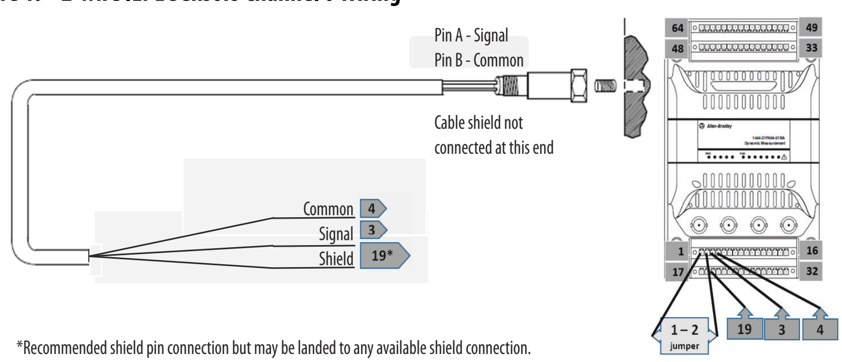
2-wire Acceleration, Pressure, or Piezoelectric Velocity Sensors

The channel must be configured for a positive, constant current supply and the transducer power output must be connected to the spare signal connection (link terminals 1 and 2 in channel 0, example above.) A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
SIG (+)	3	7	11	15
Return (-)	4	8	12	16
Then link these terminals:	1 and 2	5 and 6	9 and 10	13 and 14

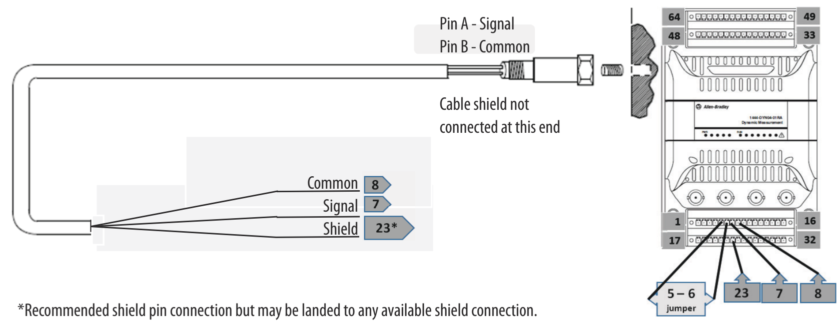
Figures 19...22 show typical wiring for 2-wire constant current sensors including IEPE Acceleration, Velocity, and Pressure Sensors.

Figure 19 - 2-wire IEPE Sensors Channel 0 Wiring



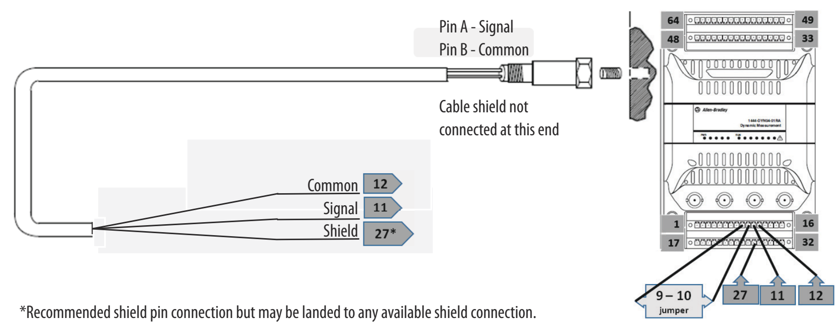
*Recommended shield pin connection but may be landed to any available shield connection.

Figure 20 - 2-wire IEPE Sensors Channel 1 Wiring



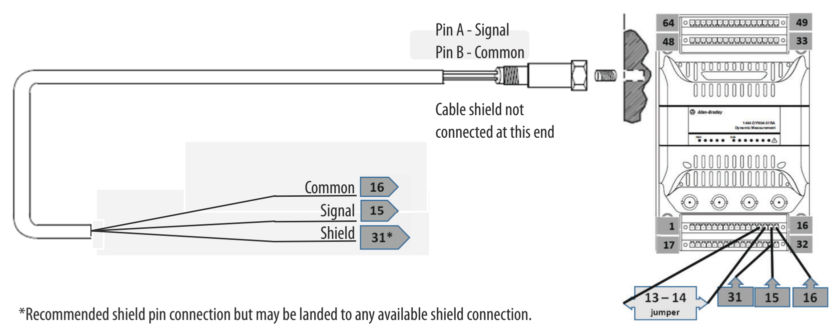
*Recommended shield pin connection but may be landed to any available shield connection.

Figure 21 - 2-wire IEPE Sensors Channel 2 Wiring



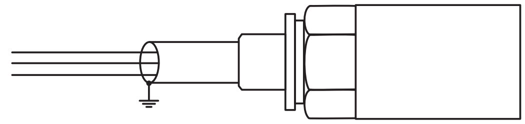
*Recommended shield pin connection but may be landed to any available shield connection.

Figure 22 - 2-wire IEPE Sensors Channel 3 Wiring



*Recommended shield pin connection but may be landed to any available shield connection.

3-wire Acceleration Sensors or Other 3-wire Transducer Systems



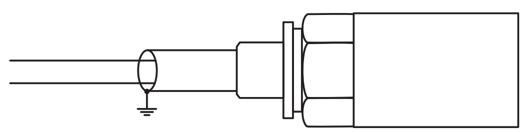
Configure the channel for the appropriate polarity supply (+25V or -25 V). A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
Power Supply	1	5	9	13
SIG (+)	2 or 3	6 or 7	10 or 11	14 or 15
Return (-)	4	8	12	16

In general, most 3-wire transducer systems requiring +25V or -25V at no more than 25 mA can be accommodated by connecting as above.

3-wire sensors are wired identically to eddy current probes (power polarity is set in module configuration). See Figures 15-18 for wiring illustrations.

2-wire Self-Generating Velocity Sensors

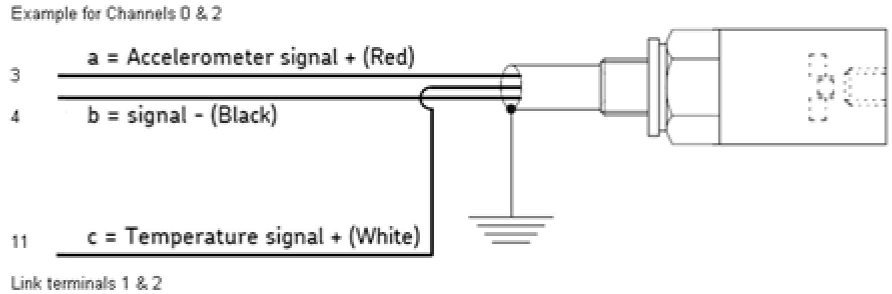


Being self-generating, no transducer power connection is required. A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
SIG (+)	2 or 3	6 or 7	10 or 11	14 or 15
Return (-)	4	8	12	16

Also use this wiring solution for externally powered 2-wire sensors.

3-wire Acceleration and Temperature Sensor



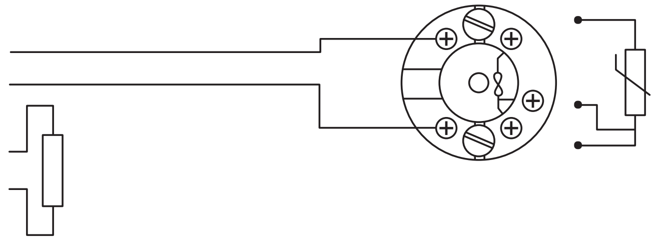
Such a sensor has two outputs and therefore occupies two input channels of a DYN module. The acceleration and temperature signals are allocated to channels in separate channel pairs so that the module configuration can be optimized.

The vibration channel must be configured for a positive, constant current supply and the transducer power output that is connected to the spare signal connection (link terminals 1 and 2 in channel 0/2, example in the preceding graphic.) Depending on the transducer that is used, the sensor can power both the vibration and the temperature sensing circuitry from one constant current supply. For sensor types that require a separate power supply for each, repeat power linking and configuration for the temperature channel as well.

A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
Acceleration SIG (+)	3	7	-	-
Return (-)	4	8	-	-
Then link these terminals:	1 and 2	5 and 6	-	-
Temperature SIG (+)	-	-	11	15

Temperature Transmitter



Configure the channel for a +24V supply. A load resistor is required at the input terminals to provide the necessary current/voltage conversion. In addition to resistance value and precision (functional requirements), consider resistor power rating pertaining to heating and maximum surface temperature under normal and fault conditions.

A list of appropriate terminals for each channel follows.

Typical Core Designation	Channel 0	Channel 1	Channel 2	Channel 3
Power	1	5	9	13
Return (-)	2	6	10	14
Fit Load Resistor	3 and 4	7 and 8	11 and 12	15 and 16

Complete the configuration as follows:

- Configure the sensitivity as: Load R * 16/TX Range (millivolt/degree)[1]
- Set an appropriate offset so 4 mA = 0 °.

(1) For slightly higher accuracy, include the effect of the channel input resistance.

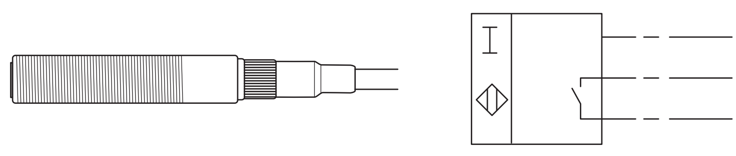
Tacho Signal from a Directly Connected Source

While it is expected that a TSC Expansion module is the normal source of a tacho signal for a system, each DYN module can accept up to two 'local' or 'direct' tacho inputs.

IMPORTANT	As these are not isolated from other module circuitry, it is not recommended that multiple tacho inputs from across different 1444 Series DYN modules are connected to the same tacho source.

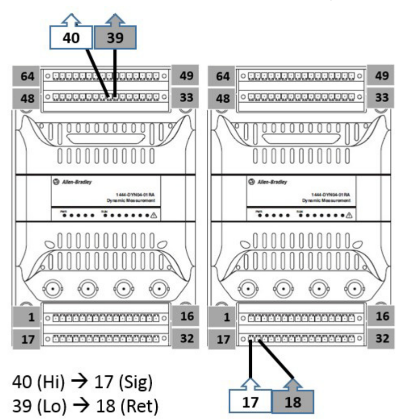
The local inputs are designed for situations where there is a TTL level tacho signal available, a tacho sensor with an open collector output (such as NPN type) or connection to an Opto output on another module. For any of the three signal source types, connect the signal to terminal 17 and the common/return connection to terminal 18.

Figure 23 - NPN type transducer connection

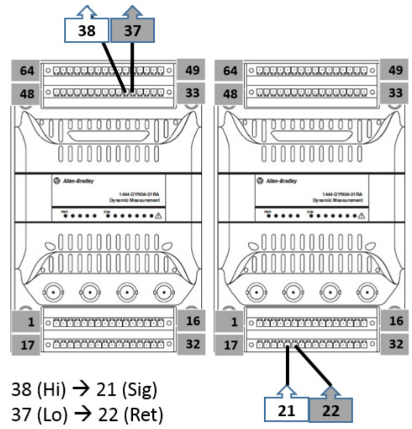


When an external signal is used to serve multiple DYN modules, the recommended wiring solution is as follows.

1. Wire the source signal to the first modules TTL inputs, per Tacho Inputs on page 55.
2. On the first module, wire one of its outputs, to the next module's TTL inputs.(#1) per Opto-isolated Outputs on page 52.



Example of wiring Discrete Output 0 to Tacho Input 0



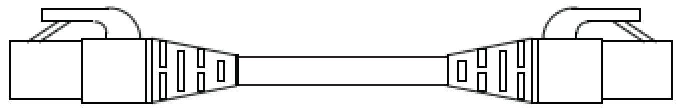
Example of wiring Discrete Output 1 to Tacho Input 1

3. Daisy chain further modules be repeating #1 and #2.
4. To output the TTL signal the wired Opto-isolated Output must be configured to replicate the "Local TTL Tach 0 Input" or "Local TTL Tach 1 Input", as appropriate. See Hardware Configuration on page 98.

Use this method to daisy chain the external TTL signal to be sure that there is isolation between modules. However, it can induce some amount of phase error.

EtherNet/IP Connector

Typically, Ethernet network connections are made with pre-assembled (standard) patch cords to interconnect modules according to the desired network topology.



Each module has an integrated switch and two functionally equal (Port 1 and Port 2) RJ45 connectors.

The total length of Ethernet cable connecting main-to- main, main-to-controller, or main-to-switch must not exceed 100 m (328 ft.).

If the entire channel is constructed of stranded cable (no fixed cable), then calculate maximum length as follows.

Maximum Length = (113-2N)/y, meters

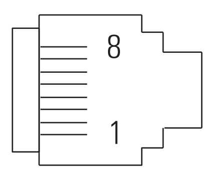
Where:

- N = the number of connections in the channel
- y = the loss factor compared to fixed cable (typically 1.2…1.5)

IMPORTANT	See Ethernet Cables, channel class and category and recommended cables under “Cable, Connector, and Mounting Accessories,” (page 12) foro further information on Ethernet connectivity.

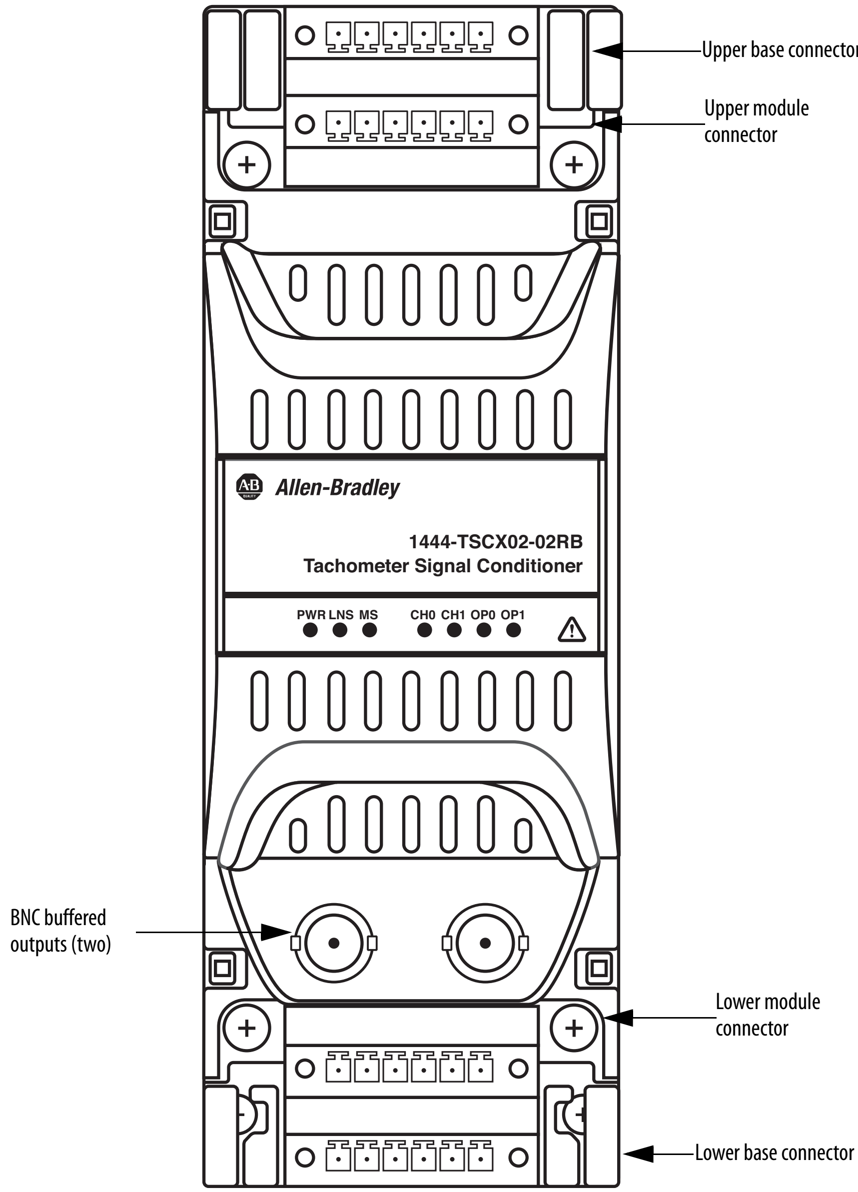
Wire the RJ45 connector as shown.

8	NC
7	NC
6	RD-
5	NC
4	NC
3	RD+
2	TD
1	TD+



Wiring Expansion Modules

An Expansion module has four removable 6-way terminal connectors, two interfacing directly to the removable module and two to the terminal base. The base and module-mounted headers are able to accept either a screw or spring terminal connector.



IMPORTANT	BNC outputs apply only to the TSC Expansion module type.

Allocations to the base or module are broadly based on the following functional requirements:

- Signal inputs/outputs and relay connections are direct to the module to minimize connection length and number of interfaces.
- The base connectors provide mainly Shield connections, noting the same base part is used across all three types of Expansion module.

Each connector is keyed to its respective mating header (two per connector) and each of the terminals is uniquely numbered.

Relay Expansion Module

There are four SPDT relays included in the relay output module (0…3) with the three contact connections for each being made available at the module terminals.

NC – Normally closed

C – Common

NO – Normally open

'Normal' is the relay contact state when unpowered.

ATTENTION: The relay connections can carry high voltage.

The base part carries mainly Shield connections that are provided as a termination point for cable screens/shields. In addition, one or more must be used to connect Shield to a local ground of the user's choice.

Do not make any connections to terminals 9, 10, 19 or 24.

Upper Base Connector	Terminal	24	23	22	21	20	19
	Name	NOT USED	SH	SH	SH	SH	NOT USED
	Application		Shield				
	Description	Do not connect	Cable shield connection points				Do not connect

Upper Module Connector							
	Terminal	18	17	16	15	14	13
	Name	REL 2 NC	REL 2 COM	REL 2 NO	REL 3 NC	REL 3 COM	REL 3 NO
	Application	Relay 2			Relay 3		
	Description	Normally closed	Common	Normally open	Normally closed	Common	Normally open

1444-RELX00-04RB Relay Expansion Module
and 1444-TB-B Terminal Base

Lower Module Connector							
	Terminal	1	2	3	4	5	6
	Name	REL 0 NC	REL 0 COM	REL 0 NO	REL 1 NC	REL 1 COM	REL 1 NO
	Application	Relay 0			Relay 1		
	Description	Normally closed	Common	Normally open	Normally closed	Common	Normally open

Lower Base Connector							
	Terminal	7	8	9	10	11	12
	Name	SH	SH	NOT USED		SH	SH
	Application	Shield				Shield	
	Description	Cable shield connection points		Do not connect		Cable shield connection points	

4…20 mA Expansion Module

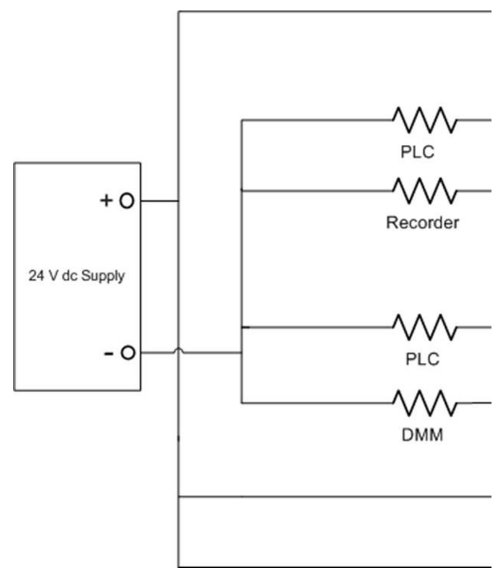
The Analog Output module provides four channels of 4…20 mA output. For each output, specific High (HI) and Low (LO) signal connections are provided (despite the High/Low description these connections are polarity insensitive). Eight electrically connected shield connections are provided.

The 4…20 mA Expansion module requires loop power, a supply in the range of 18V to 32V DC at 26 mA, to be provided to each output.

Supplying Loop Power

When loop power is not provided by other devices, a 24V supply must be provided.

The output connections are isolated from one another and the remainder of the module circuitry. While individual supplies can be applied per channel output, it is possible to deploy a common supply for multiple channels if maintaining inter-channel isolation is not important.



Above: Example wiring scheme where PLC, DMM, Recorder represent the 4…20 mA load.

As shown in the preceding graphic:

- Connect the positive (+) power to the module output high connections (pins 1, 5, 14, and 18).
- Connect the negative (-) power to the module output low connections (pins 2, 6, 13, and 17)
- Do not make any connections to terminals 3, 4, 9, 10, 15, 16, 19, or 24.

Use of the same power supply that serves the Dynamix module is allowed, if it can serve the additional load. However, when the same power supply is serving additional loads, such as additional Dynamix modules. While the supply can adequately serve the rated (normal) operating loads of all devices, surge currents during startup of other devices, surge currents during startup of other devices can affect the current provided to Loop Power, which can result affect current levels (measurements) on the system.

Upper Base Connector	Terminal	24	23	22	21	20	19
	Name	NOT USED	SH	SH	SH	SH	NOT USED
	Application		Shield				
	Description	Do not connect	Cable shield connection points				Do not connect

Upper Module Connector	Terminal	18	17	16	15	14	13
	Name	OUTPUT 2 HI	OUTPUT 2 LO	NOT USED	NOT USED	OUTPUT 3 HI	OUTPUT 3 LO
	Application	4…20 mA Output 2				4…20 mA Output 3	
	Description	High	Low	Do not connect		High	Low

1444-AOFX00-04RB Analog Output Expansion Module
and 1444-TB-B Terminal Base

Lower Module Connector							
	Terminal	1	2	3	4	5	6
	Name	OUTPUT 0 HI	OUTPUT 0 LO	NOT USED	NOT USED	OUTPUT 1 HI	OUTPUT 1 LO
	Application	4…20 mA Output 3				4…20 mA Output 2	
	Description	High	Low	Do not connect		High	Low

Lower Base Connector							
	Terminal	7	8	9	10	11	12
	Name	SH	SH	NOT USED		SH	SH
	Application	Shield				Shield	
	Description	Cable shield connection points		Do not connect		Cable shield connection points	

Tacho Signal Conditioning Expansion Module

The lower module connector carries the tacho sensor inputs, while the upper module connector carries the local tacho outputs. In addition, the TSC module has two further buffered outputs made available at the BNC connectors.

For each of the two input channels, there is a separate signal and return connection and, if needed, a transducer power supply connection. The polarity of that supply output is configurable on a per channel basis.

When the input to a TSC module is a multiple event per revolution pulse, there are choices to what some of the outputs represent.

The first of the two outputs that is provided on the upper module terminals (18 and 14) is automatically configured to be the same as the output provided on the tacho bus (expected to be one event per revolution).

The second of the two outputs provided on the upper module terminals (17 and 13) is configurable to be the same frequency as the input or as a processed/ divided down output.

All of these outputs are TTL level.

The output that is provided on the BNC is always a buffered version of the respective input tacho signal. When the input signal is known to be multiple events per revolution, the TSC module sets either status indicator 6 or 7 blue as a warning that the BNC output of that channel carries a multiple event per revolution signal. This is to serve as a warning to a local analyst.

A signal return, one connection for the two terminal outputs of each channel, is provided on the upper base connector.

Otherwise, the base part carries mainly Shield connections that are provided as a termination point for cable screens/shields. In addition, one or more must be used to connect Shield to a local ground of the user's choice.

Do not make any connections to terminals 9 or 10.

Tacho input connections:

Upper Base Connector	Terminal	24	23	22	21	20	19
	Name	RET	SH	SH	SH	SH	RET
	Application	Tacho Return	Shield				Tacho Return
	Description	Return	Cable shield connection points				Return

Upper Module Connector	Terminal	18	17	16	15	14	13
	Name	T0 OUT 0	T0 OUT 1	RET	RET	T1 OUT 0	T1 OUT 1
	Application	Tacho 0 Outputs		Tacho Returns		Tacho 1 Outputs	
	Description	1/Rev	N/Rev	Return	Return	1/Rev	N/Rev

1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module
and 1444-TB-B Terminal Base

Lower Module Connector							
	Terminal	1	2	3	4	5	6
	Name	TXP 0	SIG 0	RET 0	TXP 1	SIG 1	RET 1
	Application	Tach 0 Input			Tach 1 Input		
	Description	Transducer 0 Power	Transducer 0 Signal	Transducer 0 Return	Transducer 1 Power	Transducer 1 Signal	Transducer 1 Return

Lower Base Connector							
	Terminal	7	8	9	10	11	12
	Name	SH	SH	NOT USED		SH	SH
	Application	Shield				Shield	
	Description	Cable shield connection points		Do not connect		Cable shield connection points	

TSCX Module Transducers

The TSCX supports four types of speed sensor inputs:

- Eddy Current Probe
- NPN/PNP Proximity Switch
- Self-Generating magnetic Sensors
- TTL Signal Input

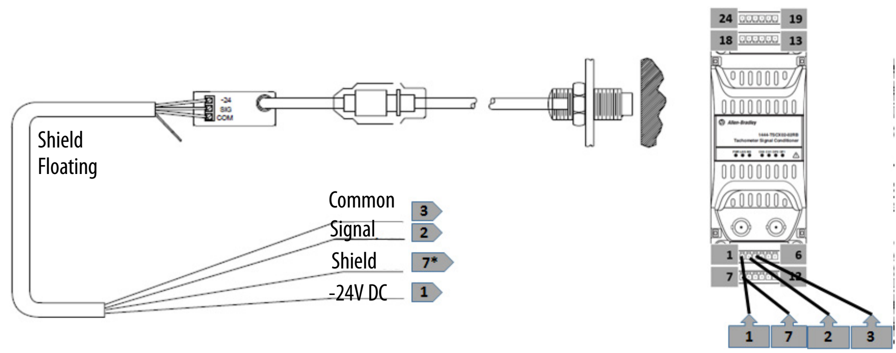
Proximity Probes

The connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = Eddy Current Probe System, and
- Transducer Power = -24V DC

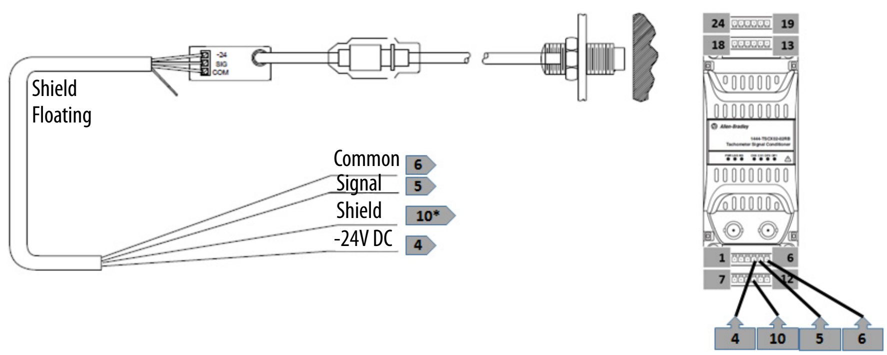
Wire the eddy current probe.

Figure 24 - Channel 0 wiring for an eddy current probe sensor



* Recommended shield pin connection but can be landed to any available shield connection.

Figure 25 - Channel 1 wiring for an eddy current probe sensor



* Recommended shield pin connection but can be landed to any available shield connection.

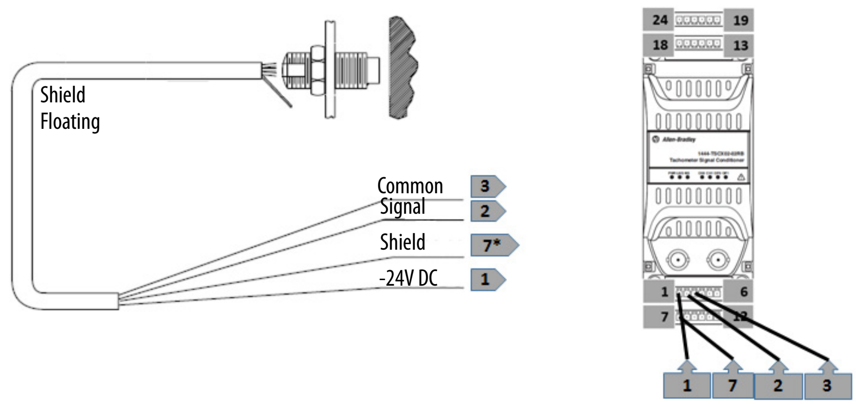
NPN/PNP Proximity Switch

The connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = NPN Proximity Switch, or
- Transducer Type = PNP Proximity Switch, and Transducer Power = +24V DC

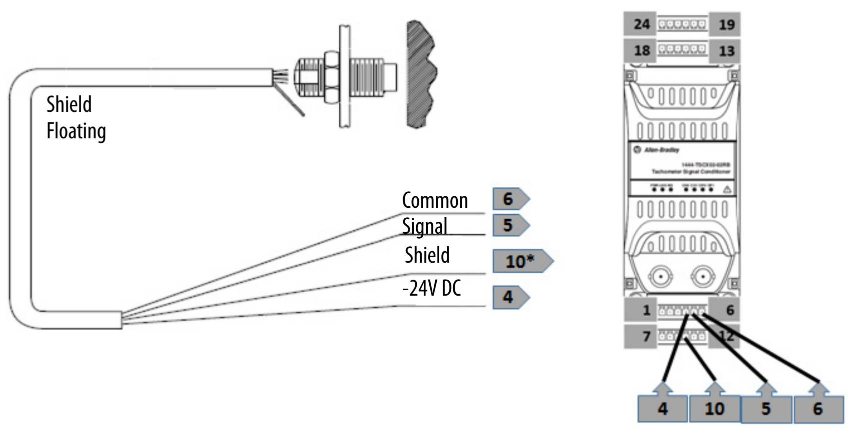
Wire the proximity switch as illustrated.

Figure 26 - Channel 0 wiring for an NPN/PNP Proximity Switch



* Recommended shield pin connection but can be landed to any available shield connection.

Figure 27 - Channel 1 wiring for an NPN/PNP Proximity Switch



* Recommended shield pin connection but can be landed to any available shield connection.

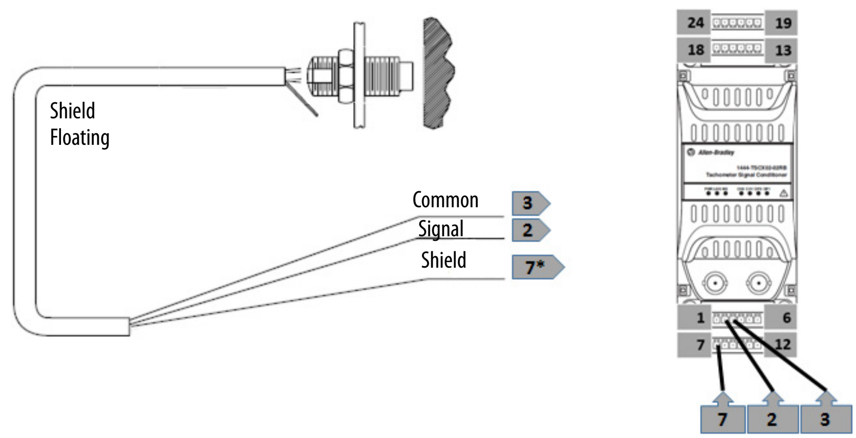
Self-generating magnetic Sensor

The connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = Self-generating Magnetic Pickup, and
- Transducer Power = OFF

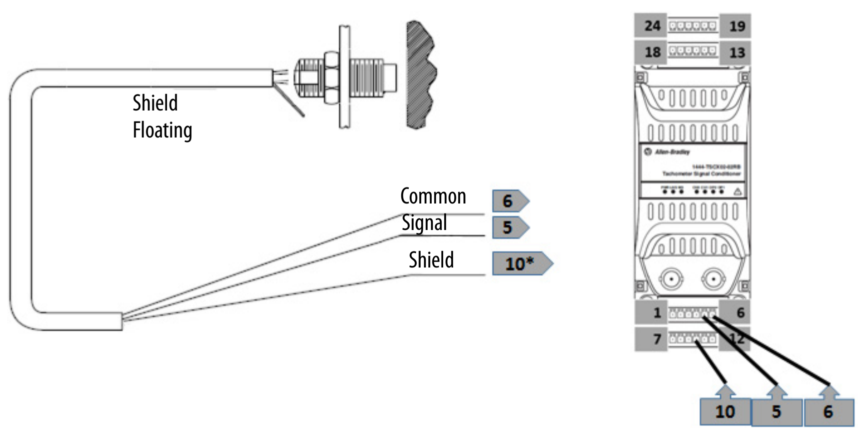
Wire the pickup as illustrated.

Figure 28 - Channel 0 wiring for a Self-generating magnetic Sensor



* Recommended shield pin connection but can be landed to any available shield connection.

Figure 29 - Channel 1 wiring for a Self-generating magnetic Sensor



* Recommended shield pin connection but can be landed to any available shield connection.

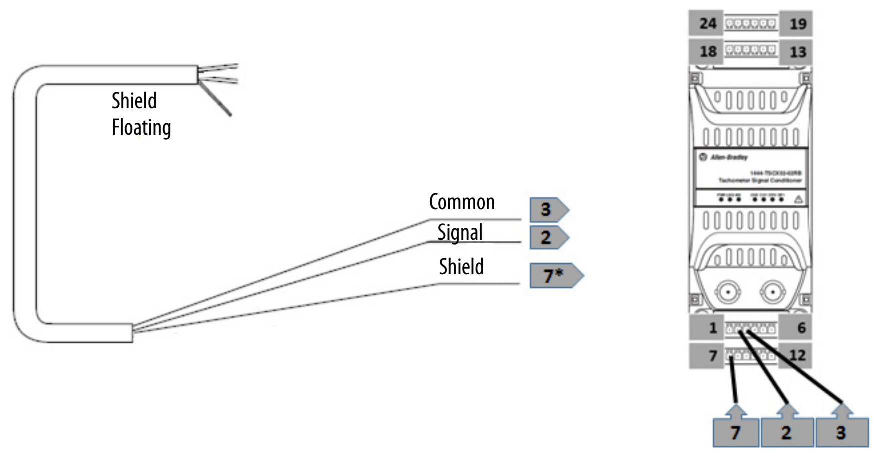
TTL Output Sensor

For any sensor or device that provides a TTL signal, such as a Hall Effect sensor, the connected channel of the Tachometer Signal Conditioner must be configured with:

- Transducer Type = TTL Signal, and
- Transducer Power = OFF

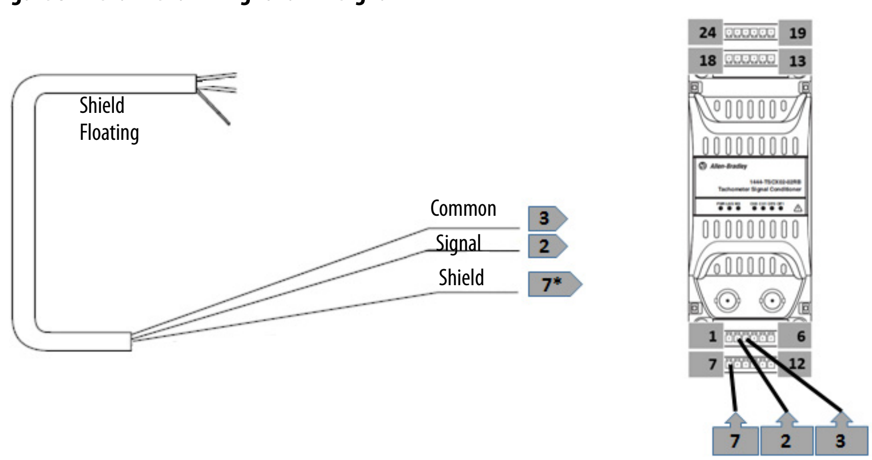
Wire the pickup as illustrated in the following.

Figure 30 - Channel 0 wiring for a TTL Signal



* Recommended shield pin connection but can be landed to any available shield connection.

Figure 31 - Channel 0 wiring for a TTL Signal



* Recommended shield pin connection but can be landed to any available shield connection.

Start the Module and Perform a Self-test

After the modules are wired, power can be applied to test the installation. At power-up, each module performs an initial Self-test.

Until a configuration is downloaded, and an Ethernet connection made, after the Self-test cycle the modules move to an idle state. Table 5 describes the status indicators:

Table 5 - Dynamic Measurement Module

Status Indicator	Color	Behavior	Status Indicator	Color	Behavior
PWR	Green	Solid	DSP	Green	Flashing
RUN	Green	Flashing	OK	Green	Solid
MS	Green	Solid	CH0	Green	Solid
NS	Green	Solid or Flashing	CH1	Green	Solid
			CH2	Green	Solid
OS	Green	Solid	CH3	Green	Solid
			RLY	Green	Solid

If the Status Indicators are not as shown above, see Table 54 on page 236.

Expansion Module Startup Behavior

During power-up expansion, Module Status Indicators provide the address setting of the module. See Startup Behavior on page 242, for more information.

Table 6 - Tacho Signal Conditioner Expansion Module

Status Indicator	Color	Behavior	Status Indicator	Color	Behavior
PWR	Green	Solid	CH0	Green or Blue	Solid
LNS	Green	Solid	CH1	Green or Blue	Solid
MS	Green	Flashing	OP0	Green	Solid
			OP1	Green	Solid

If the Status Indicators are not as shown above, see Table on page 239.

Table 7 - Relay Expansion Module

Status Indicator	Color	Behavior	Status Indicato r	Color	Behavior
PWR	Green	Solid	R0	Green	Solid
LNS	Green	Solid	R1	Green	Solid
MS	Green	Flashing	R2	Green	Solid
			R3	Green	Solid

If the Status Indicators are not as shown above, see Table on page 241.

Table 8 - Analog Output Expansion Module

Status Indicator	Color	Behavior		Status Indicato r	Color	Behavior
PWR	Green	Solid		OP0	OFF	
LNS	Green	Solid		OP1	OFF	
MS	Green	Flashing		OP2	OFF	
				OP3	OFF	

If the Status Indicators are not as shown above, see Table on page 240.

Configure the 1444 Dynamic Measurement Module

This chapter details how to define and configure the 1444 dynamic measurement module and set associated parameters.

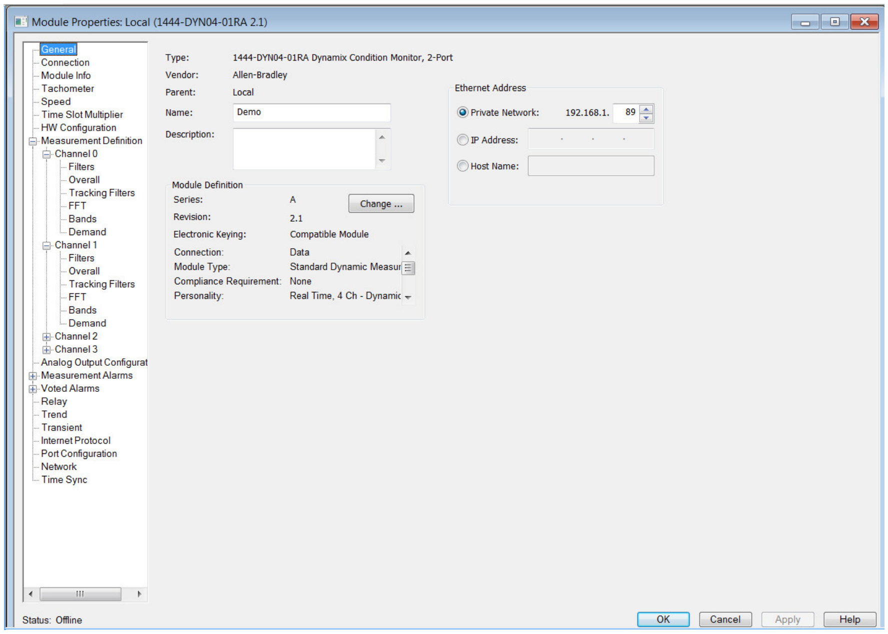
IMPORTANT Many parameters presented by the AOP are named differently than in the various objects within the module that it refers to. Consequently the parameter names listed in the CIP Objects Library (Appendix B), in some cases, do not match the parameters presented on the AOP.

See the Cross Reference at the beginning of the CIP Objects Library to determine the specific names of parameters as presented on the AOP, stored in the configuration assembly, and held in the various objects in the module.

General Page

The general page contains controls to name, describe, and define the system. You can also set the EtherNet/IP address or host name from the general page.

Figure 32 - The General Page



Module Definition

The Module Definition pages provide high-level definitions of module application and channel function. Users must define the module at this level once during initial installation, as the entries on this page are used throughout the configuration to enable, disable, or qualify further configuration attributes, selections, and options.

IMPORTANT	If parameters are changed in module definition, any dependent module configuration parameters are reset to default values.

Module Definition Versus Module Configuration

In the Logix environment, there are two steps to configure a new device:

- Defining the instance of the specific connected device
- Configuring the device.

Module Definition

Module definition is performed by using the various dialogs that are accessed through the General Page Change button.

At minimum, the attributes that are defined in module definition include any that affect the structure of the configuration, input, or output assemblies because the Add-on Profile (AOP) constructs these assemblies when the module definition is applied.

The 1444 series controller input assembly can be as simple as one measurement from each of four DC channels or as sophisticated as over 100 values that are measured from dynamic signals. In either case, in module definition specific measures must be selected to include in the input assembly. To simplify the selection and to minimize errors further along in configuration, Module definition then includes additional dependant attributes. These attributes are used to filter the selection of the input assembly attributes based on the application and the types of inputs to each channel.

Other attributes that are controlled in module definition include specification of connected expansion modules, which define the complete hardware available for configuration, as well as other high-level attributes that are not expected to be edited once the device is initially defined.

IMPORTANT	• When Module Definition is applied, the AOP creates instances of the Configuration, Input, and Output assemblies. After editing an existing Module Definition the AOP will reset only configuration parameters that have a dependency on a changed Module Definition parameter. • For example, if a Channel Input Type is changed then only the parameters associated with the changed channel will be set to their default values. Users should thoroughly review the configuration after making any change to an existing Module Definition.

Module Configuration

Module Configuration consists of all “normal configuration” pages that are added to the tree below the standard General, Connections, and Module Info pages.

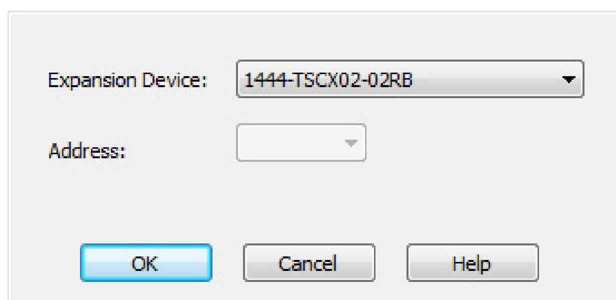
For the Dynamix 1444 Series, much of what is enabled in these pages is determined based on the selections in Module Definition.

Configuration attributes can be changed without concern for the physical device definition (connected expansion modules and sensor types) such as alarm limits, measurement definitions, and trend configuration. In many cases, the available selections are limited by those attributes, within the available selections for that type of device.

Expansion Device Definition Dialog

Part of defining a 1444 series module is specifying any connected expansion modules. It can make sense to specify modules before working through the other module definition dialogs because it defines the physical installation. The expansion device definition dialog is used to add any expansion modules that are hosted by the selected 1444-DYN04-01RA module.

The tool provides controls to select a device and assign an address.



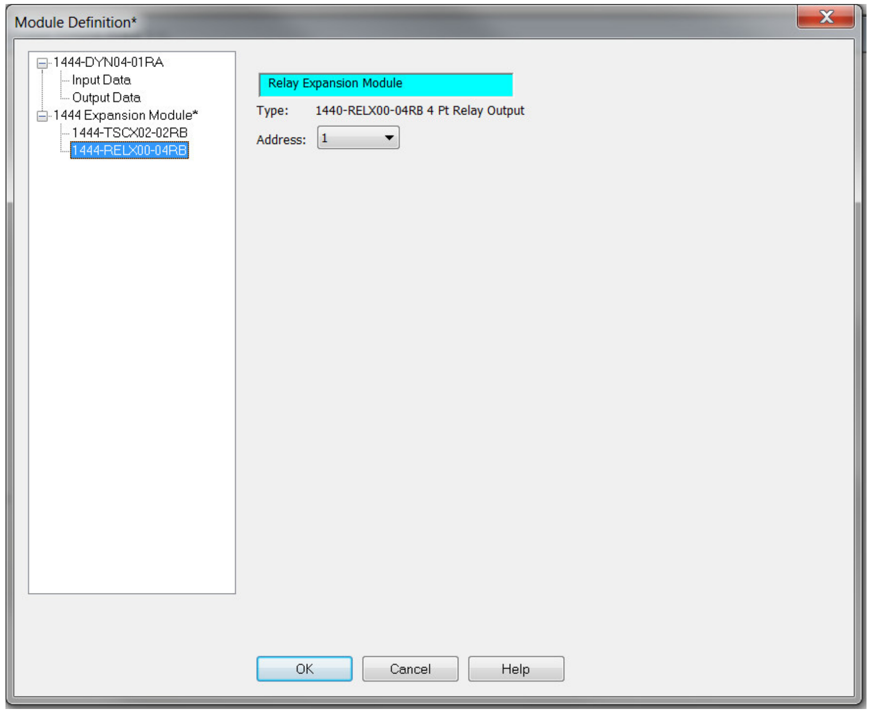
From the expansion device pull-down menu select the type of expansion module to add to the tree, and connect to the selected dynamic measurement module.

Use the address pull-down menu to select an address (0, 1, 2) for a connected relay module (1444-RELX00-04RB). See Relay Expansion Module on page 91:

- Configuration of expansion modules is included in the configuration of the expansion module’s host module.
- Addresses are set automatically for connected Tachometer Signal Conditioner (1444-TSCX02-02RB) and 4…20 mA analog (1444-AOFX00-04RB) expansion modules.

Relay Expansion Module

Figure 33 - The Relay Expansion Module Page



Use the parameters on this page to edit the address of a connected relay expansion module for the selected 1444-DYN04-01RA dynamic measurement module.

Verify that the physical address set in the relay expansion module terminal base matches the value entered here.

Define Module Functionality Page

Use the define module functionality page to specify the high-level application of the module. This page is also where the general measurement definitions for the module and each channel are made. The selections made here are used throughout the tool, including on other module definition pages and the configuration pages, to guide further selections.

In configuration the relays are numbered as follows:

- 1444-DYN04-01RA onboard Relay: relay #0
- 1444-RELX00-04RB at address 0: relays #1…4
- 1444-RELX00-04RB at address 1: relays #5…8
- 1444-RELX00-04RB at address 2: relays #9…12

IMPORTANT	If edits are made to the Module Configuration, it resets all other configurations to their default values.

Figure 34 - The Define Module Functionality Page

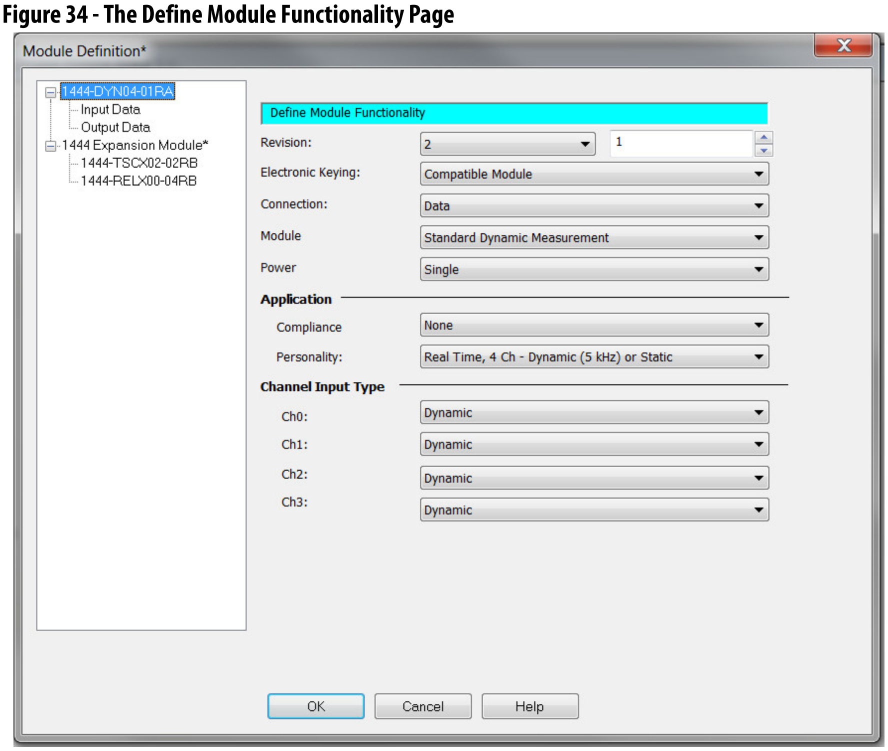


Table 9 - Module Functionality

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Power Supply</td><td>Single
Redundant</td><td>Specify if the module is powered by a single or dual power supplies.
When powered by dual supplies (redundant mode) the module monitors each power supply input and signal its status by using bit 15 of input tag member AuxProcesorStatus.
The status bit is set (1) if this parameter is set to Redundant (1) and either of the supply voltages is less than 17V DC.
Redundant power is required for all API and SIL level applications (ComplianceMode not equal to “None”).
Using External Redundant Supplies
If the application requires API-670 or SIL compliance and power redundancy is being implemented externally, then it is necessary to connect power to both power inputs on the module. If power is landed to only one input, and the Power Supply mode is set to Redundant, then a fault indication is given.</td></tr>
<tr><td>Compliance Requirement</td><td><table><tr><th>Setting</th><th>Compliance Mode</th></tr><tr><td>None</td><td>0</td></tr><tr><td>API-670 Compliant</td><td>1</td></tr></table></td><td>For general monitoring applications that do not apply protection requirement, select “None”.
Selecting API-670 Compliant or higher applies restrictions to the configuration that aid in defining an API-670 machinery Protection Systems standard compliant configuration.
When performing a safety function, the Dynamix 1444 module (including any associated auxiliary modules) implements a range of diagnostic measures to test for hardware or software failure. By specifying the mode in which the safety function operates (low/high demand mode) the extent of these checks, their frequency, and the actions on detection of a failure can all be set appropriately.
• API-670 enables a great deal of variation in many aspects of the configuration. So setting this attribute to API-670 Compliant or higher does not by itself help ensure that a configuration is API-670 compliant. API -670 compliance levels require real-time measurements. So the multiplexed personalities are not enabled when compliance levels greater than None are selected.</td></tr>
<tr><td>Personality</td><td><table><tr><th>Setting</th><th>Personality</th></tr><tr><td>Real Time, 4 Ch – Dynamic (4 kHz) or Static</td><td>1</td></tr><tr><td>Real Time, 2 Ch – Dynamic (18 kHz), 2 Ch Static</td><td>2</td></tr><tr><td>Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path</td><td>32</td></tr><tr><td>Real Time, 2 Ch – Dynamic (40 kHz)</td><td>64</td></tr><tr><td>Multiplexed, 4 Ch – Dynamic (40 kHz) or - Static – Paired</td><td>-128</td></tr></table></td><td>Module Personality defines the general measurement configuration of the module, including which channels are used, at what maximum frequency (or DC).
Two categories of Personality are provided – Real-Time and Multiplexed. Real-Time personalities are those that provide continuous measurements that update at rates of not slower than once every 40 milliseconds. The Multiplexed personalities update measurements in channel pairs, although they do not necessarily alternate equally (see Time Slot Multiplier).
The available selections are as follows.
1: Real Time, 4 Ch – Dynamic (4 kHz) or Static
All channels are available. Each channel pair can be defined for either Static (DC) or Dynamic (AC) measurements. Dynamic channels can be configured for an Fmax up to 4 kHz (240 kCPM).
2: Real Time, 2 Ch – Dynamic (18 kHz), 2 Ch Static
Channels 0 and 1 can be configured for Dynamic (AC) measurements with an Fmax of up to 18 kHz (1080 kCPM). Channels 2 and 3 can be used for Static (DC) measurements.
32: Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path
For measurements, this is the same as “1: Real Time, 4 Ch – Dynamic (4 kHz) or Static”. What is different is that the module internally connects the channel 0 and 2 inputs and the channel 1 and 3 inputs.
64: Real Time, 2 Ch – Dynamic (40 kHz)
Channels 0 and 1 (pair) can be configured for Dynamic (AC) measurements with an Fmax of up to 40 kHz (2400 kCPM), or as gSE. Channels 2 and 3 are disabled (off).
-128: Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired
Channels can be configured in pairs (0 and 1, 2 and 3) for Dynamic (AC) measurements with an Fmax of up to 40 kHz (2400 kCPM), as gSE, as Static (DC) measurements, or off.
Channel Pair measurements alternate based on the Time Slot Multiplier setting.</td></tr>
</table>

Table 9 - Module Functionality

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Ch0, Ch1, Ch2, Ch3</td><td>0: Off
1: Dynamic
2: gSE
3: Static</td><td>Channel Type is a high-level selection that is used by the AOP (not the module) to filter / manage further user selections in Module Definition and in Configuration.
The Channel Types that are enabled are based on the Module Personality selected. The selections are as follows.
<table>
<tr><td>Personality</td><td>Ch0</td><td>Ch1</td><td>Ch2</td><td>Ch3</td></tr>
<tr><td>Real Time, 4 Ch – Dynamic (5 kHz) or Static</td><td>Off,
Dynamic,
Static</td><td>Off,
Dynamic,
Static</td><td>Off,
Dynamic,
Static</td><td>Off,
Dynamic,
Static</td></tr>
<tr><td>Real Time, 2 Ch – Dynamic (20 kHz), 2 Ch Static</td><td>Off, Dynamic</td><td>Off,
Ch0 Setting</td><td>Off,
Static</td><td>Off,
Static</td></tr>
<tr><td>Real Time, 4 Ch – Dynamic (5 kHz) – Dual Path</td><td>Off,
Dynamic,
Static</td><td>Off,
Ch0 Setting</td><td>Off,
Dynamic,
Static</td><td>Off,
Ch2 Setting</td></tr>
<tr><td>Real Time, 2 Ch – Dynamic (40 kHz)</td><td>Off,
Dynamic,
gSE</td><td>Off,
Ch0 Setting</td><td>Off</td><td>Off</td></tr>
</table></td></tr>
</table>

Input Data Page

Use the Input Data Page to specify the measurements to be included in the module input assembly. The input assembly is constructed to include a fixed Status Assembly (See Assembly Object on page 435) followed by a table that consists of the selected measurements.

Selecting measurements to be included on the input assembly is not sufficient for the module to produce them. Measurements must also be configured appropriately (See Measurement Definition on page 117).

Figure 35 - The Input Data Page

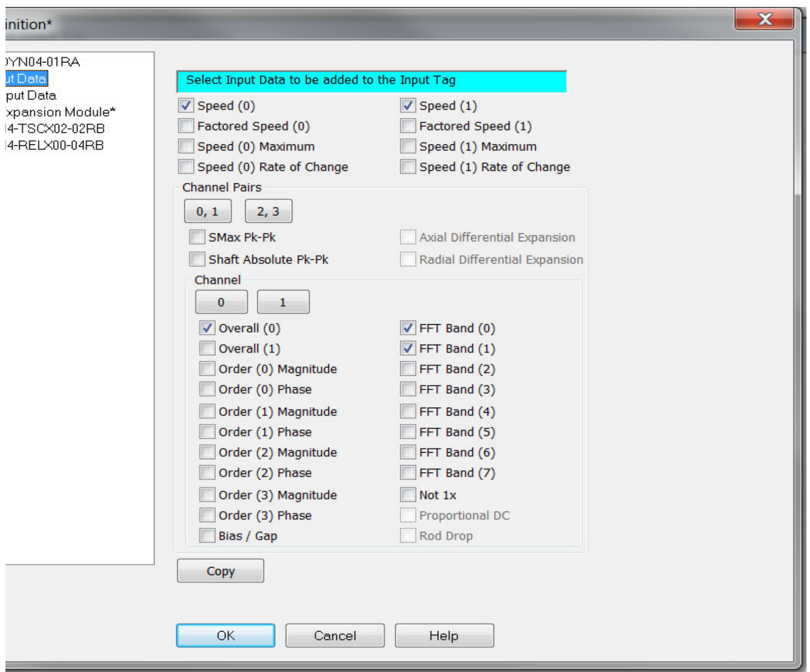


Table 10 - Input Data

Parameter	Values	Comments
Speed (0)	Checked (1) Unchecked (0)	Check this to include the Speed0 member to the input tag. The speed written is the value measured from the TTL input (0 or 1) or from the controller output (I/O), and without applying any Speed Multiplier that can be configured. Tag Member: Speed0
Speed (1)	Checked (1) Unchecked (0)	Check this to include the Speed1 member in the input tag. The speed written is the value measured from the TTL input (0 or 1) or from the controller output (I/O), and without applying any Speed Multiplier that can be configured. Tag Member: Speed1
FactoredSpeed (0)	Checked (1) Unchecked (0)	Check this to include the Factored Speed0 member to the input tag. The Factored Speed is the measured speed multiplied by the Multiplier (specified on the Speed page). Tag Member: FactoredSpeed0
FactoredSpeed (1)	Checked (1) Unchecked (0)	Check this to include the Factored Speed1 member to the input tag. The Factored Speed is the measured speed multiplied by the Multiplier (specified on the Speed page). Tag Member: FactoredSpeed1
Speed (0) maximum	Checked (1) Unchecked (0)	Check this to include the Speed0 max member to the input tag. Speed maximum is the maximum observed speed measurement since last reset. This is the maximum Speed, not Factored Speed. So it excludes any multiplier that can be specified on the Speed page. Tag Member: Speed0 max

Table 10 - Input Data

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Speed (1) maximum</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Speed1 max member to the input tag.
Speed maximum is the maximum observed speed measurement since last reset. This is the maximum Speed, not Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
Tag Member: Speed1 max</td></tr>
<tr><td>Speed (0) Rate of Change</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Speed0RateOfChange member to the input tag. This is the Rate of Change of the Speed, not of the Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
Tag Member: Speed0RateOfChange</td></tr>
<tr><td>Speed (1) Rate of Change</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Speed1RateOfChange member to the input tag. This is the Rate of Change of the Speed, not of the Factored Speed. So it excludes any multiplier that can be specified on the Speed page.
Tag Member: Speed1RateOfChange</td></tr>
<tr><td>SMax pk-pk</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the S MAX magnitude member for the selected channel pair to the input tag.
<table>
<tr><td>Channel Pair</td><td>Tag Member</td></tr>
<tr><td>0, 1</td><td>Ch0_1SMAXMAg</td></tr>
<tr><td>2, 3</td><td>Ch2_3SMAXMAg</td></tr>
</table></td></tr>
<tr><td>Shaft Absolute pk-pk</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Shaft Absolute pk-pk member for the selected channel pair to the input tag.
<table>
<tr><td>Channel Pair</td><td>Tag Member</td></tr>
<tr><td>0, 1</td><td>Ch0_1Shaft AbsolutePk_Pk</td></tr>
<tr><td>2, 3</td><td>Ch2_3Shaft AbsolutePk_Pk</td></tr>
</table></td></tr>
<tr><td>Axial Differential Expansion</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Axial Differential Expansion member for the selected channel pair to the input tag.
<table>
<tr><td>Channel Pair</td><td>Tag Member</td></tr>
<tr><td>0, 1</td><td>Ch0_1AxialDiffExpansion</td></tr>
<tr><td>2, 3</td><td>Ch2_3AxialDiffExpansion</td></tr>
</table>
If the channel type is DC, then only one DC member can be selected (Axial or Radial Differential Expansion, DC Proportional, or Rod Drop).</td></tr>
<tr><td>Radial Differential Expansion</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Radial (Ramp) Differential Expansion member for the selected channel pair to the input tag.
<table>
<tr><td>Channel Pair</td><td>Tag Member</td></tr>
<tr><td>0, 1</td><td>Ch0_1RampDiffExpansion</td></tr>
<tr><td>2, 3</td><td>Ch2_3RampDiffExpansion</td></tr>
</table>
If the channel type is DC, then only one DC member can be selected (Axial or Radial Differential Expansion, DC Proportional, or Rod Drop).</td></tr>
<tr><td>Overall (n)</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Overall (0) member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0Overall[n]</td></tr>
<tr><td>1</td><td>Ch1Overall[n]</td></tr>
<tr><td>2</td><td>Ch2Overall[n]</td></tr>
<tr><td>3</td><td>Ch3Overall[n]</td></tr>
</table></td></tr>
</table>

Table 10 - Input Data

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Order (n) magnitude</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Order (0) magnitude member for the selected channel to the input tag.<table><tr><td>Channel</td><td>Tag Member</td></tr><tr><td>0</td><td>Ch0Order[n]Mag</td></tr><tr><td>1</td><td>Ch1Order[n]Mag</td></tr><tr><td>2</td><td>Ch2Order[n]Mag</td></tr><tr><td>3</td><td>Ch3Order[n]Mag</td></tr></table></td></tr>
<tr><td>Order (n) Phase</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Order (0) Phase member for the selected channel to the input tag.<table><tr><td>Channel</td><td>Tag Member</td></tr><tr><td>0</td><td>Ch0Order[n]Phase</td></tr><tr><td>1</td><td>Ch1Order[n]Phase</td></tr><tr><td>2</td><td>Ch2Order[n]Phase</td></tr><tr><td>3</td><td>Ch3Order[n]Phase</td></tr></table></td></tr>
<tr><td>Bias / Gap</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Bias / Gap (DC volts) member for the selected channel to the input tag.<table><tr><td>Channel</td><td>Tag Member</td></tr><tr><td>0</td><td>Ch0DCV</td></tr><tr><td>1</td><td>Ch1DCV</td></tr><tr><td>2</td><td>Ch2DCV</td></tr><tr><td>3</td><td>Ch3DCV</td></tr></table></td></tr>
<tr><td>FFT Band (n)</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the FFT Band 0 member for the selected channel to the input tag.<table><tr><td>Channel</td><td>Tag Member</td></tr><tr><td>0</td><td>Ch0FFTBand[n]</td></tr><tr><td>1</td><td>Ch1FFTBand[n]</td></tr><tr><td>2</td><td>Ch2FFTBand[n]</td></tr><tr><td>3</td><td>Ch3FFTBand[n]</td></tr></table></td></tr>
</table>

Table 10 - Input Data

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Not 1x</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Not 1x member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0Not1X</td></tr>
<tr><td>1</td><td>Ch1Not1X</td></tr>
<tr><td>2</td><td>Ch2Not1X</td></tr>
<tr><td>3</td><td>Ch3Not1X</td></tr>
</table></td></tr>
<tr><td>Proportional DC</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Proportional DC member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0DC</td></tr>
<tr><td>1</td><td>Ch1DC</td></tr>
<tr><td>2</td><td>Ch2DC</td></tr>
<tr><td>3</td><td>Ch3DC</td></tr>
</table>
• The tag value displays in the specified engineering units for the proportional value.
• If the channel type is DC, then only one DC member can be selected (Axial or Radial Differential Expansion, DC Proportional, or Rod Drop).</td></tr>
<tr><td>Rod Drop</td><td>Checked (1)
Unchecked (0)</td><td>Check this to include the Rod Drop member for the selected channel to the input tag.
<table>
<tr><td>Channel</td><td>Tag Member</td></tr>
<tr><td>0</td><td>Ch0RodDrop</td></tr>
<tr><td>1</td><td>Ch1RodDrop</td></tr>
<tr><td>2</td><td>Ch2RodDrop</td></tr>
<tr><td>3</td><td>Ch3RodDrop</td></tr>
</table>
If the channel type is DC, then only one DC member can be selected (Axial or Radial Differential Expansion, DC Proportional, or Rod Drop).</td></tr>
</table>

Select Input Data for Input Tag

The parameters on this page are used to specify measurements to be included in the Input Tag. When a control is checked, the corresponding member is included in the input tag.

The page is organized into top (Module level), middle (Input Pair level) and bottom (Input level) sections.

Module Level Parameters

The parameters in the top section are all associated with speed so they are not dependent on the configuration or availability of any measurement channel.

Channel Pair Level Parameters

The parameters in this section are measurements that are made from two measurement channels. All two channel measurements are made from channels that are grouped into either of two pairs; channels 0 and 1 or channels 2 and 3.

There are two versions of each of the parameters that are shown in this section, one associated with each channel pair. Click the button for pair 0, 1 or pair 2, 3 to select the measurements for either pair.

Channel Level Parameters

The parameters in this section are measurements that are made from individual channels.

There are four versions of each of the parameters that are shown in this section, one associated with each channel. Click the button for channel 0 or 1, for channel pair 0/1, or 2 or 3, for channel pair 2/3, to select the measurements for each channel:

- The parameters on this page are used only by the AOP.
- The Module Personality and Channel Type selections of the Define Module Functionality page filter the presented measurements.
- Selecting measurements on this page forces related configuration definition/selections but cannot ensure that the configuration of the measurement is appropriate for the application and the applied signals.
- Use the Copy Button to copy the Channel Pairs and Channel selections that are visible to the other Channel Pair and Channels.

Module Definition - Select Data for Output Tag

The parameters on this page are used to specify data to be included in the Output Tag.

The module output assembly consists of one Control value and two optional arrays of floats; two speed values and 16 alarm limit values. The optional items are what are defined on this page.

Figure 36 - Module Definition - Select Data for Output

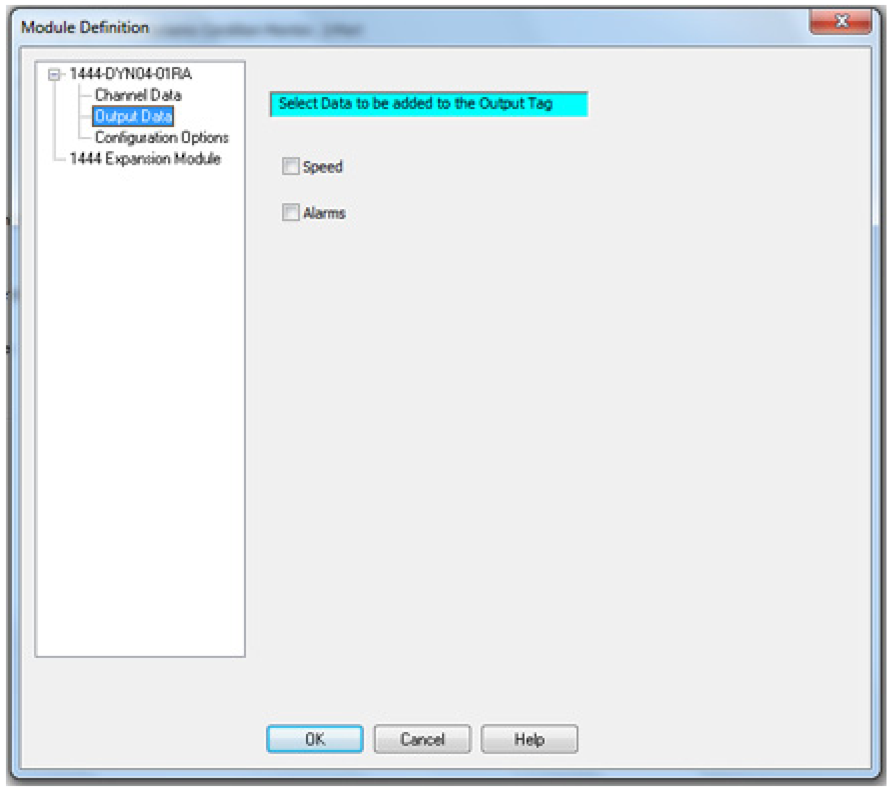


Table 11 - Data for Output Tag

Parameter	Values	Comments
Speed	Checked (1) Unchecked (0)	Check this to include two speed members in the output tag. • Speed values written to the output tag can be used to manage FFT Bands, Alarm Gating, and other speed-related functions in the module. • Sometimes a machine does not have a speed sensor (tachometer) available for the module to consume directly. But often the controller knows the speed, from a drive or other system / device. While the module requires a "trigger" type signal for some speed functions, such as Order Tracking, it needs only an RPM value for others, such as Alarm Gating.
Alarms	Checked (1) Unchecked (0)	Check this to include 16 alarm members in the output tag. • Alarm limit values written to the output tag can be used as Alert or Danger limit levels in one or more Measurement Alarms. • For some applications, static alarm values are insufficient because the behavior of the measured value changes "normally" as a function of the process. For example, the "profile" of vibration through the cycle of cutting by a machine tool follows a unique, but repeatable, pattern as the cutting tool is at rest, moves forward, engages, cuts, disengages, retracts, and then rests again. In other cases, the vibration response can vary "normally" based on the type of fluid being pumped, or the type of metal being worked. In all these cases, and many more, the controller can be programmed to serve appropriate alarm limits to the module as standard I/O. This helps ensure the detection of any deviant behavior regardless of where the process is within the profile or what material is being processed.

Internet Protocol Page

The Internet Protocol page parameters provide controls for connecting the module to a network. See ENET-UM001 for more information.

Figure 37 - The Internet Protocol Page

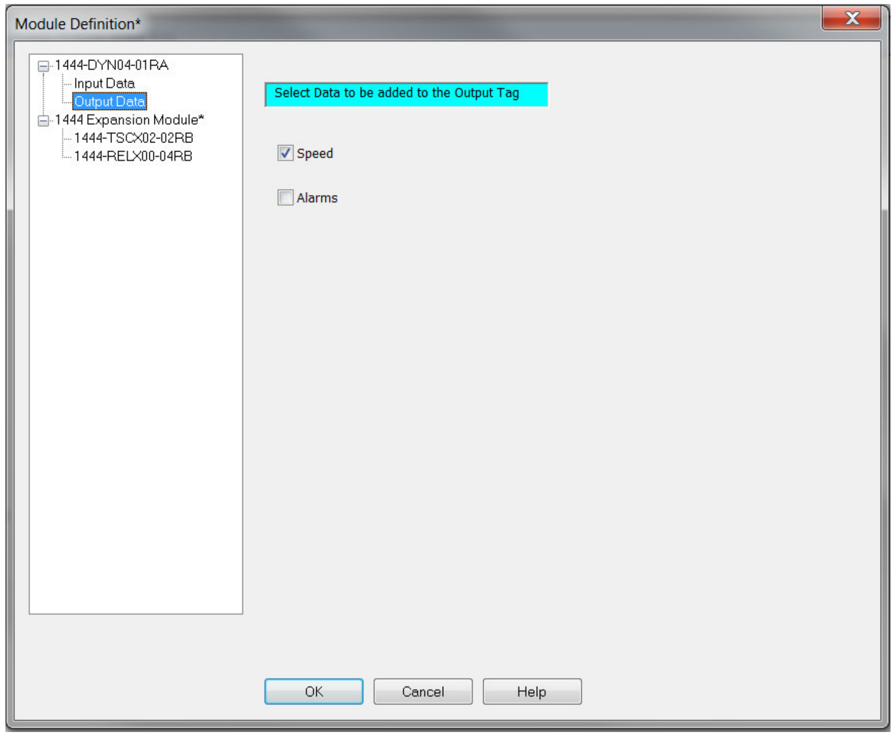


Table 12 - Internet Protocol

Parameter	Values	Comments
Internet Protocol Settings	Manually configure IP settings Obtain IP settings automatically using BOOTP Obtain IP settings automatically using DHCP IP settings set by switches on the module	
Physical Module IP Address	N/A	Type in an IP address for the system.
Domain Name	N/A	
Host Name	N/A	
Subnet Mask	N/A	
Gateway Address	N/A	
Primary DNS Server Address	N/A	
Secondary DNS Server Address	N/A	

Port Configuration Page

Use the Port Configuration page to enable and configure module ports.

Figure 38 - The Port Configuration Page

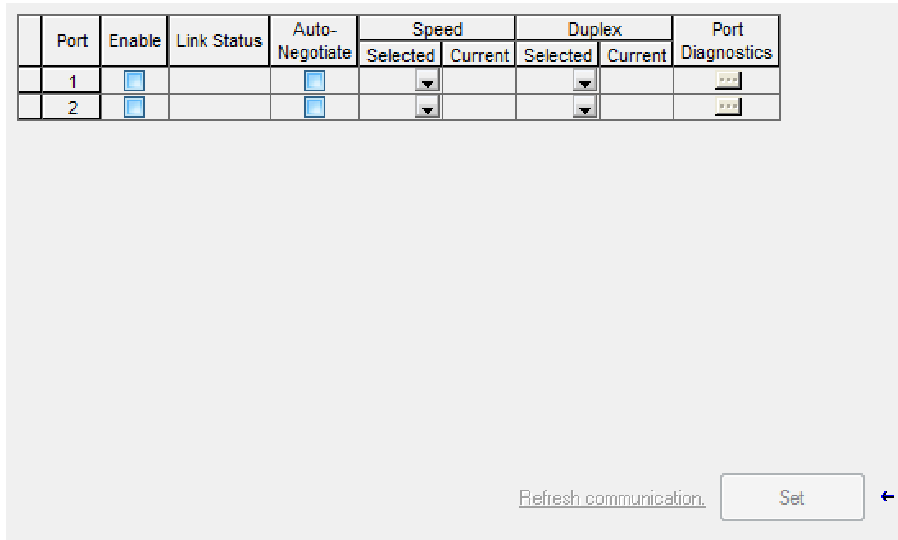


Table 13 - Port Configuration

Parameter	Value	Comments
Port		
Enable		
Link Status		
Auto-Negotiate		
Speed		
Duplex		
Port Diagnostics		

Network Page

Use the Network page to view the network topology and status. See ENET-UM001 for more information.

Figure 39 - Network Page

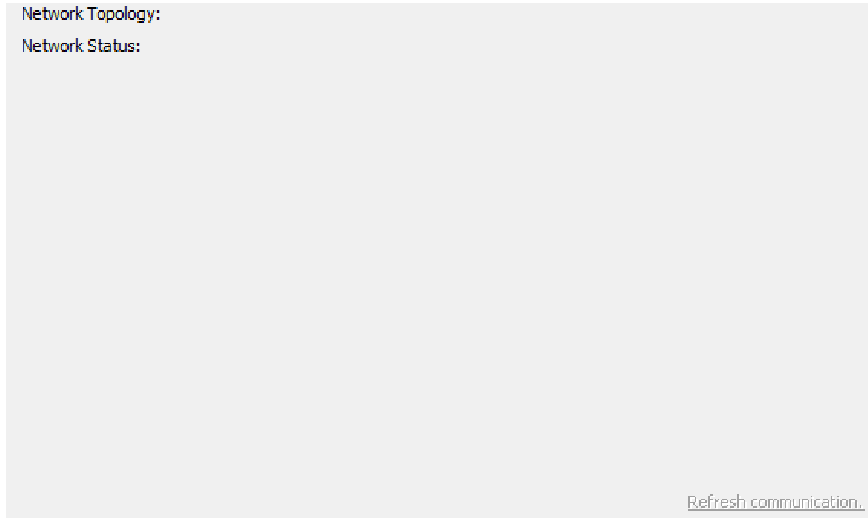
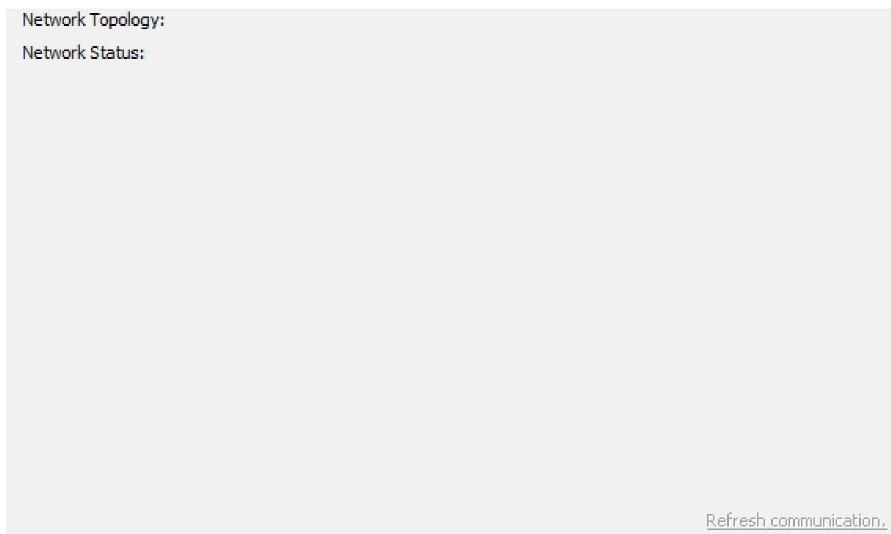


Figure 40 - The Network Page



Time Sync Page

Refer to ENET-UM001 for more information.

Figure 41 - The Time Sync Page

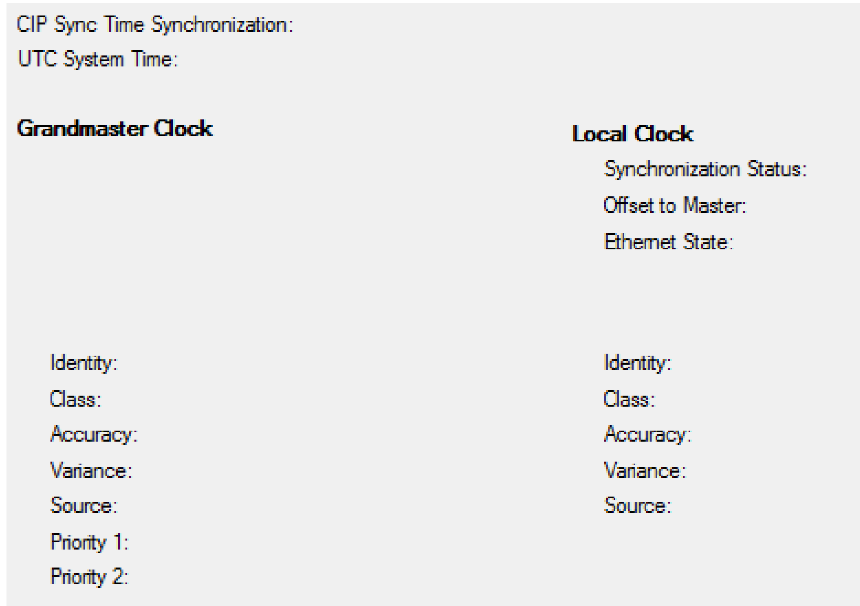
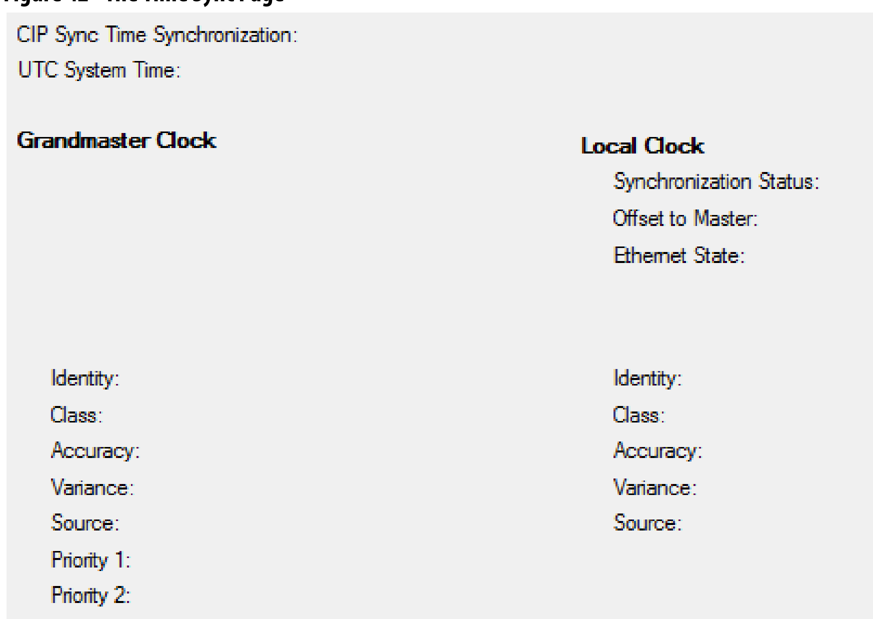
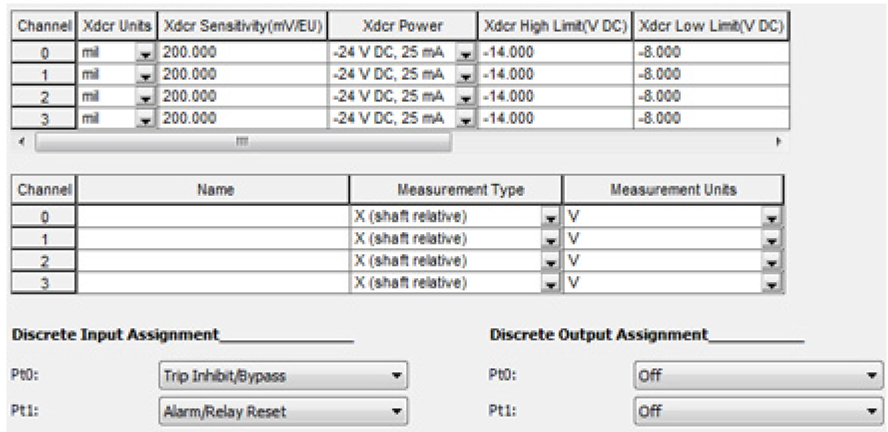


Figure 42 - The Time Sync Page



Hardware Configuration Page

Figure 43 - Configuration for Channel Inputs, Discrete Inputs, Discrete Outputs, and Dynamic Measurement Data Storage



The Hardware Configuration Page includes parameters that are associated with the physical inputs and outputs of the module. The page is divided into four general sections:

- Sensor Definition: Parameters that define the sensor that is physically connected to each channel of the module.

IMPORTANT	Because the available selections and defaults for the Sensor Definition parameters are set by the Measurement Type selection in the Channel Definition group, it can be easier to select the appropriate Measurement Type value before configuring the sensor attributes.

- Channel Definition: Parameters that define the integration and filtering requirements for each channel.
- Discrete I/O Definition: Parameters that define how the module's discrete input and output channels are used.
- Dynamic Data Storage: One parameter that defines how the module internally holds dynamic data that is captured by the module.

Table 14 - Hardware Configuration

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Xdcr Units</td><td>The supported engineering units include the following.
<table>
<tr><td>V</td><td>inch/s</td><td>bar</td><td>kW</td><td>UK g/min</td></tr>
<tr><td>mV</td><td>m/s^2</td><td>mbar</td><td>MW</td><td>m^3/min</td></tr>
<tr><td>m</td><td>mm/s^2</td><td>psi</td><td>VA</td><td>gSE</td></tr>
<tr><td>mm</td><td>inch/s^2</td><td>A</td><td>kVA</td><td>RPM</td></tr>
<tr><td>micron</td><td>g</td><td>mA</td><td>VAR</td><td>RPM/min</td></tr>
<tr><td>inch</td><td>mg</td><td>K</td><td>kVAR</td><td>EU</td></tr>
<tr><td>mil</td><td>Pa</td><td>°C</td><td>l/min</td><td></td></tr>
<tr><td>m/s</td><td>kPa</td><td>°F</td><td>cfm</td><td></td></tr>
<tr><td>mm/s</td><td>MPa</td><td>W</td><td>US g/min</td><td></td></tr>
</table>
The Engineering Units cannot be set or changed if the Channel Type is OFF or gSE.</td><td>Select the Engineering Units the sensor measures and to which the transducer sensitivity is referenced (in mV/Engineering Unit).
The Channel Type (Module Definition) and the Measurement Type determine the available selections.</td></tr>
<tr><td>Xdcr Sensitivity</td><td>Any real number between 1 and 20,000.</td><td>Enter the sensitivity of the connected sensor in mV/Engineering Unit (EU as specified in Xdcr Units above).</td></tr>
<tr><td>Xdcr Power</td><td>Select from the following.
• Off
• +24V DC, 4 mA
• +24V DC, 25 mA
• -24V DC, 25 mA
Select the power option appropriate for the connected sensor.</td><td>• Select OFF for any self-powered sensor, or for sensors that are powered from another source (including a barrier).
• +24V DC, 4 mA: This is a constant current (CC) source. It is required for standard IEPE (ICP) accelerometers and other sensors that require a 4 mA CC source.
• +24V DC, 25 mA: This is a regulated positive voltage source. Many position measurement sensors such as LVDTs and some vibration sensors require a +24V supply.
• -24V DC, 25 mA: This is a regulated negative voltage source. It is suitable for all API-670 compliant eddy current probes and other sensors that require a -24V supply.</td></tr>
<tr><td>Xdcr High Limit (V DC)</td><td>-24.000…24.000</td><td>High-voltage threshold for the TX OK monitoring window. A sensor bias voltage greater than this value forces a transducer fault condition.
To aid transducer failure detection the signal input circuitry imposes, in the absence of a functioning transducer, a bias voltage at the input. The bias applied is automatically selected based on the power supply configured for that channel:
<table>
<tr><th>Power</th><th>Typical Bias Voltage at Input</th></tr>
<tr><td>OFF</td><td>1.7 VDC</td></tr>
<tr><td>+24V DC, 4 mA</td><td>-3.9 VDC</td></tr>
<tr><td>+24V DC, 25mA</td><td>-3.9 VDC</td></tr>
<tr><td>-24V DC, 25mA</td><td>13 VDC</td></tr>
</table>
Within a channel pair (0&1, 2&3), there will be slight differences in the bias voltages (particularly noticeable on the positive bias, where it is approximately 1.3 V). This is by design and has no effect on functionality.</td></tr>
</table>

Table 14 - Hardware Configuration

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Xdcr Low Limit (V DC)</td><td>-24.000…24.000</td><td>Low voltage threshold for the TX OK monitoring window. A sensor bias voltage less than this value forces a transducer fault condition.
To aid transducer failure detection the signal input circuitry imposes, in the absence of a functioning transducer, a bias voltage at the input. The bias applied is automatically selected based on the power supply configured for that channel:
<table><tr><th>Power</th><th>Typical Bias Voltage at Input</th></tr><tr><td>OFF</td><td>1.7 VDC</td></tr><tr><td>+24V DC, 4 mA</td><td>-3.9 VDC</td></tr><tr><td>+24V DC, 25mA</td><td>-3.9 VDC</td></tr><tr><td>-24V DC, 25mA</td><td>13 VDC</td></tr></table>
Within a channel pair (0&1, 2&3), there will be slight differences in the bias voltages (particularly noticeable on the positive bias, where it is approximately 1.3 V). This is by design and has no effect on functionality.</td></tr>
<tr><td>Xdcr Location</td><td>Select from the following.
• Unknown
• Radial
• Axial</td><td>Select the location of the transducer that pertains to the alignment of the sensor with the monitored shaft.
Use Radial if the most sensitive direction of measurement is perpendicular to the shaft.
Use Axial of the most sensitive direction of measurement is parallel to the shaft.
The module does not use Transducer Location but retains it for reference by higher-level systems.</td></tr>
<tr><td>Xdcr Orientation (deg).</td><td>0…359, in 1 ° increments</td><td>Degrees are referenced (0) to the vertical top dead center (TDC) of the shaft and increment in the clockwise direction when viewed from the driver end of the machine train.
• The direction of shaft rotation does not affect orientation.
• Transducer orientation is used in the S MAX and Absolute Shaft Vibration calculations and for reference by higher-level systems.</td></tr>
<tr><td>Name</td><td>0…32 characters</td><td>Name must start with a letter or underscore ("_"). All other characters can be letters, numbers, or underscores. Name cannot contain two contiguous underscore characters and cannot end in an underscore.
The module does not use Transducer Name but retains it for reference by higher-level systems.</td></tr>
<tr><td>Measurement Type</td><td>See following table. Also see table "Channel Application Type" in Dynamix Configuration Manager Object.</td><td>Measurement Type selections are intended to simplify configuration of various common applications. It defines what filtering will be applied (LP/HP), the quality of the filtering (roll off), and if the measurement will be integrated or double integrated.
Displays the engineering units that results from applying the Measurement Type (function) to the selected Transducer Units. This is the engineering unit that is associated with dynamic measures read from the Post Filter signal source (see Filters page).</td></tr>
<tr><td>Measurement Units</td><td>N/A</td><td>Displays the engineering units that results from applying the Measurement Type (function) to the selected Transducer Units. This is the engineering unit that is associated with dynamic measures read from the Post Filter signal source (see Filters page).</td></tr>
</table>

Table 14 - Hardware Configuration

<table>
<tr><th>Parameter</th><th>Values</th><th colspan="2">Comment</th></tr>
<tr><td colspan="4">Discrete Inputs</td></tr>
<tr><td>Parameter</td><td>Values</td><td colspan="2">Comment</td></tr>
<tr><td rowspan="9">Pt0/1)</td><td rowspan="9">Set bit 0 for Pt0 or bit 1 for Pt 1 in the attribute that is associated with the selected control.</td><td colspan="2">The 1444 DYN04-01RA includes two discrete TTL class input channels. These let users physical wire an input to the module that can be used in any of several described manners.</td></tr>
<tr><td>Function</td><td>Description</td></tr>
<tr><td>Trip Inhibit/ Bypass</td><td>Inhibits trips with all voted alarms that define the Logical Input as its control</td></tr>
<tr><td>Alarm/Relay Reset</td><td>Resets all latched voted alarms where the alarm condition has cleared, which resets any associated physical relays.</td></tr>
<tr><td>Voted Alarm SPM Control</td><td>Manages Setpoint Multiplication for measurement alarms that are inputs to the associated voted alarm.</td></tr>
<tr><td>Voted Alarm Gate Control</td><td>Manages Alarm Gating for the associated voted alarm.</td></tr>
<tr><td>Voted Alarm Logic Control</td><td>Use this to wire an external input that, when actuated, forces the associated Voted Alarm to actuate, and therefore any relays assocated wtih it. See I/O Control on the Voted Alarm page for further information.</td></tr>
<tr><td>Speed 0 Fault</td><td rowspan="2">If wiring a TTL tacho source to the terminal base, rather than via the local bus, this input can be used to communicate the tacho channel status.</td></tr>
<tr><td>Speed 1 Fault</td></tr>
</table>

Table 14 - Hardware Configuration

Parameter	Values	Comment	
Discrete Outputs			
Parameter	**Values**	**Comment**	
Pt0/1	-	The 1444-DYN04-01RA includes two discrete opto isolated outputs. These provide output of selected status conditions or replication of selected input signals. i	
	-	**Function**	**Description**
	0	OFF	Output is not used
	1-13	Voted Alarm Instance 1…13 Alarm Alert Status	The status of the selected Voted Alarm when the alarm is configured to activate on an alert condition.
	17-29	Voted Alarm Instance 1…13 Danger Alert Status	The status of the selected Voted alarm when the alarm is configured to activate on danger conditions.
	33-45	Voted Alarm Instance 1…13 Fault Alert Status	The status of the selected Voted alarm when the alarm is configured to activate on a transducer fault condition.
	48-49	Local TTL Tacho 0…1 Input	Replicated from the TTL signal connected to the terminal pins
	50-51	Tacho Bus 0…1	Replicated from the TTL signal communicated over the Local Bus
	52-53	Tacho Bus 0…1 Fault	The Local Bus Tacho status
	54-55	Pt0…1 Discrete Input	Replicated from the Discrete Input
	56-59	Transducer 0…3 Fault	Transducer Status
	127	Module Status	Module Status

Channel Type:	**gSE**	
Input Tag	**Measurement Type selections**	**Comment**
	gSE	Spike Energy (gSE) is a processing technique capable of detection of low energy impacts. The measure is suitable for early detection of faults in rolling element bearings or gears and detection of other periodic or random low energy impact events.

Channel Type:	**Static (DC)**	
Input Tag	**Measurement Type selections**	**Comment**
Rod Drop	Rod Drop	A triggered position (rod-drop) measurement taken at a fixed (consistently the same) position of the rod during the stroke.
Axial Differential Expansion	Comp. Differential Exp. A/B (Axial)	The measurement of shaft axial displacement using a pair of axial eddy-current-probe monitoring a shaft collar target such that the measurement range is optimally the sum of the ranges of the individual probes.
Radial Differential Expansion	Comp. Differential Exp. A/B (Radial)	The measurement of differential expansion with axial/radial eddy-current-probe pair viewing concave or convex ramp shaft

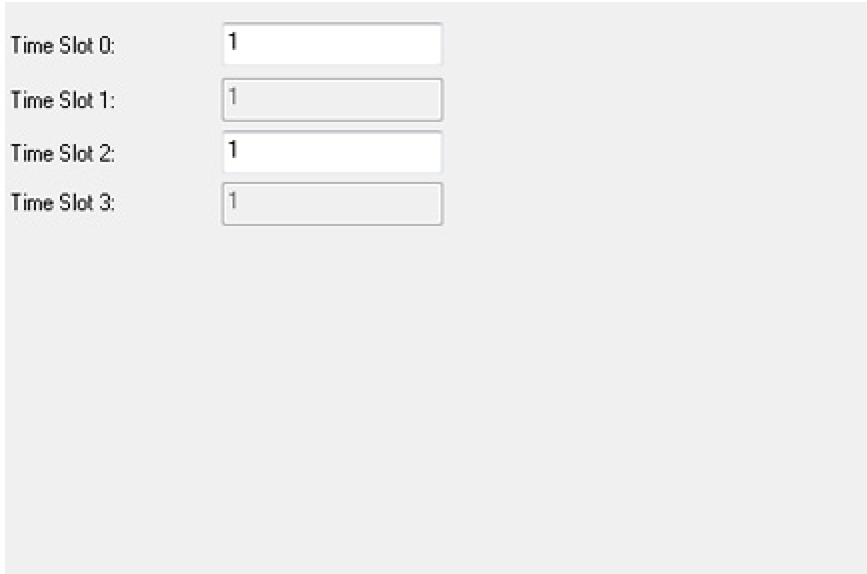
Proportional DC	Transmitter Temperature °F	Proportional voltage measurements
	Transmitter Temperature °C	
	Transmitter Temperature °K	
	DC Current	
	DC Voltage	
	Position	Common thrust/axial position measurement. Measures the offset and direction of movement.
	Accelerometer Temperature °F	Proportional voltage measurements
	Accelerometer Temperature °C	
	Accelerometer Temperature °K	
	Eccentricity	The measurement of shaft bow (the shaft peak to peak displacement) at slow roll speed by either of two methods (with or without a speed input).

Channel Type	**Dynamic (AC)**	
Input Tag	**Measurement Type selections**	**Comment**
Shaft Absolute pk-pk	Shaft Relative (LP/HP filtered)	Calculates the peak to peak shaft absolute radial displacement measured from the sum of: A shaft to case relative displacement (eddy current probe) measurement, and A case absolute displacement measurement from an integrated velocity transducer or double integrated accelerometer that is mounted in-line with the eddy current probe. The first channel of the pair must be the accelerometer or velocity sensor and its Measurement Type must be one of: absolute vibration (A to D) absolute vibration (AV to D) absolute vibration (V to D) The second channel of the pair must be the displacement sensor and its Measurement Type set to Shaft Relative (LP/HP).

Channel Type	**Dynamic (AC)**	
Input Tag	**Measurement Type selections**	**Comment**
Tags that require dynamic measurements can be processed using any of these Measurement Types.	Aero Derivative (AV - V)	Applies 60 dB/octave low pass (LP) and high pass (HP) filters. Limits the maximum frequency that the module can measure to approximately 1665 Hz. The tracking filter 0 measurement is the gas generator vibration, and the tracking filter 1 measurement is the power turbine vibration.
	X (shaft relative)	One eddy current probe, or the eddy current probe that is mounted in the X-direction for an XY pair. Applies a -24 dB/octave LP filter.
	Y (shaft relative)	An eddy current probe that is mounted in the Y direction for an XY pair. Applies -24 dB/octave filters.
	X (shaft relative) – Filtered	One eddy current probe, or the eddy current probe that is mounted in the X- direction for an XY pair. Applies -24 dB/octave LP and HP filters.
	Y (shaft relative) - Filtered	One eddy probe, or the eddy current probe that is mounted in the Y-direction for an XY pair. Applies a -24 dB/octave LP filter.
	Aero derivative (AV - D)	Applies 60 dB/octave LP and HP filters. Specifies one level of integration (velocity to displacement). Limits the maximum frequency that the module can measure to approximately 1665 Hz. The tracking filter 0 measurement is the gas generator vibration, and the tracking filter 1 measurement is the power turbine vibration.
	absolute vibration (A to A)	Non-integrated acceleration measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (A to V)	Integrated (to velocity) acceleration measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (A to D)	Double-integrated (to displacement) acceleration measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (AV to V)	Non-integrated measurements from an integrating (velocity output) accelerometer. Applies -24 dB/octave LP and HP filters.
	absolute vibration (AV to D)	Integrated (to displacement) measurements from an integrating (velocity output) accelerometer. Applies -24 dB/octave LP and HP filters.
	absolute vibration (V to V)	Non-integrated velocity measurements. Applies -24 dB/octave LP and HP filters.
	absolute vibration (V to D)	Integrated (to displacement) velocity measurements. Applies -24 dB/octave LP and HP filters.
	Dynamic Pressure	Dynamic pressure measurements. Applies -24 dB/octave LP and HP filters.
	AC Current	Dynamic current measurements. Applies -24 dB/octave LP and HP filters.
	AC Voltage	Dynamic voltage measurements Applies -24 dB/octave LP and HP filters.

Time Slot Multiplier Page

Figure 44 - Configuration for Data Acquisition Time Slot Multiplier



Parameter	Values	Comment
Time Slot 0	0…65535	Enter the Time Slot Multiplier for channel 0 (or channel pair 0,1). See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.
Time Slot 1	0…65535	Enter the Time Slot Multiplier for channel 1. See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.
Time Slot 2	0…65535	Enter the Time Slot Multiplier for channel 2 (or channel pair 2,3). See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.
Time Slot 3	0…65535	Enter the Time Slot Multiplier for channel 3. See Page Overview for a discussion of the Time Slot Multiplier and examples of how to use it.

The Time Slot Multiplier Page is accessible when the Module Personality is set to either of the multiplexed measurement selections:

- Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired
- Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Individual

IMPORTANT	• Module Personality is specified on the Module Definition >Define Module Functionality page. • If the Module Personality is set to "Multiplexed, 4 Ch – Dynamic (40 kHz)" or "Static – Paired" then the Time Slot Multipliers are applied per channel pair (channels 0 and 1 and channels 2 and 3).

When monitoring using either of the Multiplexed Personalities, the Time Slot Multipliers are used when it is necessary for some channels to update more frequently than other channels.

When using the Multiplexed Personalities, the module does not continuously measure each channel. Rather, measurements are made on one channel or channel pair at a time. Once it completes each measurement, it moves to the channel or channel pair that is "next" on the schedule as determined by the Time Slot Multiplier values.

If all channels have the same multiplier value, then the measurements cycle one to the next and back to the first. But if any of the multipliers are greater than the others then that channel or channel pair is sampled more frequently, by the ratio of the multipliers, than the channels with lower multiplier values. Table 15 and Table 16 provide examples of how the channels update with various multiplier values specified.

IMPORTANT	Determining how long it takes to cycle through the channels in a multiplexed application can be estimated by considering the measurement definition for each channel or channel pair. In general, the time it takes to measure a channel is equal to the period of the specified time waveform.

Table 15 - Multiplier Examples for Module Personality: Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired

	Example 1		**Example 2**		**Example 3**	
Multiplier	1	1	1	2	1	3
Meas. Number	Channel Pair					
	0.1	2.3	0.1	2.3	0.1	2.3
0	(0.1)			(2.3)		(2.3)
1		(2.3)		(2.3)		(2.3)
2	(0.1)		(0.1)			(2.3)
3		(2.3)		(2.3)	(0.1)	
4	(0.1)			(2.3)		(2.3)
5		(2.3)	(0.1)			(2.3)
6	(0.1)			(2.3)		(2.3)
7		(2.3)		(2.3)	(0.1)	

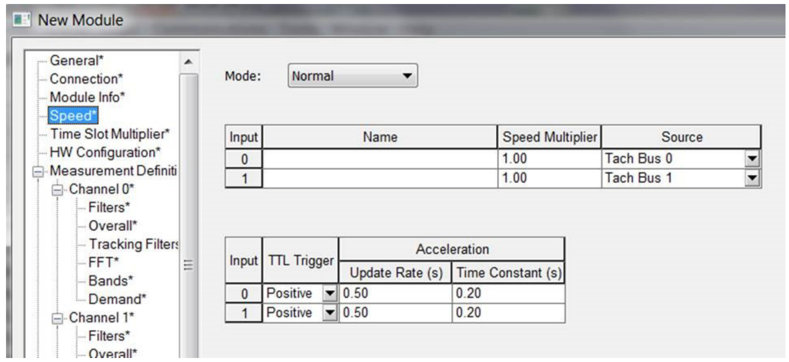
Table 16 - Multiplier Examples for Module Personality: Multiplexed, 4 Ch – Dynamic (40 kHz) or Static – Paired

	Example 1				**Example 2**				**Example 3**			
Multiplier	4	3	2	1	3	3	3	1	2	1	3	1
Meas. Number	Channel											
	0	1	2	3	0	1	2	3	0	1	2	3
0	(0)				(0)						(2)	
1	(0)					(1)					(2)	
2		(1)					(2)		(0)			
3	(0)				(0)						(2)	
4			(2)			(1)			(0)			
5	(0)						(2)			(1)		
6		(1)			(0)							(3)
7				(3)		(1)					(2)	
8	(0)						(2)				(2)	
9	(0)							(3)	(0)			
10		(1)			(0)						(2)	
11			(2)			(1)			(0)			
12	(0)						(2)			(1)		
13	(0)				(0)							(3)
14		(1)				(1)					(2)	
15				(3)			(2)				(2)	
16	(0)				(0)				(0)			

Speed Page

The Speed Page parameters define the source and processing that is applied to the module's two speed measurements.

Figure 45 - Configure Speed Inputs



Parameter	Values	Comments
Mode	Normal (0) Redundant (1)	In Normal mode the speed inputs are independent. In Redundant mode, if Tach 0 is in Fault (Not OK), then Tacho 1 is used for all functions specified for Tacho 0.
Name	Blank or must start with a letter or underscore ("_"), however, all other characters can be letters, numbers, or underscores. Cannot contain two contiguous underscore characters and cannot end in an underscore.	Enter a name of up to 32 characters for the selected tachometer.
Speed Multiplier	Support for values <> 1	Enter a multiplier for the Factored Speed value. **Notes:** • There are two speed measurements available, Speed and Factored Speed. This parameter is used to calculate the Factored Speed. • Factored Speed is used when the required speed is that of a shaft that is mechanically connected to the shaft to which the tachometer is applied.
Source	Local TTL Tach Input 0 (1) Local TTL Tach Input 1 (2) Tach Bus 0 (3) Tach Bus 1 (4) I/O Speed 0 (5) I/O Speed 1 (6)	Each speed measurement can be processed from any type source. • Synchronous measurements (Filters page) and Order Tracking (Tracking Filters pages) require speed measured from a triggered signal source, so must be either a Local TTL or Tacho Bus source. • I/O Speed selections require that Speed be included in the Controller Output assembly (in Module Definition).

Parameter	Values	Comments
TTL Trigger	Positive (0) Negative (1)	Trigger the measurement on the positive or negative going side of the TTL signal. Select Positive to trigger on the "leading edge", or Negative to trigger on the "trailing edge". Applicable only for speeds with a Local TTL or Tacho Bus source. IMPORTANT: To assure accurate phase measurements from any configured Tracking Filters, the trigger point on the TTL signal must align with the trigger point on the tachometer signal. If the TTL source is a Tachometer Signal Conditioner Expansion (TSCX) module, then to assure accurate phase measurements match this parameter to the Trigger Slope defined in the Tachometer configuration for the TSCX.
Update Rate	0.1 to 20.0 seconds	Enter the time, in seconds, between each speed measurement used to calculate the acceleration (rate of change) value. Speed measurements are updated at a rate not slower than once per 40 milliseconds but dependent on module configuration and the overall module processing requirements. The delta time between samples used for the rate of change calculation will be adjusted to the nearest interval based on the actual measurement update rate.
Time Constant	0.1 to 20.0 seconds	Enter a time constant for use in the rate of change calculation. The time constant calculation effectively smooth's the measurements as it behaves similarly to a high pass filter. The smaller the time constant the more responsive the measurement is to rapid changes (or noise).

Measurement Definition

The Input data page within Module Definition allows selection of measurements for inclusion in the controller input assembly. However, while that reserves a spot in the table, it doesn't define how the measurements must be calculated. The group of pages under module definition, including filters, overall, tracking filters, gSE, bands, DC, and demand, are where you can define the measurements.

Filters

The Filters page defines the digital signal processing that is applied to each of the channel's two independent signal paths. You can select the output from each path and from specific intermediate processing points as the source to calculate measurements such as Overall levels, FFTs, and FFT Bands.

Figure 46 - Filter Configuration for Channel

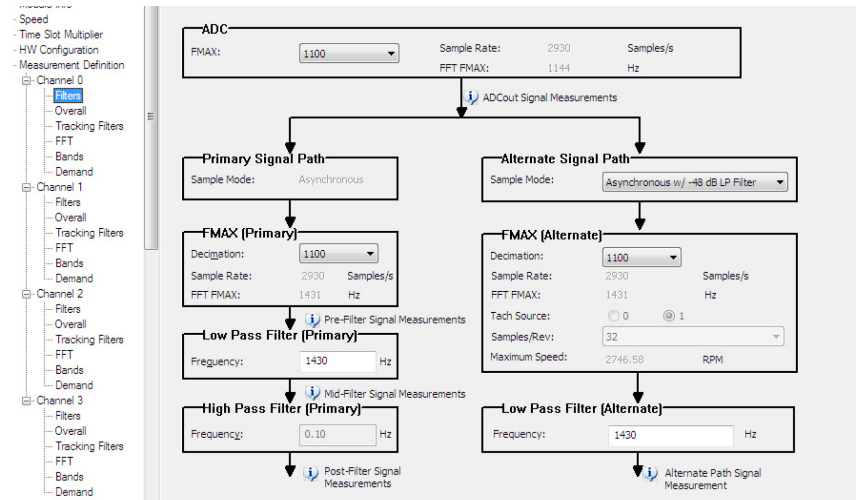


Table 17 - Filters

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>FMAX</td><td>The available FMAX selections are as follows::
<table>
<tr><th>FMAX</th><th>SRD</th><th>Conditions</th></tr>
<tr><td>40000</td><td>1</td><td>Available for 40 kHz Module Personalities (Module Definition), and if the Measurement Type (Hardware Page) is one of "40 kHz absolute vibration (A to A)", "40 kHz absolute vibration (A to V)" or "gSE"</td></tr>
<tr><td>18300</td><td>2</td><td rowspan="6">Available for the 18 kHz Module Personality (Module Definition), and if the Measurement Type (Hardware Page) is NOT any of the "40 kHz…", or either of the absolute vibration (A to A)", "40 kHz absolute vibration (A to V)" or "gSE"</td></tr>
<tr><td>12200</td><td>3</td></tr>
<tr><td>9200</td><td>4</td></tr>
<tr><td>7300</td><td>5</td></tr>
<tr><td>6100</td><td>6</td></tr>
<tr><td>5200</td><td>7</td></tr>
<tr><td>4100</td><td>9</td><td rowspan="4">Available for all 4 kHz and 18 kHz Module Personalities (Module Definition), and if the Measurement Type (Hardware Page) is NOT a "40 kHz…" type or either of the aero derivative types.</td></tr>
<tr><td>3100</td><td>12</td></tr>
<tr><td>2000</td><td>18</td></tr>
<tr><td>1800</td><td>20</td></tr>
<tr><td>1700</td><td>22</td><td rowspan="6">Available for all 4 kHz and 18 kHz Module Personalities (Module Definition), and if the Measurement Type (Hardware Page) is NOT a "40 kHz…" type.</td></tr>
<tr><td>1500</td><td>24</td></tr>
<tr><td>1400</td><td>26</td></tr>
<tr><td>1300</td><td>28</td></tr>
<tr><td>1200</td><td>30</td></tr>
<tr><td>1100</td><td>32</td></tr>
</table>
Note: If the Channel measurement type = Aeroderivative the Range is limited to 22…32.Only in the case of Individually Multiplexed channels is a divisor allowed per channel.</td><td>The module provides two (hardware) analog-to-digital converters (ADC's), one for channels 0 & 1, and one for channels 2 & 3. Each ADC samples at 93,750 samples per second (187,500 for 40 kHz personalities). However, the ADC's include a "Sample Rate Divide" (SRD) capability that reduces the rate of samples output to the module. Because the sample rate drives the resulting maximum frequency, and because it is desirable to put as much of that processing in the hardware (rather than firmware), the Dynamix module allows users to set the SRD value, effectively specifying the maximum frequency (FMAX) that is available from the ADC.
Users do not directly set the SRD. Rather a menu is provided, which lists appropriate FMAX selections that have corresponding SRD values. The available FMAX selections vary with the personality.
The value that is written to the configuration assembly is the Sample Rate Divisor, not the FMAX. Values from 1…32 are allowed. Not all 32 selections are provided in the FMAX menu.
The FMAX values that are listed are approximate values. Once selected the actual FFT FMAX (what an FFT returns) is listed after "FFT FMAX", to the right of the menu.
In the case of synchronous sampling, (one option in the Alternate Signal Path) the FMAX divided by the number of samples per shaft revolution dictates the maximum machine speed that the module can successfully monitor.
Because the module applies the SRD in hardware, rather than firmware, specify the largest FMAX (SRD) possible to minimize any further firmware-based decimation requirement. Doing so reduces the load on the processor, which can improve module performance for any non-safety or protection-related functions.</td></tr>
</table>

Table 17 - Filters

Parameter	Values	Comments
Sample Rate	Displays the sample rate from the ADC based on the selected FMAX.	The displayed value is the calculated value from: $\frac{93750}{\text{Sample Rate Divisor}}$
FFT FMAX	Displays the maximum frequency of an FFT processed from the ADC Out signal source.	The actual maximum frequency for an FFT will be slightly lower (by one FFT bin) than the value displayed as the FFT FMAX is also dependent on the selected number of lines for the FFT. ADC out FFT FMAX is the calculated value from: $\frac{93750}{\text{(SRD x2.56)}}$
Primary Path Processing Mode	Asynchronous	This is the sampling mode for the Primary Signal Path. It is not editable.
Decimation (Primary)	Select a level of decimation to apply by selecting the desired Maximum Frequency (FMAX) for the primary signal path. See the following Decimation Tables for available selections.	The primary signal path includes a decimation stage that further divides the sample rate (in firmware) from the output of the ADC. This selection presents selected FMAX values based on the Module Personality (Module Definition) and the sample rate out of the ADC. The value written to the configuration assembly is the Primary Path Decimation, not the FMAX. Values from 1…255 are possible. Not all selection are provided in the FMAX menu. The FMAX values listed are approximate values. Once selected the actual FFT FMAX (what an FFT returns) is listed after "FFT FMAX", below the menu.
Sample Rate (Primary)	Displays the sample rate of the data in the **Primary Signal Path.**	The displayed value is the calculated value from: $\frac{93750}{\text{(SRD x Primary Path Decimation)}}$
FFT FMAX (Primary)	Displays the maximum frequency (FMAX) of an FFT at the Pre-Filter, Mid-Filter, or Post-Filter stage of processing.	The actual maximum frequency for an FFT will be slightly lower (by one FFT bin) than the value displayed as the FFT FMAX is also dependent on the selected number of lines for the FFT. • If Primary Path Decimation = 1, so the FMAX is the same as the ADC Out FMAX, then this value will be the same as the ADC out FMAX. • If the Primary Path FMAX is > 1, then the FFT FMAX is the calculated value from: $\frac{93750}{\text{(SRD x Primary Path Decimation x 2.56 x 2)}}$

Low Pass Filter (Primary) Frequency	A Low Pass Filter can be applied to the measurement to assure that unwanted high frequency signals are not included in the overall measurement. However, if an LPF is applied then data processed from an FFT of the signal, at frequencies near to and above the LPF corner, will be attenuated by the filter.
	LPF Corner Frequency can be between 10 Hz and the lower of 45 kHz or the result of:
	If Fmax (Primary) Decimation = 1 then
	93750 / (2.048 x Sample Rate Divisor)
	Otherwise…
	If Channel Measurement Type = Aeroderivative then
	93750 / (2.60 x Fmax (Primary) Decimation x Sample Rate Divisor)
	Otherwise…
	93750 / (4.0 x Fmax (Primary) Decimation x Sample Rate Divisor)
	If the result of the above is <10, then the LPF is set to 10 Hz.
		Enter the frequency where the filter has attenuated the signal by 3 dB. Frequencies higher than this are attenuated -24 dB/octave (-60 dB/octave if the Channel Measurement Type is Aeroderivative).
		IMPORTANT: If the LPF frequency is within 5 Hz of its maximum (default) value it will be disabled (OFF).
		• If firmware decimation is used, then the maximum frequencies of the LPF corner can be forced lower than 45 kHz, and possibly lower than the specified Fmax. This is to assure the measurement is alias-free.
		• In all cases, the available bandwidth (Fmax) is the sample rate / 2.56 (the customary value). However, the factor necessary to assure alias-free data within the FFT varies. If decimation is performed only in hardware via the Sample Rate Divider (SRD), then the factor is 2.048, so it is above the Fmax of the FFT. But if decimation is performed in the firmware then a more conservative factor is necessary, and is then dependent on the quality of the Low Pass Filter being applied. In this case, if the standard -24 dB/octave filter is used then a factor of 4.0 must be applied. But if the -60 dB/octave filter of the Aeroderivative Channel Type is applied, then the factor is 2.60.
		• The Default LPF Corner presented is the maximum value, applying the selected decimation and the appropriate factor as discussed above.

Table 17 - Filters

Parameter	Values	Comments
High Pass Filter (Primary) Frequency	0.1…1000 Hz	Enter the frequency where the filter has attenuated the signal by 3 dB. Frequencies lower than this are attenuated -24 dB/octave (-60 dB/octave if the Channel Measurement Type is Aeroderivative). • The HPF is not available when the Channel Measurement Type is set to X (shaft relative) or Y (shaft relative). • For Channel Measurement Types that specify integration, it is performed at the outlet of the High Pass Filter. • If a signal includes a DC offset it will only be removed (AC coupled) within the High Pass Filter. If no HPF is applied the signal will include any DC offset *DC coupled).
Alternate Processing Path Processing Mode	Processing Mode • OFF • Synchronous w/ -48 dB LP Filter • Asynchronous w/ -48 dB LP Filter	Select the sampling mode and the Low Pass Filter quality to apply to the Alternate Signal Path data. • Alternate Path processing is performed only if "Alternate Path" is selected as a data source on the FFT, Bands, or Demand data pages. If it is not specified as a source Alternate Path data is not processed, regardless of its definition. • Synchronous Measurement modes are available only when a physical speed signal is available (see Speed page). Source can be from any of Tach Bus 0/1 or Local TTL Tach Input 0/1.
Decimation (Alternate)	Select a level of decimation to apply by selecting the desired Maximum Frequency (FMAX) for the alternate signal path. See the following Decimation Tables for available selections.	When asynchronously sampling the alternate signal path provides a decimation stage that further divides the sample rate (in firmware) from the output of the ADC. This selection presents selected FMAX values based on the Module Personality (Module Definition) and the sample rate out of the ADC. The value written to the configuration assembly is the Alternate Path Decimation, not the FMAX. Values from 1…255 are possible. Not all selections are provided in the FMAX menu. The FMAX values listed are approximate values. Once selected, the actual FFT FMAX (what an FFT returns) is listed after "FFT FMAX," below the menu. Because the module applies the SRD in hardware, rather than firmware, whenever possible select the required FMAX at the DC output and leave the Alternate Path Decimation equal to 1 (FMAX = ADC our FMAX). Doing so reduces the load on the processor which may improve module performance for any non-safety or protection related functions.
Sample Rate (Alternate)	Displays the sample rate of the data in the Primary Signal Path.	The displayed value is the calculated value from: $\frac{93750}{\text{(SRD x Alternate Path Decimation)}}$
FFT FMAX (Alternate)	Displays the maximum frequency (FMAX) of an FFT processed from the **Alternate Path**.	The actual maximum frequency for an FFT will be slightly lower (by one FFT bin) than the value displayed as the FFT FMAX is also dependent on the selected number of lines for the FFT. • If Alternate Path Decimation = 1, so the FMAX is the same as the ADC Out FMAX, then this value will be the same as the ADC out FMAX. • If the Alternate Path FMAX is > 1 then FFT FMAX is the calculated value from: $\frac{93750}{\text{(SRD x Alternate Path Decimation x 2.56 x 2)}}$

Table 17 - Filters

Parameter	Values	Comments
Low Pass Filter (Alternate) Frequency	A Low Pass Filter can be applied to the measurement to assure that unwanted high frequency signals are not included in the overall measurement. However, if an LPF is applied then data processed from an FFT of the signal, at frequencies near to and above the LPF corner, will be attenuated by the filter. LPF Corner Frequency can be between 10 Hz and the lower of 5 kHz or the result of: If Fmax (Alternate) Decimation = 1 then 93750 / (2.048 x Sample Rate Divisor) Otherwise… 93750 / (2.78 x Fmax (Alternate) Decimation x Sample Rate Divisor) If the result of the above is <10, then the LPF is set to 10 Hz.	Enter the frequency where the filter has attenuated the signal by 3 dB. Frequencies higher than this are attenuated -24 dB/octave (-60 dB/octave if the Channel Measurement Type is Aeroderivative). **IMPORTANT:** If the LPF frequency is within 5 Hz of its maximum (default) value it will be disabled (OFF). • The Alternate Path Low Pass Filter is available only when the Processing Mode is "Asynchronous w/ -48 dB LP Filter". • If firmware decimation is used, then the maximum frequencies of the LPF corner can be forced lower than 5 kHz, and possibly lower than the specified Fmax. This is to assure the measurement is alias-free. • The available bandwidth (Fmax) from the Alternate Signal Path is the sample rate / 2.56 (the customary value). However, the factor necessary to assure alias-free data within the FFT varies. If decimation is performed only in hardware via the Sample Rate Divider (SRD), then the factor is 2.048, so is above the Fmax of the FFT. But if decimation is performed in the firmware then a more conservative factor is necessary, and is then dependent on the quality of the Low Pass Filter being applied. For the Alternate Signal Path, the LPF is -48 dB (if used) so the factor is 2.78. • The Default LPF Corner presented is the maximum value, applying the selected decimation and the appropriate factor as discussed above.
Fmax (Alternate) Tacho Source	0, 1	Select the speed source for the tacho input to be used in the synchronous measurement. • Tacho Source is applicable only to synchronous measurement Processing Modes. • Available Tacho Sources are only those defined from a Tacho Bus or a TTL Input (see Speed page). • Synchronous measurements require a 1/rev signal. While the Tachometer Signal Conditioner module outputs a 1/rev TTL to the Tacho Bus, provided its Pulses Per Revolution attribute is set (see Tachometer page), users must help ensure that a Local TTL Input source is a 1/rev signal.
Fmax (Alternate) Samples Per Revolution	Select from: • 4 • 8 • 16 • 32 • 64 • 128	Select the number of samples to be measured per shaft revolution. • Samples per Revolution is applicable only to synchronous measurement Processing Modes. • As Samples Per Revolution is increased: – The synchronous sample rate increases, the measurement (FFT) bandwidth increases, and there are more orders available for analysis. – A particular FFT has lower resolution (lines per order) or bandwidth/number of lines. – The maximum machine rpm that can be measured reduces (sampling frequency = rpm x samples per rev). Also note that for synchronous measurements the maximum sampling rate is limited to half the maximum asynchronous rate. – The number of orders available is related only to the number of samples per revolution selected, as follows: Samples / Rev — Orders 4 — 1.4 8 — 2.9 16 — 5.8 32 — 11.5 64 — 23.0 128 — 46.0

Table 17 - Filters

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Fmax (Alternate) maximum Speed</td><td>Displays the result of: (60 x 93750 / x Sample Rate Divisor) / (Samples Per Revolution x 2)</td><td>Displays the maximum speed (RPM) at which the machine can operate while measuring synchronously with the specified filter performance.
• If the machine speed exceeds this RPM while in Synchronous Mode, the measurement does not stop. Rather, the performance of the Low Pass Filter degrades until the speed increases above a “hard stop” filter value.
• As machine speed decreases, there is no point at which the filter performance degrades. But there is a hard stop limit to how low the LPF cutoff can be set.
Low Pass Filter Hard Stop Limits
When measuring synchronously the module is limited in how high, or low, it can set the Low Pass Filter corner. So, if the calculated filter corner (per the above) exceeds the hard stop limit (high or low) the filter corner no longer increases (or decreases).
The Hard Stop Limits are based only on the Sample Rate Divide value and are calculated as:
High Limit = 32000 / SRD
Low Limit = 32 / SRD
The following table shows the hard limits for selected SRD values:
<table>
<tr><th colspan="6">Low Pass Filter Hard Stop Limits</th></tr>
<tr><td>SRD</td><td>1</td><td>8</td><td>16</td><td>24</td><td>32</td></tr>
<tr><td>Low</td><td>32</td><td>4.0</td><td>2.0</td><td>1.3</td><td>1.0</td></tr>
<tr><td>High</td><td>32000</td><td>4000</td><td>2000</td><td>1333</td><td>1000</td></tr>
</table>
</td></tr>
</table>

The Primary and Alternate signal paths both originate from the output of the Analog-to-Digital Converter (ADC). The ADC samples each channel at 93750 samples/second for all 4 kHz and 18 kHz Module Personalities or 187500 Hz for the 40 kHz personalities (See Define Module Functionality Page on page 92).

For 18 kHz modes, the output of both ADC channels can be decimated in its hardware by a factor of 2…32. Applying the divider with as large a factor as practical for the application is important because the lower the data rate from the ADC the less time the module spends processing the digital samples. This divider leaves more time available to perform other functions.

Out of the ADC the signal is split into its two paths:

- The Primary Path applies the low and high pass filtering and integration that is required of the application, and defined in part by the Channel Measurement Type (See Hardware Configuration Page on page 105). The signal processing in this path is defined in three distinct steps (Pre-Filter, Mid-Filter, and Post-Filter) where each can serve as the data source for various measurements (see Table •).

- The Alternate Path is available for applications that require more measurements with another Fmax or synchronously sampled data. Data from this path is available only at its conclusion.

Table 18 - Data source options for each measurement

Measurement	Signal Sources				
	ADC Out	Primary Path			Alternate Path Out
		Pre-Filter	Mid-Filter	Post-Filter	
gSE	•				
Tracking Filters	•				
Overall		(1)	(2)	(3)	
Not 1x				•	
SMAX				•	
Shaft Absolute				•	
TWF	(1)	(2)	(3)	(4)	(5)
FFT	(1)	(2)	(3)	(4)	(5)
FFT Bands	(1)	(2)	(3)	(4)	(5)
Demand Data	(1)	(2)	(3)	(4)	(5)

The following tables include the Decimation menu selections for each of the selectable Sample Rate Divide (SRD) values (selected by the ADC FMAX menu). Along with the displayed **menu** value, the table shows the decimation value that is written to the configuration assembly, and the actual FFT **FMAX** that the measurement would output (also displayed on the page below the decimations selection).

The menus do not provide selections for every 255 possible decimation values. Rather the menus present only selected decimated values that represent relatively uniform, rounded, increments from 25 Hz to the ADC FMAX.

Table 19 - Decimation Menu Selections: SRD 1…4

Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu
SRD = 1			**SRD = 2**			**SRD = 3**			**SRD = 4**		
Dec < 5 is not allowed	1	18311	18300	1	12207	12200	1	9155	9200		
5	3662	3700	2	4578	4600	2	3052	3100	2	2289	2300
6	3052	3100	3	3052	3100	3	2035	2000	3	1526	1500
9	2035	2000	4	2289	2300	4	1526	1500	4	1144	1100
12	1526	1500	5	1831	1800	5	1221	1200	5	916	900
13	1409	1400	6	1526	1500	6	1017	1000	6	763	800
14	1308	1300	7	1308	1300	7	872	900	7	654	700
15	1221	1200	8	1144	1100	8	763	800	9	509	500
16	1144	1100	9	1017	1000	10	610	600	11	416	400
18	1017	1000	10	916	900	12	509	500	15	305	300
20	916	900	11	832	800	15	407	400	22	208	200
22	832	800	13	704	700	20	305	300	30	153	150
26	704	700	15	610	600	30	203	200	46	100	100
30	610	600	18	509	500	40	153	150	61	75	75
36	509	500	22	416	400	61	100	100	91	50	50
45	407	400	30	305	300	81	75	75	180	25	25
61	300	300	45	203	200	121	50	50			
91	201	200	61	150	150	240	25	25			
122	150	150	92	100	100						
183	100	100	122	75	75						
243	75	75	182	50	50						

Table 20 - Decimation Menu Selections: SRD 5…9

Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu
SRD = 5			**SRD = 6**			**SRD = 7**			**SRD = 9**		
1	7324	7300	1	6104	6100	1	5232	5200	1	4069	4100
2	1831	1800	2	1526	1500	2	1308	1300	2	1017	1000
3	1221	1200	3	1017	1000	3	872	900	3	678	700
4	916	900	4	763	800	4	654	700	4	509	500
5	732	700	5	610	600	5	523	500	5	407	400

Table 20 - Decimation Menu Selections: SRD 5…9

Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu
SRD = 5			**SRD = 6**			**SRD = 7**			**SRD = 9**		
6	610	600	6	509	500	6	436	400	6	339	300
7	523	500	7	436	400	8	327	300	10	203	200
9	407	400	10	305	300	13	201	200	13	157	150
12	305	300	15	203	200	17	154	150	20	102	100
18	203	200	20	153	150	26	101	100	27	75	75
24	153	150	30	102	100	35	75	75	41	50	50
36	102	100	40	76	75	52	50	50	80	25	25
49	75	75	61	50	50	103	25	25			
73	50	50	120	25	25						
144	25	25									

Table 21 - Decimation Menu Selections: SRD 12…22

Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu
SRD = 12			**SRD = 18**			**SRD = 20**			**SRD = 22**		
1	3052	3100	1	2035	2000	1	1831	1800	1	1665	1700
2	763	800	2	509	500	2	458	500	2	416	400
3	509	500	3	339	300	3	305	300	3	277	300
5	305	300	4	254	300	4	229	200	4	208	200
7	218	200	5	203	200	6	153	150	5	166	150
10	153	150	6	170	150	9	102	100	8	104	100
15	102	100	10	102	100	12	76	75	11	76	75
20	76	75	13	78	75	18	51	50	16	52	50
30	51	50	20	51	50	36	25	25	33	25	25
60	25	25	40	25	25						

Table 22 - Decimation Menu Selections: SRD 24…32

Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu	Dec	FMAX	Menu
SRD = 24			**SRD = 26**			**SRD = 28**			**SRD = 30**			**SRD = 32**		
1	1526	1500	1	1409	1400	1	1308	1300	1	1221	1200	1	1144	1100
2	381	400	2	352	400	2	327	300	2	305	300	2	286	300
3	254	300	3	235	200	3	218	200	3	203	200	3	191	200
4	191	200	4	176	150	4	163	150	4	153	150	4	143	150
5	153	150	7	101	100	6	109	100	6	102	100	5	114	100
7	109	100	10	70	75	9	73	75	8	76	75	8	72	75
10	76	75	14	50	50	13	50	50	12	51	50	11	52	50
15	51	50	28	25	25	26	25	25	24	25	25	23	25	25
30	25	25												

Overall

The dynamic measurement module of the Dynamix 1444 Series can measure two Overall values per channel: Overall (0) and Overall (1). This page is used to configure these measurements.

For non-multiplexed Module Personalities (See Define Module Functionality Page on page 92) Overall measurements update at a rate of not slower than every 40 Milliseconds.

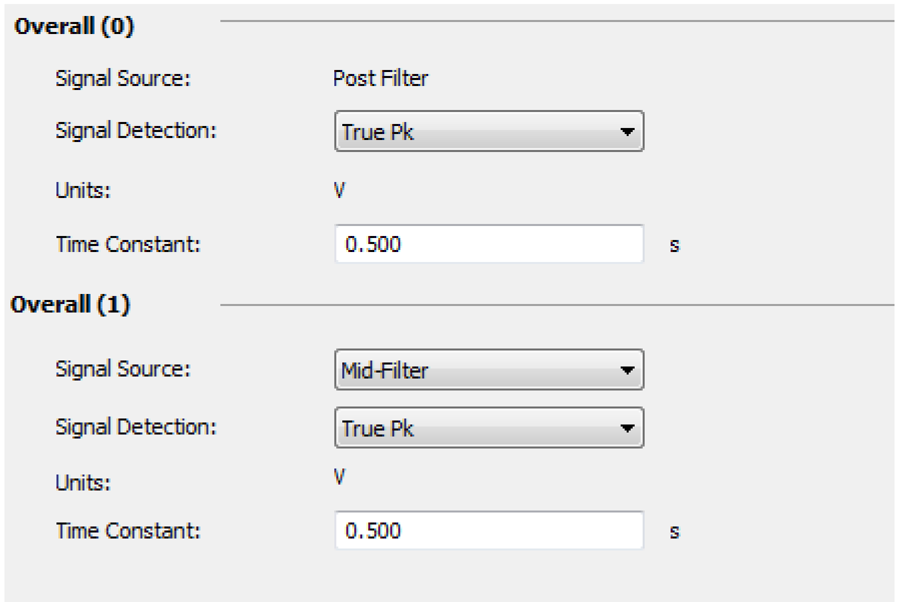


Table 23 - Overall

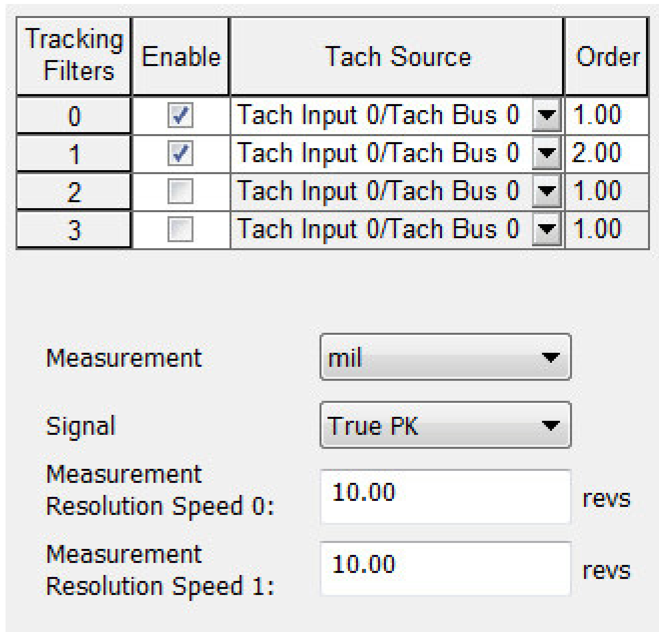
Parameter	Values	Comment
Overall (0) Signal Source	Value is fixed as "Post Filter"	The signal source for the first Overall measurement is fixed at the output of the Primary Signal Path (Post-Filter). This is the fully filtered (LP and HP) and (if necessary) integrated signal (see Filters page).
Overall (1) Signal Source	Select from: • Pre-Filter • Mid-Filter	Select the signal source for the second Overall measurement. See the Filters page for a description of the various signal source locations. **Note:** The Pre-Filter selection is available only if the Primary Path Decimation = 1 (no firmware decimation) to assure that data is alias-free.

Table 23 - Overall

Parameter	Values	Comment
Overall (0/1) Signal Detection	Select from: • True pk • True pk-pk • RMS • Scaled pk • Scaled pk-pk	Select the signal detection method for the Overall magnitude measurement. **Notes:** • True measurements are measurements that are based on the actual peak or peak-to-peak values in the signal. These are recommended when the measurement must consider the actual maximum of the measurement (such as maximum displacement) or when non-sinusoidal signals, such as impacts, must be detected. Note though that this method is also more sensitive to noise. • Scaled measurements are calculated as the Square Root of 2 x the RMS value (2x if pk-pk), or approximately 1.707 (or 2.414) x the RMS value. These are recommended when the measurement must consider the total energy in the signal
Overall (0/1) Units	Displays the Engineering Units for the measurement	The Units for Overall (0) are the units after any integration is applied and are the same as “Measurement Units” shown on the Hardware Configuration page. The Units for Overall (1) are the same as the “Xdcr Units” specified in the Hardware Configuration page as this measurement is always taken from the signal before any required integration is applied.
Overall (1) Time Constant	0.100…60.000	Enter the time constant for the overall measurement. **Notes:** • The time constant is written to the RMS or the PEAK tag value depending on the selected Signal Detection method (above). • The detection time constant defines the output smoothing filter for RMS-based detection methods, or the decay rate of the peak detection methods. Set longer time constants to reduce the responsiveness of the measurement to rapid changes (spikes / noise), or shorter to increase the responsiveness.

Tracking Filters

The dynamic measurement module of the Dynamix 1444 Series can apply up to four tracking filters per channel. This page is used to configure these filters and their measurements when at least one of the speed inputs is a TTL source (Tacho Bus or TTL Input).



Tracking Filters can be applied only for Module Personalities of:

- Real Time, 4 Ch – Dynamic (4 kHz) or Static
- Real Time, 4 Ch – Dynamic (4 kHz) – Dual Path

Additionally, the channel must be configured for Dynamic Measurements.

Up to four tracking filters can be configured per channel. Each filter can be configured to track any order, from 0.25x to 32.0x, referenced to either of the two tachometer inputs. Tracking Filters apply a constant Q bandwidth (changes with speed) and provide accurate measurements at any speed greater than approximately 15 RPM.

Aero Derivative Measurements

For Aero derivative measurement types (Hardware Page) the following fixed assignment must be configured:

- Order 0 must be set to Tachometer Input 0 (gas generator tacho) and a 1x order
- Order 1 must be set to Tachometer Input 1 (power turbine tacho) and a 1x order

The Aero derivative measurement types provide fixed (5 Hz) bandwidth tracking filters for the gas generator 1x and power turbine 1x. It is not necessary to specially configure the mode or filter definition parameters to achieve this result.

Not-1X Measurement

The Not-1X measurement is implemented by setting:

- Tracking Filter 0 must be set to 1x (either tacho can be used)
- The same measurement Engineering Units for both the order and the overall (1) (Overall Page) measurements

The Not-1X measurement then calculates the difference between the Overall (1) measurement and the first order result. The Not-1x functionality is primarily provided for XY applications and while the tracking filters can be used to provide integrated measurement data the Not-1x measurement is not usable in these applications.

The Not 1X measurement data is always presented in the same detection type as the order measurement, this measurement does not rely on the overall (1) being configured similarly.

The Not-1X measurement can if desired provide a "Not-2x", or other, indication by simply changing the order configuration of the first tracking filter on any particular channel. The 'Not-1X' is calculated whenever the first tracking filter is enabled, irrespective whether it is configured for order 1 (1x).

Order Phase

The order phase is measured from the trigger edge to the maximum/positive, signal peak, which is known as phase lag, convention.

In the following illustration where the pulse represents the tacho signal and the sine-wave the signal:

- A negative or falling edge trigger would result in a phase angle of 60°
- A positive or rising edge trigger would result in a phase angle of 90°

In order configurations that are integrating, the reported phase angle reflects that integration, for instance, velocity lags acceleration by 90° and displacement lags acceleration by 180°.

Influence of Sample Rate and Tracking Filter Definition Settings

The Tracking filter definition is specified in terms of a number of revolutions (for the measurement). The higher the number of revolutions configured:

- The sharper the tracking filter
- The more accurate/stable the assessment
- The longer the measurement acquisition time

Accuracy and stability also improve when more samples are being considered and so are sensitive not only to the Tracking Filter Definition but also to the SRD setting: the higher the sample rate (lower SRD), the better.

The filter response is similar to one FFT bin (rectangular/no windowing). So for a more objective benchmark a similar FFT case can be considered such as a 200 line FFT, based on 512 samples.

For an order measurement at a given sample rate (SRD), the equivalent maximum number of revolutions can be calculated as follows:

Max Number of revolutions = Number of lines (FFT) * 2.56 * Speed (RPM) * SRD / (60 * 93750)

Ex.: For a speed of 3600 rpm, SRD 32:

Max Number of revolutions = 10 calculated from: [200 * 2.56 * 3600 * 32 / (60 * 93750)]

If the speed was instead 60,000 RPM, then first reduce the SRD as much as is allowed or is practicable.

For the purposes of example, assume a reduction to SRD 9 (the lowest allowed when tracking filters are being used).

Then the equivalent number of revolutions in the tracking filter definition can be recalculated:

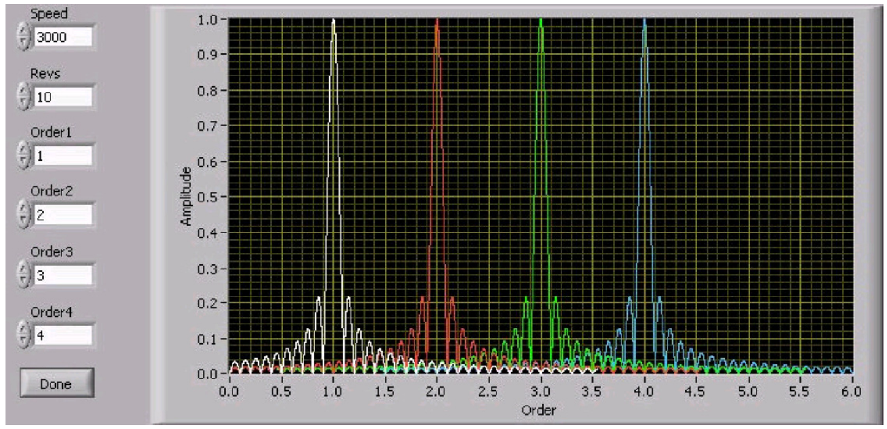
Number of revolutions = 49 calculated from: [200 * 2.56 * 60000 * 9 / (60 * 93750)]

When defining a tracking filter, first help insure that the tracked frequency is well within the bandwidth available by virtue of the SRD setting (never higher than an equivalent FFT FMAX). Then adjust the number of revolutions in the filter definition, according to the machine speed and the configured SRD, as shown in the preceding statement.

The number of revolutions determines the bin width and the spread of the response, side lobes. To quantify that, the following expression can be used (where at the calculated bin width the response is approximately 3 dB down):

- Bin width (orders) = 1 / Number of revolutions
- Bin width (Hz) = 1 / (60 * Number of revolutions / speeds in rpm)

The following grahic is a comparison of the normalized filter response, which is configured for 10 and 100 revolutions, and illustrates how configuring a higher number of revolutions minimizes the influence of other components at near frequencies:



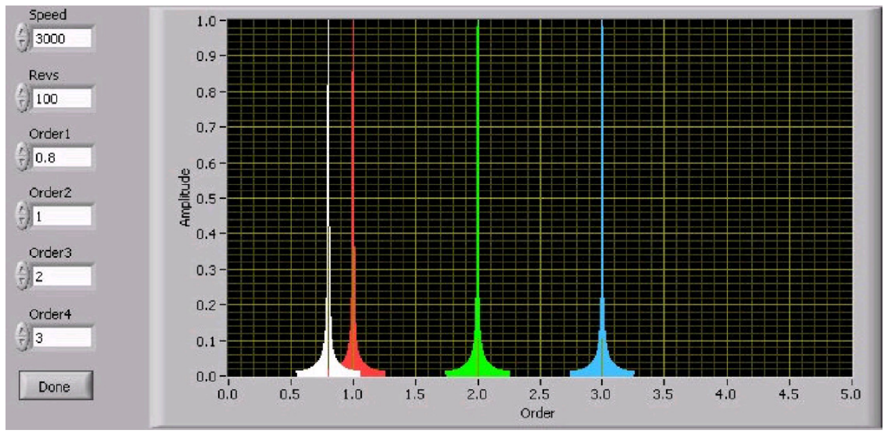


Table 24 - Tracking Filters

Parameter	Values	Comment
Enable (0…3)	Enable (checked) / Disabled (not checked)	Check the box of the tracking filters that are used. **Note:** Tracking Filters impart a significant performance demand on the module. Enabling tracking filters that are not necessary adversely affects module performance related to non-protection related measurements and functions.
Tacho Source (0…3)	Select from: • Tach Input 0/Tach Bus 0 • Tach Input 1/Tach Bus 1	Select the TTL signal source to use as the trigger for the selected tracking filter. **Note:** The signal source must be a TTL source and must be assigned to the corresponding speed input (0/1).
Order (0…3)	0.25…32.0	Enter the order that the selected filter is to track. **Notes:** • The tracked order is the entered multiple of the running speed of the selected input tacho. • Integer values (1.0, 2.0…) return both magnitude and phase values, non-integer values return only magnitude values (phase is set to 0).

Table 24 - Tracking Filters

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Measurement Units</td><td>See Help comments</td><td>Select the Engineering Units for the Tracking Filter measurements. These measurements are the units that are applied to all enabled tracking filters for the channel.
The rules for Units selection, which is based on the Xdcr Units, are provided in the following table..
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature</td><td>No change</td></tr>
<tr><td>Pressure</td><td rowspan="8">Change in class only</td></tr>
<tr><td>Flow</td></tr>
<tr><td>Angle</td></tr>
<tr><td>Current</td></tr>
<tr><td>Energy</td></tr>
<tr><td>Frequency</td></tr>
<tr><td>Power</td></tr>
<tr><td>Voltage</td></tr>
<tr><td>Acceleration</td><td rowspan="3">Selections per following table</td></tr>
<tr><td>Velocity</td></tr>
<tr><td>Length</td></tr>
</table>
For any acceleration, velocity or displacement (length) units the measurement can include any required integration (or differentiation) simply by selecting the appropriate output units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td rowspan="5">← →</td><td>m/s</td><td rowspan="5">← →</td><td>m/s^2</td></tr>
<tr><td>mm</td><td>mm/s</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>inch/s</td><td>$inch/s^2$</td></tr>
<tr><td>inch</td><td></td><td>g</td></tr>
<tr><td>mil</td><td></td><td>mg</td></tr>
</table>
</td></tr>
<tr><td>Signal Detection</td><td>Select from:
• True pk
• True pk-pk
• RMS</td><td>Select the signal detection method for all Tracking Filter magnitude measurements for this channel.</td></tr>
<tr><td>Measurement Resolution Speed 0/1</td><td>1…256</td><td>Enter the number of revolutions (bandwidth) to be applied to all tracking filters on this channel that are defined for use with this tacho (0/1).
• The Number of Revolutions (over which the order results are calculated) determines the narrowness of the filter with more revolutions resulting in a sharper/narrower, more effective, filter (see figures below). However:
– A high number of revolutions results in an accurate measurement of the specified order. However, at low speeds a high number of revolutions settings can slow the measurement response to changes.
– A low number of revolutions setting results in a broad filter that passes signals other than that of the specified order value. However, the lower the number of orders the more responsive it is to changes.
• A typical value is 10 (the default). A high value is 30, but values up to 256 are possible.</td></tr>
</table>

Tracking filters are used to provide real-time magnitude and phase measures of shaft-speed relative signals. Each tracking filter applies a -48 dB/octave band pass filter that is centered on the specified order frequency. The module measures the magnitude of each filtered signal and, when whole integer orders are specified, the phase of the filtered value.

For non-multiplexed module personalities, (See Define Module Functionality Page on page 92) tracking filter measurements update at a rate of not slower than every 40 milliseconds.

FFT

This page is used to define the FFT measurement configuration for the channel.

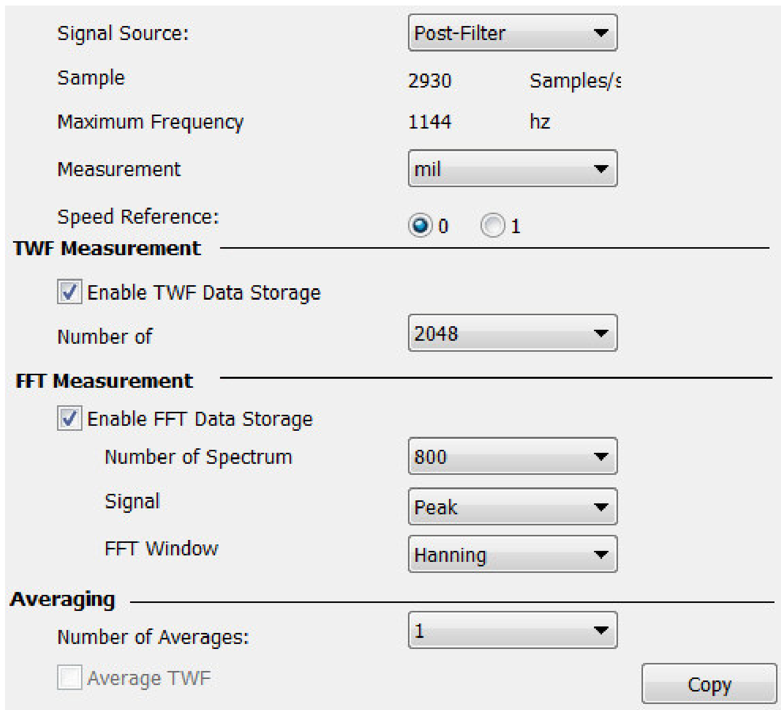


Table 25 - FFT

Parameter	Values	Comment
Enable TWF Data Storage	Enable (checked) / Disabled (not checked)	Select the checkbox to save the time waveform (TWF). The module saves the TWF to any defined Trend buffers, and makes the most recent sample available for external access. Tip: External access to "Live" TWF and FFT data, as defined on this page, requires that the TWF and/or FFT be enabled here, AND that Dynamic Data be enabled on the TREND page. Clear the checkbox so the waveform does not save. **Note:** FFT processing requires that the module measure a TWF using the TWF attributes defined on this properties page); however, saving the FFT does not require saving the TWF. If you do not choose to save the TWF, the module discards it after the calculating the FFT.
Signal Source	Select from: • Pre-Filter • Mid-Filter • Post-Filter • Alternate Path	Select the signal source for TWF and the FFT. See the Filters on page 20 properties page for a description of the various stages of signal processing where you can get the processed data. The Pre-Filter selection is available only if the Primary Path Decimation is set to 1 in the Filters properties page to help ensure that data is free of aliasing. Signal Source selections for FFT's (FFT Page) and Demand data (Demand Page), for the same channel, cannot be set to different primary path sources: • Both can be set to the same source, or. . . • One must be set to Alternate Path
Sample Rate		Displays the Sample Rate from the Filters properties page for the selected data source.

Table 25 - FFT

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Maximum Frequency (Fmax)</td><td></td><td>Displays the maximum Frequency from the Filters properties page for the selected data source.</td></tr>
<tr><td>Measurement Units</td><td>Select from:
• inch/s
• m/s
• mm/s</td><td>Select the engineering units for the TWF and FFT.
•The rules for units selection, based on the transducer units (see the HW Configuration on page 11 properties page), are provided in this table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature
Bearing Defect Units</td><td>No change allowed</td></tr>
<tr><td>Pressure
Flow
Current
Frequency
Power
Voltage
Acceleration
Velocity
Length</td><td>Change in class only</td></tr>
</table>
•For any acceleration, velocity or displacement (length) units, the module can convert the measurement between equivalent Metric and English units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td></td><td>m/s</td><td></td><td>m/s^2</td></tr>
<tr><td>mm</td><td>↑</td><td>mm/s</td><td>↑</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>|</td><td>inch/s</td><td>|</td><td>$inch/s^2$</td></tr>
<tr><td>inch</td><td>↓</td><td></td><td>↓</td><td>g</td></tr>
<tr><td>mil</td><td></td><td></td><td></td><td>mg</td></tr>
</table>
</td></tr>
<tr><td>Number of Samples</td><td>Select from:
• 256
• 512
• 1024
• 2048
• 4096
• 8192</td><td>Select the number of samples to be captured in the TWF. While this TWF and the TWF that the module uses to calculate the FFT (below) begin with the same sample, it is not necessary that they have the same number of samples. Therefore the Number of Spectrum Lines (for the FFT) is not related to this Number of Samples (for the TWF).</td></tr>
<tr><td>Speed Reference</td><td>Speed Reference 0 or 1</td><td>Select the speed reference that is associated with the TWFs and FFTs processed from this channel. The module does not use the speed reference, but stores it for reference by any higher-level software systems that must associate a shaft rotation speed with the measurement.</td></tr>
<tr><td>Enable FFT Data Storage</td><td>Enable (checked) / Disabled (not checked)</td><td>Select the checkbox to make the module process and save the FFT so it is available to be read externally from the module. The module also saves the FFT in the Trend buffers.
Tip: External access to “Live” TWF and FFT data, as defined on this page, requires that the TWF and/or FFT be enabled here, AND that Dynamic Data be enabled on the TREND page.
Clear the checkbox so the FFT does not process in the module.</td></tr>
<tr><td>Number of Spectrum Lines</td><td>1600 or 800 (not editable)</td><td>The number of lines for the FFT over the frequency range of 0 to the FMAX of the selected signal source (Filters Page).
• If no decimation is applied to the signal then bands will be calculated from a 1600 line FFT.
• If the signal source includes decimation, then the FFT will be 800 lines.
Note: FFT Bands can be calculated from any frequency range within the entire frequency span of the unfiltered spectrum, from 0 Hz to the Nyquist Frequency*, using all 2048 lines of the FFT. The Number of Lines presented here are the lines for the “filtered” FFT FMAX frequency range which is the FFT that is processed and returned on request by software.</td></tr>
</table>

Table 25 - FFT

<table>
<tr><th>Parameter</th><th>Values</th><th>Comment</th></tr>
<tr><td>Signal Detection</td><td>Select from:
• Peak
• Peak to Peak
• RMS</td><td>Select the scaling (detection) method for the FFT line (bin) values.</td></tr>
<tr><td>FFT Window Type</td><td>Select from:
• Rectangular
• Flat top
• Hanning
• Hamming</td><td>Select the window function to apply in the FFT signal processing. This table lists the available FFT window types.
<table>
<tr><th>Window type</th><th>Description</th></tr>
<tr><td>Rectangular</td><td>• No window is applied.
• Also called Normal, Uniform.
• Gives poor peak amplitude accuracy, best peak frequency accuracy.
• When amplitude accuracy, and repeatability are important, use this only for transient signals, or for exactly periodic signals within the time sample (such as integer order frequencies in synchronously sampled data).</td></tr>
<tr><td>Flat Top</td><td>• Also called Sinusoidal.
• Gives good peak amplitude accuracy, poor peak frequency accuracy for data with discrete frequency components.
• Use this when amplitude accuracy is more important than frequency resolution. In data with closely spaced peaks, a Flat Top window can smear the peaks together into one wide peak.</td></tr>
<tr><td>Hanning</td><td>• A general-purpose window that is similar to a Hamming window.
• Gives fair peak amplitude accuracy, fair peak frequency accuracy.
• Use this on random type data when frequency resolution is more important than amplitude accuracy. Most often used in predictive maintenance.</td></tr>
<tr><td>Hamming</td><td>• A general-purpose window that is similar to a Hanning window.
• Gives fair peak amplitude accuracy, fair peak frequency accuracy. It provides better frequency resolution but decreased amplitude accuracy when compared to the Hanning window.
• Use this to separate closely spaced frequency components, compared to Hanning, while providing better peak amplitude accuracy than a Rectangular window</td></tr>
</table>
</td></tr>
<tr><td>Number of Averages</td><td>Select from:
• 1
• 2
• 3
• 6
• 12
• 23
• 45
• 89
• 178</td><td>Select the number of averages for the FFT or TWF (see Average TWF later in this topic).
• If you select Average TWF, the module performs in the average time domain (available when you define the measurement to use synchronous sampling). Otherwise the module performs with an average on the linear FFT data.
• When averaging, the module updates the individual TWFs (and FFTs) as quickly as possible. How fast this occurs depends on the overall processing demands on the module, which is a function of the module configuration and the current load. This, along with the fact that the module always captures TWFs with maximum overlap, makes it impossible to define precisely how long (in time) it takes for the module to acquire any specific number of samples to use in the averaging.
• Averaging is exponential. This means that once the module has acquired the specified number of samples, then the averaged sample (result) is available after each subsequent update.</td></tr>
<tr><td>Average TWF</td><td>Enable (checked) /
Disabled (not checked)</td><td>Select the checkbox to perform in the average time domain (on the TWFs). The module can average time waveforms only if they are synchronously sampled. This requires that you set the Signal Source (above) to Alternate Path, and that you set the Alternate Path Processing Mode to Synchronous.
Clear the checkbox to average the FFTs instead of the TWFs.</td></tr>
</table>

gSE

In addition to standard displacement, velocity, and acceleration measurements, the dynamic measurement module is also capable of Spike Energy measurement.

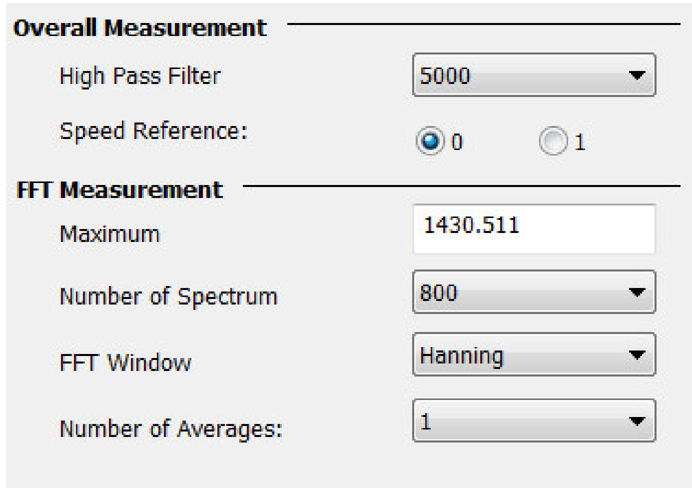


Table 26 - gSE

Parameter	Values	Comment
High Pass Filter Frequency	Select from: • 200 Hz • 500 Hz • 1000 Hz • 2000 Hz • 5000 Hz	Select the -3 dB point for the gSE measurements High Pass filter. The high pass filter is useful in removing low frequency signal components that can otherwise dominate the signal. The high pass filter attenuates signals at frequencies below a defined frequency and passes signals at frequencies above the defined frequency. The frequency that is selected is the -3 dB point of the filter.
Speed Reference	Speed Reference 0 or 1	Select the Speed Reference that is associated with the gSE TWF's / gSE FFT's processed from this channel. The Speed Reference is not used in the module. It is provided for reference by higher level (software) systems that can need to associate an RPM to the measurement.
Maximum Frequency	Select from: • 100 • 200 • 400 • 800 • 1600	Select the number of lines of resolution to be provided in the FFT.

Table 26 - gSE

Parameter	Values	Comment
Number of Spectrum Lines	Select from: • 100 • 200 • 400 • 800 • 1600	Select the number of lines of resolution to be provided in the FFT.
FFT Window Type	Select from: • Rectangular • Flat top • Hanning • Hamming	Select the window function to apply in the FFT signal processing. • FFT Windows Purpose: FFT Windows are applied to address the problem of signals that occur at frequencies that are not centered within a frequency bin. In these cases, energy from the signal can be dispersed among adjacent bins such that the amplitude of neither bin represents the actual magnitude of the signal. For example: If no window is applied (the Rectangular Window): If the frequency of a signal is precisely centered between bins, and there were no other signals present, then the magnitude of each bin is precisely ½ that of the actual signal. When viewing the FFT this presents two adjacent bins with equal and comparatively small peak amplitudes, rather than one bin with 2x that amplitude, which is what the signals amplitude actually is. Note as well that as the frequency of the signal moves across a bin the proportion of its energy that “bleeds” into adjacent bins changes. So, if using a Rectangular Window, a signal with a constant amplitude were to move 50…60 Hz (lets say 10 bins) then a Waterfall display shows the bins growing as the signal enters the bin, to a maximum that is equal to the actual signal amplitude, when the signal is centered in the bin, and then falling to zero as the signal moves above the bin. FFT Windows are used to “smooth” this effect such that the amplitude of the signal, as represented by the amplitude of the bin that it is in, is better represented. But there are trade-offs as these techniques all tend to make it more difficult to ascertain the specific frequency of a signal (which bin is it. So when selecting an FFT Window the key is to understand the intent: Is it more important to know the exact amplitude of the signals that the FFT measures, or is it more important to know the exact frequencies of the signals within the FFT? • Available FFT Windows: Rectangular – Description: No window is applied – Other Terms: Normal, Uniform – Performance: Gives poor peak amplitude accuracy, good peak frequency accuracy. – Usage: Use this only for transient signals that die out before the end of the time sample, or for exactly periodic signals within the time sample (such as integer order frequencies in synchronously sampled data). Flat Top – Description: – Other Terms: Sinusoidal – Performance: Gives good peak amplitude accuracy, poor peak frequency accuracy for data with discrete frequency components. – Use this when amplitude accuracy is more important than frequency resolution. In data with closely spaced peaks, a Flat Top window can smear the peaks together into one wide peak. Tip: Because the Bands FFT is exclusive to the bands function, so is not stored or communicated externally in any way, the Flat Top FFT Window is recommended to assure the best measurement accuracy. Hanning – Description: A general-purpose window that is similar to a Hamming window. – Performance: Gives fair peak amplitude accuracy, fair peak frequency accuracy. – Usage: It is used on random type data when frequency resolution is more important than amplitude accuracy. Most often used in predictive maintenance. Hamming – Description: – Performance: A general-purpose window that is similar to a Hanning window. – Gives fair peak amplitude accuracy, fair peak frequency accuracy. It provides better frequency resolution but decreased amplitude accuracy when compared to the Hanning window. – Usage: Use it to separate close frequency components.
Number of Averages	Select from: • 1 • 2 • 3 • 6 • 12 • 23 • 45 • 89 • 178	Select the number of averages for the gSE FFT or Time Waveform (See Average TWF on page 246). • When averaging, the individual gSE FFT’s are updated as quickly as possible. How fast this occurs is dependent on the overall processing demands on the module, which is a function of the module configuration and, to some degree, the circumstance of the moment. This, along with the fact that the waveforms are always captured without respect to an overlap requirement (so always “max overlap”), makes it impossible to define precisely how long (in time) it takes to acquire any specific number of samples that are used in the averaging. • Averaging is Exponential. This means that once the specified number of samples has been acquired that the averaged sample (result) is available upon each subsequent update.

Spike Energy is a measure of the intensity of energy that repetitive transient mechanical impacts generate. These impacts typically occur as a result of surface flaws in rolling-element bearings, gear teeth, or other devices where repeating metal-to-metal contact occurs by design. But such contact can also occur as a consequence of abnormal conditions such as rotor rub or insufficient bearing lubrication. Spike Energy is also sensitive to other ultrasonic signals, such as pump cavitation, high-pressure steam or airflow, turbulence in liquids, or control valve noise. And while repetitive impacts are easier, Spike Energy has also proven capable of detecting random impact events, singular cases of mechanical impact that can occur at any time, and that impart low energies.

This page is presented when the channel is configured for Spike Energy (gSE) measurements (see Channel Type selection, Define Module Functionality Page on page 92).

Bands

The FFT Band is a powerful tool that is commonly used in condition monitoring applications. It is also useful in process applications such as detecting the presence of cavitation in a pump or for monitoring combustion in a gas turbine. An FFT Band either calculates the total energy or returns the maximum amplitude, or its frequency, between two frequencies of an FFT.

The Bands can be calculated from a unique FFT, defined on this page, or from the gSE FFT if a gSE Channel.

Notes: If measuring from a gSE channel then:

- The FFT definition parameters (Sample Source or Number of Lines) are not used.
- The gSE FFT used for the band measurement is processed using the parameters that are provided on the gSE page.

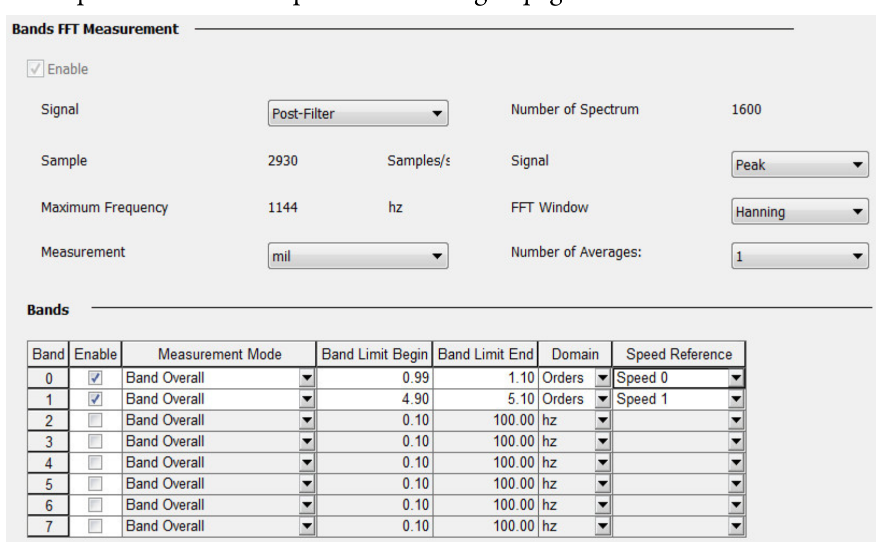


Table 27 - Bands

<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Enable</td><td>Enable (checked) /
Disabled (not checked)</td><td>Check the box if the FFT Bands is calculated from this channel.</td></tr>
<tr><td>Signal Source</td><td>Select from:
• ADCout
• Pre-Filter
• Mid-Filter
• Post-Filter
• Alternate Path</td><td>Select the signal source for the FFT to be used in the Bands measurements. See the Filters page for a description of the various signal source locations.
The Pre-Filter selection is available only if the Primary Path Decimation = 1 (no firmware decimation) to assure that data is alias-free.</td></tr>
<tr><td>Sample Rate</td><td>See Help</td><td>Displays the Sample Rate as shown in the Filters page for the selected data source</td></tr>
<tr><td>Maximum Frequency</td><td>See Help</td><td>Displays the maximum Frequency as shown in the Filters page for the selected data source</td></tr>
<tr><td>Measurement Units</td><td>See Help</td><td>Select the Engineering Units for the FFT to be used in FFT Band measurements.
The rules for Units selection, which is based on the Engineering Units of the selected Data Source, are provided in the following table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature</td><td>No change</td></tr>
<tr><td>Pressure</td><td rowspan="11">Change in class only</td></tr>
<tr><td>Flow</td></tr>
<tr><td>Angle</td></tr>
<tr><td>Current</td></tr>
<tr><td>Energy</td></tr>
<tr><td>Frequency</td></tr>
<tr><td>Power</td></tr>
<tr><td>Voltage</td></tr>
<tr><td>Acceleration</td></tr>
<tr><td>Velocity</td></tr>
<tr><td>Length</td></tr>
</table>
• For any acceleration, velocity or displacement (length) units the measurement can be converted between equivalent Metric and English units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td rowspan="5">▲
|
▼</td><td>m/s</td><td rowspan="5">▲
|
▼</td><td>m/s^2</td></tr>
<tr><td>mm</td><td>mm/s</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>inch/s</td><td>$inch/s^2$</td></tr>
<tr><td>inch</td><td></td><td>g</td></tr>
<tr><td>mil</td><td></td><td>mg</td></tr>
</table>
</td></tr>
<tr><td>Number of Spectrum Lines</td><td>Select from:
• 100
• 200
• 400
• 800
• 1600</td><td>Select the number of lines of resolution to be provided in the FFT that is used to calculate the FFT Bands.</td></tr>
<tr><td>Signal Detection</td><td>Select from:
• Peak
• Peak to Peak
• RMS</td><td>Select the scaling (detection) method for the FFT line / bin values.</td></tr>
</table>

Table 27 - Bands

Parameter	Values	Comments
FFT Window Type	Select from: • Rectangular • Flat top • Hanning • Hamming	Select the window function to apply in the FFT signal processing. • FFT Windows Purpose: FFT Windows are applied to address the problem of signals that occur at frequencies that are not centered within a frequency bin. In these cases, energy from the signal can be dispersed among adjacent bins such that the amplitude of neither bin represents the actual magnitude of the signal. For example: If no window is applied (the Rectangular Window): If the frequency of a signal is precisely centered between bins, and there were no other signals present, then the magnitude of each bin is precisely ½ that of the actual signal. When viewing the FFT this presents two adjacent bins with equal and comparatively small peak amplitudes, rather than one bin with 2x that amplitude, which is what the signals amplitude actually is. As the frequency of the signal moves across a bin the proportion of its energy that "bleeds" into adjacent bins changes. So, if using a Rectangular Window, a signal with a constant amplitude were to move 50...60 Hz (lets say 10 bins) then a Waterfall display shows the bins growing as the signal enters the bin, to a maximum equal to the actual signal amplitude, when the signal was centered in the bin, and then falling to zero as the signal moved above the bin. FFT Windows are used to "smooth" this effect such that the amplitude of the signal, as represented by the amplitude of the bin that it is in, is better represented. But there are trade-offs as these techniques all tend to make it more difficult to ascertain the specific frequency of a signal (which bin is it. So when selecting an FFT Window the key is to understand the intent: Is it more important to know the exact amplitude of the signals that are measured by the FFT, or is it more important to know the exact frequencies of the signals within the FFT? • Available FFT Windows: Rectangular – Description: No window is applied – Other Terms: Normal, Uniform – Performance: Gives poor peak amplitude accuracy, good peak frequency accuracy. – Usage: Use this only for transient signals that die out before the end of the time sample, or for exactly periodic signals within the time sample (such as integer order frequencies in synchronously sampled data). Flat Top – Description: – Other Terms: Sinusoidal – Performance: Gives good peak amplitude accuracy, poor peak frequency accuracy for data with discrete frequency components. – Use this when amplitude accuracy is more important than frequency resolution. In data with closely spaced peaks, a Flat Top window can smear the peaks together into one wide peak. Hanning – Description: A general-purpose window that is similar to a Hamming window. – Performance: Gives fair peak amplitude accuracy, fair peak frequency accuracy. – Usage: It is used on random type data when frequency resolution is more important than amplitude accuracy. Most often used in predictive maintenance. Hamming – Description: – Performance: A general-purpose window that is similar to a Hanning window. – Gives fair peak amplitude accuracy, fair peak frequency accuracy. It provides better frequency resolution but decreased amplitude accuracy when compared to the Hanning window. – Usage: Use it to separate close frequency components.
Number of Averages	Select from: • 1 • 2 • 3 • 6 • 12 • 23 • 45 • 89 • 178	Select the number of averages for the FFT that is used in FFT Band measurements. • When averaging, the individual FFT's are updated as quickly as possible. How fast this occurs is dependent on the overall processing demands on the module, which is a function of the module configuration and, to some degree, the circumstance of the moment. This, along with the fact that the waveforms are always captured without respect to an overlap requirement (so always "max overlap"), makes it impossible to define precisely how long (in time) it takes to acquire any specific number of samples that are used in the averaging. • Averaging is Exponential. This means that once the specified number of samples has been acquired that the averaged sample (result) is available, for FFT Bands to be calculated, upon each subsequent update.
Band 0…7 Enable	Enable (checked) / Disabled (not checked)	Check the box if the FFT Band (0…7) is calculated from this channel. The module (object) lets you define any of the 32 total bands to any channel. So the "Channel Source" attribute specifies to the module on which channel this band processes from (or = -128 if unused/disabled). The AOP however simply applies eight bands per channel and automatically associates (when Enabled) the bands to their respective channels.
Band 0…7 Measurement Mode	Select from: • Band Overall • Band maximum pk • Freq of Band maximum pk	Select the type of measurement to be provided by the band. • Band Overall: Returns the calculated RMS value of the band. • Band maximum pk: Returns the magnitude of the bin with the highest amplitude within the band. This value is in Peak, Peak-to-Peak, or RMS value as defined by the signal detection that is defined for the bands FFT (above). • Freq of Band maximum pk: Returns the frequency (in Hz) of the bin that contains the highest amplitude within the band. •

Table 27 - Bands

Parameter	Values	Comments
Band 0…7 Band Limit Begin	If domain = Hz, then must be > 0 If domain = Orders, then must be > 0.1	Enter the begin frequency, or order, for the band. • The module calculates the specific FFT bin that this value equates to. • If an order value is entered, the bin number that this corresponds to changes as machine speed changes. If the calculated bin is less than 0.1 or greater than the Nyquist Frequency* for the selected data source, then the FFT Band value is 0.
Band 0…7 Band Limit End	If domain = Hz, then must be > Band Limit Begin (above) and < Nyquist Frequency* If domain = Orders, then must be > Band Limit Begin (above) and < 50.0	Enter the ending frequency, or order, for the band. • The module calculates the specific FFT bin that this value equates to. • If an order value is entered, the bin number that this corresponds to changes as machine speed changes. If the calculated bin is less than 0.1 or greater than the Nyquist Frequency* for the selected data source, then the FFT Band value is 0.
Band 0…7 Domain	Select from: • Hz • Orders	Select the domain that the limits are entered in. If set to order domain, then begin and end limits are calculated with each sample.
Band 0…7 Speed Reference	Select from: • OFF • Speed 0 • Speed 1 • Factored Speed 0 • Factored Speed 1	Select the source for the speed to be used in the band limit calculation if Do main = Orders. See the Speed page for further information on speed sources.

* Nyquist Frequency

The Nyquist Frequency is defined as sample rate of the signal source divided by 2. It is the FMAX of the unfiltered FFT calculated by the FFT algorithm.

As the Nyquist Frequency does not consider anti-alias or low pass filtering any FFT Bands defined for frequencies above the FFT FMAX are not assured to be free of aliasing, or to not have been attenuated by the low pass filter.

To assure alias free measurements, do not define FFT bands at frequencies greater than default Low Pass Filter setting for the selected signal path. The default LPF is calculated as:

Decimation = 1

$$\frac{93750}{(SRD \times 2.048)}$$

Decimation >1 Filter = -24 dB

$$\frac{93750}{(SRD \times Decimation \times 4)}$$

Decimation > 1 Filter = -48 dB

$$\frac{93750}{(SRD \times Decimation \times 2.78)}$$

The LPF is the corner frequency for the filter. The corner frequency is defined as the point where the signal is attenuated by -3dB. This means that some attenuation will occur at frequencies less than the LPF corner frequency.

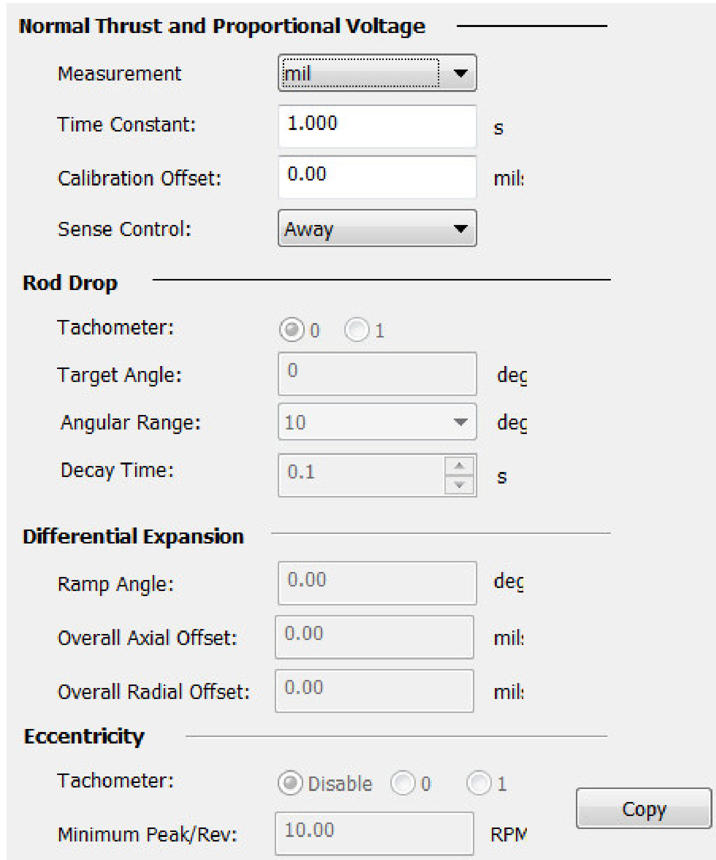
While any attenuation from the LPF will be consistently applied across measurements, if it is necessary to assure that band measurements are not attenuated by the LPF then do not set band limits at frequencies greater than the FFT FMAX value shown at the top of the page.

For standard dynamic channels, the dynamic measurement module calculates FFT bands from a unique FFT that is calculated specifically for the band measurements. This enables optimization of the definition of the FFT bands for this purpose. It provides a higher-performance solution than the common FFT or gSE FFT measurement by configuring the band measurements to update faster in most cases.

This page is presented when the channel is configured for dynamic or Spike Energy (gSE) measurements (see Channel Type selection, Define Module Functionality Page on page 92).

DC

While the dynamic measurement module is designed for measuring dynamic signals, such as vibration, it is also capable of many types of static (DC) type measurements, such as thrust, differential expansion, or rod drop. This page is where these are configured.



This page is available only for channels that are defined for Static measurements (see Channel Type,Define Module Functionality Page on page 92).

Note: While the parameters associated with all supported DC measurements are presented, only those parameters appropriate to the measurement taken must be configured.

The following is a summary overview of each of the DC measurements the module is capable of and that are configured on this page.

Normal Thrust

Also referred to as “rotor position” or “axial position”, the thrust measurement is used to monitor thrust bearing wear and to help protect against, or provide warning of, axial rubs.

Only use single-thrust motion detection (one channel) when the machine does not have to be shut down and there is another means of verifying thrust bearing failure. Use dual (redundant) thrust position measurements for applications where exceeding thrust position limits must force a machine shutdown. In this case, the voted alarm logic is defined such that both measurements must be in Danger before a shutdown (relay actuation) is executed.

On steam turbines, thrust position measurements are taken within approximately 30 cm (12 in.) of the thrust bearing, monitoring the thrust collars movement between the active and inactive thrust shoes and their subsequent wear.

The rotors thermal expansion and an increase in the required dynamic measurement range affect measurements that are taken outside of the thrust bearing area (greater than 30cm).

Configuring Thrust Measurements

IMPORTANT	If you are updating from a Firmware Revision 1 system to Revision 2 system, refer to Updating Thrust Measurements later in this section.

Before we can configure the module for thrust measurement we must understand the relationship between the position of the rotor, the thrust bearings and probe locations. The thrust bearing consists of two sets of thrust pads, the Active pads and the inactive pads, the rotor thrust collar runs against the Active pads during normal operation.

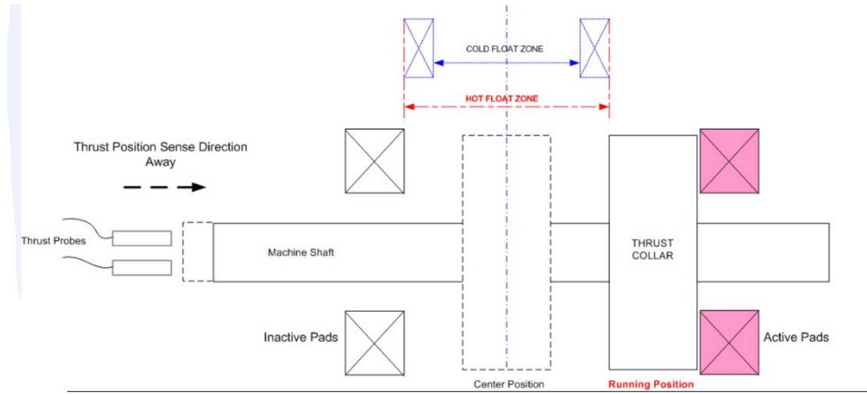
There is clearance between the two sets of pads and knowing this clearance amount is fundamental to configuring the thrust set-up. Under ambient conditions, with the machine stopped, this clearance or “float” is referred to as the “Cold Float” and can be anywhere between 0.15mm and 0.5mm (6mils to 20mils). When the machine is running at normal temperature and normal load, this clearance or float increases by potentially as much as 50% and is referred to as the “Hot Float”.

Normal practice is to establish the Cold Float by “Bumping” the rotor shaft between the inactive and active pads and measuring this distance. Bumping is used to push the rotor (it requires the coupling spacer to be removed and can require jacking equipment) first against one set of pads and then against the other. This process establishes the Cold Float, the Hot Float can only be determined by reference to the machine OEM.

The two most common applications where thrust monitoring is encountered are steam turbines and compressors.

Steam Turbines

Steam turbines normally "Thrust" toward the Exhaust End of the machine. For example, from the High-pressure end toward the Low-pressure end. The turbines normally have the thrust bearing positioned at the HP end of the machine as shown in the following diagram.



The thrust probes are also at this end of the machine, therefore, the direction of normal thrust is **AWAY** from the probes.

It is difficult, if not impossible, to set the rotor in the middle of the float. Normal practice is to locate the rotor hard against the active thrust pads and use it as the zero position.

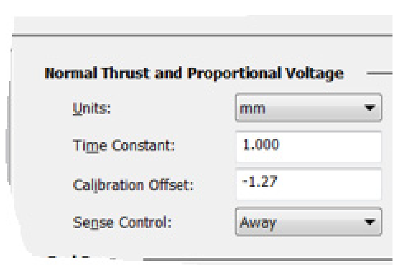
The probe gap is then adjusted to the middle of its linear range typically setting the gap to -10 Vdc, which is equivalent to 1.27 mm (50mils), for a probe sensitivity of 7.87 V/mm (200mv/mill).

The OFFSET value is then entered as -1.27 mm (-50mils), meaning minus 1.27 (50).

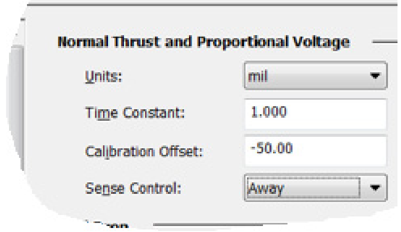
Note: For AWAY setting, enter the OFFSET value as a **Minus** value.

This value also means that movement toward the active pads result an increasing gap voltage.

Example S.I. units:

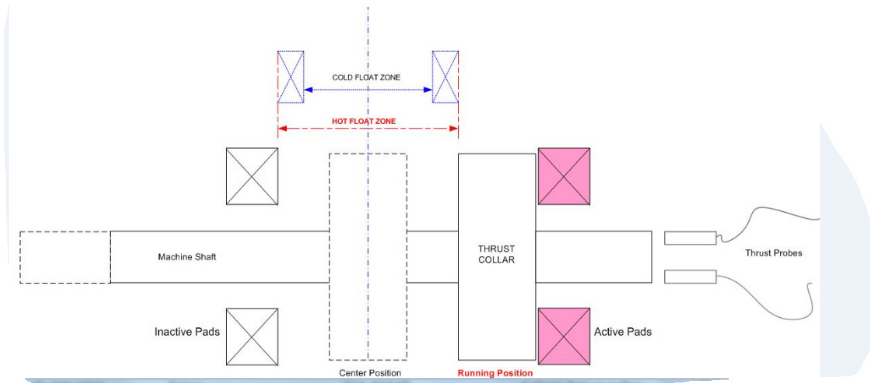


Example Imperial units:



Compressors

A compressor will normally "Thrust" toward the suction end of the machine, which is often at the none drive end, and the thrust bearing is also typically installed at this location.



In this situation the direction of normal thrust is **TOWARD** the probes.

The normal practice is again to set the rotor against the Active pads and use it as the zero position adjusting the probe gap to say -10 Vdc. This value is equivalent to 1.27 mm (50mils), for a probe sensitivity of 7.87 V/mm (200mv/mill).

The OFFSET value is entered as 1.27 mm (50mils)

Note: For TOWARD setting, enter the OFFSET as a **Plus** value.

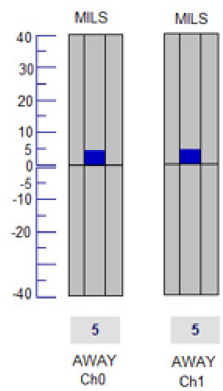
This value also means movement Toward the Active pads result in a decreasing gap voltage.

Monitoring Thrust Position with an HMI

The typical approach in configuring the HMI to visualize the rotor thrust position is to configure the monitor to show a plus value for thrust against the active pads (sometimes referred to as "normal"). Also, the monitor can show a minus value for thrust against the inactive pads (sometimes referred to as "counter").

The monitor zero value must be set with the rotor hard against the active thrust pads, or at a setting that is provided by the machine OEM who can advise on the Hot Float.

Example Steam Turbine application (imperial units) with Rotor showing five mils of movement against the active thrust pads.



This movement could represent the normal running position for this rotor due to the effect of the increased Hot Float with the machine at running temperature and load.

IMPORTANT	Do not change the probe gap setting or the monitor zero position when the machine is running otherwise all reference to rotor position is lost. Always refer to the machine OEM for specific instructions about setting the zero position of the rotor, which can differ from the preceding information.

A Guide to setting Alarm and Trip set points

The objective of thrust monitoring is to help protect the machine, not the thrust bearing. For example, to help prevent the rotating element from coming into contact with the stationary parts of the machine, which results in considerable damage, lost production and repair costs.

Some wear of the thrust bearing pads is acceptable to avoid unnecessary alarms and machine trips.

A typical thrust pad has around 0.75 mm to 1.00 mm (30...40 mils) of "white metal" or "Babbitt' inspection of the thrust pads would confirm it) material therefore if we take the preceding steam turbine application as an example with plus 5 mils (0.127mm) as the normal running position we could set the Alarm setting at 6 mils and 11 mils and the trip setting at 12mils and17mils (+0.28mm and +0.43mm).

These setting would help ensure that the thrust pads would suffer some wear before the machine was tripped but before any damage to the machine itself.

The same logic would be applied for thrust against the Inactive pads, so here we have to consider the float to determine the alarm and trip points in the counter direction.

In all cases, refer to the machine OEM for specific advice on the setting of alarm and trip points.

Updating a system from Version 1 AOP and Firmware to Version 2

If the existing system has the initial release AOP (V053) and Firmware (V2.1.3) and:

a. The firmware in the 1444 Module is updated to a later version such as 2.1.7 no changes to the configuration are necessary.
b. If both the AOP and firmware versions are updated to version 2, then the configuration must be modified as follows. For an AWAY configuration, the OFFSET must be changed to a Minus value and for a TOWARD configuration the OFFSET value must be changed to a Plus value. (The earlier version 1 AOP and Firmware required the opposite to these settings).

Proportional Voltage

Proportional (DC) Voltages are output from various sensors and systems representing pressure, amperage, flow, and other attributes. When it is necessary to measure these with the 1444 dynamic measurement module, one or more channels can be defined for Static inputs. And if it is necessary to provide this measure to the controller via the input assembly then the measured "Proportional DC" value can be selected for module output (See Select Input Data for Input Tag on page 98).

Proportional voltage measurements are calculated as y = mx + b where:

- m = the channel sensitivity (See Hardware Configuration Page on page 105) in mV/EU
- x = the measured value in Volts.
- b = the calibration offset, in the selected engineering units

IMPORTANT	A time constant can also be applied to DC measurements to reduce the effect of noise or responsiveness to rapid changes in signal.

Rod Drop

Used in reciprocating compressors, Rod Drop is a measure of the position of the piston rod relative to the proximity probe mounting location. Rod Drop provides an indirect measurement of wear of the piston rider band.

Because the distance between the probe and the piston rod varies over the length of the rods stroke, the measurement must be triggered such that it is performed consistently at the same point in the stroke. To accommodate this feature, when configuring a Rod Drop measurement, the tachometer trigger signal is used to trigger when the measurements are taken on each piston rod (channel).

The relationship between the position of each reciprocating piston rod and the rotating trigger position (tachometer trigger) is a function of the specific mechanical design of the machine. Therefore, before defining the Rod Drop measurements, determine, for each piston:

- What the mechanical relationship is between the tachometer trigger point and the position of the rod in its stroke.
- Where to take the measurement along the piston rod. The Rod Drop measurement is the average of the samples that are taken between the Start and Stop positions, as defined by the Trigger Angle and the Angular Range.

Differential Expansion

Used in steam turbine monitoring, Differential Expansion is the measure of the difference between the thermal growth of the rotor and the thermal growth of the case. During machine startup, it is used by Operators to help ensure that the heat up is managed so that the rotating and stationary components of the machine do not touch.

In a steam turbine, the rotating blades are affixed to the turbine rotor while its stationary blades are connected to the machine casing. As steam turbines operate at high temperatures, these components experience significant thermal growth from their nonoperating (cold/shutdown) state. Because of differences in the mass, material and construction of the rotor and case, the rate of thermal growth of each as the machine heats during startup are different. A rotor always expands faster than the case. This difference in thermal growth rates manifests in a varying distance between the rotating and stationary blades, with the potential for the distance to reduce until the rotating and stationary components touch. So when starting these machines it is important to do so in a manner that helps ensure that the differential between rotor and case expansion never exceeds design tolerances.

To monitor Differential Expansion, transducers can be placed on a collar or on a ramp that has been machined onto the turbine.

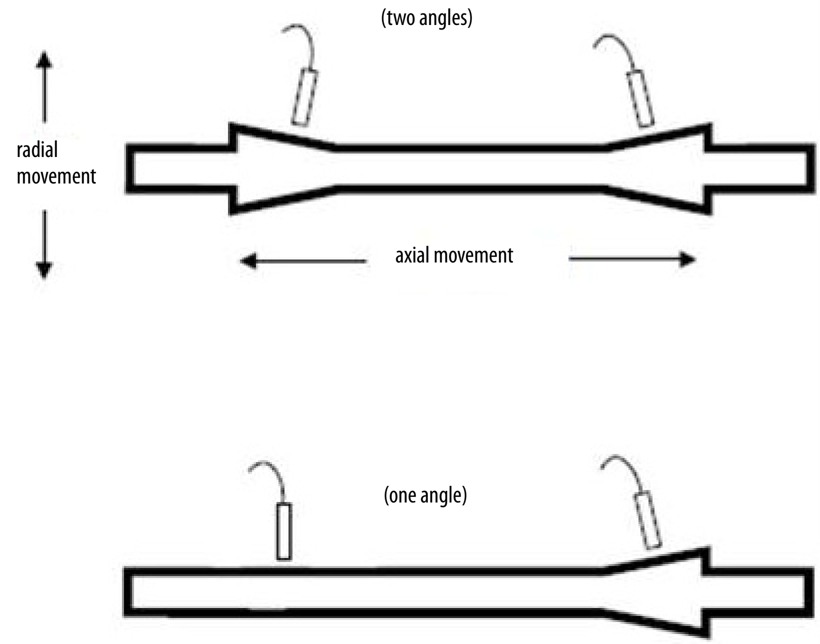
Differential Expansion requires two position measurements (sensors) that must be input to either of the module’s channel pairs (0/1 or 2/3). This page presents the applicable parameters for the selected channel. Both channels must be configured appropriately to complete the measurement.

Two modes of differential expansion measurement are supported:

Radial Cancel (Ramp) Differential Expansion

Radial Cancel, also called "Ramp", Differential Expansion is used when one or both of the sensors are installed such that they monitor the movement of an angled surface, or "ramp".

Figure 47 - Radial Cancel Mode



In radial cancel mode, the movement of the shaft is detected by measuring the gap between the probe tip and a ramp of known and consistent angle to the center line of the shaft. If two ramps are present, measure them as shown. The potential "lift" error of shaft position that is caused by jacking oil pressure is eliminated in the module calculations.

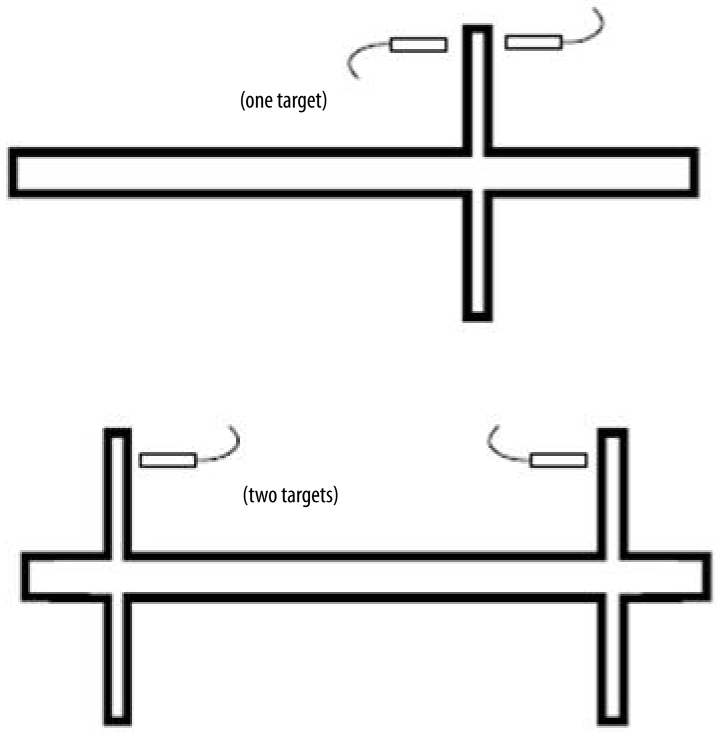
Where only one ramp is available, the "lift" error must be considered, and this is achieved by using a second probe operating on a portion of the shaft that is parallel to the center line.

IMPORTANT	For single ramp applications, the first channel of the pair (channel 0/2) must be mounted facing the ramp while the second channel (1/3) must be mounted on the shaft.

Head to Head (Axial) Differential Expansion

Head to Head, also called “Axial”, Differential Expansion is used when the sensors are aligned axially (parallel with the shaft).

Figure 48 - Head-to-Head Mode



The head-to-head mode enables the extended range operation by using two probes in a “back to back” arrangement that is shown in the illustration. This mode can be used when the machine does not have enough space for larger diameter probes. It is not necessary for the scales to be symmetrical in this mode, and probes of different voltage sensitivities can be used.

IMPORTANT When using the head-to-head mode, be aware of these facts.

- For this mode, the parameters for Normal Thrust Offset and Sense Control are also used.
- In this mode, one probe is active and one inactive. This relates to the sense/direction and must be configured such that if the gap for the probe that is configured for the active direction increases then the result becomes more positive.
- When configuring the measurement to output zero when in a central position, use the individual offsets, rather than the Axial Offset, to zero the two probes. This gives the final result a zero value. If that has to be something other than zero, the overall offset control (Axial Offset) can then be used to adjust that.
- In general, for any thrust measurement (single or dual channel), the offset control is a 'site configuration' item in the sense that it cannot normally be determined in advance.
- When having a dual channel differential expansion measurement configured, verify that and the measurement pair results, you can access the individual channel DC results (configured in the I/O data or accessed 'directly' via the DC measurement object).

Eccentricity

Used in monitoring steam turbines, Eccentricity is a measurement of the amount of sag or bow in a rotor. It can also provide indication of a bent shaft. This measurement is used by the operator during startup to indicate when the machine can safely be brought up to speed without causing rubs or damage to the seals.

Steam turbine rotors are long shafts, supported at the ends, with heavy loads in between. So when shut down (cold and not rotating) the weight of the rotor causes the shaft to bow over time. If the machine is then brought to speed, the imbalance that is caused by the bow could damage the machine. Startup procedures are provided to slowly bring the turbine to speed, and temperature, so that rotors have time to straighten out on their own. Key to this process is monitoring the amount of bow (eccentricity) so that a machine can be safely started.

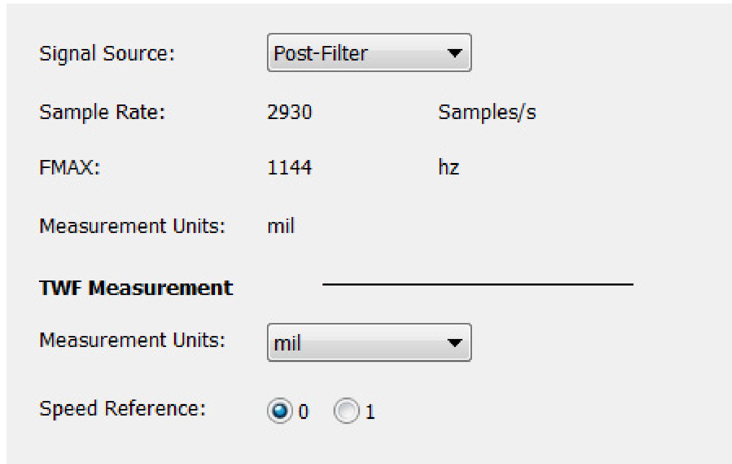
The eccentricity measurement is similar to the common overall measurement in that it is the measure of the difference between the maximum and minimum peaks in a signal. However, for a normal overall measurement this is measured by sampling rapidly while continually updating the minimum and maximum values and calculating the difference. This is done without consideration of shaft rotation. So, when the shaft is spinning rapidly, the measure could span multiple revolutions, and when spanning slowly can be measured from less than one revolution.

For eccentricity measures this latter case result in a misleading reading as the overall value grows and shrinks depending on the position of the shaft relative to the sensor as the measurements are made. To solve this problem the eccentricity measure can be defined so that it is made on a per revolution basis, regardless of how long that revolution takes to complete. This is why a tachometer can be associated with the eccentricity measurement.

When using a tachometer for eccentricity, the minimum pk/revolution (RPM) parameter is used to define a speed where the measurement method transitions from the “single peak per revolution” method to the normal fast sampling method.

Demand

In addition to its real-time and continuous measures the 1444-DYN04-01RA dynamic measurement module can serve additional data “on demand”. Demand data is accessed by using explicit data requests to the Demand Data Objects.



<table>
<tr><th>Parameter</th><th>Values</th><th>Comments</th></tr>
<tr><td>Signal Source</td><td>Select from:
Pre-Filter
Mid-Filter
Post-Filter
Alternate Path</td><td>Select the signal source for TWF and the FFT. See the Filters on page 20 properties page for a description of the various stages of signal processing where you can get the processed data. The Pre-Filter selection is available only if the Primary Path Decimation is set to 1 in the Filters properties page to help ensure that data is free of aliasing.
Signal Source selections for FFT's (FFT Page) and Demand data (Demand Page), for the same channel, cannot be set to different primary path sources:
Both can be set to the same source, or. . .
One must be set to Alternate Path</td></tr>
<tr><td>Measurement</td><td>Select from:
inch/s
m/s
mm/s</td><td>Select the engineering units for the TWF and FFT.
• The rules for units selection, based on the transducer units (see the HW Configuration on page 11 properties page), are provided in this table.
<table>
<tr><th>CLASS</th><th>CHANGE EU OPTION</th></tr>
<tr><td>Temperature
Bearing Defect Units</td><td>No change allowed</td></tr>
<tr><td>Pressure
Flow
Current
Frequency
Power
Voltage
Acceleration
Velocity
Length</td><td>Change in class only</td></tr>
</table>
•For any acceleration, velocity or displacement (length) units, the module can convert the measurement between equivalent Metric and English units.
<table>
<tr><th>Displacement</th><th></th><th>Velocity</th><th></th><th>Acceleration</th></tr>
<tr><td>m</td><td></td><td>m/s</td><td></td><td>m/s^2</td></tr>
<tr><td>mm</td><td>↑</td><td>mm/s</td><td>↑</td><td>mm/s^2</td></tr>
<tr><td>micron</td><td>|</td><td>inch/s</td><td>|</td><td>$inch/s^2$</td></tr>
<tr><td>inch</td><td>↓</td><td></td><td>↓</td><td>g</td></tr>
<tr><td>mil</td><td></td><td></td><td></td><td>mg</td></tr>
</table></td></tr>
<tr><td>Speed Reference</td><td>Speed Reference 0 or 1</td><td>Select the speed reference that is associated with the TWFs and FFTs processed from this channel. The module does not use the speed reference, but stores it for reference by any higher-level software systems that must associate a shaft rotation speed with the measurement.</td></tr>
</table>

The demand page defines the acquisition of time waveform data for demand, or advanced, condition monitoring data requests. Available services enable data requests "on demand" from the demand (advanced) data buffers with each request uniquely definable per the requestor specifications, which can include various post-processing tasks, including FFT processing.

This page is presented when the channel is configured for Dynamic measurements.

Demand data lets a deep data buffer be defined at any one of the enabled data sources (See Filters on page 118). Once defined the demand Buffer updates continuously in the background while imparting minimal additional loading to the module processors.

Configure the Tachometer Expansion Module

Tachometer Expansion Module

The 1444-TSCX02-02RB Tachometer Signal Conditioner expansion module is a two-channel monitor that converts input signals from common speed-sensing transducers into a once-per-revolution TTL class signal. It is suitable for use by up to six connected 1444-DYN04-01RA dynamic measurement modules.

The tachometer signal conditioner commonly serves speed signals to main modules other than its host. So, unlike other expansion modules, and except for configuration services, the 1444-TSCX02-02RB module operates independently of its host module. Therefore, once configured, the tachometer expansion module continuously serves TTL speed signals, regardless of the state or availability of its host module or local bus.

Tachometer Page

Page Overview

The tachometer page includes parameters that are transmitted to a connected tachometer expansion (1444-TSCX02-02RA) module for use in processing the raw speed signals.

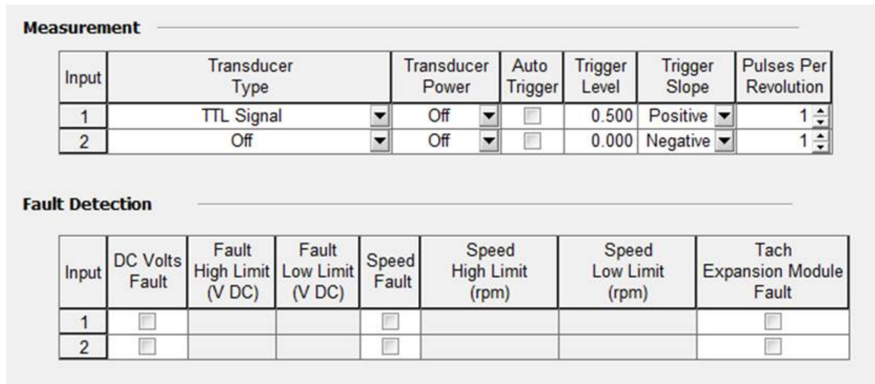


Table 28 - Tachometer

Parameter	Values	Comments
Transducer Power	**Transducer Power** / **Value** Off / 0 +24V DC / 1 -24V DC / 2	Select the power requirement for the connected sensor. **Note**: Set to "Off" if the sensor is self-powered, such as a Magnetic Pickup, or if it is powered from a separate source, including a barrier or isolator.
Auto Trigger Enable	Checked (1) Unchecked (0)	When Auto trigger is enabled (checked), the module automatically sets the trigger threshold. When not enabled (unchecked) the Trigger Level specified is applied. **Note**: Auto Trigger is not available in the initial release firmware.
Trigger Level	-32.000 ≤ Trigger Level ≤ 32.000	Enter the desired trigger level in Volts (ex. -2.4). The Tachometer Signal Conditioner module trigger function applies a fixed hysteresis of 800 mV. Consequently the minimum pulse height that can be triggered is approximately 1 volt. **Note**: The tag and object retain the value in millivolts. For example, a -2.4 Volt trigger level yields a -2400 (millivolt) tag value.
Trigger Slope	**Trigger Slope** / **Value** Positive / 0 Negative / 1	Enter the direction of the desired trigger slope. **Note**: The trigger is "leading edge" if the slope is the same as the direction as the pulse (positive slope for a positive going pulse). It is "trailing edge" if the slope is opposite the direction of the pulse (positive slope on a negative going pulse).
Pulses per Revolution	1…255	Enter the number of signal pulses per revolution of the shaft.
DC Volts Fault	Checked (1) Unchecked (0)	When enabled (checked), the tachometer signals a fault when the bias voltage of the connected sensor is outside the specified Fault High / Fault Low limits.

Table 28 - Tachometer

Parameter	Values	Comments
Fault High Limit (V DC)	-32.000 ≤ Fault High Limit ≤ 32.000	Enter the bias fault high level in Volts (ex. -2.4). The value must be greater than the Fault Low Limit. When enabled (checked), the tachometer signals a fault when the bias voltage of the connected sensor is outside the specified Fault High / Fault Low limits. **Note**: The tag and object retain the value in millivolts. For example, a -2.4 Volt trigger level is a -2400 (millivolt) tag value.
Fault Low Limit (V DC)	-32.000 ≤ Fault Low Limit ≤ 32.000	Enter the bias fault low level in Volts (ex. -2.4). The value must be less than the Fault High Limit. When enabled (checked), the tachometer signals a fault when the bias voltage of the connected sensor is outside the specified Fault Low / Fault Low limits. **Note**: The tag and object retain the value in millivolts. For example, a -2.4 Volt trigger level is a -2400 (millivolt) tag value.
Speed Fault	Checked (1) Unchecked (0)	When enabled (checked), the tachometer signals a fault when the measured speed is outside the specified Fault High / Fault Low limits.
Speed High Limit	0.0 ≤ Speed High Limit	Enter the high-speed limit. The value must be greater than the Speed Low Limit. When enabled (checked), the tachometer signals a fault when the measured speed is outside the specified Speed High / Speed Low limits.
Speed Low Limit	0.0 ≤ Speed Low Limit	Enter the low speed limit. The value must be lower than the Speed High Limit. When enabled (checked), the tachometer signals a fault when the measured speed is outside the specified Speed High / Speed Low limits.
Tach Expansion Module Fault	Checked (1) Unchecked (0)	When enabled (checked), the tachometer signals a fault when the tachometer expansion module is in fault. **Note**: If a module fault is detected, if possible, the TSC module continues to provide a signal to its various tacho outputs as, for example, a communication link timeout, which does not preclude the function of the module. Setting the Tach Expansion Module Fault communicates these detected module faults as a tacho sensor fault.

This page is not included in the AOP when no Tachometer Expansion Module is present (See Tachometer Expansion Module on page 157).

Notes:

Configure Analog Outputs

Analog Expansion Module

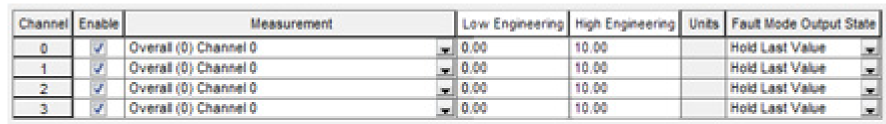
4…20 mA (analog) outputs are enabled by the addition of a 1444-AOFX00-04RB Analog Output Expansion Module. The Dynamix 1444 series analog output expansion module is a four-channel module that outputs 4…20 mA signals that are proportional to measured values of the module's host 1444-DYN04-01RA dynamic measurement module.

The 1444-AOFX00-04RB module is designed for use with a dynamic measurement module that acts as its host, serves its power, and manages the analog configuration of the module.

The analog output expansion module is designed to act as an extension of its host module. So the 1444-AOFX00-04RB module's operation is dependent on the availability of its host.

Output Configuration Page

Page Overview



Channel	Enable	Measurement	Low Engineering	High Engineering	Units	Fault Mode Output State
0	✓	Overall (0) Channel 0	0.00	10.00		Hold Last Value
1	✓	Overall (0) Channel 0	0.00	10.00		Hold Last Value
2	✓	Overall (0) Channel 0	0.00	10.00		Hold Last Value
3	✓	Overall (0) Channel 0	0.00	10.00		Hold Last Value

This is list of the different output configurations.

Table 29 - Output Configuration

Parameter	Values	Comment
Enable	Enabled (checked) or Not Enabled (not checked)	Check the box to enable output from each respective 4…20 mA output channel.
Measurement	Available selections are dependent on the Channel Type (see Define Module Functionality page in Module Definition) and the Channel Measurement Type (See Hardware Configuration Page on page 105) for the channel that is associated with each measurement. See Table 30 on page 163 to view all available settings.	Select the measurement to be output on the referenced Analog Module channel.
Low Engineering	Any	Enter the value, in Engineering Units, that is to correspond to an output magnitude of 4 mA.
High Engineering	Any	Enter the value, in Engineering Units, that is to correspond to an output magnitude of 20 mA.
Units	N/A	Displays the Engineering Units for the selected measurement.
Fault Mode Output State	Select from: • Hold Last Value • < 4 mA • > 20 mA	Select the desired behavior on fault. If "Hold Last Value" the output re mains at the last measured value before the fault occurred. If "< 4 mA" the output is driven to 2.9 mA. If "> 20 mA" the output goes to ~21 mA. Faults that result in the defined behavior include: • Transducer Fault (for the channel associated with the measurement) • Expansion Bus Failure • Expansion Module Self-Check Fail

Table 30 - Output Configuration Page Measurement Selection Options

Measurement	Channel Type	Measurement Type
Overall (0/1), Channel 0…3	Dynamic, gSE	Any
	Static	Eccentricity
DC(V), Channel 0…3	Dynamic, gSE	Any
Order magnitude (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled	
Order Phase (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled Order value is an integer (no fractions)	
FFT Band (0…8), Channel 0…3	Dynamic, gSE	Any
	FFT Band is Enabled	
Not 1X, Channel 0…3	Dynamic	Any
	Order 0 is Enabled Order 0 value = 1.0	
DC Channel 0…3	Static	Any
SMAX magnitude, Channel Pair 0/1, 2/3	Dynamic	X (shaft relative), Y (shaft relative), Aeroderivative. Shaft Relative (LP/HP filtered)
SMAX Phase, Channel Pair 0/1, 2/3		
Shaft Absolute pk-pk, Channel Pair 0/1, 2/3	Dynamic	Ch A = Shaft Relative (LP/HP filtered) Ch B = Std. case absolute vibration (AV to D) or Std. case absolute vibration (V to D)
Speed (0/1)	If Speed input is Enabled	Any
Factored Speed (0/1)		
Speed maximum (0/1)		
Speed Rate of Change (0/1)		
Axial Differential Expansion, Channel Pair 0/1, 2/3	Static	Ch A = Complementary Differential Expansion A Ch B = Complementary Differential Expansion B
Ramp Differential Expansion, Channel Pair 0/1, 2/3	Static	Ch A = Ramp Differential Expansion A Ch B = Ramp Differential Expansion B
Rod Drop 0…3	Static	Rod Drop

The Dynamix 1444 Series 1444-DYN04-01RA dynamic measurement module can output analog representations of measured data in the 4…20 mA format. The functionality is suitable for driving strip chart recorders, output to analog meters, or to replace previous communication solutions that can have been available in legacy systems. While 4…20 mA outputs are available, they are not the preferred medium for data communication from the Dynamix system.

This page is presented only when an Analog Output Expansion Module (1444-AOFX00-04RB) is present (See Expansion Device Definition Dialog on page 90). When available, one per measurement module, this page is used to configure the outputs.

Configure Relays

Relay Expansion Module

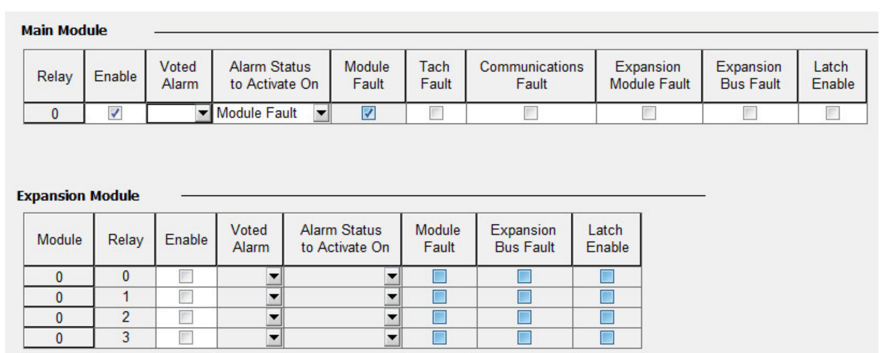
The Dynamix 1444 series relay expansion module is a four-relay module that serves to functionally add relays to its host 1444-DYN04-01RA dynamic measurement module.

The 1444-RELX00-04RB module is designed for use with a dynamic measurement module that acts as its host, serves its powers, and manages the relay module configuration.

The relay expansion module acts as an extension of its host module. So 1444-RELX00-04RB module operation is dependent on the availability of its host. However, the relay module can actuate relays independently of its host if communication to the host fail or are lost.

Relay Page

Relays generally mimic the output logic of a referenced voted alarm. Relays can also be configured to act independently of the voted alarm on module, expansion module, communication, or tachometer fault status.



Configuration options for expansion relay module relays are shown only for connected expansion relay modules (so either 4, 8 or 12 expansion relay module relays can be configured).

Table 31 - Relays

Parameter	Values	Help
Main Module Relay – Enable	Checked (1) / Unchecked (0)	Check to enable the relay.
Main Module Relay – Voted Alarm Number	Blank or 0…12 presented in a list of enabled Voted Alarms	This is the Voted Alarm that is associated with the main module relay. If blank, then at least one fault must be selected to act on.
Main Module Relay – Alarm Status to Activate On	Select from: • Alert • Danger • Xdcr Fault • Disarm • Module Fault	Alert, Danger, and Transducer Fault are states that the Voted Alarm can actuate on (see Voted Alarm page). If Disarm, is selected the relay is in Bypass mode. If Module Fault is selected, then the relay actuates only on the specified faults (not just Module Fault).
Main Module Relay – Module Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on a fault in the main module. When Fail-Safe Enable is checked for the selected Voted Alarm, if Alarm Status to Activate On is set to Module Fault this control is checked and disabled.
Main Module Relay – Tach Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on a tachometer fault. This fault actuates if a tachometer fault is indicated on any enabled speed input (see Speed page).
Main Module Relay – Communication Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on an Ethernet network fault.
Main Module Relay – Expansion Module Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on a fault reported by in any connected Expansion module.
Main Module Relay – Expansion Bus Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on a fault of the Expansion Bus.
Main Module Relay – Latch Enable	Checked (1) / Unchecked (0)	Check this when the relay must latch after having actuated on any of the selected fault conditions. Latch control for the alarm input is included in the Voted Alarm definition.
Expansion Module Relay – Enable	Checked (1) / Unchecked (0)	Check to enable the relay.
Expansion Module Relay – Voted Alarm Number	Blank or 0…12 presented in a list of enabled Voted Alarms	This is the Voted Alarm that is associated with the Expansion Module relay. If blank, then at least one fault must be selected to act on.
Expansion Module Relay – Alarm Status to Activate On	Select from: • Alert • Danger • Xdcr Fault • Disarm • Module Fault	Alert, Danger, and Transducer Fault are states that the Voted Alarm can actuate on (see Voted Alarm page). If Disarm is selected, the relay is in Bypass mode. If Module Fault is selected, then the relay actuates only on the specified faults (not just Module Fault).
Expansion Module Relay – Module Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on a fault in either the main Module or the Relay Expansion Module. When Fail-Safe Enable is checked for the selected Voted Alarm, if Alarm Status to Activate On is set to Module Fault this control is checked and disabled.
Expansion Module Relay – Expansion Bus Fault	Checked (1) / Unchecked (0)	Check this when the relay must actuate on a fault of the Expansion Bus.
Expansion Module Relay – Latch Enable	Checked (1) / Unchecked (0)	Check this when the relay must latch after having actuated on any of the selected fault conditions. Latch control for the alarm input is included in the Voted Alarm definition.

Relay Management Overview

Relays are commonly used in a monitoring system to provide annunciation of a change in machine condition, trip a machine, preclude start of a machine.

The relay management system provides a flexible implementation where relays can be defined to act on:

- Any voted alarm, which includes any faults that are implicit in the voted alarm definition
- Any voted alarm, which includes any faults that are implicit in the voted alarm definition, and selected system faults
- Any selected system faults (a dedicated fault relay)

Alarm Output

Each relay can reference one voted alarm. However, because the status of the voted alarm could be alert, danger, transducer fault, disarm, or module fault, the specific status necessary to actuate the relay must also be defined.

A voted alarm can be configured to actuate on alert, danger, and/or transducer fault. You can also define how the measurement alarms input to the voted alarm behave if a transducer fault occurs. This flexibility provides the tools necessary to define systems with relays that, for example:

- Actuate only when the voted logic is based on actual alarm level measurements
- Actuate when the voted logic is based on alarm level or faulted measurements
  In this case, the measurement alarms are defined such that a transducer fault is treated as “in alarm”.
- Actuate on transducer fault.

Main Module Fault Output

Relays can also be configured to actuate on various fault conditions. These can be selected in addition to a voted alarm input, or independently of (so acts only on faults) and any or all faults can be selected for notification by the relay.

The available faults that can be detected and acted on by the dynamic measurement module relay differ from those available to the expansion module relays. The available faults that the main module relay can be configured to act on are:

Module Fault

This is a fault reported by the main module itself on failure of any of the following:

- Startup tests
- RAM (memory) test
- Code CRC check
- Runtime tests
- RAM (memory) test (Runtime version)
- Code CRC check (Runtime version)
- Relay drive test (tests the internal relay drive circuitry when the relay configuration is fail-safe)

The level of the compliance requirement determines how which and how frequently the runtime tests are performed (See Define Module Functionality Page on page 92).

Tachometer Fault

A tachometer fault condition is communicated to the main module by any of:

- The local bus from the tachometer signal conditioner expansion module (1444-TSCX02-02RB)
- The tachometer fault status inputs (terminal connections) from the tachometer signal conditioner expansion module (1444-TSCX02-02RB) or other source
- The SpeekOK0/1 bits in the controller output control tag

See Tachometer Page on page 158 for further information on defining fault detection for a tachometer signal conditioner expansion module.

Communication Fault

A communication fault is reported if a fault occurs with the ethernet link from the module.

Expansion Module Fault

An expansion module fault is reported if any of the connected expansion modules report a module fault.

Each expansion module performs start-up tests of memory and function similar to the main module.

The relay expansion module performs the relay drive test on its relays when commanded by the main module.

Expansion Bus Fault

A timeout function is implemented that requires that a "Heartbeat™" from each expansion module is provided to help ensure that each module is communicating and that the bus is functioning.

If the heartbeat period times out, bus fault is reported in case communication fail between the main and any of its expansion modules fails.

Expansion Module Fault Output

The following faults can be detected and acted on by any of the 1444 series expansion relay module (1444-RELX00-04RB) relays.

Module Fault

This is a fault reported by the relay expansion module itself.

Each expansion module performs start up tests of memory and function similar to the main module.

The relay expansion module performs the relay drive test on its relays when commanded by the main module.

Expansion Bus Fault

A timeout function is implemented that requires that a "Heartbeat" from each expansion module is provided to help ensure that each module is communicating and that the bus is functioning.

A bus fault is reported if communication between the expansion module and its host (main module) fails - the heartbeat period times out.

Latching

Configuration of each relay of the main and expansion relay module also includes a Latch Enable control. This control differs from the Latch Enable of the Voted Alarm (See Voted Alarms Page on page 179) in that this Latch definition is associated only with relay behavior related to the Fault detection.

Resetting a latched relay re mains the same as for the standard alarm reset function.

Relay Drive Testing

The module routinely performs a test of the drive circuit on all expansion module relays that are defined as fail-safe (See Voted Alarms Page on page 179), when the module compliance requirement (See Define Module Functionality Page on page 92) is set to any of:

- API and SIL2 Low Demand Advise Only
- API and SIL2 Low Demand Trip Action
- API and SIL2 High Demand

How often the test is performed is dependent on the level of the compliance requirement with higher compliance levels requiring more frequent testing.

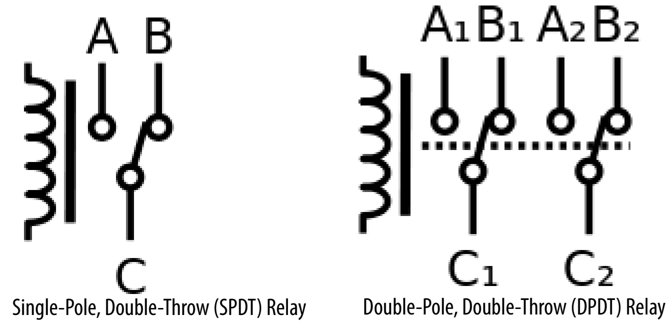
ATTENTION: The specific frequency of the testing for the configured application can be read from the module. See the Dynamix Relay Module Object in the Object Library documentation for further information.

Failure of a routine drive circuit test constitutes a "module fault" condition for expansion module.

Double-pole, Double-throw (DPDT) Relay Solutions

All 1444 Series module and expansion module relays are identical single-pole, double-throw (SPDT) type as in Figure 49. When a double-pole, double-throw (DPDT) relay is required it is possible to combine two SPDTs to act as a DPDT.

Figure 49 - Single-Pole and Double-Throw Relays



Each single-pole, double-throw relay includes one input pin (common) and individual pin connections for the relay's normally open and normally closed positions.

Each double-pole, double-throw relay includes two common pins (connections) and, for each, independent connections for the poles normally open and normally closed positions.

The 1444 series supports DPDT relay solutions by use of two identically configured standard SPDT relays. Each SPDT relay that is used in a DPDT solution can be on the same or different expansion relay module but exclude the SPDT on the main module (1444-DYN04-01RA). That relay includes (slightly) different functionality than the expansion module relays.

Notes:

Configure Alarms

The Dynamix 1444 Series 1444-DYN04-01RA dynamic measurement module includes a sophisticated alarming system that can meet the alarm detection, voting, and relay management requirements of any monitoring application. Three linked elements define the alarm system including measurement alarms, voted alarms, and relays.

Measurement Alarms Page

Page Overview

The following overview describes the dynamic measurement module.

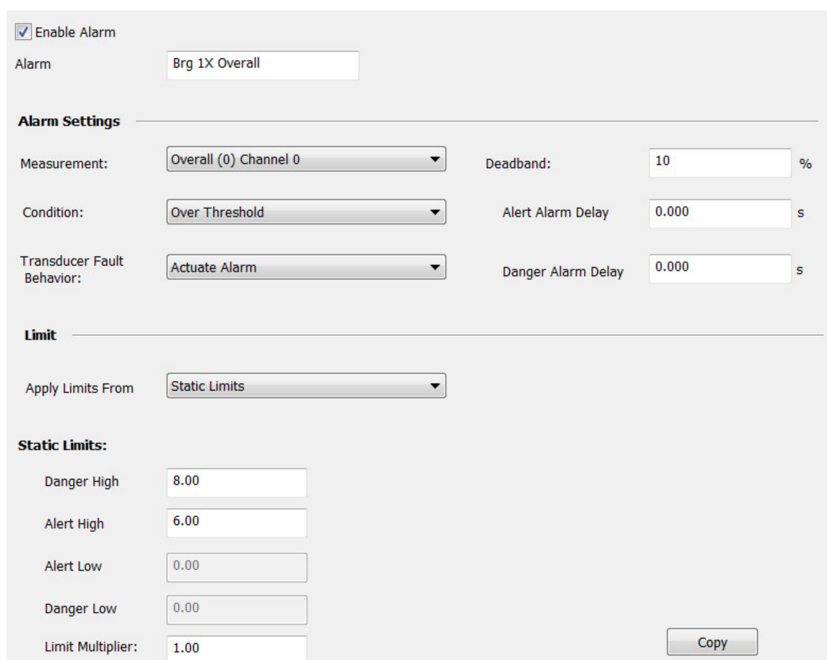


Table 32 - Alarms

<table>
<tr><th>Parameter</th><th>Values</th><th>Help</th></tr>
<tr><td>Enable Alarm</td><td>Checked (1) / Unchecked (0)</td><td>Check to enable the alarm</td></tr>
<tr><td>Alarm Name</td><td>Characters</td><td>Enter a name of up to 32 characters. There are no rules for the names content or uniqueness. However, the name is used when selecting Measurement Alarms as input to other functions, such as Voted Alarm definition, so unique names are recommended. Additionally the name:
• Must start with a letter or underscore (“_”).
• Must consist of letters, numbers, or underscores.
• Cannot contain two contiguous underscore characters.
• Cannot end in an underscore.</td></tr>
<tr><td>Measurement</td><td>Available selections are dependent on the Channel Type (see Define Module Functionality page in Module Definition) and the Channel Measurement Type (See Hardware Configuration Page on page 105) for the channel that is associated with each measurement. See the measurements table.
See Table 33 on page 176 to view all available settings.</td><td>Select the measurement to be evaluated by the selected Measurement Alarm.</td></tr>
<tr><td>Condition</td><td>Select from:
• Greater Than
• Less Than
• Inside Range
• Outside Range</td><td>Select the desired condition.</td></tr>
<tr><td>Transducer State Behavior</td><td>Select from:
• Transducer Fault Considered
• Transducer Fault Monitored
• Transducer Fault Not Considered</td><td>This selection specifies the behavior of the Measurement Alarm if a transducer fault occurs.
<table>
<tr><th>Option</th><th>Behavior</th></tr>
<tr><td>Transducer Fault Considered</td><td>The Alarm is not evaluated (so never TRUE) if the transducer is in a Fault condition.
Any alarm that was TRUE (actuated) clears if the associated transducer goes into fault.</td></tr>
<tr><td>Transducer Fault Monitored</td><td>The Alarm is forced to TRUE (actuated) when the transducer is in a Fault condition.
This is regardless of the value of the measured parameter.</td></tr>
<tr><td>Transducer Fault Not Considered</td><td>The behavior of the alarm remains strictly defined by the measurement.
Depending on the nature of a transducer fault and the specifics of the measurement, a fault can force the measurement high, or low.</td></tr>
</table>
Also consider:
<table>
<tr><td>Dual Channel Measurements</td><td>The above applies if either sensor faults.</td></tr>
<tr><td>Speed Measurements</td><td>The above applies if the speed transducer faults.</td></tr>
<tr><td>Speed Dependent Measurements</td><td>The above applies if the associated transducer faults OR if the speed transducer faults.</td></tr>
</table></td></tr>
<tr><td>Deadband</td><td>0…20</td><td>Enter a deadband (hysteresis) as a percentage of the alarm limit or alarm window range. This is the amount that the measured value must increase above or fall below (the non-alarm state direction) the limit after exceeding it before the alarm condition clears.
The intent of the deadband is to minimize “chatter”, where a measurement oscillates around the alarm limit and causes the alarm condition to repeatedly set and unset.
For window alarms, the deadband is the stated percentage of the range of the window (high - low).</td></tr>
<tr><td>Alert Alarm Delay Time</td><td>0.000…65.500 seconds</td><td>Enter the time that the measured value must persist at an Alert level before an Alert Alarm condition is set.
The intent of an alarm delay is to prevent random electronic or mechanically generated noise. This noise can create rapid, short-lived signal spikes, from being interpreted, and acted on, as if an actual alarm condition.</td></tr>
</table>

Table 32 - Alarms

<table>
<tr><th>Parameter</th><th>Values</th><th>Help</th></tr>
<tr><td>Danger Alarm Delay Time</td><td>0.000…65.500 seconds</td><td>Enter the time that the measured value must persist at a Danger level before a Danger Alarm condition is set.
The intent of an alarm delay is to prevent random electronic or mechanically generated noise. This noise can create rapid, short-lived signal spikes, from being interpreted, and acted on, as if an actual alarm condition.</td></tr>
<tr><td>Apply Limits From</td><td>Select from:
• Static Limits
• Static Limits with Adaptive Multipliers
• Output Tag Limits</td><td>Select the source for the alarm limits and any applicable multipliers.
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Static Limits</td><td>This is the normal mode. The limits are entered directly (so are static), along with one (static) multiplier that is managed by the Set Point Multiplier function.</td></tr>
<tr><td>Static Limits with Adaptive Multipliers</td><td>The limits are entered directly (so are static), but uses up to five multipliers that are applied depending on a control parameter.</td></tr>
<tr><td>Output Tag Limits</td><td>The limits are passed to the module in the Controller Output assembly. No multiplication is provided.</td></tr>
</table></td></tr>
<tr><td>Adaptive Limits</td><td>N/A</td><td>When the Limit Source is “Static Limits w/ Adaptive Multipliers”, click this to access the Adaptive Multipliers editor.
Adaptive Multipliers are uniquely defined for each Measurement Alarm.</td></tr>
<tr><td>Danger High Limit</td><td rowspan="2">Any</td><td rowspan="2">Enter a value to specify the limit that when the measurement is above/below (unsafe direction) defines a Danger Alarm condition.</td></tr>
<tr><td>Danger low Limit</td></tr>
<tr><td>Alert High Limit</td><td rowspan="2">Any</td><td rowspan="2">Enter a value to specify the limit that when the measurement is above/below (unsafe direction) defines an Alert Alarm condition.</td></tr>
<tr><td>Alert Low Limit</td></tr>
<tr><td>Danger High Output Tag Limit</td><td rowspan="4">Select from:
• O.AlarmLimit[0]
• O.AlarmLimit[1]
• …
• O.AlarmLimit[15]</td><td rowspan="4">Select the controller output tag for the alarm limit that is referenced.
Select the controller output tag for the alarm limit that is referenced.</td></tr>
<tr><td>Alert High Output Tag Limit</td></tr>
<tr><td>Alert Low Output Tag Limit</td></tr>
<tr><td>Danger Low Output Tag Limit</td></tr>
<tr><td>Limit Multiplier</td><td>≥0…1000.000</td><td>For Static Limits (normal mode), enter the multiplier that is applied when the Set Point Multiplier function is set.
The Limit Multiplier field does not display if you select “Static Limits Without Adaptive Multipliers” from the Apply Limits From pull-down menu.</td></tr>
</table>

Table 33 - Measurement Alarm Measurement Selection Options

Measurement	Channel Type	Measurement Type
Overall (0/1), Channel 0…3	Dynamic, gSE	Any
	Static	Eccentricity
DC(V), Channel 0…3	Dynamic, gSE	Any
Order magnitude (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled	
Order Phase (0…4), Channel 0…3	Dynamic	Any
	Order is Enabled Order value is an integer (no fractions)	
FFT Band (0…8), Channel 0…3	Dynamic, gSE	Any
	FFT Band is Enabled	
Not 1X, Channel 0…3	Dynamic	Any
	Order 0 is Enabled Order 0 value = 1.0	
DC Channel 0…3	Static	Any
SMAX magnitude, Channel Pair 0/1, 2/3	Dynamic	X (shaft relative), Y (shaft relative), Aeroderivative. Shaft Relative (LP/HP filtered)
SMAX Phase, Channel Pair 0/1, 2/3		
Shaft Absolute pk-pk, Channel Pair 0/1, 2/3	Dynamic	Ch A = Shaft Relative (LP/HP filtered) Ch B = Std. case absolute vibration (AV to D) or Std. case absolute vibration (V to D)
Speed (0/1)	If Speed input is Enabled	Any
Factored Speed (0/1)		
Speed maximum (0/1)		
Speed Rate of Change (0/1)		
Axial Differential Expansion, Channel Pair 0/1, 2/3	Static	Ch A = Complementary Differential Expansion A Ch B = Complementary Differential Expansion B
Ramp Differential Expansion, Channel Pair 0/1, 2/3	Static	Ch A = Ramp Differential Expansion A Ch B = Ramp Differential Expansion B
Rod Drop 0…3	Static	Rod Drop

Measurement Alarms provide the usual >, ≥, ≤ and < comparison checks between a measured value, such as “Channel 1 Overall”, and a set of Danger and Alert level limits.

Alarm Measurement Definition

Each Measurement Alarm can be uniquely defined to compare any of the measured values in the module. The measurement is not necessary in the controller input assembly. (See Select Input Data for Input Tag on page 98) However, the module must be configured to perform the measurement before it can be selected as input to a Measurement Alarm.

Alarm Limit Definition

Each measurement alarm can be uniquely defined to apply limits that are either entered as static values that are part of the measurement alarm definition, or are passed to the module as I/O in the controller output table.

Static Alarm Limits

Limits for high and low alert and danger levels can be entered. When used, the module compares the measured value with the limits each time the measurement is updated. The limits can also be multiplied, either by a set limit multiplier or by any of up to 5 'Adaptive Multipliers'.

Limit Multiplier

Typically an alarm limit multiplier is used for alarms that are applied to machines that operate above their first critical (natural) frequency. During startup, these machines experience vibration excursions that can exceed the (normal) alarm limits, as the speed of the machine traverses the critical frequency. Without applying this multiplier, the vibration levels can exceed danger setpoints, which can force a machine trip, during a normal machine startup.

Control of the limit multiplier (on/off) is provided through the set point multiplier (SPM) function. A bit on the controller output assembly or by a physical input (switch) to the module manages the SPM. SPM is defined as part of any voted alarm definition that uses the measurement alarm (See Voted Alarms Page on page 179).

Adaptive Multipliers

The five adaptive multipliers are alternatives to the single SPM- managed static limit multiplier. Adaptive multipliers enable a method for the automatic application of an alarm limit multiplier that is based on a measured attribute (such as speed). When using adaptive multipliers, each of the multipliers is associated with a range of whatever the control parameter is. If the value of the control parameter is outside of the specified ranges, such that no multiplier is applicable, then a multiplier of 1.0 is used.

Output Tag Limits

A third alternative to how limits are defined is to use output tag limits. When enabled on the select data to be added to the output tag page, in module definition, 16 values (REALs) are included in the controller output assembly for use as alarm limits. When output tag limits is selected as the alarm limits source the high/low, danger/alert limits are mapped to selected output tag locations.

When in this mode the module applies the alarm limits as read from the controller output tag. This mode then enables programmatic control of the limits from the Logix controller, which provides a far more powerful alarm management capability.

When output tag limits are applied, the limits read from the output assembly are used directly and never multiplied.

Profile Alarms

In addition to being able to manage alarms similarly to the included static limits with multipliers solutions (if programmed to do that), the output tag limits solution offers an ability to apply profile alarms.

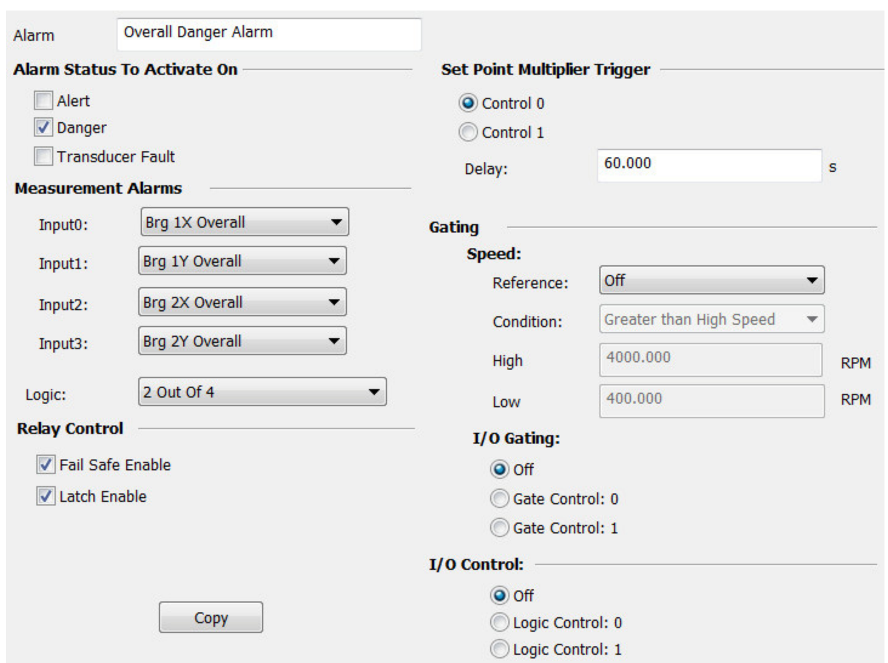
Profile alarms are used for applications where a machine performs a fixed, repetitive cycle over a defined time period or range of another control parameter. A profile alarm likely requires many limits with each correlated to a specific time, or range of the control parameter, during the cycle to create a moving envelope or 'profile' of the expected behavior of the measurement. The controller then loads the appropriate limits to the output assembly depending on where the machine is in the cycle. Then the controller observes the input assembly status information to determine status.

In these cases, the module detects and acts or notifies as appropriate when the measured value falls outside the expected envelope, or profile.

Profile Alarms can be useful in any application where the measurement (vibration, strain, dynamic pressure) varies normally, and often significantly, through a repeating process. Typical of these are machine tools and other non-continuous cutting applications, robotic, or other cyclic motion applications.

Voted Alarms Page

Voted Alarms are where Measurement Alarms are applied. They provide a means to assure that a condition warrants an intended action.



The module provides 13 voted alarms.

As with any alarm a voted alarm is configured with specific inputs and logic that assesses to a simple true/false (1/0) condition.

Table 34 - Voted Alarms

Parameter Name	Values	Comments
Alarm Name	Characters	Enter an up to 32 character name. There are no rules for the names content or uniqueness. However, the name is used when selecting Voted Alarms as input to other functions, such as Relay definitions, so unique names are recommended. Additionally the name: • Must start with a letter or underscore ("_") • Must consist of letters, numbers, or underscores • Cannot contain two contiguous underscore characters • Cannot end in an underscore
Alarm Status to Activate On – Alert	Checked (1) / Unchecked (0)	Check if Measurement Alarms with a status of Alert are evaluated as TRUE when used as inputs to this Voted Alarm.
Alarm Status to Activate On – Danger	Checked (1) / Unchecked (0)	Check if Measurement Alarms with a status of Danger are evaluated as TRUE when used as inputs to this Voted Alarm.
Alarm Status to Activate On – Transducer Fault	Checked (1) / Unchecked (0)	Check if Measurement Alarms with a status of Transducer Fault are evaluated as TRUE when used as inputs to this Voted Alarm.
Measurement Alarm – Input 0	All enabled Measurement Alarms	Select the Measurement Alarm to use in Instance 0 of the Voted Alarm logic.
Measurement Alarm – Input 1	All enabled Measurement Alarms, except the Measurement Alarm that is selected for Input 0	Select the Measurement Alarm to use in Instance 1 of the Voted Alarm logic.
Measurement Alarm – Input 2	All enabled Measurement Alarms, except the Measurement Alarms selected for Inputs 0 and 1	Select the Measurement Alarm to use in Instance 2 of the Voted Alarm logic.
Measurement Alarm – Input 3	All enabled Measurement Alarms, except the Measurement Alarms selected for Inputs 0, 1 and 2	Select the Measurement Alarm to use in Instance 3 of the Voted Alarm logic.
Logic	Select from: 1 Out Of 1 | 1 Out Of 4 1 Out Of 2 | 2 Out Of 4 2 Out Of 2 | 3 Out Of 4 1 Out Of 3 | 4 Out Of 4 2 Out Of 3 | 1 Out Of 2 AND 1 Out Of 2 3 Out Of 3 | 2 Out Of 2 OR 2 Out Of 2 | 1 Out Of 2 AND 2 Out Of 2 | 2 Out Of 2 AND 1 Out Of 2 The Logic control uses the form "A out of B". In all cases, the number "B" refers to the first B entries in the Measurement Alarm Input list.	For the Voted Alarm to evaluate to TRUE the requisite number of its inputs, per this Logic definition, must have a status of any of the types that are enabled per Alarm Status to Activate On.
Set Point Multiplier Trigger – Control 0/1	Select Control 0 or 1	Select Control 0 to use Controller Output Control Tag SPM 0 to manage the Set Point Multiplier function. Select Control 1 to use Controller Output Control Tag to manage the Set Point Multiplier function. **Note:** To use Logic (Discrete) Inputs, the specific input must also be defined to apply to the SPM function (See Hardware Configuration Page on page 105).

Table 34 - Voted Alarms

Parameter Name	Values	Comments
Set Point Multiplier Trigger – Delay	0.000…65.500 seconds	The time that the alarm (threshold) multiplier is applied after the control is toggled The SPM control, either a physical switch or the specified bit on controller output, starts (or restarts) the TIMER each time the control toggles. A toggle occurs when the state changes, such as when the control changes from OFF/UNSET to ON/SET, or ON/SET to OFF/UNSET.
Gating Speed – Reference	Select from: • Off • Speed 0 • Speed 1 • Factored Speed 0 • Factored Speed 1 Speed 0/1 is presented only if defined and Factored Speed 0/1 is presented only if the factor value is >0 (see Speed page).	Select the speed source to use as the reference in speed gating of this Voted Alarm.
Gating Speed – Condition	Select from: • Greater Than High Speed • Less than Low Speed • Inside Window • Outside Window	Select the condition to apply in the speed gating logic.
Gating Speed – High Limit	>0	The high-speed threshold.
Gating Speed – Low Limit	>0	The low speed threshold. Must be less than the High-Speed limit.
I/O Gating – Gate Control	Select Gate Control 0 or Gate Control 1	I/O gating enables a control input to be used to manage enabling (control set) and disabling (control unset) the Voted Alarm. Control inputs include the Control tag of the controller output (control 0 = bit 5, control 1 = bit 6), or either of the discrete inputs if appropriately assigned (See Hardware Configuration Page on page 105).

Table 34 - Voted Alarms

<table>
<tr><th>Parameter Name</th><th>Values</th><th>Comments</th></tr>
<tr><td>I/O Control</td><td>Select Control 0 or Control 1</td><td>I/O control enables a control input to be used to manage activating a voted alarm, regardless of other definition and the state of any defined measurement alarm inputs.
If defined, when the selected I/O control bit is set, the voted alarm actuates. The capability can provide either of:
• A means to test the relay / output behavior of the voted alarm without having to satisfy the defined alarm conditions.
• A means to use the controller to manage associated relays directly. In this condition, the remainder of the voted alarm definition is inconsequential as it is used only to map relays for direct controller management.
Control inputs include the Control tags of the controller output (bits 5 and 6), or either of the discrete inputs if appropriately assigned (See Hardware Configuration Page on page 105).</td></tr>
<tr><td>Relay Control – Fail-Safe Enable</td><td>Checked (1) / Unchecked (0)</td><td>Check to enable Fail-Safe for any relay that is assigned to this Voted Alarm.
<table>
<tr><td rowspan="2">Fail-Safe Behavior</td><td colspan="2">Relay Coil Status</td></tr>
<tr><td>In Alarm</td><td>Not in Alarm</td></tr>
<tr><td>Non-Fail-Safe</td><td>energized</td><td>de-energized</td></tr>
<tr><td>Fail-Safe</td><td>de-energized</td><td>energized</td></tr>
</table>
Fail-Safe is applicable only to physical relays that are assigned to the Voted Alarm.
The intent of Fail-Safe is to help ensure that if a loss of power occurs to the relay such that it fails in a ‘safe’ state, which is generally the same as the Alarm state.</td></tr>
<tr><td>Relay Control – Latch Enable</td><td>Checked (1) / Unchecked (0)</td><td>Check to enable Latching on this Voted Alarm.
Latching is applied to the Voted Alarm and is extended to any relays that are assigned to the alarm.
A latched Voted Alarm (and associated relay) can be reset, after the alarm condition has cleared, by setting the AlarmReset bit (bit 7) in the controller output’s Control tag, or if a discrete input is assigned this function (See Hardware Configuration Page on page 105) then by signaling that input.</td></tr>
</table>

Inputs

There are two elements to the inputs of a voted alarm including the measurement alarm status and a list of measurement alarms. The status definition provides the specific conditions that this voted alarm acts on; alert and/or danger and/or transducer fault. The other input is a list of up to four enabled measurement alarms to use as input to the voting logic (For example, 1 out of 2, 3 out of 4).

Logic

Logic is the “A out of B” voting that is applied to the inputs. Selections are provided which support various combinations of four inputs and include:

Logic	
1 Out Of 1	1 Out Of 4
1 Out Of 2	2 Out Of 4
2 Out Of 2	3 Out Of 4
1 Out Of 3	4 Out Of 4
2 Out Of 3	1 Out Of 2 AND 1 Out Of 2
3 Out Of 3	2 Out Of 2 OR 2 Out Of 2
	1 Out Of 2 AND 2 Out Of 2
	2 Out Of 2 AND 1 Out Of 2

For the AND and/OR combinations the inputs are grouped in the order entered, that is, inputs 0 and 1 for the BEFORE the AND/OR statement logic and inputs 2 and 3 for the AFTER the AND/OR statement logic.

For a vote to resolve to TRUE (1) the logic must be satisfied with inputs that are all in the same condition, and as defined for the voted alarm (alert/danger/fault).

In addition to defining the condition and inputs for the logical assessment, voted alarms enable definition of several control attributes. These include managing set point multiplication, gating controls, and relay controls.

Set Point Multiplication

SPM enables application of the limit multiplier to any measurement alarms that are linked to the voted alarm, where the measurement alarm is applying only static limits. SPM control includes two items: the input to use and any delay required.

SPM Control Input

The SPM function can be controlled from either of two inputs. These inputs can be either the SPM bits included in the controller output assembly (bits 1 and 2), or either of the physical discrete inputs to the module (Pt0, Pt1) that can be assigned to this function (See Hardware Configuration Page on page 105). The selection lets either controller output tag SPM 0/Pt0 or controller output tag SPM 1/Pt1 be used.

A second attribute, delay time, is also provided for SPM control. This value is used to define how long the SPM function remains active AFTER the SPM control has changed state. The timer starts (or restarts) each time the output assembly control bit, SetPointMultiplier0En/ SetPointMultiplier0En, is set or cleared or, if using the digital inputs, each time Pt(0) / Pt(1) is closed or opened. This behavior is intended to force continued positive assertion of the function, which precludes users inadvertently leaving the SPM function enabled.

As an alternative to the timer the module provides speed based multiplication, see Adaptive Multipliers under Measurement Alarms.

Gating

Gating is used to specify when a voted alarm is applied. While the gate condition is TRUE, the Voted Alarm is evaluated. If the gate condition is FALSE, the voted alarm is not evaluated.

> Because satisfying any defined gate condition is a prerequisite to the voted alarm, if the voted alarm is TRUE when the gate condition becomes FALSE, then the voted alarm transitions to FALSE, unless latched. See Latching on page 185. And, unless latched, any relays that are assigned to the voted alarm also transition.

The module provides two methods of gating: speed and I/O (Logic) gate control.

Speed gating lets you select either of the two speed inputs, either the direct or factored speed value, a high and/or low speed limit, and the customary conditional (<, ≤, ≥, >). The gate is TRUE and the voted alarm that is applied when the measured speed satisfies the condition (evaluates to TRUE).

For I/O (Logic) gate control, the control signal can be provided either from the controller, via its control output tag, or from either of the discrete inputs when properly assigned (See Hardware Configuration Page on page 105).

For controller-based gate management, 2 bits are provided in the controller output's control tag (bits 5 and 6). Either control (0/1) can be specified for each voted alarm. When the control bit is set (1), then the gate is TRUE and the voted alarm is evaluated.

Gating can also be controlled by use of either of the discrete inputs. The assigned discrete input must be configured on the hardware configuration page, and must also be selected (0/1) in the specific voted alarm definition.

Relay Control

When a relay is assigned a voted alarm as its input, it inherits the voted alarm latching and fail-safe definitions.

Latching

Latching applies to both the (logical) voted alarm and to any associated physical relay. When an alarm is latched it does not reset until the condition has cleared (is no longer in the alarm state), and (then) the reset command is been signaled.

There are four methods available to reset a voted alarm, and all relays that reference it:

- Controller output: 2 bits are included in the control tag of the controller output.
- Discrete Inputs: Either of the two discrete inputs can be assigned to reset alarms (See Hardware Configuration Page on page 105).
- Either of two alarm reset service requests can be sent to the module.
- The AOP status page, which executes the service request.

Each voted alarm includes a control selection that defines which of the two inputs (of any of the above types) is used to reset the alarm. In this way, it is possible to define a more discrete control over which voted alarms are reset on command.

Fail-Safe

The voted alarm fail-safe definition is not used by the voted alarm (logic). Rather it is inherited by any relays that reference the alarm (See Relay Page on page 165).

When defined as fail-safe the coil of the relay is energized when not in an alarm condition, and de-energized when it is in the alarm condition. This means that if the module fails as the result of or due to a loss of power to the relay that the relay moves to its alarm position. This is presumably its “safe” condition.

Relays

Relays are the final element of the 1444 series Alarm management System. While the voted alarm can act as a “virtual relay” it cannot switch off power to a motor, route power to a light or other annunciator, or control a solenoid valve that can trip a turbine. Also, in applications that require SIL or API-670 compliance, relays are the only approved interface between the monitor system and the emergency shutdown system or final actor when used to initiate a forced shutdown.

See Relay Page on page 165 for an overview on using relays in the 1444 series system.

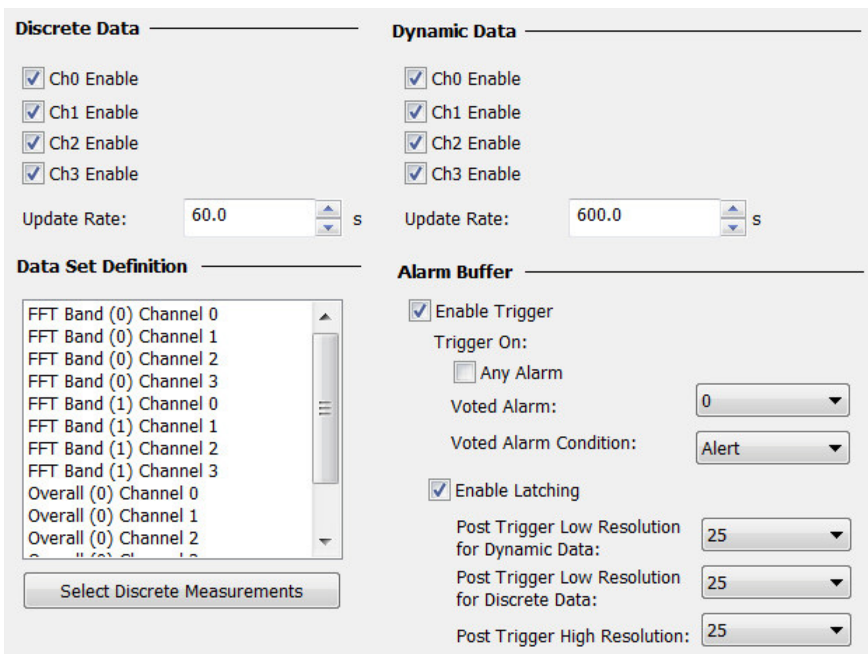
Trend and Transient Capture

This chapter explains trends and transient capture.

Trend Page

Page Overview

The dynamic measurement module includes a trend buffer capability that captures a set of internal data records that are sampled at a defined periodicity and that span a defined amount of time. The module also supports an Alarm Buffer, a copy of the trend buffer, with additional high-resolution data at the trigger point, which is saved and held upon a user-defined trigger.



The Trend Page is used to configure both the Trend and the Alarm Capture functions.

Discrete Data Buffers

The trend definition includes selections that are associated with discrete and dynamic data.

Dynamic data refers to time waveforms and FFT. Discrete data are any single value data, including DC measurements, speeds, and values that are processed from a dynamic signal such as overall or 1x magnitude.

The module updates data to the discrete buffer at two different rates:

- High Resolution

  In the background, the module continually samples the data at a fast update rate of approximately 100 milliseconds. A total of 320 records are retained sampled at this rate.

  The update rate can vary, from the defined 100 milliseconds, as higher priority processor demands take precedence. This can occur as routine functions, dependent on configuration, or as a consequence of circumstance: any higher priority immediate processing demands such as an action taken on alarm or a host data request.

- Low Resolution

  At a user specified timer, in multiples of 100 milliseconds, the module retains a record for its long term (low resolution) buffer.

  Low-Resolution samples are updated independent of the High-Resolution data. Therefore, even if the timers were to trigger at the same millisecond, the measurements read to the two buffers can be different. This is because the measurement tasks of the module execute at a higher priority than buffer management.

Trend Buffer

The trend buffer is composed of 640 records that are sampled at the low-resolution rate and that overwrite in a circular, first-in-first-out manner. The buffer updates continuously when the module is in RUN mode.

Dynamic Buffer

In addition to the discrete measurement buffer, the trend function can also hold a buffer of dynamic data records. The dynamic data buffer is composed of 64 records, each containing a time waveform and/or FFT for each channel, as defined on the FFT page.

Dynamic data records are sampled in the same manner as the Low-Resolution discrete data, by using its own 100 millisecond multiplier. However, regardless of the multiplier setting, how fast dynamic data updates depends on module performance, which is a function of module configuration and circumstances.

IMPORTANT The discrete data is not processed from the same TWF or FFT that is captured in the dynamic data buffer.

- FFT derived measurements (FFT Bands) are processed from an independent FFT that is calculated by the module's DSP specifically for that purpose (See Bands on page 139). This is another FFT than the one defined on the FFT page and calculated in the modules microprocessor.
- Non-FFT derived measurements, such as Overall, 1x magnitude, DC values are processed from the data stream, with possible different filtering, sampling, or integration selections (See Filters on page 118), so also do not necessarily correlate with the captured TWF or FFT.

Alarm Buffer

The alarm buffer consists of a copy of the trend buffer's 640 discrete and 64 dynamic records that are sampled at their user specified rates. Also there is a second "high resolution" 320 record discrete buffer that is sampled at a fixed 100 millisecond update rate.

For each of the data sets, the low and high-resolution discrete buffers and the dynamic data buffer, independent definition of how much of the buffer to capture post trigger is provided. This lets any portion of the 640, 320 and 64 record buffers be updated after the trigger.

Triggering the Alarm Buffer

The alarm buffer "triggers" on an event that can be any of:

- Voted Alarm

  This is the 'normal' method. You can select any unique alarm and the alarm status: alert, danger, or fault (See Voted Alarms Page on page 179).

- Any Voted Alarm

  When defined, this triggers alarm buffer capture when any voted alarm actuates. This is regardless of the status so could be alert, danger, or fault.

- Controller Output Tag

  Regardless of the trigger on selection, the alarm buffer always triggers when the AlarmBufferTrigger, bit 8 of the control tag, in the controller output assembly is set.

- Service Request

  Regardless of the trigger on selection, the alarm buffer always triggers upon receipt of the dynamix data manager object alarm buffer trigger service.

Latch the Alarm Buffer

A latch capability is provided for the alarm buffer. When the latch is enabled, once triggered and saved, the alarm buffer does not update on subsequent trigger events until the latch has been reset.

Reset the Alarm Buffer

Reset a buffer, whether it is latched or not, as a way to determine when new data is available.

A latched alarm buffer is reset by either of the following:

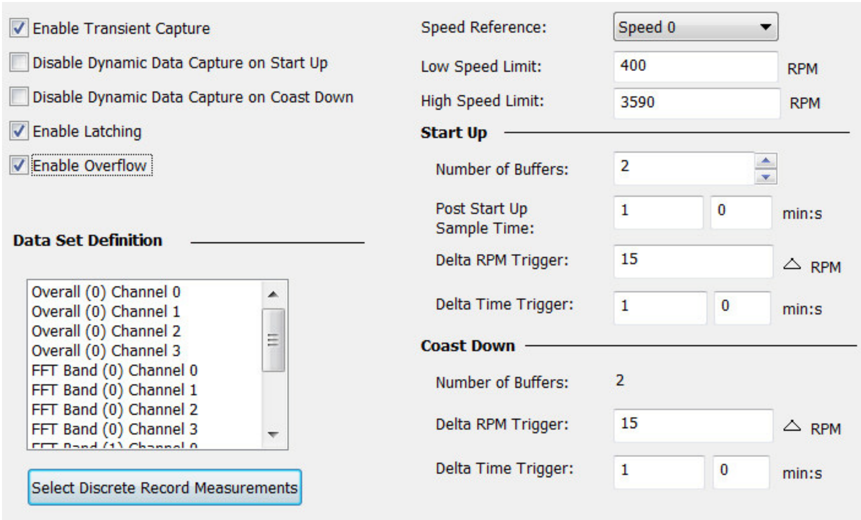
- Set the AlarmBufferReset bit (bit 9) of the controller output assembly control tag.
- Send the reset service to the dynamix data manager object 3

When a buffer is reset, even if it is not configured to latch, the status is set to 'Armed' and with 'Zero Stored Records'.

ATTENTION: After an alarm buffer is reset, any existing stored data is no longer available.

Transient Capture Page

Page Overview



The transient capture page enables definition of the modules transient data management facility. The capabilities that are provided are intended to help ensure the capture of critical data necessary to diagnose machine condition during its run up (start) and run down (stop) events. The capabilities are designed to help ensure this regardless of whether; the event is scheduled or occurs unexpectedly, is a long or short duration event, or if the machine's acceleration/deceleration is fast, slow, or varying.

Observing, comparing, and diagnosing the behavior of machines, as their speed changes often, provides unique insight into the condition of the machine that is impossible to obtain during its normal operating, constant speed, state. When the speed of a machine changes the dynamic forces that are applied to its bearings and structure change, both in magnitude and in frequency. Non-dynamic forces also change; thermal growth/contraction as the machine heats up or cools down, bearing loading as the machines load is increased or shed, condenser vacuum pressure changes impart forces. These, and other start up/coast down-specific changes, can help find otherwise unknown faults and conditions before the fault propagates.

The controls on this page are active only when at least one speed input is enabled (See Speed Page on page 115).

Buffers

The dynamic measurement module implements transient data capture by the application of four configurable buffers where each buffer:

- Contains 640 discrete data records and 64 dynamic data records

The structure (content) of the discrete data record is user-defined and can contain any measured values, such as speed, 1x magnitude, bias, overall, and many others from any channel.

The dynamic record content can include a time waveform and/or an FFT that are processed from any enabled data source (See Filters on page 118 and Bands on page 139).

- Can be allocated to hold either start up or coast down data.
- A buffer can contain data from only one transient event.

Overflow

When overflow is enabled, if a buffer is filled before a transient is concluded, then the data acquisition moves to the next available (not latched) buffer of the same type. This effectively enables definition of:

- One start up or coast down buffer with 2560 discrete and 256 dynamic records.
- One start up and one coast down buffer each with 1280 discrete and 128 dynamic records.
- One start up or coast down buffer with the standard 640 discrete and 64 dynamic records, and one coast down or start up buffer with 1920 discrete and 192 dynamic records.

Initiating a Transient Event

When a transient event is initiated, by the referenced speed crossing below the high or above the low speed thresholds, transient data acquisition is begun to the first available buffer of the applicable type (start up or coast down) that is not latched.

Dynamic Data

To include TWF and FFT data with the transient data, enable the measurements on each channels FFT Page. The FFT and TWF saved will be as defined on the FFT Pages but with a maximum TWF size of 2048 points and a maximum FFT size of 800 lines.

Sampling During a Transient Event

During a transient event, while the reference speed remains between the low and high-speed thresholds, the executing buffer updates at prescribed delta RPM* and delta time triggers. In the case of start ups, delta RPM updates trigger only in the increasing speed direction while for coast downs delta RPM updates trigger in either increasing or decreasing speed directions.

- Independent delta RPM and delta time triggers can be defined for startup and coast down.
- If the delta RPM is set to 0, then no samples are taken on speed change.
- The delta RPM triggers can be set from 1…1000 RPM, or 0 if disabled, and the delta time triggers from 1…65,535 seconds (about 18 hours).
- A discrete data record is saved on each trigger.
- A dynamic data record is captured on every tenth (10^{th}) trigger, considering both delta RPM and delta TIME triggers.

*The module evaluates speed at 96 millisecond intervals. Consequently measurements may not be captured at precisely the specified delta RPM.

Concluding a Transient Event

A start-up transient concludes when the referenced speed crosses above the high-speed threshold. If during the startup the speed falls below the low threshold, then the transient is suspended, so sampling stops.

A coast down transient concludes when the referenced speed falls below the low speed threshold. If during the coast down the speed crosses above the high threshold, then the transient is suspended, so sampling stops.

If sampling stops due to a suspended start-up or coastdown, then the data from the event is retained anyway if at least 20% of the discrete data records have been collected. If less than 20% of the data was collected, then the event data is discarded.

Latching

If latching is enabled, then a buffer latches once it has been filled, so has no remaining empty records. A latched buffer is not available for update until it is reset.

In the event a transient event occurs when no buffers are available, the data manager functions as if a buffer were available, triggering samples and monitoring status, but no data is stored.

A transient buffer latch is reset by any of the following:

- Controller Output: The TransientBufferxReset bit (bits 10…13) of the controller output assembly's control tag, where x is the number of the buffer (0…3).
- Dynamix transient data manager object service
- Uploading the transient Buffer

The data manager automatically resets a buffer after it has been uploaded to a host.

Notes:

Operate the Module

This chapter describes the reset types the module offers.

Resetting the Module

Supported Reset Types

The module supports three forms of resets including types 0, 1 and 2.

Reset Type Methods	Hardware	Remote Reset Service (Code 5)
		Remote Reset not allowed while a class 1 connection is active, or if the class 1 connection was closed abnormally.
		Send data value
Common Reset (0) Out of Box Reset (1) Hard Reset (2)	Power cycle Power cycle with 888 address N/A	0 (or blank) 1 2

Type 0: Common Reset

A common reset deletes all trend, alarm, and transient data, and wipes the executing configuration and the ID of its host controller. After reset, the module loads the configuration that is stored in nonvolatile memory and restarts monitoring.

A common reset does not delete data in nonvolatile memory, which includes its saved configuration, the module event log and its connection information, including any saved IP address.

A type 0 common reset is executed by sending a type 0 reset service or by cycling module power.

Because a module immediately loads its configuration from nonvolatile memory and begins monitoring, a module does not persist in its common reset state.

Type 1: Out of Box Reset

An out of box reset deletes all trend, alarm, and transient data, and wipes the executing configuration and the ID of its host controller. It also deletes any saved configuration from nonvolatile memory.

An out of box reset also deletes the connection information of the module, including any IP address saved in memory.

A type 1 out of box reset is executed by sending a type 1 reset service or by powering up the module with its terminal base IP address set to “888”.

A module persists in its out-of-box reset state until a configuration has been downloaded to the module. Until a valid configuration is received, the module operates in its default out of box configuration (a basic voltmeter with no defined measurements, alarms, or any configured output).

Type 2: Hard Reset

A hard reset deletes all trend, alarm, and transient data, and wipes the executing configuration and the ID of its host controller.

A hard reset does not delete the module connection information, including any saved IP address or the saved configuration.

A type 2 hard reset is executed by sending a type 2 reset service.

Because a module immediately loads its configuration from nonvolatile memory and begins monitoring, a module does not persist in its hard reset state.

Reset Procedures

The following table summarizes the information that is held in the volatile and nonvolatile memories, and indicates what each type of reset deletes.

Delete on Reset	Common (Type 0)	Out of Box (Type 1)	Hard Reset (Type 2)
Trend and Transient Data Alarm Trend Data Host Controller ID Executing Configuration	Yes		
Saved Configuration Connection Information	No	Yes	
Event Log	No		

Hardware Type 0 Common Reset

To perform a type 0 common reset:

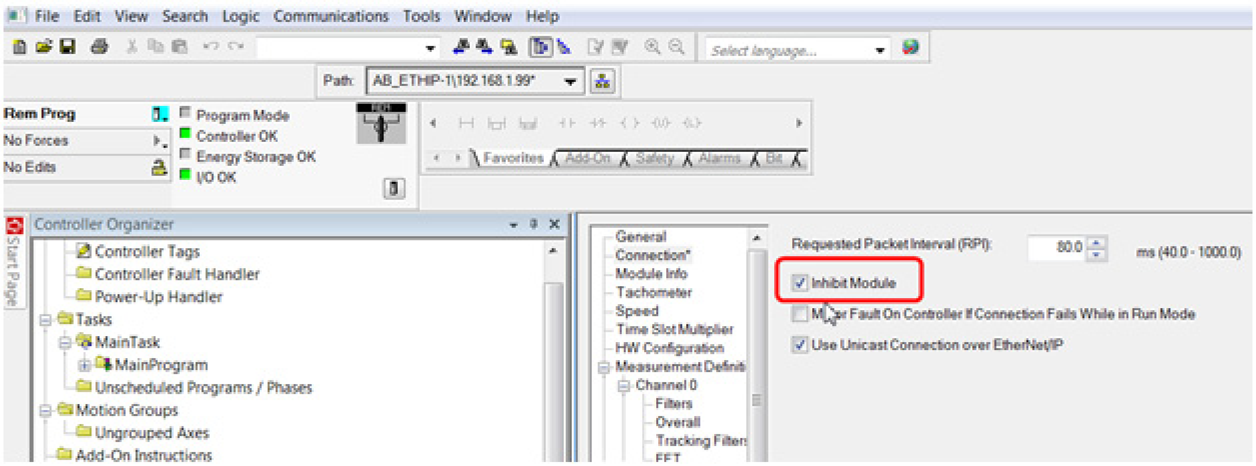
5. Disconnect power from the module.
6. Wait at least 2 seconds.
7. Restore power to the module.

The module powers up and connects to the network that uses the connection information previously established. After completing its self-test procedure, the module loads the configuration that is saved in nonvolatile memory and begins monitoring.

Hardware Type 1 Out of Box Reset

To perform a type 1 out-of-box reset:

1. In Studio 5000 Logix Designer, go to the connection page of the module properties and inhibit the module.



2. Remove the module from its base.

ATTENTION: Removing a module from its base while powered (hot swap) is not allowed when operating in a hazardous area.

---

3. Note the current setting of the IP address switches.
4. Set the IP address switches to '888'.
5. Replace the module and let it power up.
6. Wait until Status Indicator behavior stabilizes.

   The module is not able to communicate over Ethernet.
7. Remove the module from its base.
8. Set the IP address switches to their original setting.
9. Replace the module and let it power up.

The module is now in its out of box reset state. Un-inhibiting the module forces a connection to be re-established and a configuration downloaded, after which it is no longer be in its out of box reset state.

Command Type 0, 1 or 2 Reset

The identity object of the module includes a 'reset' service that can be used to execute any type reset.

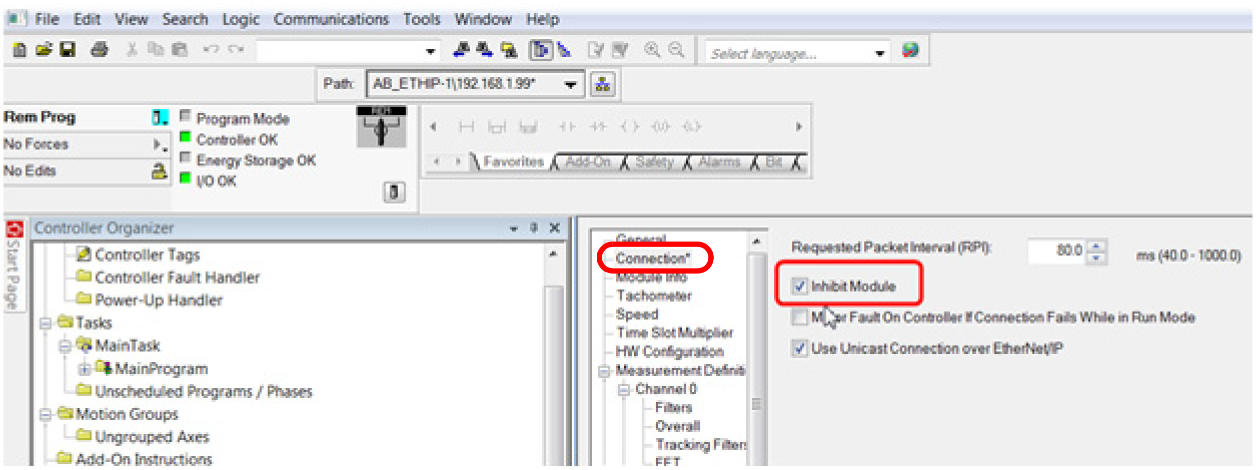
Follow this procedure to execute a reset service.

1. Set the compliance requirement to "none".

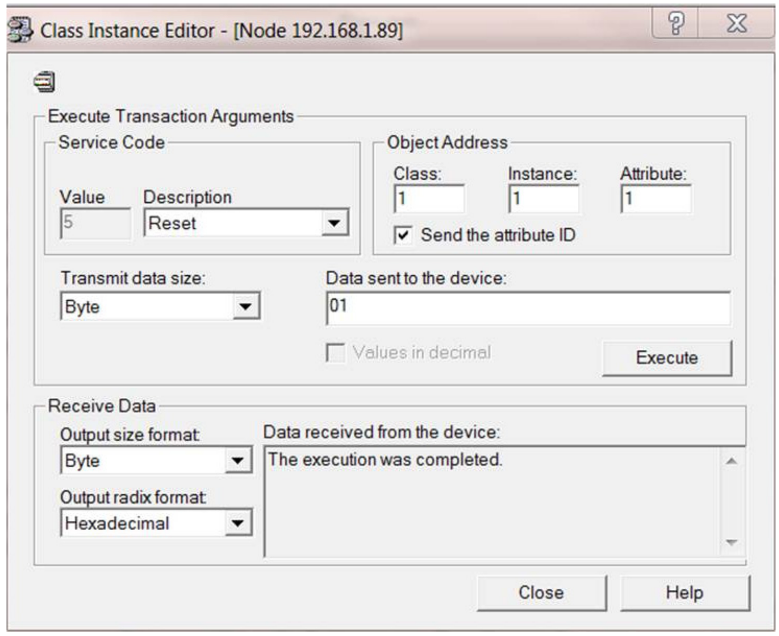
   If the compliance requirement is not "none", then the configuration needs modified as the module does not accept a reset service when configured with a compliance requirement greater than 'none'.

   See Define Module Functionality Page on page 92 for more information on setting the compliance requirement.

2. In Studio 5000 Logix Designer, select connection and check inhibit module.



3. Execute the reset service.



Sending a type 1 reset service using the class instance editor of RSNetWorx for EtherNet/IP to a Dynamix module at address 192.168.1.89. If the "data sent to the device:" is blank (default) a type 0 common reset is sent.

4. When ready, re-establish the connection by un-inhibiting the module.

When the connection is reestablished, the controller updates the module with the current configuration.

IMPORTANT	If the compliance mode of the module is reduced to facilitate remote reset, then reset the compliance requirement before restoring the module to normal operation.

Updating Module Firmware

Use ControlFLASH to update the firmware in the 1444 series main module and any connected expansion modules.

The firmware for 1444 series expansion modules is included in the update that is provided for the 1444-DYN04-01RA dynamic measurement module. When the main module is updated, the process also automatically updates the firmware in any connected expansion modules.

To update the firmware in a Dynamix 1444 Series (main) module, follow these steps:

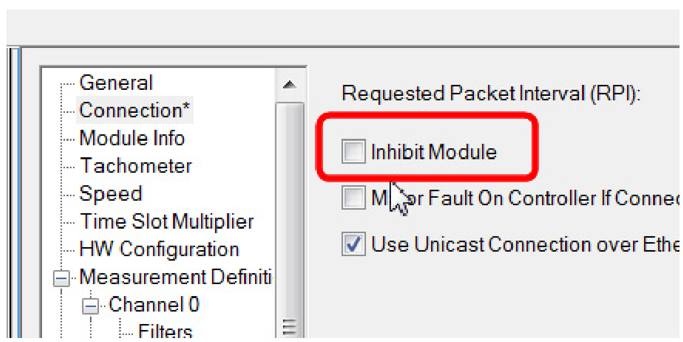
1. Place the module into either its out of box (Type 1) or Hard (Type 2) reset state per the procedures in Resetting the Module on page 197.

   The module accepts a command to update its firmware only when in a reset state. Do not re-establish a connection to the module from the controller once it has been reset.

2. Make sure that the module is inhibited and does not have any established connections.

3. Update the firmware using ControlFlash.

4. From Studio 5000 Logix Designer, from the connection page of the module properties, clear the inhibit module checkbox to uninhibit the module.



When the module is uninhibited the controller establishes a connection to the module and downloads its configuration.

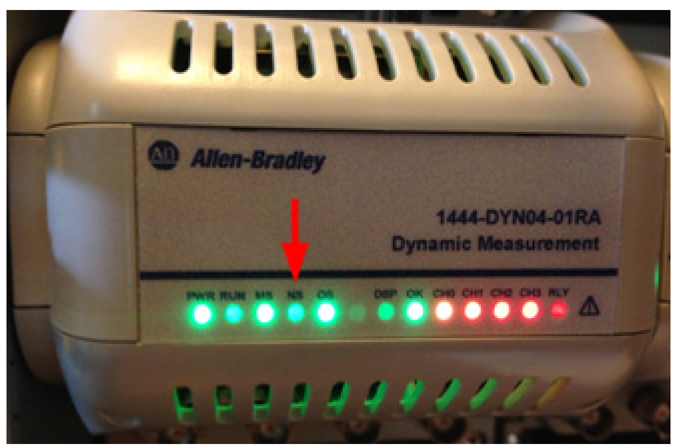
Managing GET and SET Service Access

Accessing data and managing module configuration requires the initiating device to communicate SET and GET commands to the various objects as defined in the CIP Objects Library. However, while GET commands are allowed from any device, for security reasons the module places restrictions on the use of SET commands.

SET

SET service commands are used to change the module configuration. As changing the configuration can pose a security risk, the module does not accept a SET command from any device other than the controller with which the module has established a (CIP transport) class 1 connection, even if that device is not accessible:

- When a class 1 connection is established, the module remembers the ID of the connected controller. Class 3 connections include the ID of the host device that is sending the command. If the ID’s do not match, the module compares the ID communicated with the Class 3 connection request to that of its host controller, and disallows the connection.
- If the module does not have an open class 1 connection, following a reset or if the host normally closed its connection. Then, the module does not hold a host ID and accepts class 3 connection SET commands from any device.
- While not unique to a class 1 connection, the connection status of the module is indicated by its Network Status (NS) Indicator.



IMPORTANT	If the host controller of the module fails such that the connection closes unexpectedly, the module cannot be configured until that same controller is restored or until the module has been power cycled (type 0 or 1 reset).

GET Services

GET service commands, which use a (CIP transport) class 3 connection, are allowed from any device.

A maximum of three class 3 connections, other than one from its host controller, can be connected at any one time. This is the limit to the number of devices that can simultaneously access data from the module, in addition to its host controller.

Managing Nonvolatile Memory Configuration

The Dynamix 1444 Series main module maintains a copy of its valid, executing configuration in its nonvolatile memory. At power-up, if a valid configuration is held in this memory, it is loaded and executed. This assures that on power cycle that the module immediately begins functioning as required, even if communication to its host controller are not available.

The following sections describe the processes in saving a configuration to the nonvolatile memory of the module, and deleting the configuration from the memory.

Saving a Configuration to Nonvolatile Memory

The communication of a configuration to the module involves several steps.

- Communicate the data

  Using the SET Service of the modules configuration manager object, the remote device sends the necessary configuration data.

  During the transmission if an error is detected the module aborts the process.

- Evaluate Attributes

  Upon receipt of configuration data the module evaluates each attribute concerning its allowed range. If any attribute is not within its allowed range, the module transmits a failure message.

- Apply the configuration

  Once the configuration is communicated successfully, the host device sends an Apply message to command the module to implement the changes.

  When an apply service is received, the module further evaluates the data to detect dependency errors – violations of limitations to parameters due to their dependency on other parameter settings.

  If an error occurs in values of dependent parameters, the apply service responds with a failure.

  If no errors are detected, then the module applies the changes to the executing configuration. It also then saves the updated configuration to nonvolatile memory.

Deleting a Saved Configuration from Nonvolatile Memory

Once a configuration is saved in nonvolatile memory it can only be deleted by executing an out of box (type 1) reset. See Resetting the Module on page 197.

Only one configuration is retained in nonvolatile memory. The saved configuration is automatically updated each time that a valid configuration is applied.

Setting The IP Address

The Dynamix 1444 Series supports both static and automatic IP Address Configuration.

IMPORTANT	When a static IP is used, the address is fixed to the terminal base. But when automatic, the address is held in the module itself. This distinction drives different behaviors when replacing or moving modules to help troubleshoot a problem or for other reasons.

Static IP Configuration

The main module terminal base (1444-TB-A) includes three switches that set the last octet of the address. See “Configure the main Terminal Base,” page 41, for information on the using the terminal base address switch.

Automatic IP Configuration

Dynamix supports both BOOTP and DHCP methods of setting the module address. To use either of these methods set the three IP address switches to “000”.

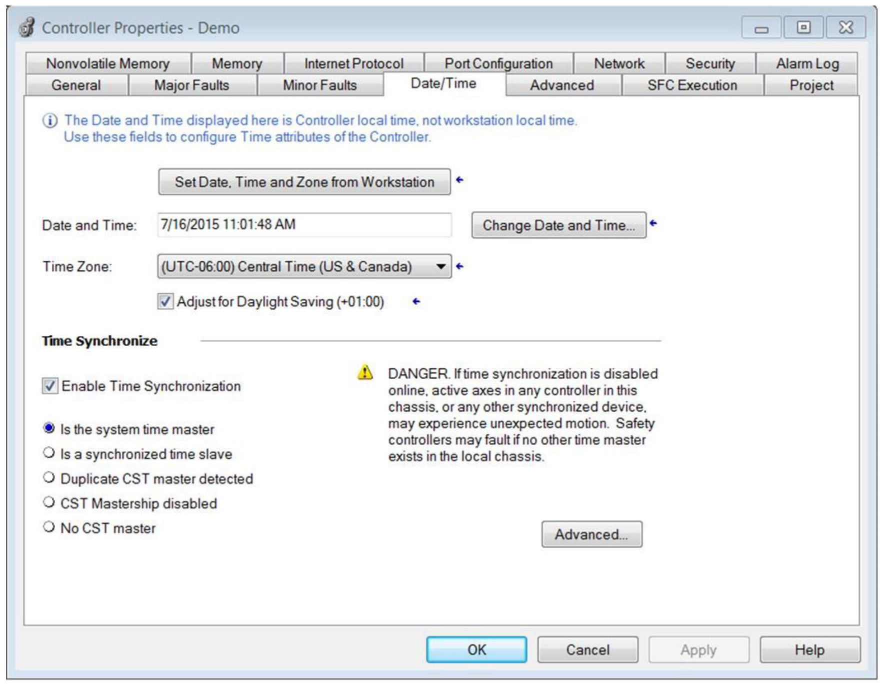
Time Management

The Dynamix 1444 Series modules include an onboard real-time clock*. The clock, which has a maximum drift accuracy of 100 ms per year, maintains time in Coordinated Universal Time** (UTC) format and is set by synchronizing with the controller time using the IEEE-1588 standard version 2 based CIP Sync protocol.

The Dynamix 1444 primarily uses time for captured data. This data includes event log entries, demand data, trend, and alarm trend data and transient data. It also stamps the current time to any “live” FFT and TWF data returned as “live” data by the Normal CM Object. Data returned on the controller’s input assembly are not time-stamped. Consequently, if the module is used only to serve “level” data to the controller or other devices, then managing accurate time is not always required.

While CIP Sync is designed to continuously update (synchronize) time between the controller and the module, continuous synchronization with the controller is not required. Once the time is set in the module, it will retain that time until the next power cycle. Consequently, if communication with the controller are lost, the module continues to manage and report accurate time.

For module time management to operate correctly CIP Sync must be configured in the host controller.



Refer to publication IA-AT003B, "Integrated Architecture and CIP Sync Configuration", for further information on configuring CIP Sync in your controller.

Note: Module Time is a 64-bit integer value in units of microseconds with a power up value of 0 which corresponds to an epoch of January 1, 1970. Coordinated Universal Time (UTC) The time standard for `civil time', representing time at the Prime Meridian. The time does not include time zone or daylight savings time offsets. Module Time is based on UTC.

Module Inputs

The Dynamix 1444 Series Monitor Systems accepts the following inputs.

1444-DYN04-01RA Dynamic Measurement Module

Eight inputs of three types are provided.

Channel Inputs

Four inputs are provided to connect common dynamic measurement sensors such as eddy current probes, accelerometers, velocimeters, strain, pressure, and other electrically compatible dynamic sensors.

Transducer Fault Detection

Transducer fault detection is based on bias voltage level, and current if the sensors is a powered eddy current probes (see the following).

Bias Level Fault Detection

For most sensors, when operating normally the sensors bias level will be at an expected level that falls within the default bias limits shown in the following table.

Measurement Type		Sensor Type	Default Sensor Power	Default Bias Limits*	
Name	Index			Low Limit	High Limit
absolute vibration (A to A)	84	Accelerometer	+24 V DC, 4 mA	6	18
absolute vibration (A to V)	85	Accelerometer	+24 V DC, 4 mA	6	18
absolute vibration (A to D)	86	Accelerometer	+24 V DC, 4 mA	6	18
18 kHz absolute vibration (A to A)	160	Accelerometer	+24 V DC, 4 mA	6	18
18 kHz absolute vibration (A to V)	161	Accelerometer	+24 V DC, 4 mA	6	18
40 kHz absolute vibration (A to A)	225	Accelerometer	+24 V DC, 4 mA	6	18
40 kHz absolute vibration (A to V)	226	Accelerometer	+24 V DC, 4 mA	6	18
gSE	227	Accelerometer	+24 V DC, 4 mA	6	18
Position	6	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Rod Drop	7	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Eccentricity	79	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
X (shaft relative)	81	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Y (shaft relative)	82	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. A (Axial)	193	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. B (Axial)	194	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. A (Radial)	195	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Comp. Differential Exp. B (Radial)	196	Eddy Current Probe	-24 V DC, 25 mA	-14	-8

Measurement Type		Sensor Type	Default Sensor Power	Default Bias Limits*	
Name	Index			Low Limit	High Limit
Shaft Relative (LH/HP) filtered	198	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
X (shaft relative) - Filtered	77	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Y (shaft relative) - Filtered	78	Eddy Current Probe	-24 V DC, 25 mA	-14	-8
Aero derivative (AV to D)	83	Integrating Accelerometer	+24 V DC, 4 mA	6	18
absolute vibration (AV to V)	87	Integrating Accelerometer	+24 V DC, 4 mA	6	18
absolute vibration (AV to D)	88	Integrating Accelerometer	+24 V DC, 4 mA	6	18
Aero derivative (AV to V)	80	Integrating Accelerometer	+24 V DC, 4 mA	6	18
Dynamic Pressure	93	Pressure Transducer	+24 V DC, 4 mA	-1	1
DC Current	4	Proportional Signal	Off	-1	1
DC Voltage	5	Proportional Signal	Off	-1	1
AC Current	95	Proportional Signal	Off	-1	1
AC Voltage	96	Proportional Signal	Off	-1	1
absolute vibration (V to V)	89	Velocimeter	Off	6	18
absolute vibrations (V to D)	90	Velocimeter	Off	6	18

*Bias levels assume the sensor is powered as shown. If the sensor is not powered as shown, then the observed bias level may be different.

When a sensor fails, the external circuit can go to an open condition. It can also be driven towards zero or the provided source power voltage (typically ±24V), depending on the nature of the fault. For an open condition, the circuit design forces the bias to move rapidly to a 'fault' state. How quickly the bias level transitions to its fault state is dependent on the specified failure mode, the bias level at the time of the fault, and the bias limits entered. It is not possible to assure that for every possible fault mode, limit selection, and signal conditioning solution that the bias transitions past its fault limits within a known time. Consequently it is recommended that alarms be defined with not less than 1 second delay. This delay assures that in the event of a transducer fault that the fault is detected before the alarm is enunciated.

Current Based Fault Detection

For negatively powered eddy current probes (only), the Dynamix 1444 Series includes dedicated hardware to monitor the current being provided to the probe driver and the bias level returned. This feature provides fast detection of supply current that drops below 2 mA or a positive bias voltage being detected. Either or both detections trigger a 'wire-off' state to be declared which is normally then an input to the TX OK state.

Clearing a Fault

When monitoring a wire-off condition, for powered eddy current probes, when a faulted sensor is replaced, or a loose wire is reconnected, measurements that are made on the associated channel can spike as they transition to their normal state. This condition is often exacerbated by momentarily intermittent (on/off) connections as wires are connected and tightened in place.

To prevent further alarms due to these transitory events the module will latch any 'wire-off' state for 30 seconds after the fault condition has cleared before transitioning a faulted transducer to its normal, non-faulted state.

Speed Inputs

Two inputs are provided to accept transistor-transistor logic (TTL) signals. The TTL signals need a clear distinction between 'low' and 'high' values such that a trigger threshold of 2.5V does not falsely trigger on high or low signal level or noise.

These inputs are designed to sample sufficiently fast to satisfy the module speed measurement specifications.

Speed Input Fault Detection

Speed input fault detection is dependent on the type of input provided. The following table lists the each of the supported types of speed input and how the module manages fault detection for each of them.

Source	Fault Detection
Local TTL Tach Input	No fault detection is associated with TTL signal input. However, an associated tachometer status signal, a TTL, can be wired to the associated digital input for the selected speed input. When the local Logic Inputs are being used a described in the proceeding statement, leave open for a Tacho OK state and short he appropriate input to trigger a Tacho Fail condition.
Tach Bus	No fault detection is associated with the TTL signal itself. However, the tachometer signal conditioner module communicates transducer status via additional signal lines on the Local Bus.
I/O Speed	When speed is communicated from the controller, as tags in the controller output assembly, the module reads speed input status from output assembly bits 3 (Speed 0 OK) and 4 (Speed 1 OK). When used, set the Speed OK bit (= 1) for FAULT, or 0 for NORMAL.

Tachometer Signal Condition Input Fault Detection

Transducer fault detection is based on bias voltage level, measured speed or on tachometer signal conditioner module fault as follows:

Fault Detection Method	Description
Bias Fault	Bias level fault detection functions similarly to bias fault detection for the normal channel inputs (see proceeding information).
Speed Fault	Considers the transducer is in fault of the pulse rate (equivalent) is slower or faster than the specified speed.
Module Fault	The Tachometer Signal Conditioner Expansion module detects a module fault.

When a fault is detected it is communicated as simply “Transducer Fault” on the local bus. Further detail is available in the Tachometer Signal Conditioner Module Status assembly structure on controller input (see I/O message formats, module status structure).

Digital Inputs

Two inputs are provided to accept TTL signals. The TTL signals need a clear distinction between ‘low’ and ‘high’ values such that a trigger threshold of 2.5V does not falsely trigger on high or low signal level or noise.

These inputs are intended for control functions, such as a switch for turning ON/OFF startup multiplier function.

1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module

Two inputs are provided to connect common eddy current probes/PNP proximity switches, self-generating magnetic speed sensors or TTL speed signals.

1444-RELX00-04RB Relay Expansion Module

The relay expansion module does not accept analog inputs.

1444-AOFX00-04RB 4…20 mA Output Expansion Module

The 4…20 mA output expansion module does not accept analog inputs.

Module Outputs

The Dynamix 1444 Series Monitor Systems accepts the following outputs.

1444-DYN04-01RA Dynamic Measurement Module

Six outputs of two types are provided.

Channel Buffer Outputs

Four outputs, one per channel, are provided via ESD and short circuit protected +/-20V supplies. The outputs are accessible by BNC connectors or terminal pins that are independently resistive current limiting protected.

Digital Outputs

Two Opto-isolated open-collector circuits that provide TTLsignals. The outputs are suitable for use in providing simple status (on/off) indication or for replicating and transmitting a TTL speed input to another 1444-DYN04-01RA module.

1444-TSCX02-02RB Tachometer Signal Conditioner Expansion Module

Four outputs are provided to allow raw and conditioned buffer outputs.

Raw Buffer Outputs

Two outputs, one per channel, are provided via BNC connectors. These outputs provide an ESD and short circuit protected replica of the raw input signals.

These signals are N/rev. If the BNC output is a multiple event per revolution signal, the associated status indicator (6 or 7)illuminates blue.

Conditioned Buffer Outputs

Two outputs, one per channel, are provided via terminal pin connectors. These outputs provide an ESD, EFT and surge protected replica of the signals that are output to the local Expansion bus, and provided to any dynamic measurement modules on the bus.

These signals are presumed to be 1/revolution.

1444-RELX00-04RB Relay Expansion Module

The relay expansion module has no analog outputs.

1444-AOFX00-04RB 4…20 mA Output Expansion Module

Four ESD- and EFT-protected outputs. Each output is a 4…20 mA proportional signal that represents a selected measurement.

The outputs are not powered, requiring independent loop power, and are Opto-isolated from the module and each other.

Services

See CIP Objects on page 243, for available common and object-specific services.

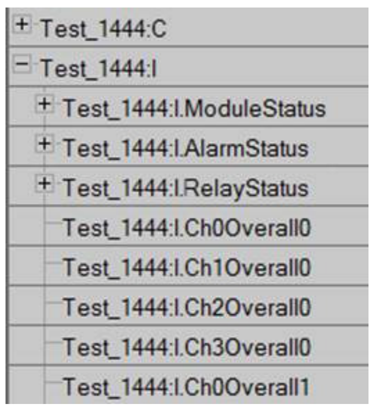
I/O Message Formats

Assemblies are created in Logix and defined by the 1444 modules' Add-on Profile (AOP). The AOP for the 1444's dynamic measurement module creates assemblies for input, output, and configuration. The structure, content, and meaning of the parameters of each of the assemblies, except configuration, is provided in the following.

Input Assembly

The input assembly consists of four structures; three fixed Status data structures, and a variably defined data structure.

In the Studio 5000 Tag Monitor the structures are presented similarly as shown below (replacing 'Test' with the module name).



The structures are defined as follows:

Input Assembly Structure		
Module Status Structure	ModuleStatus	Fixed
Alarm Status Structure	AlarmStatus[13]	Fixed
Relay Status Structure	RelayStatus	Fixed
Input Data Structure	Input Data Parameters	Variable

Module Status Structure

The status structure consists of these parameters:

dint	AuxiliaryCommunicationProcessor
int	TrendBuffer
int	AlarmBuffer
int	Transient
int	Reserved
dint	DSP
int	ChannelTransducer
sint	Speed
sint	A/D
int	RelayModule0
int	RelayModule1
int	RelayModule2
int	Reserved
int	4-20 mAModule
int	TachoSignalConditionerModule

While the module does not provide a single "Module OK" status value, it is possible to monitor the individual Module Status Structure members' hex or decimal values rather than the status of each of its individual bits. The following table provides the expected hex (decimal) values for each structure member if in its "OK" state.

Type	Member	OK Value Hex (Decimal)	Comments
dint	AuxiliaryCommunicationProcessor	0xC3FF0000 (3,288,268,800)	
int	TrendBuffer AlarmBuffer Transient	N/A	Information only
dint	DSP	0x00000000 (0)	Normal
		0x00000400 (1,024)	Configuration has changed. The bit will reset when the (same) configuration is downloaded from the controller or when the module is power cycled or reset.
int	ChannelTransducer	0x000000FF (255)	Assumes 4 channels enabled, not a multiplexing configuration.
sint	Speed	0x01 (1)	Tach 0 enabled
		0x03 (3)	Tach's 0 & 1 enabled
sint	A/D	0x00 (0)	
int	RelayModule0 RelayModule1 RelayModule2 4-20mAModule	0x0F02 (3,842)	Present and configured
		0x0000 (0)	Not present
int	TachoSignalConditionerModule	0x0002 (2)	May change as machine slows or stops. Use masking to avoid that: MaskedStatus = Status AND 0xF3FF

The data type for each attribute is either a 'sint' (8 bits), an 'int' (16 bits), or a 'dint' (32 bit). In each case, the state of the individual bits as provided in Table 35 defines status. It is possible for multiple bits to be set.

Table 35 - Auxiliary Processor Status

Auxiliary / Communication Processor Status					
Bit	**Status**	**Description (if = 1)**	**Bit**	**Status**	**Description (if = 1)**
0	Reserved		16	+1V5 OK	
1	Network fault	Device powered off or with no IP address configured. Network cable not detected. An exclusive owner connection has timed out.	17	DSP +1V6 OK	
2	Network address fault	Indicates an IP addressing conflict (address in use by another device). When set, this error contributes to an "EIP communication fail." in the context of ta module fault relay.	18	DSP 3V3D OK	
3	DSP DPM Fault	Dual Port Memory Fault	19	+5VA OK	
4	CIP Sync Support		20	+25V5 OK	
5	Reserved		21	+24V OK	
6	Reserved		22	- 25V5 OK	
7	Reserved		23	- 24V OK	
8	Reserved		24	AD0_0 +6V5 Fault	
9	Reserved		25	AD0_1 +5V_Ref Fault	
10	Reserved		26	Reserved	
11	Reserved		27	Reserved	
12	Reserved		28	Reserved	
13	Reserved		29	Reserved	
14	Reserved		30	AD1_2 V_PROT01 Fault	
15	Redundant Power Fault	One of the power supply inputs is at less than 17 Volts.	31	AD1_3 V_PROT23 Fault	

Table 36 - Trend Buffer Status

Trend Buffer Status		
Bit	**Status**	**Description (if=1)**
0	Trend Overall (Low Res) Records Cycling	Static Trend data is being collected
1	Trend Overall (High Res) Records Cycling	Alarm Trend data is being collected
2	Trend FFT Records Cycling	Dynamic Trend data, including FFT's, is being collected
3	Trend Waveform Records Cycling	Dynamic Trend data, including TWF's, is being collected
4…15	Reserved	

Table 37 - Alarm Buffer Status

Alarm Buffer Status				
Bit	**Status**	**Value**	**Description**	
0…3	Low-Resolution Overall Buffer	0	Disabled	Buffer/data type is not being captured
		1	Armed	Waiting for alarm event trigger
		2	Populating	Alarm event in progress
		3	Data Ready	Alarm data available
		4	Latched	Data available and latched until reset
4…7	High-Resolution Overall Buffer	same as above		
8…11	FFT Data Buffer			
12…15	Time Waveform Data Buffer			

Table 38 - Transient Status

Transient Status				
Bit	**Status**	**Value**	**Name**	**Description**
0…8	Transient Buffer 0	0	Free	Available / ready for transient event
		1	Data Ready Normal	Transient completed normally, could be overwritten by a new event.
		2	Data Latched Normal	Transient completed normally, buffer latched.
		3	Transient in progress RPM	Delta RPM data acquisition in progress.
		4	Transient in progress Time	Delta Time data acquisition in progress.
		5	Data Ready Aborted	Speed returned above/below initiating threshold, could be overwritten by a new event.
		6	Data Latched Aborted	Speed returned above/below initiating threshold, could be overwritten by a new event.
		7	Data Ready time-out	Speed crossed initiating threshold then timed out, could be overwritten by a new event.
		8	Data Latched time-out	Speed crossed initiating threshold then timed out, buffer latched.
4…7	Transient Buffer 1	same as above		
8…11	Transient Buffer 2			
12…15	Transient Buffer 3			

Table 39 - DSP Status

DSP Status					
Bit	**Status**	**Description (if=1)**	**Bit**	**Status**	**Description (if=1)**
0	DSP Ready	If bits 0, 1 and 2 are 0, the DSP is ready, anything else the DSP is either starting up or changing configuration	16	Any calibration timeout	
1			17	Relay 0 Inhibit active	main Module Relay is inhibited
2			18	Relay 0 drive fail	main Module Relay failed drive test
3	Functionally Safe Mode	Module Compliance Requirement is set to a SIL level	19	Loop Time Warning	Extended loop time warning
4	DSP Memory Fault		20	Multiplexing	Multiplexing mode is active
5	DSP code CRC error	If on recalling a configuration from update the DSP finds a CRC mismatch, the configuration is considered corrupt, the module is set to its default configuration, and the bit is set.	21	Reserved	
6	Reserved		22	Any tacho fail	Main module TTL speed inputs
7	Aux Processor DPM fault	Will be briefly set during the module startup sequence. Otherwise indicates that the DSP has reset or that the auxiliary communication processor configuration has failed.	23	Reserved	
8	High Temperature Warning		24	Reserved	
9	Any Setpoint Multiplier active	Alarm limits are being multiplied	25	Reserved	
10	DSP Configuration change	Set when the DSP receives a different configuration	26	Reserved	
11	Reserved		27	Reserved	
12	Any Alarm Inhibit active	One or more voted alarms is inhibited	28	Reserved	
13	Expansion bus Halt requested		29	+5VA Fault	
14	Expansion bus or module fault	Any expansion module not present, responding, or reporting a configuration failure. If an expansion module is missing or experiences a communication failure during configuration, then this bit will remain set until the configuration process completes successfully following a subsequent download.	30	+24V Fault	
15	Any calibration failure		31	- 24V Fault	

Table 40 - Transducer Status

Transducer Status		
Bit	**Status**	**Description (if=1)**
0	Channel 0 Enabled	Channel is configured for dynamic or static measurements
1	Channel 1 Enabled	Channel is configured for dynamic or static measurements
2	Channel 2 Enabled	Channel is configured for dynamic or static measurements
3	Channel 3 Enabled	Channel is configured for dynamic or static measurements
4	TX 0 Enabled	
5	TX 1 Enabled	
6	TX 2 Enabled	
7	TX 3 Enabled	
8	TX 0 Fault	
9	TX 1 Fault	
10	TX 2 Fault	
11	TX 3Fault	
12	Wire Off 0 Detected	
13	Wire Off 1 Detected	
14	Wire Off 2 Detected	
15	Wire Off 3 Detected	

Table 41 - Speed Status

Speed Status		
Bit	**Status**	**Description (if=1)**
0	Tacho 0 enabled	Speed 0 measurement is enabled
1	Tacho 1 enabled	Speed 1 measurement is enabled
2	Tacho 0 fault	Speed 0 indicates fault
3	Tacho 1 fault	Speed 1 indicates fault
4	Max Speed Event Tach 0	A new maximum speed even is detected on Speed 0. Bits toggle when a new event is detected
5	Max Speed Event Tacho 1	
6	Redundant Tacho Fault	Redundant tachometer mode is set and the tachometer has switched due to a tachometer failure
7	Reserved	

Table 42 - A/D Status

A/D Status		
Bit	**Status**	**Description**
0	Ch 0 Calibration Failure	Hardware fault. See Calibration, page 211
1	Ch 1 Calibration Failure	
2	Ch 2 Calibration Failure	
3	Ch 3 Calibration Failure	
4…7	Reserved	

Table 43 - Relay Module 0 Status

Relay Module 0		
Bit	**Status**	**Description (if=1)**
0	Module Not Responding	
1	Module Configured	Relay module 0 has a valid configuration
2	Code CRC Fault	
3	High Temperature Warning	
4	Link/bus fail	
5	Halt is Active	
6	RAM Fault	
7	RAM access error	
8	Relay 0 not inhibited	Relay 0 is inhibited
9	Relay 1 not inhibited	Relay 1 is inhibited
10	Relay 2 not inhibited	Relay 2 is inhibited
11	Relay 3 not inhibited	Relay 3 is inhibited
12	Relay 0 drive failure	Relay 0 failed drive test
13	Relay 1 drive failure	Relay 1 failed drive test
14	Relay 3 drive failure	Relay 2 failed drive test
15	Relay 3 drive failure	Relay 3 failed drive test

Table 44 - Relay Module 1 Status

Relay Module 1		
Bit	**Status**	**Description (if=1)**
0	Module Not Responding	
1	Module Configured	Relay module 1 has a valid configuration
2	Code CRC Fault	
3	High Temperature Warning	
4	Link/bus fail	
5	Halt is Active	
6	RAM Fault	
7	RAM access error	
8	Relay 0 not inhibited	Relay 0 is inhibited
9	Relay 1 not inhibited	Relay 1 is inhibited
10	Relay 2 not inhibited	Relay 2 is inhibited
11	Relay 3 not inhibited	Relay 3 is inhibited
12	Relay 0 drive failure	Relay 0 failed drive test
13	Relay 1 drive failure	Relay 1 failed drive test
14	Relay 3 drive failure	Relay 2 failed drive test
15	Relay 3 drive failure	Relay 3 failed drive test

Table 45 - Relay Module 2 Status

Relay Module 2		
Bit	**Status**	**Description (if=1)**
0	Module Not Responding	
1	Module Configured	Relay module 2 has a valid configuration
2	Code CRC Fault	
3	High Temperature Warning	
4	Link/bus fail	
5	Halt is Active	
6	RAM Fault	
7	RAM access error	
8	Relay 0 not inhibited	Relay 0 is inhibited
9	Relay 1 not inhibited	Relay 1 is inhibited
10	Relay 2 not inhibited	Relay 2 is inhibited
11	Relay 3 not inhibited	Relay 3 is inhibited
12	Relay 0 drive failure	Relay 0 failed drive test
13	Relay 1 drive failure	Relay 1 failed drive test
14	Relay 3 drive failure	Relay 2 failed drive test
15	Relay 3 drive failure	Relay 3 failed drive test

Table 46 - Expansion Module Response Codes

Expansion Module Response Codes		
Bits	**Status**	**Description**
0...2	Relay Module 0	If an expansion module sends an exception response the value is: 0: Normal / no exception 1: Invalid command / command not recognized 3: Message and message content do not agree 5: No message data received 6: Module is not configured
3...5	Relay Module 1	
6...8	Relay Module 2	
9...11	Analog Output Module	
12...14	Tachometer Signal Conditioner Module	
15	Reserved	

Table 47 - 4…20 mA Module Status

4…20 mA Module		
Bit	**Status**	**Description (if=1)**
0	Module Not Responding	
1	Module Configured	Analog module has a valid configuration
2	Code CRC Fault	
3	High Temperature Warning	
4	Link/bus fail	
5	Halt is Active	
6	RAM Fault	
7	RAM access error	
8…11	Reserved	Default = 1
12…15	Reserved	

Table 48 - Tachometer Signal Conditioner Module Status

TSC Module		
Bit	**Status**	**Description (if=1)**
0	Module Not Responding	
1	Module Configured	TSC module has a valid configuration
2	Code CRC Fault	
3	High Temperature Warning	
4	Link/bus fail	
5	Halt is Active	
6	RAM Fault	
7	RAM access error	
8	Reserved	
9	Reserved	
10	Speed 0 is estimated	
11	Speed 1 is estimated	
12	+25V5 Supply Fail	

13	-25V5 Supply Fail	
14	Tacho 0 sensor fail	
15	Tacho 1 sensor fail	

Alarm Status Structure

The alarm status structure consists of an array of 13 voted alarm status structures (table 13).

The input assembly excludes the specific status of measurement alarms. These are only available when the measurement alarm is an input to a voted alarm, in which case its status is available in the appropriate voted alarm input measure alarm 0 state parameter.

The data type for each attribute is either an 'int' (16 bits), or a 'dint' (32 bit). In each case, status is defined by the state of the individual bits as provided in Table 13. It is possible for multiple bits to be set.

The status structure consists of these parameters.

dint	VotedAlarm [13]

The data type for each attribute is either an 'int' (16 bits), or a 'dint' (32 bit). In each case, status is defined by the state of the individual bits as provided in Table . It is possible for multiple bits to be set.

Voted Alarm Status Values

IMPORTANT	Voted alarm status records do not associate 1:1 to the 13 voted alarm definitions. Reference the alarm number attribute (bits 10…13) of each voted alarm status record to identify the voted alarm that the entry applies to.

Voted Alarm Status Record Assignment

Voted alarm status records are applied first to physical relay. This assures that every physical relay has an associated voted alarm status record even if the relay is not used. For example, if an application includes one 1444-REX00-04RB expansion relay module (address 1) and the configuration enabled relays 0 and 2 from the expansion module referencing them to voted alarms 0 and 1, plus enabled the main module's onboard relay with it referencing voted alarm 12, then the voted alarm status records would be allocated as shown here:

Physical Device			Configuration		Voted Alarm Status Record	
Device	Address	Relay Number	Relay Number	Referenced Voted Alarm	Number	Referenced Voted Alarm
Main		0	0	12	**0**	**12**
RELX 0	1	0	1	0	**1**	**0**
		1	2	OFF	**2**	**inhibited**
		2	3	1	**3**	**1**
		3	4	OFF	**4**	**inhibited**
RELX 1	2	0	Expansion modules not installed			
		1				
		2				
		3				
RELX 2	3	0				
		1				
		2				
		3				

Once voted alarm status records are allocated to any physical relays, any remaining voted alarm status records are assigned to any voted alarms that were not already assigned, having been associated with a physical relay. This allocation is done simply by assigning un-referenced enabled voted alarms, in order, to the next available voted alarm status record. For example, if the above configuration also enabled voted alarms 7…11 to use as 'virtual' alarms, then the voted alarm status record allocation would be:

Physical Device			Configuration		Voted Alarm Status Record	
Device	Address	Relay Number	Relay Number	Referenced Voted Alarm	Number	Referenced Voted Alarm
Main		0	0	12	**0**	**12**
RELX 0	1	0	1	0	**1**	**0**
		1	2	OFF	**2**	**inhibited**
		2	3	1	**3**	**1**
		3	4	OFF	**4**	**inhibited**
Expansion modules not installed					**5**	**7**
					6	**8**
					7	**9**
					8	**10**
					9	**11**
					10	**unused**
					11	
					12	

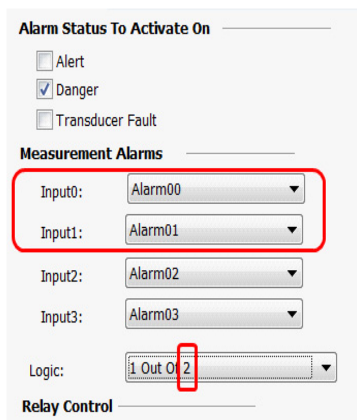
For a default configuration where no expansion relay modules are installed, and the main module relay is not used, the following assignments would apply if the first four voted alarms are enabled.

It is possible for an enabled voted alarm that is not referenced by a physical relay to not be referenced by a voted alarm status record.

For more information, see Dynamix 1444 Monitoring System User Manual, publication1444-UM001.

Voted Alarm Logic Clarification

When defining the logic to apply in a voted alarm the Logic control uses the form "A out of B". In all cases, the number "B" refers to the first B entries in the measurement alarm input list...



Each input_ member can be assigned to any enabled measurement alarm. Consequently the Logic can be made to apply to any group of measurement alarms.

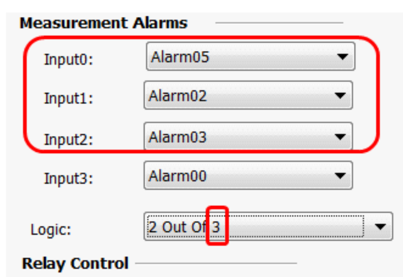


Table 49 - Voted Alarm Status

Voted Alarm Status 0…12		
Bit	**Status**	**Description**
0	Activated	One or more associated relay outputs (and status indicators) is set
1	Disabled	Alarm is disabled
2	Latching	Configured as latching
3	Alarming	Required conditions for the "alarm state" are true

Table 49 - Voted Alarm Status

4	Bypassed	Alarm is bypassed (associated relays / status indicators held in non-alarm state
5	SPM	Setpoint multiplier is active
6	Reserved	
7	First Out	Set if the first alarm to activate since last Reset or Bypass
8	Reserved	
9	Reserved	
10…13	Alarm Number	Voted alarm instance that this refers to (0…13). *
14…15	Activate Status	0=Normal, 1=Alert, 2=Danger, 3=TX Fault
16	Inp Meas Alarm 0 State	State of the measurement alarm referenced for alarm input 0
17	Inp Meas Alarm 0 TX OK	TX OK status of the measurement alarm referenced for alarm input 0
18	Inp Meas Alarm 1 State	State of the measurement alarm referenced for alarm input 1
19	Inp Meas Alarm 1 TX OK	TX OK status of the measurement alarm referenced for alarm input 1
20	Inp Meas Alarm 2 State	State of the measurement alarm referenced for alarm input 2
21	Inp Meas Alarm 2 TX OK	TX OK status of the measurement alarm referenced for alarm input 2
22	Inp Meas Alarm 3 State	State of the measurement alarm referenced for alarm input 3
23	Inp Meas Alarm 3 TX OK	TX OK status of the measurement alarm referenced for alarm input 3
24	Speed Gate Status	0 = not gating, 1 = gating
25	Speed Gate TX OK	TX OK status of the input used for speed gating
26	Logic Gating Status 0	If a digital input (switch) is defined for logic gating, then indicates switch status, else indicates status of assigned I/O gating control
27	Logic Gating Status 1	If a digital input (switch) is defined for logic gating, then indicates status of assigned I/O gating control, else is unused
28	Reserved	
29	Logic Control Status 0	If a digital input (switch) is defined for logic control, then indicates switch status, else indicates status of assigned I/O control
30	Logic Control Status 1	If a digital input (switch) is defined for logic gating, then indicates status of assigned I/O control, else is unused
31	Reserved	

- The alarm number is presented in the assembly in bit format. The alarm instance is the decimal value represented by the 4 bits. For example:

-test:I.AlarmStatus[0].VotedAlarmInstance0	0
-test:I.AlarmStatus[0].VotedAlarmInstance1	1
-test:I.AlarmStatus[0].VotedAlarmInstance2	0
-test:I.AlarmStatus[0].VotedAlarmInstance3	0

The proceeding table indicates the status of voted alarm number 2. However:

- The voted alarm instance provided in the status assembly is a value from 1 - 13. To get the voted alarm instance, as referenced to the AOP (0-12), subtract 1 from the decimal value of the presented 4 bit value.

Table 50 - Alarm Status Structure

The status structure consists of these parameters.

dint	VotedAlarm [13]
int	Relay
int	Reserved

The data type for each attribute is either an 'int' (16 bits), or a 'dint' (32 bit). In each case status is defined by the state of the individual bits as provided in Table 1. It is possible for multiple bits to be set.

Relay Status Structure

The relay status structure contains the parameters shown below (table 14). It communicates the status of the dynamic measurement module's single onboard relay (relay 0) and the status of the relays in each of the up to three connected expansion relay module's (relays 1...4, 5...8 and 9...12).

The table consists of discrete bits, one per relay. When set the bit indicates that the associated relay is energized.

The status structure consists of these parameters.

Table 51 - Relay Status

Relay Status		
Bit	**Status**	**Description (if=1)**
0	Relay 0 Energized	main module relay is energized
1	Relay 1 Energized	Relay Expansion Module 0, Relay 0 is Energized
2	Relay 2 Energized	Relay Expansion Module 0, Relay 1 is Energized
3	Relay 3 Energized	Relay Expansion Module 0, Relay 2 is Energized
4	Relay 4 Energized	Relay Expansion Module 0, Relay 3 is Energized
5	Relay 5 Energized	Relay Expansion Module 1, Relay 0 is Energized
6	Relay 6 Energized	Relay Expansion Module 1, Relay 1 is Energized
7	Relay 7 Energized	Relay Expansion Module 1, Relay 2 is Energized
8	Relay 8 Energized	Relay Expansion Module 1, Relay 3 is Energized
9	Relay 9 Energized	Relay Expansion Module 2, Relay 0 is Energized
10	Relay 10 Energized	Relay Expansion Module 2, Relay 1 is Energized
11	Relay 11 Energized	Relay Expansion Module 2, Relay 2 is Energized
12	Relay 12 Energized	Relay Expansion Module 2, Relay 3 is Energized
13…15	Reserved	

Input Data Structure

The input data structure is written immediately following the status data, described above. It consists of an array of 4 byte floating point numbers that represent the various measurements selected for input in module definition.

The parameters are some subset of those listed in Table 30.

Table 52 - Input Data Parameters

#	Parameter	Description
0	Ch0Overall0	Overall values after integration and high pass filters
1	Ch1Overall0	
2	Ch2Overall0	
3	Ch3Overall0	
4	Ch0Overall1	Optional Overall values from selected data source
5	Ch1Overall1	
6	Ch2Overall1	
7	Ch3Overall1	
8	Ch0DCV	Channel bias (or gap) values
9	Ch1DCV	
10	Ch2DCV	
11	Ch3DCV	
12	Ch0Order0Mag	Tracking filter 0 magnitude values
13	Ch1Order0Mag	
14	Ch2Order0Mag	
15	Ch3Order0Mag	
16	Ch0Order0Phase	Tracking filter 0 phase values
17	Ch1Order0Phase	
18	Ch2Order0Phase	
19	Ch3Order0Phase	
20	Ch0Order1Mag	Tracking filter 1 magnitude values
21	Ch1Order1Mag	
22	Ch2Order1Mag	
23	Ch3Order1Mag	
24	Ch0Order1Phase	Tracking filter 1 phase values
25	Ch1Order1Phase	
26	Ch2Order1Phase	
27	Ch3Order1Phase	
28	Ch0Order2Mag	Tracking filter 2 magnitude values
29	Ch1Order2Mag	
30	Ch2Order2Mag	
31	Ch3Order2Mag	

Table 52 - Input Data Parameters

#	Parameter	Description
32	Ch0Order2Phase	Tracking filter 2 phase values
33	Ch1Order2Phase	
34	Ch2Order2Phase	
35	Ch3Order2Phase	
36	Ch0Order3Mag	Tracking filter 3 magnitude values
37	Ch1Order3Mag	
38	Ch2Order3Mag	
39	Ch3Order3Mag	
40	Ch0Order3Phase	Tracking filter 3 phase values
41	Ch1Order3Phase	
42	Ch2Order3Phase	
43	Ch3Order3Phase	
44	Ch0FFTBand0	FFT Band 0 magnitude values
45	Ch1FFTBand0	
46	Ch2FFTBand0	
47	Ch3FFTBand0	
48	Ch0FFTBand1	FFT Band 1 magnitude values
49	Ch1FFTBand1	
50	Ch2FFTBand1	
51	Ch3FFTBand1	
52	Ch0FFTBand2	FFT Band 2 magnitude values
53	Ch1FFTBand2	FFT Band 2 magnitude values
54	Ch2FFTBand2	
55	Ch3FFTBand2	
56	Ch0FFTBand3	FFT Band 3 magnitude values
57	Ch1FFTBand3	
58	Ch2FFTBand3	
59	Ch3FFTBand3	
60	Ch0FFTBand4	FFT Band 4 magnitude values
61	Ch1FFTBand4	
62	Ch2FFTBand4	
63	Ch3FFTBand4	
64	Ch0FFTBand5	FFT Band 5 magnitude values
65	Ch1FFTBand5	
66	Ch2FFTBand5	
67	Ch3FFTBand5	

Table 52 - Input Data Parameters

#	Parameter	Description
68	Ch0FFTBand6	FFT Band 6 magnitude values
69	Ch1FFTBand6	
70	Ch2FFTBand6	
71	Ch3FFTBand6	
72	Ch0FFTBand7	FFT Band 7 magnitude values
73	Ch1FFTBand7	
74	Ch2FFTBand7	
75	Ch3FFTBand7	
76	Ch0Not1X	Not 1x values
77	Ch1Not1X	
78	Ch2Not1X	
79	Ch3Not1X	
80	Ch0DC	DC measurement values
81	Ch1DC	
82	Ch2DC	
83	Ch3DC	
84	Ch0_1S MAXMag	SMAX magnitude values
85	Ch2_3SMAXMag	
86	Ch0_1SMAXPhase	SMAX Phase values
87	Ch2_3SMAXPhase	
88	Ch0_1Shaft Absolute Pk_Pk	Shaft Absolute values
89	Ch2_3Shaft Absolute Pk_Pk	
90	Speed0	Speed values
91	Speed1	
92	FactoredSpeed0	Speed values
93	FactoredSpeed1	
94	Speed0 max	maximum speed since last reset
95	Speed1 max	
96	Speed0RateOfChange	Speed rate of change per minute
97	Speed1RateOfChange	
98	Ch0_1AxialDiffExpansion	Differential Expansion values
99	Ch2_3AxialDiffExpansion	
100	Ch0_1RampDiffExpansion	
101	Ch2_3RampDiffExpansion	
102	Ch0RodDrop	Rod Drop values
103	Ch1RodDrop	
104	Ch2RodDrop	
105	Ch2RodDrop	

Output Assembly

The output assembly consists of one control integer optionally followed by two speed values and/or an array of 16 alarm values. The speed and/or alarm limit values are present when specified in module definitions.

The control integer is an array of bits with each bit managing a specific control function as defined in this table.

Table 53 - Output Assembly

Bit	Control	Description
0	Trip Inhibit	When set, Trip Inhibit prevents any alarm activation (and/or cancel standing alarms), including the associated alarm action (relay). When Inhibit is set, all relays are held in their non-alarm state.
1	Setpoint Multiplier 0 Enable	When set forces TRUE any defined Control 0 / 1 attribute of configured Voted Alarms.
2	Setpoint Multiplier 1 Enable	
3	Speed 0 OK	When speed is passed on the output (two speed values following this) these controls allow definition of the status of the speed values. If set (1) the speed status is considered in fault.
4	Speed 1 OK	
5	Control 0	When set activates I/O control per: If I/O Gate Control is specified, then the gate condition is satisfied with the control is set. If I/O Logic Control is specified, then the voted alarm actuates when the control is set.
6	Control 1	
7	Alarm Reset	Resets all latched alarms where the alarm condition is no longer present.
8	Alarm Buffer Trigger	When set the Alarm Buffer triggers. This copies the current Trend Buffer and high-resolution data buffer. If any post trigger data is specified, then data acquisition continues until the buffer is filled.
9	Alarm Buffer Reset	Resets the alarm buffer, if it is latched. When the buffer is reset, regardless if it is latched, any existing content is lost.
10	Transient Buffer 0 Reset	Reset a latched buffer. When a buffer is reset, regardless if it is latched, any existing content is lost.
11	Transient Buffer 1 Reset	
12	Transient Buffer 2 Reset	
13	Transient Buffer 3 Reset	
14	Reserved	
15	Reserved	

Calibration

The dynamic measurement module includes no adjustable components so does not require periodic calibration.

To assure measurement accuracy within specification, the digital signal processor (DSP) of the module self-calibrates at each power-up. The calibration function generates a set of coefficients that are applied to measurements.

After each calibration these coefficients are checked against design limits. Coefficients exceeding their design limits indicate a hardware fault. So if the check fails, a calibration failure is indicated by a solid red DSP status indicator and an appropriate bit set in the input status assembly's DSP status value.

If calibration fails, the module operates for approximately one minute and then forces the DSP to restart, and recalibrate. This cycle repeats until calibration passes.

Status

This section defines status indicator location, definition, and behavior for main and Expansion modules.

Status Indicators

Main Module Status Indicators

The dynamic measurement module (1444-DYN04-01RA) includes 14 status indicators. Twelve indicators are on the top of the module and one additional status indicator on each of the Ethernet connectors.

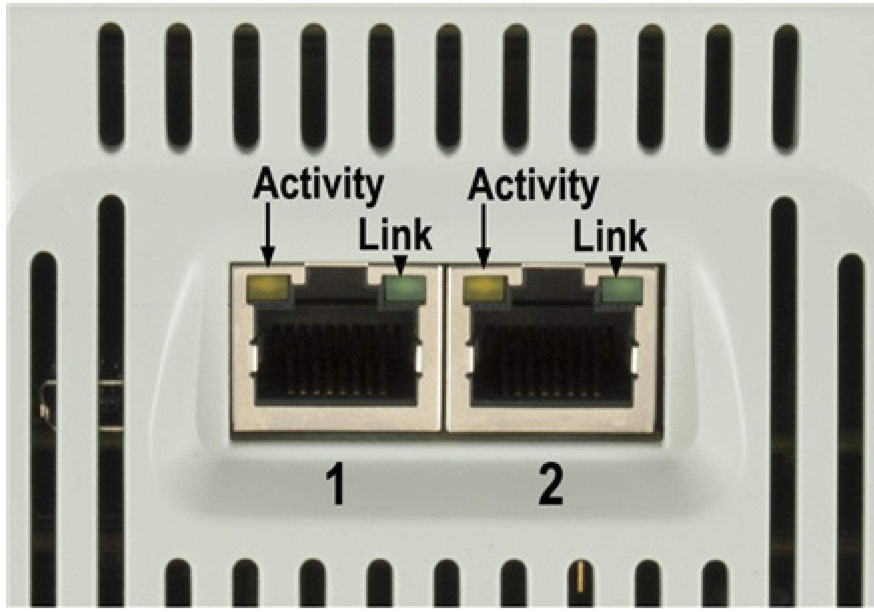
Table 54 provides descriptions of the meaning of the 12 status indicators on the top of the main module.

Table 54 - DYN Module Status Indicators

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	6.5V power not OK	6.5V power OK	—	—	—	—	—	—	—
RUN	Aux processor run status	Powered off or not running	—	Application running	O/S running	Configuration activity	—	—	—	—
MS	Module status	Powered off	Operational	No configuration	—	During FW, update indicates update is being written to memory	major fault, not recoverable	Duplicate IP address	Firmware Update in process	—
NS	Network status	No network connection	Connected	No connections	—	—	Duplicate IP address	Connection timeout	Firmware Update in process	—
OS	Operating Status	Powered off	OK / Normal	Redundant power fail	If DSP Status Indicator is flashing green: Configuring If DSP Status Indicator is solid green or off: Storing to memory	—	Inhibit	—	Firmware update in process	—
DSP	DSP Run	Powered off	DSP paused or not running	DSP running	—	Setpoint Multiplier active	—	DSP is in boot loader mode	—	—
OK	DSP Status	Powered off or channels disabled during configuration transfer process	OK	—	—	—	Calibration, DSP, or configuration error	—	Firmware update in process	—
CH0	Channel 0 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
CH1	Channel 1 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
CH2	Channel 2 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
CH3	Channel 3 status	Channel disabled	Channel OK/ TX OK	—	—	—	Channel TX Fault	—	—	—
RLY	Relay status	Relay not in use	Relay not in alarm	—	Relay inhibited	—	Relay in alarm (actuated)	—	—	—

Ethernet Port Status Indicators

Each Ethernet ports RJ45 jack is fitted with two status indicators.



Status Indicator (color)	Off	On	Blinking
Activity (amber)	No network activity	—	Network activity present
Link (green)	No link established	Link established	—

Expansion Module Status Indicators

When the expansion module is inserted and powered, the power status indicator shows green. The two remaining status indicators provide information as to the status of the expansion bus and the module controller.

Normal expected status indicator states for these three status indicators with a healthy system are:

- Power Status (PWR): Solid green
- Network Status (LNS): Solid green
- Processor Status (MS): Flashing green

As indication of controller faults or warnings: MS = Red - Flashing red for fault, such as cannot read valid module type code, and solid red for self-check failure.

Processor over temperature is treated as a critical self-check failure (solid red indication). A fault is signaled for temperatures over 85 °C. MS = BLUE indicates a communication error, a warning status only. However, a communication error can ultimately result in a critical link failure.

IMPORTANT	Expansion modules are not considered part of status indicator requirements set by ODVA for EtherNet/IP equipment.

The expansion modules have a total of seven status indicators, comprising a group of three common (system) status indicators and a further group of four, which are module type specific. The behavior and indication that is provided by the status indicators varies between module startup and operation.

Operating Status Indication

The following tables provide descriptions of each expansion modules status indicators.

Tacho (TSC) Module

The first two status indicators reflect the two tacho channels and the second two the output signal available on the channel BNC connectors.

Tacho Channels

If the tacho channel is enabled, the status indicator is green. The status indicator flashes off when a pulse is detected. At low speed/event rates, the repetitive flash off reflects actual detections. However, the rate of flashing is limited to the MSP run flash rate, so that at higher speeds the flashing is simply an indicator of events and not necessarily the actual time of those events.

A normal expected state for a healthy channel is flashing green (machine running). If a tacho sensor failure is detected, the blue rather than green status indicator is active.

An internal power supply fault (out of specification ±25.5V supply) triggers the red Status Indicator to be active. If both channels are enabled, both similarly indicate that fault, but whether it affects tacho operation depends on the module configuration (whether a transducer is used and which one).

BNC Connectors

If the channel is enabled and one event per revolution is configured, then the status indicator is green. If the channel is enabled and multiple events per revolution are configured, then the status indicator is blue. The indicator serves as a warning to any local analyst using that output.

Table 55 - TSCX Status Indicator

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	5V power not OK	5V power OK	—	—	—	—	—	—	—
LNS	Local network status	Tacho module not configured	Configured and bus OK	Configured and bus NOT OK	—	—	—	—	—	—
MS	Module status	—	—	Processor activity / OK	—	Processor warning	Processor critical error	—	—	—
CH0	Channel 0 status	Channel not in use	Channel / TX OK	Pulse detection(1)	Channel TX fault	Pulse detection error(1)	±25.5V fail2	Pulse detection(1)	—	—
CH1	Channel 1 status	Channel not in use	Channel / TX OK	Pulse detection(1)	Channel TX fault	Pulse detection error(1)	±25.5V fail(2)	Pulse detection(1)	—	—
OP0	Output 0 status	Output not in use	Output 1 event / rev	Bus or relay drive fail(2)	Output >1 event / rev(3)	—	—	—	—	—
OP1	Output 1 status	Output not in use	Output 1 event / rev	Bus or relay drive fail(2)	Output >1 event / rev(3)	—	—	—	—	—

(1) At low speed the flash rate reflects pulse rate, but the flash rate limits at the maximum flash rate of the Status Indicator.

(2) If two channels are enabled, both show the same state as these supplies are common.

(3) Blue status indicates normal operation but signals that measurements taken on the buffered outputs are >1 / Rev, an important detail when connecting the buffered output to other instruments.

4…20 mA Output Status Indicators

Each status indicator represents the state of that particular channel or output. Normal expected status indicator states for a healthy system are all solid green.

For each output (channel), if the output is not enabled, the associated status indicator is off.

If enabled:

- Blue if the output is inhibited or the link is halted
- Red when the link fault output value is imposed by the expansion module
- In either case, the output is likely being held static (same value maintained)

Otherwise, the output status indicator is green.

The color is always solid, except all enabled channels flash the active color during a link fault.

Table 56 - AOFX Status Indicators

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	5V power not OK	5V power OK	—	—	—	—	—	—	—
LNS	Local network status	Relay module not configured	Configured and bus OK	Configured and bus NOT OK	—	—	—	—	—	—
MS	Module status	—	—	Processor activity / OK	—	Processor warning	Processor critical error	Processor critical error	—	—
OP0	Output 0 status	Output not in use	Host controlling(1)	Bus fail	Output state held(2)	Bus fail	—	Bus fail. Output held at fault indication level	—	—
OP1	Output 1 status	Output not in use	Host controlling(1)	Bus fail,	Output state held(2)	Bus fail	—	Bus fail. Output held at fault indication level	—	—
OP2	Output 2 status	Output not in use	Host controlling(1)	Bus fail	Output state held(2)	Bus fail	—	Bus fail. Output held at fault indication level	—	—
OP3	Output 3 status	Output not in use	Host controlling(1)	Bus fail	Output state held(2)	Bus fail	—	Bus fail. Output held at fault indication level	—	—

(1) Host controlling means that the module is receiving level data for output from its host module.

(2) Output is being held due to bus halt. Halt is where the expansion module is advised to temporarily extend its link timeout.

Relay Output Module

Each status indicator represents the state of that particular channel or output. Normal expected status indicator states for a healthy system are all solid green.

If the output is not enabled, all associated status indicator are off.

If enabled: Blue if the relay is inhibited or the link is halted (output state being held)

Otherwise:
- Red when the relay contacts are in the alarm state
- Green when the relay contacts are in the non-alarm state

The active color flashes for any channel with a detected relay drive fail and for all enabled channels during a link fault.

IMPORTANT	The definition of what contact state red or green represents is a part of the expansion module configuration.

Table 57 - RELX Status Indicators

Status Indicator	Description	OFF	Green		Blue		Red		Red/Green	Blue/ Green
			Solid	Flashing (off)	Solid	Flashing (off)	Solid	Flashing (off)	Flashing	Flashing
PWR	Power status	5V power not OK	5V power OK	—	—	—	—	—	—	—
LNS	Local network status	Relay module not configured	Configured and bus OK	Configured and bus NOT OK	—	—	—	—	—	—
MS	Module status	—	—	Processor activity / OK	—	Processor warning	Processor critical error	Processor critical error	—	—
R0	Relay 0 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—
R1	Relay 1 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—
R2	Relay 2 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—
R3	Relay 3 status	Relay disabled	Relay not in alarm	Bus or relay drive fail(1)	Relay state held(2)	Bus or relay drive fail(1)	Relay in alarm(3)	Bus or relay drive fail(2)	—	—

(1) Relay is held when inhibited or bus halt. Halt is where the auxiliary module is advised to temporarily extend its link timeout.

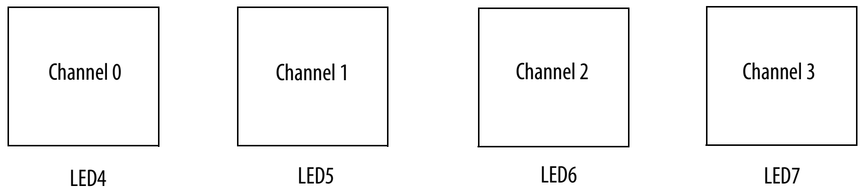
(2) ANY color flashing indicates Bus or Relay drive fail. Bus fail is indicated similarly on all enabled channels.

(3) Relay in Alarm means that the Voted Alarm that is associated with the relay is in the alarm state, or that any fault conditions associated with the relay are faulted.

Startup Behavior

At startup, the group of four is used to indicate the configured bus address of the expansion module.

The blue “channel” status indicators flash to indicate the module address in binary (bit 0 being to the right) for 10 seconds.



Example for relay module, address 7 (or 0111 in binary):

During this period, all controllable status indicators, except indicators displaying the address, are unlit (the green status indicator to the left is the hardware controlled, power status indicator).

CIP Objects

This appendix defines the specific CIP Objects supported by the Dynamix measurement module.

Parameter – Tag – Object Attribute Cross-reference

The following table maps the parameters on each page of the AOP to its controller tag and to the specific object attribute of the module that it populates. Some tags are hidden, and if the compliance requirement of the module is set to any SIL level, most tags are hidden.

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Parameter	Tag Member	Object	Attribute
Define Module Functionality			
Power Supply	ModuleControl.RedundantPowerSupply	Dynamix Module Control Object	Redundant Power Supply
Personality	Module.PersonalityApplied	Dynamix Configuration Manager Object	AOP Module Type
Speed Page			
Mode	ModuleControl.TachoMode	Dynamix Configuration Manager Object	Tacho Mode
Name	TachName[***0…1***]	Dynamix Configuration Manager Object	Tach 0 Name**…**Tach 1 Name
Speed Multiplier	Speed[***0…1***].Multiplier	Dynamix Tacho and Speed Measurement Object	Speed Multiplier
Source	Speed[***0…1***].TachSource	Dynamix Tacho and Speed Measurement Object	Tacho Source
TTL Trigger	Speed[***0…1***].TachTriggerSlope	Dynamix Tacho and Speed Measurement Object	Tacho Trigger
Acceleration Update Rate	Speed[***0…1***].AccelUpdateRate	Dynamix Tacho and Speed Measurement Object	ROC Delta Time
Acceleration Time Constant	Speed[***0…1***].AccelTimeConstant	Dynamix Tacho and Speed Measurement Object	ROC TC
Tachometer Page			
Transducer Type	Tach[***0…1***].SensorType	Dynamix TSC Module Object	Input Sensor Type
Transducer Power	Tach[***0…1***].Power	Dynamix TSC Module Object	Sensor Power Supply
Auto Trigger	Tach[***0…1***].AutoTrigger	Dynamix TSC Module Object	Trigger Mode
Trigger Level	Tach[***0…1***].TriggerLevel	Dynamix TSC Module Object	Trigger Threshold
Trigger Slope	Tach[***0…1***].TriggerSlope	Dynamix TSC Module Object	Trigger Slope/Edge
Pulses per Revolution	Tach[***0…1***].PulsePerRevolution	Dynamix TSC Module Object	Sensor Target, Pulses Per Revolution
DC volts Fault	Tach[***0…1***].DCVFault	Dynamix TSC Module Object	Sensor OK Definition
Fault High Limit (V DC)	Tach[***0…1***].FaultHLimit	Dynamix TSC Module Object	Sensor OK High Threshold
Fault Low Limit (V DC)	Tach[***0…1***].FaultLLimit	Dynamix TSC Module Object	Sensor OK Low Threshold
Speed Fault	Tach[***0…1***].SpeedFault	Dynamix TSC Module Object	Sensor OK Definition
Speed High Limit	Tach[***0…1***].SpeedHLimit	Dynamix TSC Module Object	High RPM Threshold
Speed Low Limit	Tach[***0…1***].SpeedLLimit	Dynamix TSC Module Object	Low RPM Threshold
Tach Expansion Module Fault	Tach[***0…1***].ExpansionModuleFault	Dynamix TSC Module Object	Sensor OK Definition

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Time Slot Multiplier Page			
Time Slot 0…3	TimeSlotMultiplier[***0…3***]	Dynamix MUX Object	Time Slot 0 DAQ Time Multiplier
HW Configuration Page			
Xdcr Units	Ch***0…3***Sensor.DCEngineeringUnits	Dynamix Transducer Object	Transducer DC Units
Xdcr Units	Ch***0…3***Sensor.ACEngineeringUnits	Dynamix Transducer Object	Transducer AC Units
Xdcr Sensitivity	Ch***0…3***Sensor.DCSensitivity	Dynamix Transducer Object	Transducer DC Sensitivity
Xdcr Sensitivity	Ch***0…3***Sensor.ACSensitivity	Dynamix Transducer Object	Transducer AC Sensitivity
Xdcr Power	Ch***0…3***Sensor.TranducerPower	Dynamix Transducer Object	TX Power Setup
Xdcr High Limit (V DC)	Ch***0…3***Sensor.HLimit	Dynamix Transducer Object	Transducer OK High Threshold
Xdcr Low Limit (V DC)	Ch***0…3***Sensor.LLimit	Dynamix Transducer Object	Transducer OK Low Threshold
Xdcr Location	Ch***0…3***Description.Location	Dynamix Transducer Object	Transducer Location
Xdcr Orientation (deg)	Ch***0…3***Description.Oreintation	Dynamix Transducer Object	Transducer Orientation
Name	Ch***0…3***Description.Name	Dynamix Transducer Object	Transducer Name
Measurement Type	Module.Ch***0…3***AppType	Configuration Manager Object	Channel Application Type
Pt0 (1)	TripInhibitSource	Dynamix Voted Alarm Object	Trip Inhibit / Bypass source
	AlarmResetSource	Dynamix Voted Alarm Object	Alarm Reset Source
	VotedAlarm***00…12***.LogicInput	Dynamix Voted Alarm Object	Alarm Multiplier Control
	VotedAlarm***00…12***.LogicGateSource	Dynamix Voted Alarm Object	Logic Gating Source
	VotedAlarm***00…12***.LogicLogicSource	Dynamix Voted Alarm Object	Logic Control Source
	Speed[***0…1***].TachFaultSource	Dynamix Tacho and Speed Measurement Object	Tacho OK Source
Pt0 (1)	ModuleControl.Pt0***0…1***OutputAssign	Dynamix Module Control Object	Opto Output ***0…1*** Allocation
Filters Page			
Sample Rate Divisor	Ch***0…3***Filter.SampleRateDivisor	Dynamix Channel Setup Object	SRD
Fmax (Primary) Decimation	Ch***0…3***Filter.FMAXDecimation	Dynamix Channel Setup Object	Decimation
Low Pass Filter (Primary) Frequency	Ch***0…3***Filter.LowPassFreq	Dynamix Channel Setup Object	LP Filter -3 dB Point
High Pass Filter (Primary) Frequency	Ch***0…3***Filter.HighPassFreq	Dynamix Channel Setup Object	HP Filter -3 dB Point
Alternate Processing Path Processing Mode	Ch***0…3***Filter.AltPathMode	Dynamix Channel Setup Object	Alternate Path control
Fmax (Alternate) Decimation	Ch***0…3***Filter.AltPathFMAXDecimation	Dynamix Channel Setup Object	Decimation (attribute 23)
Low Pass Filter (Alternate) Frequency	Ch***0…3***Filter.LowPassFreq	Dynamix Channel Setup Object	Alternate LP Filter -3 dB Point
Alternate Path Tachometer	Ch***0…3***Filter.SyncTachoSource	Dynamix Channel Setup Object	Synchronous Tacho Source
Alternate Path Synchronous Pulses Per Revolution	Ch***0…3***Filter.SynchSamplesPerRevolution	Dynamix Channel Setup Object	Synchronous Samples Per Revolution
Overall Page			
Overall (1) Signal Source	Ch***0…3***Overall.SourceB	Dynamix AC Measurement Object	AC Overall Measurement Source
Overall (0) Signal Detection	Ch***0…3***Overall.SignalDetectionA	Dynamix AC Measurement Object	AC Overall magnitude - Detection Method
Overall (1) Signal Detection	Ch***0…3***Overall.SignalDetectionB	Dynamix AC Measurement Object	AC Overall magnitude - Detection Method
Overall (0) Time Constant	Ch***0…3***Overall.RMSTimeConstantA	Dynamix AC Measurement Object	AC Overall Measurement RMS TC
	Ch***0…3***Overall.PkTimeConstantA	Dynamix AC Measurement Object	AC Overall Measurement Peak TC

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Overall (1) Time Constant	Ch***0…3***Overall.RMSTimeConstantB	Dynamix AC Measurement Object	AC Overall Measurement RMS TC
	Ch***0…3***Overall.PkTimeConstantB	Dynamix AC Measurement Object	AC Overall Measurement Peak TC
Tracking Filters Page			
Enable (0…3)	Ch***0…3***TrkFltrs.TrkFltr***0…3***En	Dynamix Order Measurement Object	Order Measurement Configuration
Tacho Source (0…3)	Ch***0…3***TrkFltrs.TrkFltr***0…3***TachSrc	Dynamix Order Measurement Object	Order Measurement Configuration
Order (0…3)	Ch***0…3***TrkFltrs.TrkFltr***0…3***	Dynamix Order Measurement Object	Order ***0…3*** setup
Measurement Units	Ch***0…3***Orders.Units	Dynamix Order Measurement Object	Order Measurement Units
Signal Detection	Ch***0…3***Overall.SignalDetection	Dynamix Order Measurement Object	Order Measurement Scaling
Measurement Resolution Speed 0	Ch***0…3***Overall.Speed0FilterNumRevolutions	Dynamix Order Measurement Object	Order Filter Definition (Tacho 0)
Measurement Resolution Speed 1	Ch***0…3***Overall.Speed1FilterNumRevolutions	Dynamix Order Measurement Object	Order Filter Definition (Tacho 1)
FFT Page			
Enable TWF Data Storage	Ch***0…3***Complex.TWFEn	Dynamix Normal CM Data Object	Enable
Signal Source	Ch***0…3***Complex.Source	Dynamix Normal CM Data Object	Signal Source
Measurement Units	Ch***0…3***Complex.Units	Dynamix Normal CM Data Object	Measurement Units
Number of Samples	Ch***0…3***Complex.TWFSamples	Dynamix Normal CM Data Object	Waveform Record Length
Speed Reference	Ch***0…3***Complex.SpeedRef	Dynamix Normal CM Data Object	Associated Tacho Source
Enable FFT Data Storage	Ch***0…3***Complex.FFTEn	Dynamix Normal CM Data Object	Enable
Number of Spectrum Lines	Ch***0…3***Complex.FFTNumLines	Dynamix Normal CM Data Object	FFT Line Resolution
Signal Detection	Ch***0…3***Complex.FFTSignalDetection	Dynamix Normal CM Data Object	FFT Line Value Detection/Scaling
FFT Window Type	Ch***0…3***Complex.FFTWindowType	Dynamix Normal CM Data Object	FFT Window Function
Number of Averages	Ch***0…3***Complex.AveragesCount	Dynamix Normal CM Data Object	Number of Averages
Average TWF	Ch***0…3***Complex.AvgTWFEn	Dynamix Normal CM Data Object	Enable
gSE Page			
High Pass Filter Frequency	Ch***0…3***Filter.HighPassFreq	Dynamix Channel Setup Object	HP Filter -3 dB Point
Speed Reference	Ch***0…3***Complex.SpeedRef	Dynamix Normal CM Data Object	Associated Tacho Source
Maximum Frequency	Ch***0…3***Filter.LowPassFreq	Dynamix Channel Setup Object	LP Filter -3 dB Point
Number of Spectrum Lines	Ch***0…3***Complex.FFTNumLines	Dynamix Normal CM Data Object	FFT Line Resolution
FFT Window Type	Ch***0…3***Complex.FFTWindowType	Dynamix Normal CM Data Object	FFT Window Function
Number of Averages	Ch***0…3***Complex.AveragesCount	Dynamix Normal CM Data Object	Number of Averages
FFT Bands Page			
Enable	ModuleControl.Ch***0…3***DSP_FFT.En	Dynamix Module Control Object	Enable
Signal Source	ModuleControl.Ch***0…3***DSP_FFT.Source	Dynamix Module Control Object	Signal Source
Measurement Units	ModuleControl.Ch***0…3***DSP_FFT.Units	Dynamix Module Control Object	Measurement Units
Number of Spectrum Lines	ModuleControl.Ch***0…3***DSP_FFT.FFTNumLines	Dynamix Module Control Object	Line Resolution
Signal Detection	ModuleControl.Ch***0…3***DSP_FFT.SignalDetection	Dynamix Module Control Object	FFT Line Value Detection/Scaling
FFT Window Type	ModuleControl.Ch***0…3***DSP_FFT.WindowType	Dynamix Module Control Object	Window Function

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Number of Averages	ModuleControl.Ch***0…3***DSP_FFT.AveragesCount	Dynamix Module Control Object	Number of Averages
Enable	Ch***0…3***Band***0…7***.En	Dynamix FFT Band Object	Channel Source
Measurement Mode	Ch***0…3***Band***0…7***.Type	Dynamix FFT Band Object	FFT Band magnitude - Type
Band Limit Begin	Ch***0…3***Band***0…7***.LimitBegin	Dynamix FFT Band Object	Start frequency in Hz
		Dynamix FFT Band Object	Start frequency in orders
Band Limit End	Ch***0…3***Band***0…7***.LimitEnd	Dynamix FFT Band Object	Stop frequency in Hz
		Dynamix FFT Band Object	Stop frequency in orders
Do main	Ch***0…3***Band***0…7***.Do main	Dynamix FFT Band Object	Source of band frequency limits
Speed Reference	Ch***0…3***Band***0…7***.SpeedRef	Dynamix FFT Band Object	Tacho source for band limits
DC Page			
Normal Thrust and Proportional Voltage – Measurement Units	Ch***0…3***DC.Units	Dynamix Transducer Object	Transducer DC Units
Normal Thrust and Proportional Voltage –Time Constant	Ch***0…3***DC.TimeConstant	Dynamix DC Measurement Object	DC Measurement TC
Normal Thrust and Proportional Voltage – Calibration Offset	Ch***0…3***DC.Offset	Dynamix DC Measurement Object	DC Measurement Offset
Normal Thrust and Proportional Voltage – Sense Control	Ch***0…3***DC.SenseControl	Dynamix DC Measurement Object	DC Measurement Sense Control
Rod Drop - Tachometer	Ch***0…3***DC.RodDropTriggerSource	Dynamix DC Measurement Object	Rod Drop Trigger Source
Rod Drop – Target Angle	Ch***0…3***DC.RodDropTargetAngle	Dynamix DC Measurement Object	Rod Drop Trigger Angle
Rod Drop –Angular Range	Ch***0…3***DC.RodDropAngularRange	Dynamix DC Measurement Object	Rod Drop Measurement Range
Rod Drop – Decay Time	Ch***0…3***DC.RodDropDecayTime	Dynamix DC Measurement Object	Rod Drop Decay Time
Differential Expansion – Ramp Angle	Ch0_1.SensorAAngle when Channel 0	Dynamix Dual Measurement Object	Sensor A Ramp Angle
	Ch0_1.SensorBAngle when Channel 1	Dynamix Dual Measurement Object	Sensor B Ramp Angle
	Ch2_3.SensorAAngle when Channel 2	Dynamix Dual Measurement Object	Sensor A Ramp Angle
	Ch2_3.SensorBAngle when Channel 3	Dynamix Dual Measurement Object	Sensor B Ramp Angle
Differential Expansion – Overall Axial Offset	Ch0_1.AxialOffset when Channel 0 or 1	Dynamix Dual Measurement Object	Overall Axial Offset
	Ch2_3.AxialOffset when Channel 2 or 3	Dynamix Dual Measurement Object	Overall Axial Offset
Differential Expansion – Overall Radial Offset	Ch0_1.RadialOffset when Channel 0 or 1	Dynamix Dual Measurement Object	Overall Radial Offset
	Ch2_3.RadialOffset when Channel 2 or 3	Dynamix Dual Measurement Object	Overall Radial Offset
Eccentricity - Tachometer	Ch***0…3***Overall.ConfigurePkPerRevolution	Dynamix AC Measurement Object	Configure Peak Per Revolution
Eccentricity – Minimum pk/revolution	Ch***0…3***Overall.MinPeakPerRevolutionRPM	Dynamix AC Measurement Object	Minimum RPM
Demand Page			
Signal Source	Ch***0…3***Demand.Source	Dynamix Advanced CM Data Object	Source Selection
TWF Measurement Units	Ch***0…3***Demand.TWFUnits	Dynamix Advanced CM Data Object	Measurement Units
Speed Reference	Ch***0…3***Demand.SpeedRef	Dynamix Advanced CM Data Object	Associated Tacho Source
Analog Output Page			
Enable	Ch***0…3***AnalogOut.En	Dynamix Current Output Module Object	Current Output Enable
Measurement	Ch***0…3***AnalogOut.MeasurementID	Dynamix Current Output Module Object	Current Output Measurement Identifier
Low Engineering	Ch***0…3***AnalogOut.LowEngineering	Dynamix Current Output Module Object	4 mA Output Scaling

Table 58 - Parameter – Tag – Object Attribute Cross-reference

High Engineering	Ch***0…3***AnalogOut.HighEngineering	Dynamix Current Output Module Object	20 mA Output Scaling
Fault Mode Output State	Ch***0…3***AnalogOut.FaultValue	Dynamix Current Output Module Object	Current Output Not OK Configuration
Measurement Alarm Page			
Enable Alarm	MeasAlarm***00…23***.En	Dynamix Measurement Alarm Object	Alarm Enable
Alarm Name	MeasAlarmName00_04[***x0…4***]	Dynamix Measurement Alarm Object	Alarm Name
	MeasAlarmName05_11[***0…6***]	Dynamix Measurement Alarm Object	Alarm Name
	MeasAlarmName12_18[***0…6***]	Dynamix Measurement Alarm Object	Alarm Name
	MeasAlarmName19_23[***0…4***]	Dynamix Measurement Alarm Object	Alarm Name
Measurement	MeasAlarm***00…23***.ID	Dynamix Measurement Alarm Object	Alarm Measurement Identifier
Condition	MeasAlarm***00…23***.Condition	Dynamix Measurement Alarm Object	Alarm Form
Transducer Fault Behavior	MeasAlarm***00…23***.SensorFaultAction	Dynamix Measurement Alarm Object	Alarm Type
Deadband	MeasAlarm***00…23***.AlarmDeadband	Dynamix Measurement Alarm Object	Hysteresis
Alert Alarm Delay Time	MeasAlarm***00…23***.AlertDelayTime	Dynamix Measurement Alarm Object	Delay/Sustain Time (Alert)
Danger Alarm Delay Time	MeasAlarm***00…23***.DangerDelayTime	Dynamix Measurement Alarm Object	Delay/Sustain Time (Danger)
Apply Limits From	MeasAlarm***00…23***.LimitMode	Dynamix Measurement Alarm Object	Alarm Processing Mode
Danger High Limit	MeasAlarm***00…23***.HDangerAlarmLimit	Dynamix Measurement Alarm Object	High Danger Threshold
Alert High Limit	MeasAlarm***00…23***.HAlertAlarmLimit	Dynamix Measurement Alarm Object	High Alert Threshold
Alert Low Limit	MeasAlarm***00…23***.LAlertAlarmLimit	Dynamix Measurement Alarm Object	Low Alert Threshold
Danger Low Limit	MeasAlarm***00…23***.LDangerAlarmLimit	Dynamix Measurement Alarm Object	Low Danger Threshold
Danger High Output Tag Limit	MeasAlarm***00…23***.HDangerAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for High Danger Threshold
Alert High Output Tag Limit	MeasAlarm***00…23***.HAlertAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for High Alert Threshold
Alert Low Output Tag Limit	MeasAlarm***00…23***.LAlertAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for Low Alert Threshold
Danger Low Output Tag Limit	MeasAlarm***00…23***.LDangerAlarmOutputRef	Dynamix Measurement Alarm Object	Profile mode - Reference for Low Danger Threshold
Limit Multiplier	MeasAlarm***00…23***.LimitMultiplier	Dynamix Measurement Alarm Object	Alarm Multiplier
Control Parameter	MeasAlarm***00…23***.AdaptiveSource	Dynamix Measurement Alarm Object	Adaptive Monitoring Source
High Limit	MeasAlarm***00…23***.Range***0…4***HLimit	Dynamix Measurement Alarm Object	Range ***0…4*** – upper control value

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Multiplier	MeasAlarm***00…23***.Range***0…4***Multiplier	Dynamix Measurement Alarm Object	Range ***0…4*** – Alarm Multiplier
Voted Alarm Page			
Alarm Name	VotedAlarmName00_01[***0…1***]	Dynamix Voted Alarm Object	Alarm Name
	VotedAlarmName02_08[***0…6***]	Dynamix Voted Alarm Object	Alarm Name
	VotedAlarmName09_12[***0…3***]	Dynamix Voted Alarm Object	Alarm Name
Alarm Status to Activate On – Alert	VotedAlarm***00…13***.AlarmOnAlert	Dynamix Voted Alarm Object	Alarm Usage
Alarm Status to Activate On – Danger	VotedAlarm***00…13***.AlarmOnDanger	Dynamix Voted Alarm Object	Alarm Usage
Alarm Status to Activate On – Transducer Fault	VotedAlarm***00…13***.AlarmOnTransducerFault	Dynamix Voted Alarm Object	Alarm Usage
Measurement Alarm – Input 0	VotedAlarm***00…13***.Alarm0Input	Dynamix Voted Alarm Object	Alarm Input 0
Measurement Alarm – Input 1	VotedAlarm***00…13***.Alarm1Input	Dynamix Voted Alarm Object	Alarm Input 1
Measurement Alarm – Input 2	VotedAlarm***00…13***.Alarm2Input	Dynamix Voted Alarm Object	Alarm Input 2
Measurement Alarm – Input 3	VotedAlarm***00…13***.Alarm3Input	Dynamix Voted Alarm Object	Alarm Input 3
Logic	VotedAlarm***00…13***.LogicCondition	Dynamix Voted Alarm Object	Alarm Logic Configuration
Setpoint Multiplier Trigger – Control 0	VotedAlarm***00…13***.LogicInput0	Dynamix Voted Alarm Object	Alarm Multiplier Control
	VotedAlarm***00…13***.ControllerSPM0	Dynamix Voted Alarm Object	Alarm Multiplier Control
Setpoint Multiplier Trigger – Control 1	VotedAlarm***00…13***.LogicInput1	Dynamix Voted Alarm Object	Alarm Multiplier Control
	VotedAlarm***00…13***.ControllerSPM1	Dynamix Voted Alarm Object	Alarm Multiplier Control
Setpoint Multiplier Trigger – Delay	VotedAlarm***00…13***.SPMDelayTime	Dynamix Voted Alarm Object	Alarm Multiplier ON Time
Gating Speed – Reference	VotedAlarm***00…13***.SpeedGatingEnSource	Dynamix Voted Alarm Object	Speed Gating Control
Gating Speed – Condition	VotedAlarm***00…13***.SpeedGateCondition	Dynamix Voted Alarm Object	Speed Gating Detection
Gating Speed – High Limit	VotedAlarm***00…13***.HSpeedGateLimit	Dynamix Voted Alarm Object	Higher Speed Threshold
Gating Speed – Low Limit	VotedAlarm***00…13***.LSpeedGateLimit	Dynamix Voted Alarm Object	Lower Speed Threshold
I/O Gating – Gate Control	VotedAlarm***00…13***.LogicGateSource	Dynamix Voted Alarm Object	Logic gating source
I/O Control	VotedAlarm***00…13***.LogicControlSource	Dynamix Voted Alarm Object	Logic control source
Relay Control – Fail-Safe Enable	VotedAlarm***00…13***.FailSafeEn	Dynamix Voted Alarm Object	Alarm Type
Relay Control – Latch Enable	VotedAlarm***00…13***.LatchEn	Dynamix Voted Alarm Object	Alarm Behavior
Relay Page			
Main Module Relay – Enable	ModuleControl.RelaySource	Dynamix Module Control Object	Relay Source
Main Module Relay – Voted Alarm Number	ModuleControl.RelaySource	Dynamix Module Control Object	Relay Source
Main Module Relay – Alarm Status to Activate On	ModuleControl.RelaySource	Dynamix Module Control Object	Relay Source
Main Module Relay – Module Fault	ModuleControl.ModuleFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Tach Fault	ModuleControl.TachFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Communication Fault	ModuleControl.CommunicationFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Expansion Module Fault	ModuleControl.ExpModuleFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Expansion Bus Fault	ModuleControl.ExpBusFault	Dynamix Module Control Object	User Local Relay Control
Main Module Relay – Latch Enable	ModuleControl.LatchEnabled	Dynamix Module Control Object	User Local Relay Control

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Expansion Module Relay – Enable	ExpansionRelay***0…2***.Relay***0…3***Source	Dynamix Relay Module Object	Relay ***0…3*** Source
Expansion Module Relay – Voted Alarm Number	ExpansionRelay***0…2***.Relay***0…3***Source	Dynamix Relay Module Object	Relay ***0…3*** Source
Expansion Module Relay – Alarm Status to Activate On	ExpansionRelay***0…2***.Relay***0…3***Source	Dynamix Relay Module Object	Relay ***0…3*** Source
Expansion Module Relay – Module Fault	ExpansionRelay***0…2***.Relay***0…3***TripOnModuleFaul t	Dynamix Relay Module Object	Relay ***0…3*** User Relay Control
Expansion Module Relay – Expansion Bus Fault	ExpansionRelay***0…2***.Relay***0…3***TripOnExpBusFault	Dynamix Relay Module Object	Relay ***0…3*** User Relay Control
Expansion Module Relay – Latch Enable	ExpansionRelay***0…2***.Relay***0…3***LatchEnabled	Dynamix Relay Module Object	Relay ***0…3*** User Relay Control
Trend Page			
Discrete Data - Ch***0…3*** Enable	Trend.DiscreteData***0…3***En	Dynamix Data Manager Object	Trend Data-Set Enable
Discrete Data – Update Rate	Trend.DiscreteUpdateMultiplier	Dynamix Data Manager Object	Trend Overall Update Multiplier
Dynamic Data - Ch***0…3*** Enable	Trend.DynamicData***0…3***En	Dynamix Data Manager Object	Trend Data-Set Enable
Dynamic Data – Update Rate	Trend.DynamicUpdateMultiplier	Dynamix Data Manager Object	Trend Dynamic Update Multiplier
Data-Set Definition	Trend.DiscreteParams[4]	Dynamix Data Manager Object	DWORD 0-…
Alarm Buffer – Enable Trigger	Trend.AlarmTriggerSource	Dynamix Data Manager Object	Alarm Data Storage Trigger Source
Alarm Buffer – Trigger On Any Alarm	Trend.AlarmTriggerSource	Dynamix Data Manager Object	Alarm Data Storage Trigger Source
Alarm Buffer – Voted Alarm Condition	Trend.AlarmTriggerSource	Dynamix Data Manager Object	Alarm Data Storage Trigger Source
Alarm Buffer – Enable Latching	Trend.AlarmLatchEn	Dynamix Data Manager Object	Alarm Data Storage Latching
Alarm Buffer – Post Trigger Low Resolution for Dynamic Data	Trend.DynamicLowResoultionPost Trigger	Dynamix Data Manager Object	Alarm % Post Trigger for Dynamic Data Records
Alarm Buffer – Post Trigger Low Resolution for Discrete Data	Trend.DiscreteLowResoultionPost Trigger	Dynamix Data Manager Object	Alarm % Post Trigger for Low-Resolution Overall Records
Alarm Buffer – Post Trigger High Resolution for Discrete Data	Trend.DiscreteHighResoultionPost Trigger	Dynamix Data Manager Object	Alarm % Post Trigger for High-Resolution Overall Records
Selected Parameters	Trend.DiscreteParams[***0…3***]	Dynamix Data Manager Object	DWORD ***0…3***
Transient Page			
Enable Transient Capture	TransientCapture.En	Dynamix Transient Data Manager Object	Transient Data Mode Control
Disable Dynamic Capture on Start Up	TransientCapture.OnStartUpDisable	Dynamix Transient Data Manager Object	Transient Data Mode Control
Disable Dynamic Capture on Coast Down	TransientCapture.OnCoastDownDisable	Dynamix Transient Data Manager Object	Transient Data Mode Control
Enable Latching	TransientCapture.LatchEn	Dynamix Transient Data Manager Object	Transient Data Mode Control
Enable Overflow	TransientCapture.OverflowEn	Dynamix Transient Data Manager Object	Transient Data Mode Control
Data-Set Definition	TransientCapture.DiscreteParams[4]	Dynamix Transient Data Manager Object	DWORD ***0…3***
Speed Reference	TransientCapture.ControlSpeedRef	Dynamix Transient Data Manager Object	Source of Speed Data
Low Speed Limit	TransientCapture.LowSpeedLimit	Dynamix Transient Data Manager Object	Low Speed Threshold
High-Speed Limit	TransientCapture.HighSpeedLimit	Dynamix Transient Data Manager Object	High-Speed Threshold

Table 58 - Parameter – Tag – Object Attribute Cross-reference

Start Up – Number of Buffers	TransientCapture.NumStartUpBuffers	Dynamix Transient Data Manager Object	Transient Data Mode Control
Start Up – Post Start Up Sample Time	TransientCapture.PostStartUpSample Time	Dynamix Transient Data Manager Object	Extra startup sample time
Start Up – Delta RPM Trigger	TransientCapture.StartUpDeltaRPM	Dynamix Transient Data Manager Object	Overall Delta RPM (SU)
Start Up – Delta Time Trigger	TransientCapture.StartUpDeltaTime	Dynamix Transient Data Manager Object	Overall Delta Time (SU)
Coast Down – Delta RPM Trigger	TransientCapture.CoastDownDeltaRPM	Dynamix Transient Data Manager Object	Overall Delta RPM (CD)
Coast Down – Delta Time Trigger	TransientCapture.CoastDownDeltaTime	Dynamix Transient Data Manager Object	Overall Delta Time (CD)

Engineering Units (ENGUNITS data type)

The Dynamix 1444 series supports the following engineering units. Each unit is assigned a specific value, which is what is used to populate the member of the configuration assembly, so is communicated to the module. In the CIP Library, all attributes of type ENGUNITS require a value, as shown.

Table 59 - Engineering Units (ENGUNITS data type)

Value	Descriptor	Value	Descriptor	Value	Descriptor
11520	V	4873	Pa	3330	kVA
11521	mV	4874	kPa	3331	VAR
8704	m	3072	MPa	3332	kVAR
8707	mm	4871	bar	5139	l/min
8708	micron	4872	mbar	5122	cfm
8711	inch	4864	psi	5129	US g/min
2048	mil	7168	A	2560	UK g/min
11008	m/s	7170	mA	2561	m^3/min
2304	mm/s	4610	K	2560	gSE
11015	inch/s	4608	^oC	2561	gE
5376	m/s^2	4609	^oF	7951	RPM
2816	mm/s^2	9728	W	3841	RPM/min
5378	$inch/s^2$	9734	kW	3840	EU
5380	g	3328	MW		
2817	mg	3329	VA		

IMPORTANT If there is a need to set engineering unit values, then care must be taken to help ensure that the units of the sensor and subsequent converted or integrated units are consistent with the functionality allowed and the configuration implemented. It is recommended that the desired unit entries be modeled using the AOP first to help ensure that the desired unit is allowed given the specific configuration.

Dynamix Configuration Manager Object

The dynamix configuration manager object (class code 0x38A) defines the personality of the module that is based on the selected module type and channel application types. It also provides the means by which a complete configuration is downloaded to the module.

Table 60 - Class Attributes

Attribute ID	Access Rule	NV	Name	Description of Attribute
1	Get	NV	Revision	Defines revision of Dynamix Configuration Manager Object
8	Get	NV	Template Revision	
9	Get/Set	NV	Configuration Group 1	See structure definition
10	Get/Set	NV	Configuration Group 2	See structure definition
11	Get/Set	NV	Configuration Group 3	See structure definition
12	Get/Set	NV	Configuration Group 4	See structure definition
13	Get/Set	NV	Configuration Group 5	See structure definition
14	Get/Set	NV	Configuration Group 6	See structure definition
15	Get/Set	NV	Configuration Group 7	See structure definition
16	Get/Set	NV	Configuration Group 8	See structure definition
17	Get/Set	NV	Configuration Group 9	See structure definition
18	Get/Set	NV	Configuration Group 10	See structure definition
19	Get/Set	NV	Configuration Group 11	See structure definition
20	Get/Set	NV	Configuration Group 12	See structure definition
21	Get/Set	NV	Configuration Group 13	See structure definition
22	Get/Set	NV	Configuration Group 14	See structure definition
23	Get/Set	NV	Configuration Group 15	See structure definition
24	Get/Set	NV	Configuration Group 16	See structure definition
25	Get/Set	NV	Configuration Group 17	See structure definition
26	Get/Set	NV	Configuration Group 18	See structure definition
27	Get/Set	NV	Configuration Group 19	See structure definition
28	Get/Set	NV	Configuration Group 20	See structure definition
29	Get/Set	NV	Configuration Group 21	See structure definition
30	Get/Set	NV	Configuration Group 22	See structure definition
31	Get/Set	NV	Configuration Group 23	See structure definition
32	Get/Set	NV	Configuration Group 24	See structure definition
33	Get/Set	NV	Configuration Group 25	See structure definition
34	Get/Set	NV	Configuration Group 26	See structure definition
35	Get/Set	NV	Configuration Group 27	See structure definition
36	Get/Set	NV	Configuration Group 28	See structure definition
37	Get/Set	NV	Configuration Group 29	See structure definition

Table 61 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	-	Configuration Status	BYTE	Defines module configuration status.	0: Out Of Box State (no configuration loaded) 1: Configuration loaded from nonvolatile memory 2: Configuration downloaded from controller.
17	Get	NV	AOP Module Type	SINT	AOP definition module personality.	Module Type
18	Get	NV	Module Type (applied)	SINT	Defines module personality.	Module Type
25	Get	NV	Compliance Mode	SINT	Whether considered a safety critical application and if so what level (such as API or API and SIL).	Compliance Mode
Channel Application Types						
32	Get	NV	AOP Channel 0 Application Type	INT	AOP definition - application types.	Application Index
33	Get	NV	AOP Channel 1 Application Type	INT		
34	Get	NV	AOP Channel 2 Application Type	INT		
35	Get	NV	AOP Channel 3 Application Type	INT		
36	Get	NV	Channel 0 Application Type	INT	Applied - application types.	Application Index
37	Get	NV	Channel 1 Application Type	INT		
38	Get	NV	Channel 2 Application Type	INT		
39	Get	NV	Channel 3 Application Type	INT		
64	Get	-	CIP Sync Support	BYTE	Availability of CIP Sync.	1: Available

Attribute Semantics

Table 62 - Module Type

Index	Description
1	RT - 4 Dynamic (4 kHz)
2	RT - 2 Dynamic (18 kHz) / 2 Static
32	RT - 2 Dynamic (4 kHz) - Dual Path
64	RT - 2 Dynamic (40 kHz)
-128	MX - 4 Dynamic (40 kHz) - Paired Channels
-96	MX - 4 Dynamic (40 kHz) - Individual Channels

The listed values are NEGATIVE 128 and NEGATIVE 64 (not dash).

Table 63 - Channel Application Type

Index	Description	Primary Path Filtering	Integration	Notes*
0	OFF	-	-	-
1	Temperature Transmitter (F)	OFF	-	1
2	Temperature Transmitter (C)	OFF	-	1
3	Temperature Transmitter (K)	OFF	-	1
4	DC Current	OFF	-	1
5	DC Voltage	OFF	-	1
6	Position	OFF	-	1
7	Rod Drop	OFF	-	1
8	Bearing Temperature (F)	OFF	-	1
9	Bearing Temperature (C)	OFF	-	1
10	Bearing Temperature (K)	OFF	-	1
77	X (shaft relative) - Filtered	LP-HP (24 dB)	-	4
78	Y (shaft relative) - Filtered	LP-HP (24 dB)	-	4
79	Eccentricity	LP (24 dB)	-	2
80	Aero Derivative (AV to V)	LP-HP (60 dB)	-	3
81	X (shaft relative)	LP (24 dB)	-	4
82	Y (shaft relative)	LP (24 dB)	-	4
83	Aero Derivative (AV to D)	LP-HP (60 dB)	Yes	3
84	Standard Case Absolute Vibration (A to A)	LP-HP (24 dB)	-	4
85	Standard Case Absolute Vibration (A to V)	LP-HP (24 dB)	Yes	4
86	Standard Case Absolute Vibration (A to D)	LP-HP (24 dB)	Yes	4
87	Standard Case Absolute Vibration (AV to V)	LP-HP (24 dB)	-	4
88	Standard Case Absolute Vibration (AV to D)	LP-HP (24 dB)	Yes	4
89	Standard Case Absolute Vibration (V to V)	LP-HP (24 dB)	-	4
90	Standard Case Absolute Vibration (V to D)	LP-HP (24 dB)	Yes	4
92	Dynamic Pressure (with filters)	LP-HP (24 dB)	-	5
93	Dynamic Pressure*	OFF	-	5
95	AC Current	LP-HP (24 dB)	-	4
96	AC Voltage	LP-HP (24 dB)	-	4
160	18 kHz Case Absolute Vibration (A to A)	LP-HP (24 dB)	-	6
161	18 kHz Case Absolute Vibration (A to V)	LP-HP (24 dB)	Yes	6
193	Complementary Differential Expansion A	OFF	-	1
194	Complementary Differential Expansion B	OFF	-	1
195	Ramp Differential Expansion A	OFF	-	1
196	Ramp Differential Expansion B	OFF	-	1
198	Shaft Relative (Absolute Shaft)	LP-HP (24 dB)	-	4
225	40 kHz Case Absolute Vibration (A to A)	LP-HP (24 dB)	-	7
226	40 kHz Case Absolute Vibration (A to V)	LP-HP (24 dB)	Yes	7
227	gSE (Spike Energy)	Special HP-LP	-	8

*Notes corresponding to numbers in preceding table:

1. Static/DC measurement types do not have AC (overall) measurement capabilities. In addition, no alternate path processing is available but Normal/Advanced CM data acquisition capabilities are available from main path sources.
2. Eccentricity will use a peak per revolution AC measurement assessment (see AC Measurement Object). Otherwise eccentricity falls within the 'general' dynamic category regarding capabilities, note 4.
3. Aero derivative applications types are based on specific processing requirements.

Generally two channels are deployed per turbine, one with a sensor positioned at the gas generator (compressor) frame, the other on the Power turbine frame. The expected input signal is velocity (AV) and type 83 integrates this signal to displacement, whereas type 80 does not.

The tacho signals are expected to be representative of gas generator and power turbine shaft speeds. Running a tracking filter from each tacho allows the (1x) components in the signal from each contributing source/shaft to be identified and measured.

- LP/HP filtering with 60 dB per octave characteristic
- Two fixed (5 Hz) bandwidth tracking filters for the gas generator 1x and power turbine 1x.
- The first order is/must be Tacho 0, the second order Tacho 1.
- Outside a speed range of 5…400 Hz, the output of the tracking filters is set to zero.
- Expected SRD is 32 (minimum that is allowed is 22).
- In this SRD range full CM capability, including synchronous sampling are available.

4. These are applications in the 'general' dynamic category where, for up to 4 kHz bandwidth, full filtering, processing, measurement and condition monitoring capabilities are available. SRD is adjustable from 32…9 (the latter providing the 4 kHz bandwidth).
5. Types 92 and 93 are for Dynamic Pressure applications.

Type 93 instigates a special processing scheme that is optimized for faster update of FFT band measurement data to support gas turbine combustion monitoring. Other measurement processing, including CM data transfer, is not supported in this mode.

Type 92 supports FFT bands but also retains primary path filter options, Overall (0) processing and a CM data transfer capability.

In both cases, the FFT band update rate is influenced by the total processing load placed on the module, for best performance deploy with the remaining channels configured for DC measurements or set OFF.

6. In 18 kHz mode, the following restrictions apply:
   - No tracking filter functionality is supported
   - Normal/Advanced CM data is only available from a main path source
   - To accommodate the 18 kHz bandwidth, the SRD for channels 0/1 is now adjustable, down to 2.
   - The SRD for channels 2/3 must be 32.
7. Due to the high sample rate invoked for '40 kHz' mode, the following restrictions apply:
   - The full 40 kHz bandwidth is available to the Overall (1) measurement (if set pre-filter)
   - FFT band and CM Data sources must relate to decimated sample streams, with a minimum decimation of 5.
   - Normal and Advanced CM data is available if their sources are both set post-filter [3]
   - No alternate path processing or tracking filter functionality is supported '40 kHz' is a special mode that is designed to be applied to both channels of a channel pair, with no SRD adjustment.
   - A mixture of application types 225 & 226 is however allowed.
8. Due to the high sample rate and signal processing requirements of gSE measurements, the following restrictions apply:
   - Overall (1) measurement is not supported
   - FFT band and CM Data sources must relate to decimated sample streams, decimation is set automatically based on filter settings.
   - Normal and Advanced CM data is available if their sources are both set post-filter [3]
   - No alternate path processing or tracking filter functionality is supported

gSE is a special mode that is designed to be applied to both channels of a channel pair, with no SRD adjustment

The dynamic pressure application type (not filtered version) instigates a special processing scheme that is optimized for faster update of FFT band measurement data. The application type includes disabling overall measurement processing, to support gas turbine combustion monitoring. Other measurement processing is not supported in the mode.

Table 64 - Compliance Mode

Index	Description
0	Open
1	API-670 only

Table 65 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0D			Apply Attributes	Applies pending configuration attributes (use any instance)
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute
0x10	x	-	Set Attribute Single	Sets the specified attribute

Object Specific Services

Table 66 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B				Not implemented
0x4C	x	x	Get Configuration Signature	The module calculated configuration CRC (along with some additional data) can be obtained using this Object Specific service. No instance or attribute is required. Configuration Time/Data and (Calculated) CRC relate only to Safety Configurations and Safety related parameters. Configuration Counter is fully general. Response:

Data Type	Name	Description
UINT32	Configuration Time	Milliseconds from previous midnight. AOP supplied. Updated and persistent only when valid.(1)
UINT16	Configuration Date	Days since 1/1/1972. AOP supplied. Updated and persistent only when valid.*
UINT32	Configuration Counter	Number of successful configurations since last power on. Not persistent (0 in Out of Box state).
UINT32	Calculated Safety CRC	The last calculated CRC. Updated and persistent only when valid.*

(1) The Time/Date/CRC fields are only updated and persistent when the configuration i a Safety Configuration (compliance mode indices 2...4) and the configuration is valid. For example, the module calculated CRC and the AOP supplied CRC match The additional data (a non-persistent Configuration Counter) is updated by a successful configuration download or restore of configuration from Nonvolatile Memory, irrespective of the compliance type. A counter-value of zero indicates tha the module is in Out of box State.

Configuration Group 1

Group 1 contains configuration attributes specific to the AOP and others from these objects:

- Mux Object (0x39B)
- Configuration Manager Object (0x38A)
- Transducer Object (0x38E)

Table 67 - Configuration Group 1

Source Object	Source Instance	Source Attribute	Name	Data Type
-	-	-	CfgRevNumber	DINT
-	-	-	LocalAOP	DINT[2]
0x38B	1	16	Time Slot 0 Minimum DAQ Time Multiplier	INT
0x38B	1	17	Time Slot 1 Minimum DAQ Time Multiplier	INT
0x38B	1	18	Time Slot 2 Minimum DAQ Time Multiplier	INT
0x38B	1	19	Time Slot 3 Minimum DAQ Time Multiplier	INT
-	-	-	CRC/Time/Date for verifying a safety configuration	DINT[3]
0x38A	1	17	AOP Module Type	SINT
		18	Module Type (Applied)	SINT
		25	Compliance Mode	SINT
-	-	-	Pad	SINT
0x38A	1	32	Channel 0 AOP Application Type	INT
		33	Channel 1 AOP Application Type	INT
		34	Channel 2 AOP Application Type	INT
		35	Channel 3 AOP Application Type	INT
		36	Channel 0 Application Type	INT
		37	Channel 1 Application Type	INT
		38	Channel 2 Application Type	INT
		39	Channel 3 Application Type	INT
0x38E	1	24	Transducer AC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	1	25	Transducer AC Sensitivity	REAL
		26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	1	27	Transducer DC sensitivity	REAL
		28	TX Power Setup	SINT
		32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT
0x38E	1	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL
0x38E	2	24	Transducer AC Units	ENGUNITS
			Pad	INT
0x38E	2	25	Transducer AC Sensitivity	REAL
		26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	2	27	Transducer DC sensitivity	REAL
		28	TX Power Setup	SINT
		32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT

Table 67 - Configuration Group 1

Source Object	Source Instance	Source Attribute	Name	Data Type
0x38E	2	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL
0x38E	3	24	Transducer AC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	25	Transducer AC Sensitivity	REAL
		26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	27	Transducer DC sensitivity	REAL
		28	TX Power Setup	SINT
		32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT
0x38E	2	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL
0x38E	3	24	Transducer AC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	25	Transducer AC Sensitivity	REAL
	3	26	Transducer DC Units	ENGUNITS
-	-	-	Pad	INT
0x38E	3	27	Transducer DC sensitivity	REAL
0x38E	4	28	TX Power Setup	SINT
0x38E	4	32	Transducer OK Configuration	BYTE
-	-	-	Pad	INT
0x38E	4	33	Transducer OK High Threshold	REAL
		34	Transducer OK Low Threshold	REAL

Configuration Group 2

Group 2 contains configuration attributes from these objects:

- Channel setup Object (0x38F)
- Module Control Object (0x39E)
- Tacho and Speed Measurement Object (0x395)
- TSC Module Object (0x394)

Table 68 - Configuration Group 2

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38F	1	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x38F	1	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x38F	2	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	Pad	SINT	
-	-	Pad	INT	
0x38F	2	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x38F	3	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 68 - Configuration Group 2

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38F	3	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x38F	4	16	LP Filter -3 dB Point	REAL
		17	HP Filter -3 dB Point	REAL
		18	Decimation	INT
		19	SRD	SINT
		20	Alternate Path enable	SINT
		21	Synchronous Tacho Source	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x38F	4	22	Synchronous samples per revolution	INT
		23	Alternate Path Decimation	INT
		24	Alternate LP Filter -3 dB Point	REAL
0x39E	0	16	Configured Auxiliary Modules	BYTE
		24	Tacho Mode	SINT
		32	Opto Output 0 Allocation	SINT
		33	Opto Output 1 Allocation	SINT
		40	User Local Relay Control	BYTE
		42	Relay Source	SINT
		64	Redundant Power Supply	SINT
-	-	-	Pad	SINT
0x39E	0	72	Channel 0 DSP FFT Enable	SINT
		73	Channel 0 DSP FFT Signal Source	SINT
		74	Channel 0 DSP FFT Measurement Units	ENGUNITS
		75	Channel 0 DSP FFT Line Resolution	SINT
		76	Channel 0 DSP FFT Window Function	SINT
		77	Channel 0 DSP FFT Number of averages	SINT
		78	Channel 0 DSP FFT Line value detection/scaling	SINT
		79	Channel 1 DP FFT Enable	SINT
		80	Channel 1 DSP FFT Signal Source	SINT
		81	Channel 1 DSP FFT Measurement Units	ENGUNITS
		82	Channel 1 DSP FFT Line Resolution	SINT
		83	Channel 1 DSP FFT Window Function	SINT
		84	Channel 1 DSP FFT Number of averages	SINT
		85	Channel 1 DSP FFT Line value detection/scaling	SINT
		86	Channel 2 DP FFT Enable	SINT

Table 68 - Configuration Group 2

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39E	0	87	Channel 2 DSP FFT Signal Source	SINT
		88	Channel 2 DSP FFT Measurement Units	ENGUNITS
		89	Channel 2 DSP FFT Line Resolution	SINT
		90	Channel 2 DSP FFT Window Function	SINT
		91	Channel 2 DSP FFT Number of averages	SINT
		92	Channel 2 DSP FFT Line value detection/scaling	SINT
		93	Channel 3 DP FFT Enable	SINT
		94	Channel 3 DSP FFT Signal Source	SINT
		95	Channel 3 DSP FFT Measurement Units	ENGUNITS
		96	Channel 3 DSP FFT Line Resolution	SINT
		97	Channel 3 DSP FFT Window Function	SINT
		98	Channel 3 DSP FFT Number of averages	SINT
		99	Channel 3 DSP FFT Line value detection/scaling	SINT
0x395	1	16	Tacho source	SINT
		17	Tacho OK Source	SINT
-	-	-	Pad	INT
0x395	1	19	Speed Multiplier	REAL
		21	Tacho Trigger Slope/Edge	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x395	1	24	ROC Delta Time	REAL
		25	ROC TC	REAL
0x395	2	16	Tacho source	SINT
		17	Tacho OK Source	SINT
-	-	-	Pad	INT
0x395	2	19	Speed Multiplier	REAL
		21	Tacho Trigger Slope/Edge	SINT
-	-	-	Pad	SINT
0x395	-	-	Pad	INT
0x395	2	24	ROC Delta Time	REAL
		25	ROC TC	REAL
0x394	0	18	Mode Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x394	1	16	Input Sensor Type	SINT
		24	Sensor Power Supply	SINT
		25	Sensor Target, pulses per revolution	INT
		32	Trigger Mode	SINT
-	-	-	Pad	SINT

Table 68 - Configuration Group 2

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x394	1	33	Trigger Threshold	INT
		34	Trigger Slope/Edge	SINT
		40	Sensor OK Definition	BYTE
		41	Sensor OK High Threshold	INT
		42	Sensor OK Low Threshold	INT
		43	High RPM Threshold	REAL
		44	Low RPM Threshold	REAL
		48	Tacho Bus Output	SINT
		49	TSCX Terminal/BNC Output	SINT
-	-	-	Pad	INT
0x394	2	16	Input Sensor Type	SINT
		24	Sensor Power Supply	SINT
		25	Sensor Target, pulses per revolution	INT
		32	Trigger Mode	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x394	2	33	Trigger Threshold	INT
		34	Trigger Slope/Edge	SINT
		40	Sensor OK Definition	BYTE
		41	Sensor OK High Threshold	INT
		42	Sensor OK Low Threshold	INT
		43	High RPM Threshold	REAL
		44	Low RPM Threshold	REAL
		48	Tacho Bus Output	SINT
		49	TSCX Terminal/BNC Output	SINT
-	-	-	Pad	INT

Configuration Group 3

Group 3 contains configuration attributes from these objects:

- Relay Module Object (0x39C)
- Dual Measurement Object (0x392)
- AC Measurement Object (0x390)

Table 69 - Configuration Group 3

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39C	1	17	Relay 0 Source	SINT
		18	Relay 1 Source	SINT
		19	Relay 2 Source	SINT
		20	Relay 3 Source	SINT
0x39C	1	36	Relay 0 User Relay Control	BYTE
		37	Relay 1 User Relay Control	BYTE
		38	Relay 2 User Relay Control	BYTE
		39	Relay 3 User Relay Control	BYTE
0x39C	2	17	Relay 0 Source	SINT
		18	Relay 1 Source	SINT
		19	Relay 2 Source	SINT
		20	Relay 3 Source	SINT
0x39C	2	36	Relay 0 User Relay Control	BYTE
		37	Relay 1 User Relay Control	BYTE
		38	Relay 2 User Relay Control	BYTE
		39	Relay 3 User Relay Control	BYTE
0x39C	3	17	Relay 0 Source	SINT
		18	Relay 1 Source	SINT
		19	Relay 2 Source	SINT
		20	Relay 3 Source	SINT
0x39C	3	36	Relay 0 User Relay Control	BYTE
		37	Relay 1 User Relay Control	BYTE
		38	Relay 2 User Relay Control	BYTE
		39	Relay 3 User Relay Control	BYTE
0x392	1	16	Sensor 0 Ramp Angle	REAL
		17	Sensor 1 Ramp Angle	REAL
		18	Overall Axial Offset 0/1	REAL
		19	Overall Radial Offset 0/1	REAL
0x392	2	16	Sensor 2 Ramp Angle	REAL
		17	Sensor 3 Ramp Angle	REAL
		18	Overall Axial Offset 2/3	REAL
		19	Overall Radial Offset 2/3	REAL

Table 69 - Configuration Group 3

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x390	1	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	1	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT
0x390	1	33	Minimum RPM for Peak per revolution	REAL
0x390	2	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	2	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x390	3	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	3	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT
0x390	3	33	Minimum RPM for Peak per revolution	REAL
0x390	4	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	4	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x390	5	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	5	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT

Table 69 - Configuration Group 3

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x390	5	33	Minimum RPM for Peak per revolution	REAL
0x390	6	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	6	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x390	7	17	AC Overall Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x390	7	18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
		32	Configure Peak per revolution	SINT
-	-	-	Pad	INT
0x390	7	33	Minimum RPM for Peak per revolution	REAL
0x390	8	16	AC Overall Measurement Source	SINT
-	-	-	Pad	SINT
0x390	8	17	AC Overall Measurement Units	ENGUNITS
		18	AC Overall Measurement RMS TC	REAL
		19	AC Overall Measurement Peak TC	REAL
		20	AC Overall magnitude - Detection	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Group 4

Group 4 contains configuration attributes from these objects:

- DC Measurement Object (0x391)
- Tracking Filter Object (0x393)

Table 70 - Configuration Group 4

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x391	1	16	DC Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x391	1	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x391	1	35	Rod Drop Decay Time	REAL
0x391	2	16	DC Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x391	2	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x391	2	35	Rod Drop Decay Time	REAL
0x391	3	16	DC Measurement Units	ENGUNITS
-	3	-	Pad	INT
0x391	3	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT

Table 70 - Configuration Group 4

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x391	3	35	Rod Drop Decay Time	REAL
0x391	4	16	DC Measurement Units	ENGUNITS
-	-	-	Pad	INT
0x391	4	17	DC Measurement TC	REAL
		18	DC Measurement Offset	REAL
		19	DC Measurement Sense Control	SINT
		20	DC Measurement Type	USINT
		32	Rod Drop Trigger Source	SINT
		33	Rod Drop Trigger Angle	INT
		34	Rod Drop Measurement Range	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x391	4	35	Rod Drop Decay Time	REAL
0x393	1	16	Tracking Filter Configuration	BYTE
-	-	-	Pad	SINT
0x393	1	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	1	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL
0x393	2	16	Tracking Filter Configuration	BYTE
-	-	-	Pad	SINT
0x393	2	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	2	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL
0x393	3	16	Tracking Filter Configuration	BYTE

Table 70 - Configuration Group 4

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
0x393	3	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	3	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL
0x393	4	16	Tracking Filter Configuration	BYTE
-	-	-	Pad	SINT
0x393	4	17	Order Measurement Units	ENGUNITS
		18	Order Measurement Scaling	SINT
		19	Tracking Filter Mode	SINT
-	-	-	Pad	INT
0x393	4	20	Tracking Filter Definition (Tacho 0)	REAL
		21	Tracking Filter Definition (Tacho 1)	REAL
		32	Tracking Filter 0 setup	REAL
		33	Tracking Filter 1 setup	REAL
		34	Tracking Filter 2 setup	REAL
		35	Tracking Filter 3 setup	REAL

Configuration Groups 5…16

The Measurement Alarm Object has 24 instances, spread across 12 groups (two instances per configuration group).

In the following table, for a particular group, N = 1 + (2*(Group; 5))

Examples:

- Group 5: N = 1 (source instances 1 and 2)
  - to
- Group 16: N = 23 (source instances 23 and 24)

Table 71 - Configuration Groups 5...16

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	N	16	Alarm Enable	SINT
-	-	-	Pad	SINT
0x396	N	17	Alarm Measurement Identifier	INT
		19	Alarm Form	SINT
		20	Alarm Type	SINT
		21	Alarm Processing Mode	SINT
-	-	-	Pad	SINT
0x396	N	24	Low Alert Threshold	REAL
		25	High Alert Threshold	REAL
		26	Low Danger Threshold	REAL
		27	High Danger Threshold	REAL
		32	Hysteresis	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x396	N	33	Delay/Sustain Time (Alert)	DINT
		34	Delay/Sustain Time (Danger)	DINT
		35	Alarm Multiplier	REAL
		40	Adaptive Monitoring Source	INT
-	-	-	Pad	INT

Table 71 - Configuration Groups 5...16

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	N	41	Range 1 - upper control value	REAL
		42	Range 1 - Alarm Multiplier	REAL
		43	Range 2 - upper control value	REAL
		44	Range 2 - Alarm Multiplier	REAL
		45	Range 3 - upper control value	REAL
		46	Range 3 - Alarm Multiplier	REAL
		47	Range 4 - upper control value	REAL
		48	Range 4 - Alarm Multiplier	REAL
		49	Range 5 - upper control value	REAL
		50	Range 5 - Alarm Multiplier	REAL
		64	Profile mode - Reference for Low Alert Threshold	SINT
		65	Profile mode - Reference for High Alert Threshold	SINT
		66	Profile mode - Reference for Low Danger Threshold	SINT
		67	Profile mode - Reference for High Danger Threshold	SINT
0x396	N+1	16	Alarm Enable	SINT
-	-	-	Pad	SINT
0x396	N+1	17	Alarm Measurement Identifier	INT
		19	Alarm Form	SINT
		20	Alarm Type	SINT
		21	Alarm Processing Mode	SINT
-	-	-	Pad	SINT
0x396	N+1	24	Low Alert Threshold	REAL
		25	High Alert Threshold	REAL
		26	Low Danger Threshold	REAL
		27	High Danger Threshold	REAL
		32	Hysteresis	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x396	N+1	33	Delay/Sustain Time (Alert)	DINT
		34	Delay/Sustain Time (Danger)	DINT
		35	Alarm Multiplier	REAL
		40	Adaptive Monitoring Source	INT
-	-	-	Pad	INT
0x396	N+1	41	Range 1 - upper control value	REAL
		42	Range 1 - Alarm Multiplier	REAL
		43	Range 2 - upper control value	REAL
		44	Range 2 - Alarm Multiplier	REAL
		45	Range 3 - upper control value	REAL

Table 71 - Configuration Groups 5...16

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	N+1	46	Range 3 - Alarm Multiplier	REAL
		47	Range 4 - upper control value	REAL
		48	Range 4 - Alarm Multiplier	REAL
		49	Range 5 - upper control value	REAL
		50	Range 5 - Alarm Multiplier	REAL
		64	Profile mode - Reference for Low Alert Threshold	SINT
		65	Profile mode - Reference for High Alert Threshold	SINT
		66	Profile mode - Reference for Low Danger Threshold	SINT
		67	Profile mode - Reference for High Danger Threshold	SINT

Configuration Group 17

Group 17 contains voted alarm object class attributes and instances 1…7.

Table 72 - Configuration Group 17

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	0	16	Trip Inhibit/Bypass Source	BYTE
		17	Alarm Reset Source	BYTE
-	-	-	Pad	INT
0x397	1	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	1	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT

Table 72 - Configuration Group 17

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	1	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	2	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	2	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	2	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	3	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	3	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT

Table 72 - Configuration Group 17

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x397	3	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	4	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	4	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	4	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
0x397	4	49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	5	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 72 - Configuration Group 17

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	5	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	5	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	6	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	6	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	6	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	7	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT

Table 72 - Configuration Group 17

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x397	7	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	7	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD

Configuration Group 18

Group 18 contains voted alarm object instances 8…13 and options to configure the input and output assemblies.

See Assembly Object on page 435, 0x04, for more on this configurability.

Table 73 - Configuration Group 18

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	8	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	8	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	8	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD

Table 73 - Configuration Group 18

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	9	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
0x397	9	26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	9	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	9	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	10	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	10	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT

Table 73 - Configuration Group 18

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	10	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	11	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
0x397	11	27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	11	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	11	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	12	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	12	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT

Table 73 - Configuration Group 18

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	INT
0x397	12	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
0x397	13	16	Alarm Usage	BYTE
		18	Alarm Behavior	SINT
		19	Alarm Type	SINT
		24	Alarm Logic Configuration	SINT
		25	Alarm Input 0	SINT
		26	Alarm Input 1	SINT
		27	Alarm Input 2	SINT
		28	Alarm Input 3	SINT
		32	Alarm Multiplier Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x397	13	33	Alarm Multiplier ON Time	DINT
		40	Speed Gating Control	SINT
		41	Speed Gating Detection	SINT
-	-	-	Pad	INT
0x397	13	42	Lower Speed Threshold	REAL
		43	Higher Speed Threshold	REAL
		48	Logic gating source	WORD
		49	Logic gating sense	USINT
		56	Logic Control source	WORD
-	-	-	Not used (Input Assembly Index)	SINT
-	-	-	Not used (Output Assembly Index)	SINT
-	-	-	Pad	INT
-	-	-	Not used (Number of input members)	UINT
-	-	-	*DWORD 0 (member list)	DWORD
-	-	-	*DWORD 1 (member list)	DWORD
-	-	-	*DWORD 2 (member list)	DWORD
-	-	-	*DWORD 3 (member list)	DWORD
-	-	-	*BYTE 0 (output member list)	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Group 19

Group 19 contains configuration attributes from these objects:

- Current Output Module Object (0x39D)
- Normal CM Data Object (0x398)
- Advanced CM Data Object (0x39A)
- FFT Band Object (0x399) Instances 1…4

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39D	0	15	Current Module Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	0	16	Auxiliary Link time out	UINT
0x39D	1	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	1	17	Current Output Measurement Identifier	INT
0x39D	1	19	20 mA Output scaling	REAL
0x39D	1	20	4 mA Output scaling	REAL
0x39D	1	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	2	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	2	17	Current Output Measurement Identifier	INT
0x39D	2	19	20 mA Output scaling	REAL
0x39D	2	20	4 mA Output scaling	REAL
0x39D	2	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	3	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	3	17	Current Output Measurement Identifier	INT
0x39D	3	19	20 mA Output scaling	REAL
0x39D	3	20	4 mA Output scaling	REAL
0x39D	3	24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	4	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	4	17	Current Output Measurement Identifier	INT
0x39D	4	19	20 mA Output scaling	REAL
0x39D	4	20	4 mA Output scaling	REAL
0x39D	4	24	Current Output Not OK Configuration	SINT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x398	0	16	Synchronization enable	SINT
0x398	0	17	Waveform/FFT storage format	BYTE
-	-	-	Pad	INT
0x398	1	16	Enable	BYTE
0x398	1	17	Signal Source	SINT
0x398	1	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	1	19	Measurement Units	ENGUNITS
0x398	1	20	Associated Tacho Source	SINT
0x398	1	21	Waveform Record Length	SINT
0x398	1	24	FFT Enable	SINT
0x398	1	25	FFT Line Resolution	SINT
0x398	1	26	FFT Window Function	SINT
0x398	1	27	FFT Averages	SINT
0x398	1	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	2	16	Enable	BYTE
0x398	2	17	Signal Source	SINT
0x398	2	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	2	19	Measurement Units	ENGUNITS
0x398	2	20	Associated Tacho Source	SINT
0x398	2	21	Waveform Record Length	SINT
0x398	2	24	FFT Enable	SINT
0x398	2	25	FFT Line Resolution	SINT
0x398	2	26	FFT Window Function	SINT
0x398	2	27	FFT Averages	SINT
0x398	2	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	3	16	Enable	BYTE
0x398	3	17	Signal Source	SINT
0x398	3	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	3	19	Measurement Units	ENGUNITS
0x398	3	20	Associated Tacho Source	SINT
0x398	3	21	Waveform Record Length	SINT
0x398	3	24	FFT Enable	SINT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x398	3	25	FFT Line Resolution	SINT
0x398	3	26	FFT Window Function	SINT
0x398	3	27	FFT Averages	SINT
0x398	3	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	4	16	Enable	BYTE
0x398	4	17	Signal Source	SINT
0x398	4	18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	4	19	Measurement Units	ENGUNITS
0x398	4	20	Associated Tacho Source	SINT
0x398	4	21	Waveform Record Length	SINT
0x398	4	24	FFT Enable	SINT
0x398	4	25	FFT Line Resolution	SINT
0x398	4	26	FFT Window Function	SINT
0x398	4	27	FFT Averages	SINT
0x398	4	28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x39A	0	16	Synchronized data control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39A	1	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	1	17	Measurement Units	ENGUNITS
0x39A	1	18	Associated Tacho Source	SINT
0x39A	1	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	2	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	2	17	Measurement Units	ENGUNITS
0x39A	2	18	Associated Tacho Source	SINT
0x39A	2	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	3	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	3	17	Measurement Units	ENGUNITS
0x39A	3	18	Associated Tacho Source	SINT
0x39A	3	19	Waveform Record Length	SINT
-	-	-	Pad	INT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39A	4	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	4	17	Measurement Units	ENGUNITS
0x39A	4	18	Associated Tacho Source	SINT
0x39A	4	19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x399	1	16	Channel Source	SINT
0x399	1	17	Data Source	SINT
0x399	1	18	Source of band frequency limits	SINT
0x399	1	23	Tacho source for band limits	SINT
0x399	1	19	Start frequency (Orders/Hz)	REAL
0x399	1	20	Stop frequency (Orders/Hz)	REAL
0x399	1	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	2	16	Channel Source	SINT
0x399	2	17	Data Source	SINT
0x399	2	18	Source of band frequency limits	SINT
0x399	2	23	Tacho source for band limits	SINT
0x399	2	19	Start frequency (Orders/Hz)	REAL
0x399	2	20	Stop frequency (Orders/Hz)	REAL
0x399	2	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	3	16	Channel Source	SINT
0x399	3	17	Data Source	SINT
0x399	3	18	Source of band frequency limits	SINT
0x399	3	23	Tacho source for band limits	SINT
0x399	3	19	Start frequency (Orders/Hz)	REAL
0x399	3	20	Stop frequency (Orders/Hz)	REAL
0x399	3	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	4	16	Channel Source	SINT
0x399	4	17	Data Source	SINT
0x399	4	18	Source of band frequency limits	SINT
0x399	4	23	Tacho source for band limits	SINT
0x399	4	19	Start frequency (Orders/Hz)	REAL
0x399	4	20	Stop frequency (Orders/Hz)	REAL

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	4	24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	0	15	Current Module Control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	0	16	Auxiliary Link time out	UINT
0x39D	1	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	1	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	2	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	2	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	3	16	Current Output Enable	SINT
-	-	-	Pad	SINT
0x39D	3	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39D	4	16	Current Output Enable	SINT
-	-	-	Pad	SINT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39D	4	17	Current Output Measurement Identifier	INT
		19	20 mA Output scaling	REAL
		20	4 mA Output scaling	REAL
		24	Current Output Not OK Configuration	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x398	0	16	Synchronization enable	SINT
		17	Waveform/FFT storage format	BYTE
-	-	-	Pad	INT
0x398	1	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	1	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	2	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	2	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	3	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
0x398	3	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x398	4	16	Enable	BYTE
		17	Signal Source	SINT
		18	Number of averages	SINT
-	-	-	Pad	SINT
0x398	4	19	Measurement Units	ENGUNITS
		20	Associated Tacho Source	SINT
		21	Waveform Record Length	SINT
		24	FFT Enable	SINT
		25	FFT Line Resolution	SINT
		26	FFT Window Function	SINT
		27	FFT Averages	SINT
		28	FFT Line value detection/scaling	SINT
-	-	-	Pad	SINT
0x39A	0	16	Synchronized data control	BYTE
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x39A	1	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	1	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	2	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	2	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	3	16	Source Selection	SINT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
-	-	-	Pad	SINT
0x39A	3	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x39A	4	16	Source Selection	SINT
-	-	-	Pad	SINT
0x39A	4	17	Measurement Units	ENGUNITS
		18	Associated Tacho Source	SINT
		19	Waveform Record Length	SINT
-	-	-	Pad	INT
0x399	1	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	2	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	3	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 74 - Configuration Group 19

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	4	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
0x399	4	19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Groups 20 and 21

Group 20 contains configuration attributes from the FFT Band Object (0x399) Instances 5…18.

Group 21 contains configuration attributes from the FFT Band Object (0x399) Instances 19…32.

Table 75 - Configuration Groups 20 and 21

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	5/19	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	6/20	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 75 - Configuration Groups 20 and 21

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	7/21	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	8/22	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	9/23	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	10/24	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 75 - Configuration Groups 20 and 21

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	11/25	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	12/26	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	13/27	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	14/28	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Table 75 - Configuration Groups 20 and 21

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x399	15/29	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	16/30	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	17/31	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT
0x399	18/32	16	Channel Source	SINT
		17	Data Source	SINT
		18	Source of band frequency limits	SINT
		23	Tacho source for band limits	SINT
		19	Start frequency (Orders/Hz)	REAL
		20	Stop frequency (Orders/Hz)	REAL
		24	FFT Band magnitude - Type	SINT
-	-	-	Pad	SINT
-	-	-	Pad	INT

Configuration Group 22

Group 22 contains configuration attributes from the following objects:

- Transducer Object (0x38E)
- Tacho and Speed Measurement Object (0x395)

Table 76 - Configuration Group 22

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38E	1	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x38E	2	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x38E	3	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x38E	4	16	Transducer Name	SINT[32]
		17	Transducer Orientation	INT
		18	Transducer Location	SINT
		19	Transducer Output Sense	SINT
0x395	1	18	Tacho 0 Name	SINT[32]
0x395	2	18	Tacho 1 Name	SINT[32]

Configuration Group 23

Group 23 contains configuration attributes from the following objects:

- TSC Module Object (0x394)
- Measurement Alarm Object (0x396) Instances 1…5

Table 77 - Configuration Group 23

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x394	1	17	Input Name 0	SINT[32]
	2	17	Input Name 1	SINT[32]
0x396	1	18	Alarm Name	SINT[32]
	2	18	Alarm Name	SINT[32]
	3	18	Alarm Name	SINT[32]
	4	18	Alarm Name	SINT[32]
	5	18	Alarm Name	SINT[32]

Configuration Group 24

Group 24 contains configuration attributes from the Measurement Alarm Object (0x396) Instances 6…12. Configuration Group 25

Table 78 - Configuration Group 24

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	6	18	Alarm Name	SINT[32]
	7	18	Alarm Name	SINT[32]
	8	18	Alarm Name	SINT[32]
	9	18	Alarm Name	SINT[32]
	10	18	Alarm Name	SINT[32]
	11	18	Alarm Name	SINT[32]
	12	18	Alarm Name	SINT[32]

Configuration Group 25

Group 25 contains configuration attributes from the Measurement Alarm Object (0x396) Instances 13…19.

Table 79 - Configuration Group 25

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	13	18	Alarm Name	SINT[32]
	14	18	Alarm Name	SINT[32]
	15	18	Alarm Name	SINT[32]
	16	18	Alarm Name	SINT[32]
	17	18	Alarm Name	SINT[32]
	18	18	Alarm Name	SINT[32]
	19	18	Alarm Name	SINT[32]

Configuration Group 26

Group 26 contains configuration attributes from the following objects:

- Measurement Alarm Object (0x396) Instances 20…24
- Voted Alarm Object (0x397) Instances 1 and 2

Table 80 - Configuration Group 26

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x396	20	18	Alarm Name	SINT[32]
	21	18	Alarm Name	SINT[32]
	22	18	Alarm Name	SINT[32]
	23	18	Alarm Name	SINT[32]
	24	18	Alarm Name	SINT[32]
0x397	1	17	Voted Alarm 0 Name	SINT[32]
	2	17	Voted Alarm 1 Name	SINT[32]

Configuration Group 27

Group 27 contains configuration attributes from the Voted Alarm Object (0x397) Instances 3…9.

Table 81 - Configuration Group 27

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	3	17	Voted Alarm 2 Name	SINT[32]
	4	17	Voted Alarm 3 Name	SINT[32]
	5	17	Voted Alarm 4 Name	SINT[32]
	6	17	Voted Alarm 5 Name	SINT[32]
	7	17	Voted Alarm 6 Name	SINT[32]
	8	17	Voted Alarm 7 Name	SINT[32]
	9	17	Voted Alarm 8 Name	SINT[32]

Configuration Group 28

Group 28 contains configuration attributes from the Voted Alarm Object (0x397) Instances 10…13.

Table 82 - Configuration Group 28

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x397	10	17	Voted Alarm 9 Name	SINT[32]
	11	17	Voted Alarm 10Name	SINT[32]
	12	17	Voted Alarm 11Name	SINT[32]
	13	17	Voted Alarm 12Name	SINT[32]

Configuration Group 29

Group 29 contains configuration attributes from the following objects:

- Current Output Module Object (0x39D)
- Data Manager Object (0x38B)
- Transient Data Manager Object (0x38C)

Table 83 - Configuration Group 29

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x39D	1	18	Current Output 0 Name	SINT[32]
	2	18	Current Output 1 Name	SINT[32]
	3	18	Current Output 2 Name	SINT[32]
	4	18	Current Output 3 Name	SINT[32]
0x38B	1	17	Trend Overall Update Multiplier	INT
-	-	-	Pad	INT
0x38B	1	18	Trend Dynamic Update Multiplier	DINT
		19	Alarm Overall Update Multiplier	INT
		24	Trend Data-Set Enable	BYTE
		32	Alarm Data Storage Trigger Source	SINT
		33	Alarm Data Storage Latching	SINT
		34	Alarm% Post Trigger for the High Resolution (100 ms) Overall Records	SINT
		35	Alarm% Post Trigger for the Low Resolution (Configured Rate) Overall Records	SINT
		36	Alarm% Post Trigger for Dynamic Data Records (10x Configured Overall Rate)	SINT
0x38B	1	48	DWORD 0 (Trend Static Data Source)	DWORD
		49	DWORD 1 (Trend Static Data Source)	DWORD
		50	DWORD 2 (Trend Static Data Source)	DWORD
		51	DWORD 3 (Trend Static Data Source)	DWORD
0x38C	1	16	Transient Data Mode Control	WORD
		18	Transient - Dynamic Data Selection	SINT
		23	Source of Speed Data	SINT
		24	Low-Speed Threshold	DINT
		25	High-Speed Threshold	DINT
		26	Overall Delta RPM (SU)	INT
		27	Overall Delta RPM (CD)	INT
		28	Overall Delta RPM (SU)	INT
		29	Overall Delta RPM (CD)	INT
		30	Disable Dynamic Data Storage	BYTE
-	-	-	Pad	SINT

Table 83 - Configuration Group 29

Source Object	Source Instance	Source Attribute ID	Name	Data Type
0x38C	1	31	Extra Startup Sample Time	INT
		64	DWORD 0 (Transient Static Data Source)	DWORD
		65	DWORD 1(Transient Static Data Source)	DWORD
		66	DWORD 2 (Transient Static Data Source)	DWORD
		67	DWORD 3 (Transient Static Data Source)	DWORD

Dynamix Data Manager Object

The Data Manager Object(class code 0x38B) defines the setup, data storage, and data access for Dynamix Trend and Dynamix Alarm data records. The Normal CM Data Object (0x398) configures which dynamic data is available to the Data Manager Object.

Table 84 - Object Instances

Instance ID	Description
0	Data Manager Class Instance
1	Data Manager Setup Instance

Table 85 - Class Attributes

Attribute ID	Access Rule	NV	Name	Description of Attribute
1	Get	NV	Revision	Defines revision of Dynamix Data Manager Object

Table 86 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Trend Data-Set Usage	BYTE	Not implemented - fixed at zero	Use attribute 24
2	Get	V	Trend Data-Set Status	BYTE	Returns the current operational mode	Bit 0 is set when the Low-Resolution Overall Trend records are cycling Bit 1 is set when the High-Resolution Overall Trend records are cycling Bit 2 is set when the FFT dynamic records are cycling Bit 3 is set when the TWF dynamic records are cycling Bits 4 to 7 are not used “Cycling” means that the buffer has filled and is now overwriting earlier entries.
3	Get	V	Trend Overall Data Records	UINT	Returns the number of static data records that the buffer	Fixed depth: 641
4	Get	V	Trend Dynamic Data Record Sets	UNIT	Returns the number of dynamic data records that the buffer currently holds.	Fixed depth: 64
5	Get	V	Alarm Data-Set Usage	USINT	Not implemented	Use attribute 24
6	Get	V	Alarm Data-Set Status	WORD	Returns the current operational status.	See Alarm Data-Set Status in Attribute Semantics

Table 86 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
7	Get	V	Alarm Overall (High Resolution) Data Records	UNIT	Returns the number of overall data records (at the fast update rate) that the buffer currently holds.	Fixed depth: 320
8	Get	V	Alarm Overall (Low Resolution) Data Records	UNIT	Returns the number of (low resolution) overall data records that the buffer currently holds.	Fixed depth: 640
9	Get	V	Alarm Dynamic Data Records	UNIT	Returns the number of dynamic data records that the buffer currently holds.	Fixed depth: 64
Update Rates				Group of 3 configuration attributes		
17	Get	NV	Trend Overall Update Multiplier	INT	The rate at which Trend Overall data records are stored, based on the fast update rate.	Multiples of 100 ms Default of 10 Range: 1…32767
18	Get	NV	Trend Dynamic Update Multiplier	DINT	The rate at which Trend Dynamic data records are stored, based on the fast update rate.	Multiples of 100 ms Default of 100 Range: 10…327670
19	Get	NV	Alarm Overall Update Multiplier	INT	Defines overall record update rate for use in alarm storage, which is based on the fast update rate.	Equal to Attribute 17 Range: 1…32767
Trend Data Storage				A configuration attribute		
24	Get	V	Trend Data-Set Enable	BYTE	Activate Trend Storage on a per channel basis	Bit enabled control. Se "Trend Data-Set Enable" under Attribute Semantics.
Alarm Data Storage				Group of 5 configuration attributes		
32	Get	V	Alarm Data Storage Trigger Source	SINT	Reference to Voted Alarm Object, including OFF option.	
33	Get	V	Alarm Data Storage Latching	SINT	If latching, the alarm data buffer does not update on subsequent alarm excursions unless the latch has been reset.	0: Not latching 1: Latching
34	Get	V	Alarm % Post Trigger for the High Resolution (100 ms) Overall Records	SINT	Overall, post-trigger setting for the 100 ms update rate - set in eighths of the total buffer length	Range: 0…8 Default: 2 (25%) (80 / 320 records)
35	Get	V	Alarm % Post Trigger for the Low Resolution (Configured Rate) Overall Records	SINT	Overall, post-trigger setting for the user configured update rate - set in eighths of the total buffer length	Range: 0…8 Default: 2 (25%) (160 / 640 records)
36	Get	V	Alarm % Post Trigger for Dynamic Data Records (10x Configured Overall Rate)	SINT	Overall, post-trigger setting for the dynamic data records - set in eighths of the total buffer length	Range: 0…8 Default: 2 (25%) (16 / 64 records)
Static Data Source				A group of four DWORDs where each bit indicates whether that measurement is included or not.		
48	Get	V	DWORD 0	DWORD		Range: 0…4294967295
49	Get	V	DWORD 1	DWORD		Range: 0…4294967295
50	Get	V	DWORD 2	DWORD		Range: 0…4294967295
51	Get	V	DWORD 3	DWORD	DWORD 3 is only partially populated with measurements, hence the lower range.	Range: 0…1023

Attribute Semantics

Table 87 - Alarm Data-Set Status

Bits	Description
0…3	Low-Resolution Overall Buffer
4…7	High-Resolution Overall Buffer
8…11	FFT Dynamic Data
12…15	TWF Dynamic Data

Within each section:

Value	Description
0x00	AB_STATUS_DISABLED (buffer/data type not being captured)
0x01	AB_STATUS_ARMED (waiting for alarm event trigger)
0x02	AB_STATUS_POPULATING (alarm event in progress)
0x03	AB_STATUS_DATA_READY (alarm data available)
0x04	AB_STATUS_LATCHED (as 0x03 but data is latched until reset)

Example 0x4444 is all buffers have latched alarm data available.

Trend Data-Set Enable

Bit	0	1	2	3	4	5	6	7
Type	Overall				Dynamic			
Channel	0	1	2	3	0	1	2	3

Alarm Data Storage Trigger Source

Bits	Description
0	OFF
1…13	Voted alarm instance 1…13, output type: Alert
14	Any Alert
15…16	Reserved
17…29	Voted alarm instance 1…13, output type: Danger
30	Any Danger
31…32	Reserved
33…45	Voted alarm instance 1…13, output type: TX OK
46	Any TX OK (TX Fail)
47…48	Reserved
49	Any Voted Alarm Output
Higher values	Reserved

0x00 disables any automatic storage function that is based on an alarm status.

Either by the controller via its output table or by a service, the alarm data storage can be triggered. These controls and the configured trigger source are ORed.

Table 88 - Status Data Bit Allocations

Bits	DWORD 0	DWORD 1	DWORD 2	DWORD 3
0	Overall (0) Channel 0	Order (2) Phase Channel 0	FFT Band (20)	Factored Speed 0
1	Overall (0) Channel 1	Order (2) Phase Channel 1	FFT Band (21)	Factored Speed 1
2	Overall (0) Channel 2	Order (2) Phase Channel 2	FFT Band (22)	Axial Differential Expansion Channel Pair 0
3	Overall (0) Channel 3	Order (2) Phase Channel 3	FFT Band (23)	Axial Differential Expansion Channel Pair 1
4	Overall (1) Channel 0	Order (3)Mag Channel 0	FFT Band (24)	Ramp Differential Expansion Radial Channel Pair 0
5	Overall (1) Channel 1	Order (3)Mag Channel 1	FFT Band (25)	Ramp Differential Expansion Radial Channel Pair 1
6	Overall (1) Channel 2	Order (3)Mag Channel 2	FFT Band (26)	Rod Drop Channel 0
7	Overall (1) Channel 3	Order (3)Mag Channel 3	FFT Band (27)	Rod Drop Channel 1
8	DC(V) Channel 0	Order (3) Phase Channel 0	FFT Band (28)	Rod Drop Channel 2
9	DC(V) Channel 1	Order (3) Phase Channel 1	FFT Band (29)	Rod Drop Channel 3
10	DC(V) Channel 2	Order (3) Phase Channel 2	FFT Band (30)	
11	DC(V) Channel 3	Order (3) Phase Channel 3	FFT Band (31)	
12	Order (0)Mag Channel 0	FFT Band (0)	Not 1X Channel 0	
13	Order (0)Mag Channel 1	FFT Band (1)	Not 1X Channel 1	
14	Order (0)Mag Channel 2	FFT Band (2)	Not 1X Channel 2	
15	Order (0)Mag Channel 3	FFT Band (3)	Not 1X Channel 3	
16	Order (0) Phase Channel 0	FFT Band (4)	DC Channel 0	
17	Order (0) Phase Channel 1	FFT Band (5)	DC Channel 1	
18	Order (0) Phase Channel 2	FFT Band (6)	DC Channel 2	
19	Order (0) Phase Channel 3	FFT Band (7)	DC Channel 3	
20	Order (1)Mag Channel 0	FFT Band (8)	S maxMag Channel Pair 0	
21	Order (1)Mag Channel 1	FFT Band (9)	S maxMag Channel Pair 1	

Table 88 - Status Data Bit Allocations

Bits	DWORD 0	DWORD 1	DWORD 2	DWORD 3
22	Order (1)Mag Channel 2	FFT Band (10)	S max Phase Channel Pair 0	
23	Order (1)Mag Channel 3	FFT Band (11)	S max Phase Channel Pair 1	
24	Order (1) Phase Channel 0	FFT Band (12)	Shaft Absolute pk-pk Channel Pair 0	
25	Order (1) Phase Channel 1	FFT Band (13)	Shaft Absolute pk-pk Channel Pair 1	
26	Order (1) Phase Channel 2	FFT Band (14)	Speed 0	
27	Order (1) Phase Channel 3	FFT Band (15)	Speed 1	
28	Order (2)Mag Channel 0	FFT Band (16)	Speed 0 maximum	
29	Order (2)Mag Channel 1	FFT Band (17)	Speed 1 maximum	
30	Order (2)Mag Channel 2	FFT Band (18)	Speed 0 Rate of Change	
21	Order (2)Mag Channel 3	FFT Band (19)	Speed 1 Rate of Change	

Table 89 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x05	x	x	Reset*	Alarm buffer reset
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

*A latched alarm buffer requires a reset to rearm it ready for a new trigger/alarm event (status is set to armed, zero stored records indicated and earlier data is no longer available). An alarm buffer reset is sent by the reset service above or via the controller output data.

If an alarm buffer reset is sent, the buffer will reset/rearm as described, irrespective of whether latching is configured. This reset acts as a marker that the data has been read/is finished with. The reset also provides for a clear indication of when a new event has been detected.

Availability of Dynamic Data

Immediately after power cycle or configuration download, dynamic data takes some time to become available as internal sample buffers must be populated based on the new time configuration.

In most cases, the delay may be a few seconds. However, for configurations with very low sample rates, the delay could be several minutes.

Object Specific Services

Table 90 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Alarm Buffer Trigger	Force the alarm data to be saved as if an alarm has occurred. This save is intended to be used when an alarm or event external to the DMx-M has occurred.
0x4C	-	x	CM Record Request*	Specify the Record Request parameters (defined in the following section). Since the records can be large and the request can be for many records, the Record Request usually has to be sent multiple times.

*Data types consisting of multiple bytes, are transferred in little endian format (least significant byte first).

A data communication session starts at the first service request and ends after the final response of the exchange. However, the session is subjected to an (inactivity) timeout of 30 seconds.

0x4C CM Record Request

CM data is retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that the service returns. When the packet count down value returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host sends the following CM Record Request Parameters as part of an 0x4C service request.

Table 91 - CM Record Request Parameters

Byte Offset within Structure	Structure Member	Data Type	Description
0	BufferSelect	INT	Specify the buffer to retrieve the data from: • eHIGH_RES_TREND (0) • eLOW_RES_TREND (1) • eFFT (2) • eTWF (3) • eTACHO (4) • eHIGH_RES_ALARM (5) • eLOW_RES_ALARM (6) • eFFT_ALARM (7) • eTWF_ALARM (8) • eTACHO_ALARM (9) The BufferSelect does not change during a session.
2	RequestedCount	UNIT	RequestedCount = 0 returns all records in the buffer. RequestedCount = 1 returns the most recently collected record. Any other positive count returns that number of records from the buffer. If the count is greater than the max available records, the max available records are returned instead. The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in CM Record Response must be passed here.
5	ChannelSelect	BYTE	4 Bits indicating the source channel. The ChannelSelect does not change during a session (see Channel Select). This field is ignored for all overall buffer types (eHIGH_RES_TREND, eLOW_RES_TREND, eHIGH_RES_ALARM, eLOW_RES_ALARM)
6	SpecialRequest	BYTE	Set SR_ mAG_PHASE (Bit 0) to request phase and magnitude data from an FFT buffer, otherwise just magnitude data is returned. Bits 1 and 2 are not used. Set SR_FILTER (Bit 3) to request that if samples are decimated or synchronously re-sampled then only 50% of the configured FFT lines are to be returned. For further information, see FFT Data Filter (SR_FILTER) under Sampling Control in the Channel Setup Object.
7	Pad	BYTE	Used to align data to a 32-bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the CM Record Response must be passed here.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The host sends the following CM Record Request Parameters as part of an 0x4C service request.

Byte Offset within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to three instances are supported.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0 though 3 are valid channels.
2	CompletedRecords	UNIT	This is incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UNIT	For a given session the RecordSize
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent CM Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that are transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array	DWORD[50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows:

High and Low-Resolution Trend (eHIGH_RES_TREND, eLOW_RES_TREND, eHIGH_RES_ALARM, eLOW_RES_ALARM)

Table 92 - Record Type Structures

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Can be used to calculate the bandwidth for the FFT.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	If SR_ mAG_PHASE (Bit 0) is set, phase array follows the mag array in the LineArray. Otherwise, just the magnitude array. Bit 3 is set if FFT Data Filter has been applied.
17	Reserved1	BYTE	
18	Reserved2	UINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

FFT (eFFT, eFFT_ALARM)

Table 93 - Record Type Structures

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy
4	TimestampSec	UDINT	Seconds since 1970
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution
12	identifier*	DWORD	Data source, mode, tacho source, and measurement units
16	ucDataSelect	BYTE	If Bit 0 is set, phase array follows the mag array in the LineArray. Otherwise, just the magnitude array. Bits 1 and 2 indicate FFT scaling: 0 Peak, 1 Peak to Peak, 2 RMS
17	ucSpeedByte0	BYTE	RPM value of the referenced speed source for the FFT data. Actual RPM = Value/100 Value provided is a 24 bit (3 byte) integer. First (least significant) byte, bits 0…7.
18	ucSpeedByte1	BYTE	Second byte, bits 8…15
19	ucSpeedByte2	BYTE	Last byte, bits 16…23
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

If the FFT is a synchronous measurement then the RPM value is also provided in the SamplePeriodInSecs parameter. In that case, the two RPM values are identical.

Waveform (eTWF, eTWF_ALARM)

Table 94 - Record Type Structures

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

Tacho (eTACHO, eTACHO_ALARM)

Table 95 - Record Type Structures

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	INTUD	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

For FFT and TWF data

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining three bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with ‘data on the wire’ of 0x 10DC7DO5:

- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous, it can be determined for the identifier field with use of the following format:

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post-filter)
5…6	Transfer path 1 data mode (bit 5 = 0 asynchronous bit 5 = 1 synchronous then bit 6 indicates which tacho was used)
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	Reserved

Behavior

Through the object-specific service 0x4C, the data manager object gives access to historical data (Trend and Alarm). See the normal CM object for access to 'Live' Dynamic data. Also for the Advanced CM data object for access to dynamically configurable analysis data (variable FFT lines, and so on) and to the Transient data manager object for access to stored transient event data.

CM Record Request - Recommendations for Network side implementation

The data is returned in multiple packets as an array of records of size RecordSize - this data amount can be a significant depending on the extent of the data requested. The recommended way to handle this data transfer is to store the payload to a file for later retrieval.

It is recommended to store the first packet request and response packet to the file. Thereafter, store the record array payload that is contained within each subsequent packet. If this procedure is followed, the packet arrangement within the file would be as follows:

- RecordRequest Packet
- RecordResponse Packet (with first packet payload at the end)
- Second Response Packet payload
- Subsequent Response Packet payloads
- Last Response Packet payload

Instigate further sessions to retrieve data from any other required buffers or channels. Retrieval of any record from the file can then be accomplished as follows:

1. Open the file.
2. Read a record with size of CM Record Request from the head of the file.
3. Access the BufferSelect variable to determine the type of record the file holds.
4. Read a record with size CM Record Response from the file pointer.
5. Access the RecordSize variable to determine the size of the record.
6. Start at the address of the first Record in the Data Array in the first CM Record Response. Then index to any record by using the RecordSize to seek to the correct point in the file.
7. Then read out the record of size RecordSize.

Dynamix Transient Data Manager Object

The Transient Manager Object (class code 0x38C) defines the setup of transient data acquisition mode and provides access to the associated transient data buffers. Furthermore this object allows for transient type definition, which can differentiate between normal and fast transients.

Table 96 - Object Instances

Instance ID	Description
0	Transient Data Manager Class Instance
1	Transient Data Manager Setup Instance

Table 97 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute
1	Get	NV	Revision	UINT	Defines revision of Dynamix Transient Data Manager Object

Table 98 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Transient Static Records	STRUCT	The number of overall/static data records currently stored in each of the 4 transient buffers.	Four UINT Maximum: 640 per
2	Get	V	Transient Dynamic Records		The number of dynamic data records currently stored in each of the 4 transient buffers.	Four UINT Maximum: 64 per
3	Get	V	Run-up Data-Set Usage	BYTE	Provide information as to which of the 4 buffers are configured for Run-up data storage	Bits 0…3 for the 4 normal mode buffers.
4	Get	V	Coast-Down Data-Set Usage	BYTE	Provide information as to which of the 4 buffers are configured for coast down data storage	Bits 0…3 for the 4 normal mode buffers.
5	Get	V	Transient Buffer Status	DWORD	Coded reference to the current status of each of the 4 buffers such as: Free, Populating, Data Ready, Processing, and Latched conditions.	4 x4 bits for the Normal Transient buffers.
High-Level Transient Operation				Group of 2 configuration attributes.		
16	Get	V	Transient Data Mode Control	WORD	Configuration of transient data-collection Mode (Normal or fast transient, buffer allocations, and so on).	Range: 0…1825
16	Get	V	Transient - Dynamic Data Source Selection	SINT	Future functionality. Default is whatever the Normal CM Data defines.	Fixed value: 0
Transient Data Acquisition				Group of 9 configuration attributes		
23	Get	V	Source of Speed Data	SINT	Source of speed data for transient data acquisition.	Range: 1…4
24	Get	V	Low Speed Threshold	DINT	Defines the speed threshold that initiates a startup transient and identifies where a coast-down transient stops.	RPM Range: 1…28000
25	Get	V	High-Speed Threshold	DINT	Defines the speed threshold that initiates a coast down transient and identifies where a start-up transient stops.	RPM Range: 50…29000

Table 98 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
26	Get	V	Overall Delta RPM (SU)	INT	Speed interval at which the overall transient data records are stored. Separate delta RPM for run up and coast down events.	1…1000 RPM in 1 RPM steps 0: no delta RPM storage
27	Get	V	Overall Delta RPM (CD)	INT	Speed interval at which the overall transient data records are stored. Separate delta RPM for run up and coast down events.	1…1000 RPM in 1 RPM steps 0: no delta RPM storage
28	Get	V	Overall Delta Time (SU)	INT	Delta time interval that triggers overall value data storage when RPM change re mains within delta RPM value.	s Range: 1…3600
29	Get	V	Overall Delta Time (CD)	INT	Delta time interval that triggers overall value data storage when RPM change re mains within delta RPM value.	s Range: 1…3600
30	Get	V	Disable Dynamic Data Storage	BYTE	Ability to disable dynamic data storage (if it is not of interest).	Bit 0 for SU Bit 1 for CD, disable. Range: 0…3
31	Get	V	Extra Startup Sample Time	INT	Extends the time duration of a start-up event.	s Range: 0…32767
Transient Static Data Source				Group of 4DWORDs where each bit indicates whether that measurement is included or not.		
64	Get	V	DWORD 0	DWORD		Range: 0…4294967295
65	Get	V	DWORD 1	DWORD		Range: 0…4294967295
66	Get	V	DWORD 2	DWORD		Range: 0…4294967295
67	Get	V	DWORD 3	DWORD	DWORD 3 is only partially populated with measurements, hence the lower range.	Range: 0…1023

Attribute Semantics

Transient Buffer Status

The status for the normal mode buffers occupy the first (lowest) 16 bits. The highest 16 bits are reserved.

Bits 0…3 are for Buffer 0, through to bits 12…15 for Buffer 3.

Within each section, the following values/meaning have been allocated:

- **0x00** Buffer Free (available, ready for a transient event)
- **0x01** Data Ready Normal (transient completed normally, buffer latched)
- **0x02** Data Latched Normal (transient completed normally, but could be overwritten by a new event)
- **0x03** Transient in progress RPM (delta time acquisition in progress)
- **0x04** Transient in progress Time (delta time acquisition in progress)
- **0x05** Data Ready Aborted (speed crossed back over the same threshold, but could be overwritten by a new event)
- **0x06** Data Latched Aborted (speed crossed back over the same threshold, buffer latched)
- **0x07** Data Ready timeout (speed crossed one RPM threshold then timed out, but could be overwritten by a new event)
- **0x08** Data Latched timeout (speed crossed one RPM threshold then timeout, buffer latched)

Example 0x****2222 would indicate all four transient buffers latched with data from transient events that completed normally.

In the case where the speed crossed back over the same threshold (an incomplete transient event), a buffer that is configured as latching will still be left unlatched. This condition makes it available for a new event if the amount of data that is stored is less than a fixed percentage of the buffer capacity. This function helps ensure that an aborted transient event with little data available is automatically 'released' for potential capture of later events.

The percentage is not configurable but is TBD.

Timeout refers to the situation where one speed threshold is crossed and the buffer is filled to maximum capacity before any further speed threshold crossing occurs.

Transient Data Mode

Bits	Description
0	Disable (0) or enable (1) transient mode
1	Startup: Bit set for Fast Transient Data Collection Mode. Default is Normal Transient Data Collection Mode (Sets of overall and Dynamic data)
2	Coast down: Bit set for Fast Transient Data Collection Mode. Default is Normal Transient Data Collection Mode (Sets of overall and Dynamic data)
3…5	Number of buffers that are allocated to start up in Normal Mode (referred to by RU or SU). Values 0…4, default 2.
6…8	Number of buffers that are allocated to coast down in Normal Mode (CD). Values 0…4, default 2.
9	Buffer latch control
10	Use additional available buffers for the same (extended) transient event
11…15	Reserved for future functionality (fast transient capture using long time records)

Not all bit combinations are valid: total number of buffers that are allocated must be no more than 4.

Startup buffers are allocated first, to the lower buffers.

Source of Speed Data for Transient Data Acquisition

Any one of the following can be identified as the speed reference used in transient data acquisition:

Value	Description
1	Tacho/Speed 0
2	Tacho/Speed 1
3	Factored speed from Tacho 0
4	Factored speed from Tacho 1
Higher Values	Reserved

Table 99 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

The data types consisting of multiple bytes are transferred in little endian format (least significant byte first).

Also note that a data communication session starts at the first service request and ends after the final response of the exchange. However, it is subject of an (inactivity) timeout of 30 seconds.

Table 100 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Reset transient buffer 0	Buffer-specific controls
0x4C	x	x	Reset transient buffer 1	
0x4D	x	x	Reset transient buffer 2	
0x4E	x	x	Reset transient buffer 3	
0x4F	-	x	Transient Buffer Upload	See “0x4F Transient Record Request”

0x4F Transient Record Request

Transient data is retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that the service returns. When the packet count down value returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host sends the following Transient Record Request Parameters as part of an 0x4F service request. This process is identical to the Data Manager Object (0x38B), Service 0x4C CM Buffer Upload. Both services call the same service handling code. That code is why the buffer select codes do not overlap with the codes for the Data Manager Object.

Table 101 - 0x4F Transient Record Request

Byte Offset within Structure	Structure Member	Data Type	Description
0	BufferSelect	INT	Specify the buffer to retrieve the data from: • eOVERALL_TD0 (10), eFFT_TD0 (11), • eTWF_TD0 (12), eTACHOL_TD0 (13), • eOVERALL_TD1 (14), eFFT_TD1 (15), • eTWF_TD1 (16), eTACHOL_TD1 (17), • eOVERALL_TD2 (18), eFFT_TD2 (19), • eTWF_TD2 (20), eTACHOL_TD2 (21), • eOVERALL_TD3 (22), eFFT_TD3 (23), • eTWF_TD3 (24), eTACHOL_TD3 (25) The BufferSelect does not change during a session.
2	RequestedCount	UINT	RequestedCount = 0 returns all records in the buffer. RequestedCount = 1 returns the most recently collected record. Any other positive count returns that number of records from the buffer. If the count is greater than the max available records, the max available records is returned instead. The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in CM Record Response must be passed here.
5	ChannelSelect	BYTE	4 Bits indicating the source channel. The ChannelSelect does not change during a session. This field is ignored for all overall buffer types (eOVERALL_TD0, eOVERALL_TD1, eOVERALL_TD2, eOVERALL_TD3)
6	SpecialRequest	BYTE	Bits 0, 1 and 2 are not used. Set SR_FILTER (Bit 3) to request that if samples are decimated or synchronously re-sampled then only 50% of the configured FFT lines are to be returned. For further information, see FFT Data Filter (SR_FILTER) under Sampling Control in the Channel Setup Object.
7	Pad	BYTE	Used to align data to a 32-bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the response must be passed here.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The Dynamix 1444, as part of an 0x4F service response, return the following:

Table 102 - 0x4F Service Responses

Byte Offset within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to 3 instances are supported.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0…3 are valid channels.
2	Completed Records	UINT	This is incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UINT	For a given session the RecordSize returned here is fixed.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) • eLiveMeasurementInProgress (13) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array	DWORD [50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows:

Table 103 - Overall Data (eOVERALL_TDx)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	DWORD	
12	Reserved	DWORD	
16	OverallEnableBlock0	DWORD	Static Data Source (1 of 4), attributes 64…67.
20	OverallEnableBlock1	DWORD	
24	OverallEnableBlock2	DWORD	
28	OverallEnableBlock3	DWORD	
32	ByteCount	UDINT	The size of the following array in bytes.
36	OverallArray	REAL	The array of overall data.

Table 104 - FFT (eFFT_TDx)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and no of samples per revolution.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	Not used for transient data. Only Magnitude data is available. Bit 3 is set if FFT Data Filter has been applied.
17	ucSpeedByte0	BYTE	RPM value of the referenced speed source for the FFT data. Actual RPM = Value/100 Value provided is a 24 bit (3 byte) integer. First (least significant) byte, bits 0…7
18	ucSpeedByte1	BYTE	Second byte, bits 8…15
19	ucSpeedByte2	BYTE	Last byte, bits 16…23
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

Table 105 - Waveform (eTWF_TDx)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

Table 106 - Tacho (eTACHO_TDx)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
34	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

Dynamix Event Log Object

The event log object refers to a module-based event log, where a history of key events can be held in NV memory - both alarm and system events are retained. At least the last 6,500 event entries can be retained, but noting that an actual event can generate multiple log entries.

The event log referred to by this object is Dynamix module functionality, independent of any Logix functions of the same, or similar name.

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining 3 bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with 'data on the wire' of 0x 10DC7D05:
- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous, it can be determined for the identifier field with use of the following format:

Table 107 - Dynamix Event Log Object

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post=filter)
5…6	Transfer path 1 data mode (bit = 0 asynchronous, bit 5 = 1 synchronous then bit 6 indicates which tacho was used)
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	Reserved

Behavior

Data that are stored during a transient event consists of both overall and dynamic data.

Attributes 64…67 specifies the overall data to be captured:
- Those attributes can specify different data to that data stored in the Trend Buffer or that transferred across the I/O connection
- The set of measurements can be freely chosen from all channel and measurement combinations
- A maximum of 61 measurements is supported, the speed reference for the transient event is added automatically.
- Each overall record consists of current values of all configured measurements, triggered by a change in rpm or elapsed time.

The dynamic data is generally that specified by the Normal CM data object. It is limited to a maximum of 800 line FFT and 2048 point TWF.

Each dynamic record consists of TWF/FFT, generally from across the four channels, triggered by a change in rpm or elapsed time. Dynamic records are captured at one tenth the configured overall rates to match their relative storage depths.

Four transient buffers are provided, so up to four different transient events can be stored on the module. If long transient events are expected, it is possible (by configuration) to designate that more buffers of the same type be used for the same transient event. It is also possible to configure buffer latching so that the captured data would represent the 'first' transient events rather than the most recent.

Transient buffers can be reset (clear current data, set status to free ready to accept new data) by the I/O connection or by the object-specific services provided. Both methods can reset individual transient buffers.

Table 108 - Object Instances

Instance ID	Description
0	Event Log Class Instance

Table 109 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute
1	Get	NV	Revision	UINT	Current object revision.
8	Get	NV	Last Alarm Time/Date	STRUCT	Time Stamp of last Alarm logged. Can be 16 bytes.
9	Get	NV	Last Event Time/Date	STRUCT	Time Stamp of last Event logged. Can be 16 bytes.
10	Get	NV	Erase Cycles	UDINT	Number of update erase cycles so far. < 100,000 advised.

Table 110 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x01	x	-	Get Attributes All	Returns the contents of the specified attribute
0x0E	x	-	Get Attribute Single	Returns the contents of the specified attribute

Table 111 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	-	Event log upload	This service allows block upload of the Event data using a predefined format. Partial uploads (such as the last 250 events) is supported.

0x4B Event Log Record Request

Event log entries are retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that the service returns. When the packet count down value returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host, as part of an 0x4B service request, sends the following Request Parameters. This process is identical to the Data Manager Object (0x38B), Service 0x4C CM Buffer Upload. Both services call the same service handling code. That code is why the buffer select codes do not overlap with the codes for the data manager object.

Table 112 - Event Log Entries

Byte Offset within Structure	Structure Member	Data Type	Description
0	BufferSelect	INT	Specify the buffer to retrieve the data from: eEVENT_LOG (26) The BufferSelect does not change during a session.
2	RequestedCount	UNIT	RequestedCount = 0 returns all records in the buffer. RequestedCount = 1 returns the most recently collected record. Any other positive count returns that number of records from the buffer. If the count is greater than the max available records, the max available records is returned instead. The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in the response must be passed here.
5	Reserved	BYTE	
6	Pad	INT	Used to align data to a 32-bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the response must be passed here.

The Dynamix 1444 return the following as part of an 0x4B service response.

Table 113 - 0x4B Service Responses

Byte Offset within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent Record Request. Up to 3 instances are supported.
2	Completed Records	UINT	This is incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UINT	In this case, it is fixed at the size of one event log record, 16 bytes.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array		Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

DWORD[50]

The Generalized Event Type Structure is as follows:

Table 114 - Event Data (eEVENT_LOG)

Byte Offset within Structure	Structure Member	Data Type	Description
0	Event Type	BYTE	Events fall into one of these types: • SYSTEM (0x01) • ALARM (0x02) • BUFFER (0x03).
1	Event ID	BYTE	For each Event, Type a range (0 up to a maximum 256) of Event IDs are defined. See event-specific definitions.
2	Event Time Seconds	DWORD	Seconds since 1970.
6	Event Time Subsecond	WORD	Microseconds.
8	Event Specific Information	BYTE	Last 8 bytes - See event-specific definitions in behavior section
9		BYTE	
10		BYTE	

Table 114 - Event Data (eEVENT_LOG)

11		BYTE	
12		BYTE	
13		BYTE	
14		BYTE	
15		BYTE	

Behavior

Events that are stored in the log fall in to one of these types: SYSTEM (0x01), ALARM (0x02), BUFFER (0x03).

Each has a common header, followed by 8 bytes that are specific to the type. Many events (such as startup) are self-explanatory 'change events' and have no additional data that is provided in the event-specific information bytes.

Change Events

Change events are logged when there is a detected change in the status content and are not triggered directly by the actual state (‘good or bad’).

Table 115 - System Event Types

ID	Name	Description	Bytes 8…15 Application
01	NetX start-up	The communication processor has reset/ restarted	No data byes are used
02	Transitioned to Program Mode	Configuration activity is underway	No data byes are used
03	Configuration Count update	A configuration activity has successfully completed	Bytes 10/11 indicate the new count
04	Transitioned to Run mode	Configuration activity is complete	No data byes are used
05	Switch to Out Of Box Configuration	An instruction to switch the Out of Box mode is being processed (reset type 1/2)	No data byes are used
06	I/O connection opened	Forward open for an I/O connection received	No data byes are used
07	I/O connection closed	Forward close for an I/O connection received or connection lost	No data byes are used
08	Firmware Update	A Firmware Update was successfully processed	Byte 10 indicates which firmware was updated (instance number)
09…13	Not allocated		
14	Redundant power supply status	A change in the redundant power supply status has been detected	Byte 8 is previous state and 9 the current 1 is fail, 1 is OK
15	AUX module detection	Identifies change in which auxiliary modules are detected	Byte 8 is previous state and 10 the current Bit set indicates that the module is missing
16	AUX module status	A change in auxiliary module reported status has been logged	Byte 8 is previous state and 9 the current 1 is fail, 0 is OK

Table 115 - System Event Types

ID	Name	Description	Bytes 8…15 Application
17	Internal power supply status	Internal power supply status change	Bytes 8/9 are previous NetX status bits 16...31, bytes 10/22 are the new status data
18	NetX status (other)	Detected network issues	Byte 8 is previous NetX status bits 16...31, bytes 10/11 are the new status data
19	Controller output assembly	Changes in the 16-bit output assembly control data have been detected	Bytes 8/0 are previous controller data, bytes 10/11 are the new controller data
20	Object service	Monitoring of key-object services	Byte 10 is an index indicating the action, byte 11 is used to distinguish between instances
21	DSP (reported) status	Changes in the DSP status DWORD	Bytes 8/11 are previous DSP Status DWORD, Bytes 12/15 are new DSP Status DWORD
22	Main transducer status	Changes in the Channel/Transducer status WORD	Bytes 8/9 are previous TX status bits 0...15, bytes 10/11 are the new TX status bits 0...15
23	Speed/tacho status	Changes in the Speed/tacho status Byte	Byte 8 is previous state and 10 the current
24	Relay states	Relay state change	Bytes 8/9 are previous relay status bits 0...15, bytes 10/11 are the new relay status bits 0...15
25	AUX Module Exception	A change in Auxiliary module exception codes	Bytes 8/9 are previous exception data, bytes 10/11 are the new exception data
26	Calibration status	A change in module (channel) calibration status	Byte 8 is previous state and 10 the current
27	DSP startup response	Whether the DSP start-up was judged normal or not	Byte 3 indicates the startup state: 0 - not responding, 1- normal, 2- boot loader mode detected
Notes			
Expansion Module Detection			
	• The same bit allocations are used as in Module Control Attributes 2 and 16 • Here, bit set indicates that module is expected but missing		
Expansion Module Status			
	• Bytes 8 and 12 both indicate the particular module reporting the change • The same bit allocations are used as in Module Control Attributes 2 and 16 • Bytes 9 and 13 are unused • Bytes 10/11 represent the previous status, bytes 14/15 the new status		
Internal Power supply status			
	• The expected (OK state) returned values are 255...195		
AUX Processor status (other) include:			
	• bit 1 (value 2) set in the case of a network fault (example: disconnected • bit 2 (value 4) set in the case of a network address conflict being detected		
Object service			

Table 115 - System Event Types

ID	Name	Description	Bytes 8…15 Application
	• Byte 10 is an index indicating the action 1. Alarm Buffer Trigger (Data Manager Object) 2. Alarm Buffer Reset (Data Manager Object) 3. Reset Transient Data Buffer 4. Zero DC measurement 5. Zero Dual Channel measurement In the case of 3, 4, and 5 where there are multiple measurements or buffers, byte 11 indicates the instance number.		
DSP (reported) status includes:			
	• bit 7 (value 128) set when the DSP is running from a configuration from its own Nonvolatile Memory • bit 10 (value 4) set when the DSP has received a different configuration from the NetX		
Relay Status			
	• Bits 0 to 12 represent the maximum possible system relay count of 13, a bit set to 1 indicated relay energized		
Calibration Status			
	• The high byte of the Channel/TX/Speed DWORD • Four bits used, a bit set indicates that channel has a calibration failure		

Table 116 - Alarm Event Types

ID	Name	Bytes 8...15 Application
01	Measurement Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
02	(OK) Voted Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
03	(Alert) Voted Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
04	(Danger) Voted Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
05	Special Relay Source Alarm Status	Previous Alarm Status 8...11 * New Alarm Status 12...15
Notes		
	While the returned data is the same, the trigger is different in each case. A measurement alarm status event is triggered by a change in the upper 16 bits, this can be considered 'pre-alarm' data. A voted alarm status change is triggered by a change in the overall alarm state (true or false). The voted alarm status changes are categorized as OK, Alert, or Danger, which is based on which alarm output they relate to (encoded as bits 14/15). The special relay source alarm status is used where a dedicated module fail or 'inhibit active' relay has been configured and reflects a change in status of this monitoring.	

Table 117 - Buffer Event Types

ID	Name	Bytes 8…15 Application
01	Trend Data-Set Status	Bytes 8/9 are previous Trend Buffer status, bytes 10/11 are the new Trend Buffer status
02	Alarm Data-Set Status	Bytes 8/9 are previous Alarm Buffer status, bytes 10/11 are the new Alarm Buffer status
03	Transient Data-Set Status	Bytes 8/9 are previous Transient Buffer status, bytes 10/11 are the new Transient Buffer status
Notes		
	Buffer events indicate a change in status of these buffers (example: armed to populating or population to data ready)	

Worked Example of Event Decoding

Each event log entry is a 16 byte record consisting of a number of sub structures: Example hex data on the wire: 01 15 71F53854 9600 00 00 00 00 00 40 00 00

Table 118 - Event Log Entries

Subsection	Location	Example
Event Type	Byte 0	01
Event ID	Byte 1	15
Event time (seconds)	Bytes 2…5	5438F571
Event time (subseconds)	Bytes 6…7	0096
Event Data	Bytes 8…15	00 00 00 00 00 40 00 00

Decoding Example:

- Event type 0x01: System event
- Event ID 0x15: DSP (reported) status, decimal 21.
- Event time 0x5438F571: 11 October 2014 10:16:33 (local time)
- Event time 0x0096: 15 ms (150 x 0.1 ms), so 10:16:33:015
- Event Data: up to 4 bytes of pre-event data, 4 bytes of post-event data
- For a DSP (reported) status event all 8 bytes are used.
- Pre-event status is: 0x00000000
- Post-event status is: 0x00004000

Analysis: bit 14 of the DSP status has changed from 0 to 1 (meaning a link or auxiliary module error has been detected).

Dynamix Transducer Object

The transducer object (class code 0x38E)defines the properties of the sensor that is connected to one of the four available physical inputs.

Attributes describe physical measurement parameters and transducer OK monitoring setup, as also some sensor-mounting geometry settings.

This object reports transducer DC Volts (bias) measurement and transducer status.

Table 119 - Object Instances

Instance ID	Description
0	Transducer Class Instance

Table 120 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	TX Overall Status	BYTE	Coded information to represent transducer Enabled and OK status	Bits 0…3 represent transducer enabled status (1 = enabled). Bits 4…7 represent transducer OK status (1 = OK).

Table 121 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	DC Bias	REAL	The DC level at the input in fixed units of DC Volts.	Data
2	Get	V	TX Detailed Status	BYTE	Detailed bit-coded Transducer Status (Data).	See TX OK Configuration Decoding
Transducer Descriptions				Group of 4 attributes that are used for reference purposes only.		
16	Get	V	Transducer Name	SINT[32]	Descriptive name.	32 characters
17	Get	V	Transducer Orientation	INT	Definition of sensor orientation angle in degrees. Orientation angle is usually a radial angular orientation.	0…359 degree input range in increments of 1 °
18	Get	V	Transducer Location	SINT	Transducer location definition.	0: Unknown 1: Radial 2: Axial
19	Get	V	Transducer Output Sense	SINT	Sensor output sense - information only. The DC measurement object has normal/counter control.	Fixed at zero
Transducer Output Definition				Group of 5 configuration attributes.		
24	Get	V	Transducer AC Units	ENGUNITS	Transducer measurement units that are used for AC measurement base.	Supported engineering units
25	Get	V	Transducer AC Sensitivity	REAL	TX AC Sensitivity in mV/TX AC units.	Range: 1…20000
26	Get	V	Transducer DC Units	ENGUNITS	Transducer measurement units that are used for DC measurement base.	Supported engineering units

Table 121 - Instance Attributes

27	Get	V	Transducer DC sensitivity	REAL	Transducer DC sensitivity in mV/ TX DC units.	Range: 1…20000
28	Get	V	TX Power Setup	SINT	Coded configuration for sensor power supply configuration. Definition is independent of the selected transducer/application type.	Transducer OK Configuration
TX OK Detection				Group of 3 configuration attributes.		
32	Get	V	Transducer OK Configuration	BYTE	Definition of which conditions are included in a TX OK assessment	Transducer OK Configuration
33	Get	V	Transducer OK High Threshold	REAL	High-voltage threshold for the TX OK monitoring window	V Range: 22…-21
34	Get	V	Transducer OK Low Threshold	REAL	Low voltage threshold for the TX OK monitoring window	V Range: 22…-21

Attribute Semantics

TX OK Configuration Decoding

Bit	Description (when bit is set = 1)
0	Channel enabled
1	Transducer enabled
2	Transducer fault
3	Wire off indicated

In the case of Module Personality “Real Time - 2 Dynamic (4 kHz) - Dual Path”:

Dual path uses both channel pairs to process a single pair of transducer signals without requiring external linking of the signal inputs. The sensors are connected normally to channels 0 & 1 but are processed by both channel pairs (channel 0 to channel 2, and channel 1 to channel 3). Consequently only channels 0 and 1 should be used for transducer status.

'Wire off' refers to additional failure sensing applied to Eddy Current Probe systems which are powered by the module. Wire off is only incorporated into Transducer Fail, when specific configuration criteria are met. If those criteria are not met and/or the capability has been disabled by setting attribute 32 to a non-zero value - then bit 3 will be forced OK (zero value). If the wire off detection capability is being actively used then in the event of a transducer fail being indicated, the value of bit 3 will confirm if a wire off has been detected. Be aware that there is the possibility of multiple checks (simultaneously) triggering an indication of transducer failure.

TX Power Setup

Following transducer power-supply options apply per transducer output.

Value	Description
0	OFF
1	CC (+24V / 4 mA constant current output)
2	+CV (+24V / 25 mA voltage regulated output)
3	-CV (-24V / 25 mA voltage regulated output)

Following transducer power-supply options apply per transducer input.

To aid transducer failure detection the signal input circuitry imposes, in the absence of a functioning transducer, a bias voltage at the input. The bias that is applied is automatically selected based on the power supply that is configured for that channel:

Value	Description
0	OFF - Bias Off (typically around 1.7 V DC at the input)
1	CC - Bias Negative (typically around -3.9 V DC at the input)
2	+CC - Bias Negative (typically around -3.9 V DC at the input)
3	-CV - Bias Positive (typically around 13 V DC at the input)

Within a channel pair, there will be slight differences in the bias voltages (particularly noticeable on the positive bias, where it is of the order of 1.3 V). This is by design and has no effect on functionality.

Transducer OK Configuration

0	automatic (all relevant checks included)
1	wire-off monitoring excluded (any value in range 1 to 7 will be treated the same)

The Transducer OK status is based on the following checks.

For the Transducer Status to be “OK” the following must be true:

- The transducer DC/bias voltage must be within the configured OK window limits (attributes 33/34)
- The channel must have passed an internal calibration check, at last startup

Where the sensor is a negatively powered Eddy Current Probe the module will perform two additional checks:

- The transducer power supply provided by the module is delivering at least 2 mA
- The transducer DC/bias voltage remains negative.

These two checks are based on hardware monitoring, designed to be quickly detect any discrepancy and are referred to as 'wire-off' detection. Once a wire-off condition has been detected, this failure is latched for 30 seconds, any reoccurrence causing this timer to be restarted such that recovery from a wire-off condition will be 30 seconds after the last detected event. This measure aims to ensure that signals have stabilized.

Table 122 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix Channel Setup Object

The Channel Setup Object (class code 0x38F) defines the basic sample rate, decimation, and filter cutoff frequencies and alternate path processing for each of the channels.

Table 123 - Object Instances

Instance ID	Description
0	Channel Setup Class Instance
1…4	Instances 1…4 define the setup for channels 0…3

Table 124 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	WORD	Bit-coding of enabled instances.	Decoding information.

Table 125 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Enabled Status	BOOL	Definition of enabled status of channel setup.	0: Disabled 1: Enabled (Active)
2	Get	V	Synchronous max RPM	REAL	Highest machine speed that the synchronous configuration supports.	RPM
3	Get	V	Synchronous Min RPM	REAL	Lowest machine speed that the synchronous configuration supports.	RPM
Configuration Group				Group of 9 configuration attributes.		
16	Get	V	LP Filter -3 dB Point	REAL	Low Pass Filter -3 dB corner frequency definition.	Hz Range 10…40000
17	Get	V	HP Filter -3 dB Point	REAL	High Pass Filter -3 dB corner frequency definition (this attribute is also the gSE HP Filter -3 dB).	Hz Range 0.1…39000
18	Get	V	Decimation	INT	Provides a control for specifying decimation in the main asynchronous processing stream.	Sampling Control
19	Get	V	SRD	SINT	SRD (Sample Rate Divider).	Sampling Control Range: 2…12
20	Get	V	Alternate Path Control	SINT	Alternate path control.	0: Asynchronous 1: Synchronous 2: Not Used 3: Asynchronous with independent -48 dB/octave LP filtering
21	Get	V	Synchronous Tacho Source	SINT	Only applicable when alternate path is set to option 1 or 2.	1: Tacho 0 2: Tacho 1
22	Get	V	Synchronous Samples Per Revolution	INT	Only applicable when alternate path is set to option 1 or 2.	4, 8, 16, 32,64, 128
23	Get	V	Decimation	INT	Only applicable when alternate path is set to option 3.	Range 1…255 Constraints due to attribute 24 are as described in Sampling Control
24	Get	V	Alternate LP Filter -3 dB Point	REAL	Only applicable when alternate path is set.	Hz Range 10…5000

Attribute Semantics

Enabled Instances

Following bit-coding scheme is used to identify which channel setup instances are enabled:

Bit	Description
0…3	Measurement channels 0…3 0: disabled 1: enabled
4…7	Reserved for full multiplexing
8…12	Reserved for full multiplexing
13…15	Reserved - set to 0

Disabled instances return error 0x08 (Service Not supported) when disabled instances are addressed with common services.

Sampling Control

The following are different aspects of Sampling Control.

Table 126 - Sampling Control

Category	Description
Fundamentals	SRD represents sample rate divide and must be set equal across a channel pair (0/1 and 2/3) unless multiplexing individual channels. Actual sample rate is the base sample rate that is divided by the SRD With the A/D in single mode (most applications), the base sample rate is 93,750 Hz. With the A/D in double mode (frequencies up to 40 kHz), the base sample rate is 187,500 Hz.
Limits (Asynchronous and Synchronous Processing)	Based on Nyquist, the setting of SRD/sample rate determines the maximum frequency that can be assessed. In the case of synchronous sampling, the maximum frequency and the configured number of samples per revolution dictates the maximum machine speed that can be successfully processed. The module confirms a maximum machine rpm for a given configuration by way of instance attribute 2. Further guidelines are as follows: • Filter -3 dB points must always be set at less than [Sample rate] / 2.048 • Bandwidth of an FFT in the same configuration, is less and calculated by [Sample rate] / 2.56 • The center frequency of the highest line of an N line FFT is given by [Sample rate] * [N-1] / [2.56 * N] Example for SRD 32 (single mode) • Filter -3 dB must be less than 1431 Hz • FFT bandwidth (decimation = 1) is 1144.41 Hz • Corresponding center frequency of highest line of an 800 line FFT is 1142.98 Hz, 1600 line FFT is 1143.69 Hz. Note: The preceding information applies to all FFT of whatever line resolution and whether used for Condition Monitoring or FFT Band Data. The calculation of sample rate must include any decimation that is applied to the samples before this (FFT or filter) processing, see also, in the following information, decimation.

Table 126 - Sampling Control

Category	Description
Disabling a LP filter	You can disable the LP filter to use more of the available bandwidth for the overall (0) measurement. Minimizing (unnecessary) filtering is also beneficial for reducing module processing load and generally retaining the fidelity of the signal. While within a particular channel application type you cannot explicitly choose to disable an LP filter, it can be achieved by choosing to set the filter cutoff frequency at the maximum allowed: SRD / 2.048 (noting that for calculation purposes, '40 kHz mode' has an SRD of '1'. On receiving the configuration, if the configuration setting is above or within 5 Hz of, the calculated maximum then the module automatically disables that LP filter. Main path and alternate path (asynchronous) filters are considered separately as appropriate to the configuration.
Decimation of asynchronous samples	A decimation of n further reduces sample rate by retaining only the nth sample. Decimation is commonly used for the following purposes to: • Provide the user with an FFT whose Fmax is lower than what is implied or attainable by the SRD • Permit internal sample transfer for CM data purposes (such transfers cannot support the 40 kHz bandwidth) • Reduce the sample rate into an HP filter, where the difference between the filter -3 dB and the sample rate is a large ratio. The latter is not considered likely to be necessary unless the ratio of sample rate to HP filter cutoff frequency significantly exceeds 3000. On a 5 kHz measurement bandwidth (SRD 9) that would equate to an HP filter cutoff, lower than 3 Hz. In all cases decimation requires prior LP filtering of the samples, to avoid aliasing. Dependent on the application/path, filtering can be by -24 or -48 dB/octave filters. To avoid the possibility of aliasing, it is recommended that the following maximum filter cutoff settings are imposed: • -24 dB (LP followed by an HP): 0.25 x the decimated sample rate • -48 dB (LP alternate path only): 0.36 x the decimated sample rate • -60 dB (Aero derivative mode only):0.385 x the decimated sample rate Synchronous resampling also requires anti-alias protection and this protection is provided by a -48 dB LP filter. The difference between this and asynchronous decimation by a -48 dB LP filter is that in the synchronous case the filter -3 dB point is continually and automatically adjusted according to the machine speed.
FFT Data Filter (SR_FILTER)	When FFT data is requested that relies on a signal that has been decimated or resampled synchronously, as described previously, one of the internal LP filters has to be used to provide anti- aliasing protection for the resampled stream. Due to the relatively slow roll-off of these filters, they have to be positioned well within the expected FFT FMAX. This positioning means that a proportion of the FFT lines reflect frequencies at which the signal amplitudes are significantly attenuated. If the FFT Data Filter capability is enabled (appropriate bit set in the FFT request), then if the data to be returned is affected by this then only 50% of the Normal lines are returned. This return allows for the worst case of the -24 dB/octave filter. With this control, you have the choice at the point of request whether to receive the full or the reduced (filtered) Data-Set. • If the bit is set and the data is not decimated or synchronously re-sampled, then 100% of the available FFT lines are returned. • Whether the data has or has not been filtered is indicated by a bit in ucDataSelect of the FFT header • The actual filter setting is not checked, simply whether this filter is decimated or synchronously resampled data • Where data filtering results in different number of lines being returned, the data requests will be appropriately grouped, for like data lengths • This data filter can be requested on any CM data object that supports the return of FFT spectral data
Higher Frequency modes	In the 'normal' (20 kHz max) case: SRD settings are in the range 2 to 32 and are set appropriately for the channel application. The default decimation is 1. In the gSE/40 kHz case: The SRD will be fixed at 2 and internally the A/D set is set at double mode (that combination is equivalent to an SRD of 1).

Table 126 - Sampling Control

Category	Description
gSE Mode	In gSE mode: • Use the HP filter setting as required (typically 100, 200, 500, 1000, 2000, or 5000 Hz but not restricted to these values) • Use the LP filter setting to indicate the required FFT FMAX (typically 25, 100, 200, 300, or 1000 Hz but again not limited to these values) Based on the preceding information, the module automatically implements suitable decimation - the configured decimation is ignored. The settings for gSE results in the filters being unusually set (HP > LP) - this setting is normal for gSE measurements.
Aero-derivative mode	Note: When an Aero derivative mode has been selected, the roll off the LP and HP filters are automatically increased from the standard -24 dB to the -60 dB required for that application.

Table 127 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix AC Measurement Object

The AC Measurement Object (class code 0x390) defines configuration of an AC overall measurement by selecting source, smoothing constants, and definition of measurement units. Two instances are linked to each available transducer channel.

Table 128 - Object Instances

Instance ID	Description
0	AC Measurement Class Instance
1…8	AC measurement setup and data for channels 0…3 • Instances 1…2 for transducer channel 0, AC measurements A, and B • Instances 3…4 for transducer channel 1, AC measurements A, and B • Instances 5…6 for transducer channel 2, AC measurements A, and B • Instances 7…8 for transducer channel 3, AC measurements A, and B

The second instance in each case relates to a secondary overall measurement (B) with another source, measurement units, and potentially different detection method to the primary overall. Example, primary: mm/s RMS, secondary: g peak. Currently, other instance attributes are common to the pair of instances/ measurements but work to support the setting of independent time constants for overall (0) and overall (1) ('A and B') is ongoing.

- The gSE application supports only one overall measurement per channel, Overall (0).
- The Dynamic pressure application is FFT band focused/optimized so does not support either of the overall measurements.

Table 129 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	STRUCT	Bit-wise coding of enabled AC measurement instances.	Decoding information.
				BYTE	Active instances for channels 0…3.	
				BYTE	Reserved for full multiplexing.	
				BYTE	Reserved for full multiplexing.	

Table 130 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	RMS Value	REAL	RMS measurement value.	
2	Get	V	True Peak Value	REAL	True Peak measurement value.	
3	Get	V	True Peak to Peak Value	REAL	True pk-pk measurement value.	
4	Get	V	Peak Value	REAL	True pk-pk value / 2.	
5	Get	V	Scaled Peak Value	REAL	Calculated pk value from RMS.	
6	Get	V	Scaled Peak to Peak Value	REAL	Calculated pk-pk value from RMS.	
7	Get	V	Average Value	REAL	Rectified average.	
8	Get	V	Magnitude Value	REAL	A magnitude value from a choice of detection methods (effectively attributes 1…7), made by configuration.	
AC Overall Measurement				Group of 8 configuration attributes.		
16	Get	V	AC Overall Measurement Source	SINT	Source selection.	Coding information
17	Get	V	AC Overall Measurement Units	ENGUNITS	AC measurement units.	Options and selection criteria
18	Get	V	AC Overall Measurement RMS TC	REAL	Time constant definition for RMS measurement (demanded).	Range: 0.1…60 s, default of 1
19	Get	V	AC Overall Measurement Peak TC	REAL	Time constant definition for Peak measurement (demanded).	Range: 0.1…60 s, default of 1
20	Get	V	AC Overall Magnitude - Detection Method	SINT	Detection method for the overall magnitude value.	Options
			Measurement Time Constants		Group of 2 configuration attributes.	
24	Get	V	Actual RMS TC	REAL	Actual implemented RMS TC value that is based on channel-data acquisition setup.	Seconds
25	Get	V	Actual Peak TC	REAL	Actual implemented Peak TC value that is based on channel-data acquisition setup.	Seconds

Table 130 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
Peak per Revolution Assessment				Group of 2 configuration attributes.		
32	Get	V	Configure Peak per Rev	SINT	Option to enable Peak level assessment on a once per revolution basis, including tacho source selection.	Peak per Rev details
33	Get	V	Minimum RPM for Peak per Rev	REAL	Peak per revolution only active above this value.	Peak per Rev details

Attribute Semantics

Enabled Instances

Following bit-coding scheme is used to identify active static AC measurement instances. Three bytes are used to describe active instances for each subchannel.

Byte	Bit	Description
1	0…7	AC measurement instances 1…8 0: disabled 1: enabled
2	0…7	Reserved for full multiplexing
3	0…7	Reserved for full multiplexing

Disabled instances return error 0x08 (Service Not supported) when disabled instances are addressed with common services.

Source Selection

For the overall AC measurement A, the source is fixed (the level assessment is made after the user configured low and high pass filters). For the overall AC measurement B, the source is variable:

Index	Source
1	**Pre-Filter** - before the user configured low pass filter
2	**Mid-Filter** - after the user configured low pass filter

Source selection for the overall AC measurement B configures the dual path processing capability for that channel, so that:

- in an integrating configuration, both acceleration and velocity overalls are available
- or in a non-integrating configuration to have both band pass filtered and wide band data available.

AC Units

Actual selection of AC engineering units are a subset of the master-engineering units list. The selection is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

AC magnitude Detection Method

Value	Description
0	True peak
1	True peak to peak
2	RMS
3	Rectified average
4	Peak
5	Scaled peak
6	Scaled peak to peak

Peak per Revolution Assessment

In case of active eccentricity application and assessment on a per revolution basis these attributes determine enable option and the low RPM limit where once per revolution assessment defaults to normal peak-value assessment.

Option	Description
0x00	Peak per revolution disabled
0x01	Tacho/Speed 0
0x02	Tacho/Speed 01
Higher Values	Reserved

Lower RPM limit range: 4…600 RPM, recommended default of 10 RPM.

Table 131 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix DC Measurement Object

The DC Measurement Object (0x391) defines configuration of DC overall measurement by selecting smoothing constants, and definition of measurement units. One instance is linked to each available transducer channel and is fully separate from the DC Volts overall value

Table 132 - Object Instances

Instance ID	Description
0	DC Measurement Class Instance
1…4	DC measurement setup and data for channels 0…3 • Instances 1 for transducer channel 0, DC measurement • Instances 2 for transducer channel 1, DC measurement • Instances 3 for transducer channel 2, DC measurement • Instances 4 for transducer channel 3, DC measurement

Table 133 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	STRUCT	Bit-wise coding of enabled DC measurement instances.	Decoding information.
				BYTE	Active instances for channels 0…3.	
				BYTE	Reserved for full multiplexing.	
				BYTE	Reserved for full multiplexing.	

Table 134 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	DC Value	REAL	Processed DC measurement output.	
2	Get	V	Rod Drop Value	REAL	Processed rod-drop value output.	0 when rod drop application is not active for this channel
3	Get	V	DC Bias	REAL	Measured in DC Volts. The same as attribute 1 of the Transducer Object	
DC Measurement				Group of 5 configuration attributes		
16	Get	V	DC Measurement Units	ENGUNITS	The DC measurement units.	Options and selection criteria
17	Get	V	DC Measurement TC	REAL	Time constant definition for DC measurement (demanded).	Range: 0.1…60 s, default of 1
18	Get	V	DC Measurement Offset	REAL	Measurement offset in selected measurement units.	Is added to the measurement. Range: -50000…50000
19	Get	V	DC Measurement Sense Control	SINT	Sense control of the DC measurement for axial/thrust applications.	0: Active/Normal 1: Inactive/Counter

Table 134 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
24	Get	V	Actual DC Measurement TC	REAL	Actual implemented DC TC value that is based on channel data-acquisition setup.	Seconds
Rod Drop				Group of 5 configuration attributes.		
32	Get	V	Rod Drop Trigger Source	SINT	Enable rod-drop measurement processing and identify the tacho source.	Rod-drop configuration details
33	Get	V	Rod Drop Trigger Angle	INT	The target angle for the rod drop measurement (the mid-point of the range).	0…359 degrees
34	Get	V	Rod Drop Measurement Range	SINT	The angular range of the rod drop measurement	2…20 degrees Step 2
35	Get	V	Rod Drop Decay Time	REAL	The rod-drop measurement decay time	Range: 0.1…60 s
40	Get	V	Rod Drop maximum machine Speed	INT	Calculated account of trigger range and sampling rate	RPM

Attribute Semantics

Enabled Instances

The following bit-coding scheme is used to identify active static DC measurement instances.

Byte	Bit	Description
1	0…3	DC measurement instances 1…8 0: disabled 1: enabled
	4…7	Reserved and set to 0
2	0…3	Not used in protection mode
	4…7	Reserved and set to 0
3	0…3	Reserved and set to 0
	4…7	Reserved and set to 0

Output Enable

Transducer disabled status overrules enabled channel processing setup.

DC Units

Actual selection of DC engineering units is a subset of the master engineering units list. The selection is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Rod Drop Configuration

Rod-drop processing is assessed in parallel to normal DC measurements. Rod drop units of measurement is the same as the configured DC Measurement units.

Instance must be active and rod-drop function must be enabled to obtain access to the rod-drop measurement value.

Trigger source

Option	Description
0x00	Rod-drop disabled
0x01	Tacho/Speed 0
0x02	Tacho/Speed 01
Higher Values	Reserved

The following explain the rod-drop functionality in more detail.

- The rod-drop functionality is enabled / disabled by virtue of the selected channel application type. If the rod drop application has been selected, then for the configuration to be legitimate, an appropriate tacho source must be selected. If the rod drop application is not selected, then the setting of the trigger source is irrelevant. For example, in those circumstances, 0x00/Off can be used but does not have to be used.
- The rod-drop measurement is made every revolution. except in the case where the configured measurement range encompasses the trigger point itself. In that situation, the measurement is made every other revolution.
- The rod-drop measurement is only applicable at speeds greater than 10 rpm. Below 10 rpm the measurement defaults to a normal DC measurement (although the configured rod-drop TC not the DC TC still apply). This measurement also provides a means by which rod drop 'mode' is exited if the tacho pulses suddenly stop.

Rod-Drop maximum machine speed

The maximum machine speed is calculated such that there is always at least one sample available to base the measurement on.

The SRD (Channel Setup Object, Attribute 19) determines sample rate, the decimation setting does not play any part.

Maximum RPM = (Sample Rate Hz * Measurement Range Degrees) / 6

Round the result down to an integer RPM.

Target Positive Direction

Allow sense control of the axial/thrust measurement for displacement transducer type based applications. The following options apply:

- Active/Normal (target movement away from probe - ECP system output more negative, is considered a positive DC output).
- Inactive/Counter (target movement towards probe - ECP system output less negative, is considered a positive DC output).

Table 135 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 136 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	x	Zero Channel	Option to take the current measurement value and assign to offset attribute (considering current setting of this attribute value) such as to zero the measurement channel. • To satisfy security requirements, this service only executes if an alarm inhibit is being imposed via the I/O connection (output) data. • This is an instance level service (the instance that is specified dictates the particular channel 'zero'd').

Dynamix Dual Measurement Object

This Dual Measurement Object (class code 0x392) defines, in combination with selected application type in measurement channel setup, the additional behavior of the fixed channel pairs.

It provides access to available Dual Channel measurement results and defines channel pair-specific configuration parameters for differential expansion.

Table 137 - Object Instances

Instance ID	Description
0	Dual Measurement Class Instance
1	Instance 1 for transducer pair 0…1
2	Instance 2 for transducer pair 2…3

Table 138 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 139 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	S max Peak	REAL	Processed S max Peak output.	0 output when not an XY application
2	Get	V	Phase angle of the S max Peak Vector	REAL	Phase angle of attribute 1.	0 output when not an XY application
5	Get	V	Axial Differential Expansion	REAL	Processed axial differential expansion output (CDE or Ramp).	0 output when not configured
6	Get	V	Radial Ramp Diff Expansion	REAL	Processed radial differential expansion output (ramp only).	0 output when not configured
8	Get	V	Shaft Abs Vib Peak	REAL	Processed shaft abs vib pk output.	0 output when not configured
9	Get	V	Shaft Abs Vib pk-pk	REAL	Processed shaft abs vib pk-pk output.	0 output when not configured
Differential Expansion				Group of 4 configuration attributes.		
16	Get	V	Sensor A Ramp Angle	REAL	Ramp angle for sensor input A in degrees.	Setup information
17	Get	V	Sensor B Ramp Angle	REAL	Ramp angle for sensor input B in degrees.	Setup information
18	Get	V	Overall Axial Offset	REAL	An overall (axial) offset in DC measurement units.	Applicable to Ramp and CDE applications Range: -50000…50000
19	Get	V	Overall Radial Offset	REAL	An overall (radial) offset in DC measurement units.	Ramp only Range: -25000…25000

Attribute Semantics

Output Enable

Transducer disabled status overrules the enabled channel processing setup.

Ramp Angle

Ramp angle is held explicitly for information, used to calculate required ramp differential expansion coefficients for internal processing of Ramp Differential Expansion. A ‘normal’ probe with a plain target has a ramp angle of 0°. Ramp angle applies to both probes A and B.

Typical ramps are around 12° (up to 45° on occasion).

Ramp angles can be positive or negative depending on whether a concave/convex ramp is used

Allowed configuration range: -45…45.

Overall Axial Offset

The channel pair is not currently configured for a differential expansion application, read attribute requests for attribute 18 returns zero, irrespective of the actual configured value.

Table 140 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 141 - Object Specific Service

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	x	Zero Dual Channel	Option to take the current measurement value and assign to offset attribute (considering current setting of this attribute value) such as to zero the measurement channel. • To satisfy security requirements, this service executes if an alarm inhibit is being imposed via the I/O connection (output) data. • This code is an instance level service (the instance that is specified dictates the particular channel pair 'zero'd').

Behavior

Smax Measurements

In an XY application, the Smax result (magnitude and phase) is calculated using the individual overall results and not at the sample level. Using the two (orthogonal) processed scalar values in this way corresponds to 'Method A' in the International Standards. Using method A:

- The Smax amplitude can be overestimated, but not under estimated
- Any calculated phase angle is in the range 0 to 90 °.

If the two scalar values are identical, the phase reports 45 °.

If the first channel of the pair has the larger amplitude, the phase angle reads < 45 °.

If the second channel of the pair has the largest amplitude, the phase angle reads > 45 °.

Shaft Absolute Vibration Measurements

When configured in this mode the calculation of absolute shaft vibration is performed at a sample level. This method is necessary because any simpler method based on overall values could be misleading as to the actual, absolute vibration amplitudes.

CDE (Complementary Differential Expansion) Measurements

The two channels are configured with opposite sense and with suitable individual offsets such that at the nominal cross-over point their individual measurements are zero (DC Measurement Object instance attributes). While the 'normal' sense probe returns a negative displacement value then it is the lead probe for the CDE measurement, otherwise the 'counter' sense probe is used.

The implementation includes protection against one probe failure (the CDE is not based on a probe in TX Fail if the other probe of the pair is TX OK) and also incorporates a progressive changeover between probes. This changeover is incorporated to avoid a sudden jump in the measurement value around the cross-over point. It is applied automatically over ±15% of the offset of the normal sense probe, about the changeover point. The following graphic illustrates he operation of these features where the yellow highlights indicate the single channel providing the CDE data:

Both probes OK

CH0 (Normal)		CH1 (counter)		CDE mil
V	DC mil	V	DC mil	
-1.92	-20.42	-9.92	-19.59	-20.42
-2.91	-15.43	-8.92	-14.6	-15.43
-3.91	-10.44	-7.92	-9.62	-10.44
-4.91	-5.45	-6.93	-4.63	-5.41
-5.91	-0.46	-5.93	0.36	-0.08
-6.91	4.53	-4.93	5.35	5.25
-7.9	9.52	-3.93	10.35	10.35
-8.9	14.51	-2.93	15.34	15.34
-9.9	19.49	-1.93	20.33	20.33

Counter Probe failed

CH0		CH1		CDE mil
V	DC mil	V	DC mil	
-1.91	-20.43	-9.91	-19.56	-20.43
-2.91	-15.44	-8.92	-14.58	-15.44
-3.91	-10.45	-7.92	-9.6	-10.45
-4.91	-5.45	-6.92	-4.62	-5.45
-5.91	-0.46	-5.93	0.37	-0.46
-6.91	4.53	-4.93	5.36	4.53
-7.9	9.52	-3.93	10.34	9.52
-8.9	14.5	-2.93	15.34	14.5
-9.9	19.49	-1.93	20.33	19.49

Normal Probe failed

CH2		CH3		CDE mil
V	DC mil	V	DC mil	
-1.94	-20.28	-9.93	-19.66	-19.66
-2.94	-15.29	-8.94	-14.68	-14.68
-3.94	-10.3	-7.94	-9.7	-9.7
-4.94	-5.31	-6.94	-4.71	-4.71
-5.94	-0.32	-5.95	0.27	0.27
-6.93	4.67	-4.95	5.26	5.26
-7.93	9.66	-3.95	10.25	10.25
-8.93	14.65	-2.95	15.24	15.24
-9.93	19.65	-1.95	20.23	20.23

In the example with both probes OK, there are three CDE results shown that are based on both probe results.

- The first as the normal sense probe approaches its limit, is still weighted towards the data from that probe.
- The second, close to the cross-over point is nearly equally weighted.
- The third as the counter sense probe is taking over, is now weighted towards the data from that probe.

Final CDE value can be separately adjusted by means of the overall axial offset, attribute 18 above.

Dynamix Tracking Filter Object

The Tracking Filter Object (class code 0x393) defines configuration and provides access to Order based measurement data. One instance is linked to each available measurement channel with capability to define up to four tracking filters.

Table 142 - Object Instances

Instance ID	Description
0	Tracking Filter Class Instance
1	Instance 1 for channel 0
2	Instance 2 for channel 1
3	Instance 3 for channel 2
4	Instance 4 for channel 3

Table 143 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 144 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	magnitude 0	REAL	magnitude reading for first defined order.	0 output when not configured or no speed
2	Get	V	Phase 0	REAL	Phase reading (0…359 deg) for first defined order.	0 output when not configured or no speed
3	Get	V	magnitude 1	REAL	magnitude reading for second defined order.	0 output when not configured or no speed
4	Get	V	Phase 1	REAL	Phase reading (0…359 deg) for second defined order.	0 output when not configured or no speed
5	Get	V	magnitude 2	REAL	magnitude reading for third defined order.	0 output when not configured or no speed
6	Get	V	Phase 2	REAL	Phase reading (0…359 deg) for third defined order.	0 output when not configured or no speed
7	Get	V	magnitude 3	REAL	magnitude reading for fourth defined order.	0 output when not configured or no speed
8	Get	V	Phase 3	REAL	Phase reading (0…359 deg) for fourth defined order.	0 output when not configured or no speed
9	Get	V	Not 1X magnitude	REAL	magnitude of AC components other than 1x.	
General Tracking Filter Setup				Group of 6 configuration attributes.		
16	Get	V	Tracking filter Configuration	BYTE	A bit-wise coded entry that specifies if the filter is enabled and which Tacho source is used (0/1).	Coding information

Table 144 - Instance Attributes

17	Get	V	Order Measurement Units	ENGUNITS	Definition of measurement engineering units that indirectly also allow for signal integration/ differentiation.	Options and selection criteria
18	Get	V	Order Measurement Scaling	SINT	The scaled measurement detection that is used for the order assessments.	0: Peak 1: pk-pk 2: RMS
19	Get	V	Tracking Filter Mode	SINT	Define order signal processing-mode.	0: Constant Q 1: Fixed frequency
20	Get	V	Tracking Filter Definition (Tacho 0)	REAL	The filter Q factor or Frequency bandwidth that is associated with the selected processing mode.	Currently only fixed Q mode supported, by specifying a number of revolutions. Default: 10 Range: 1…256
21	Get	V	Tracking Filter Definition (Tacho 1)	REAL	The filter Q factor or Frequency bandwidth that is associated with the selected processing mode.	Separate definitions to support different settings in Fixed frequency mode. For fixed Q mode, the AOP sets 20 and 21 equal.
24	Get	V	Order Update Rate (Tacho 0)	REAL	Approximation of the anticipated order measurement update rate that is based on signal processing and order setup.	Seconds
25	Get	V	Order Update Rate (Tacho 1)	REAL	Approximation of the anticipated order measurement update rate that is based on signal processing and order setup.	Seconds
Order Requirement Definitions				Group of 4 configuration attributes.		
32	Get	V	Tracking filter 0 setup	REAL	Order 0 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 1.0

Table 144 - Instance Attributes

33	Get	V	Tracking filter 1 setup	REAL	Order 1 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 2.0
34	Get	V	Tracking filter 2 setup	REAL	Order 2 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 3.0
35	Get	V	Tracking filter 3 setup	REAL	Order 3 Definition - integer values return Mag/Phase as where only Mag is returned for non-integer settings.	0.25…32.0 orders default value 4.0

Attribute Semantics

Order Measurement Units

Actual selection of Order engineering units are a subset of the master engineering units list. The selection is also based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Options prompt the selection of units that indirectly enables differentiation or integration of the base signal.

Operating Mode

Current implementation only supports constant Q mode. This attribute is therefore reserved (0) to support future fixed frequency mode.

The associated configuration parameter instance is read-only until fixed frequency mode is supported.

For Aero-derivative application types (80 and 83) where fixed bandwidth tracking filters for the gas generator, 1x and power turbine 1x are required on a per channel basis. A 5 Hz fixed bandwidth mode is automatically implemented on order 0 (T0) and order 1 (T1). Outside a speed range of 5…400 Hz the output of these tracking filters is set to zero.

General Order Setup

For one byte, bit wise control is used to allow for enabling individual tracking filters and assigning a tacho channel.

Four 2-bit arrangements are used:

Bit	Description
0	Tracking filter 0 0: Enable; 1: Disabled Default: Enabled
1	Tracking filter 0 0: Tacho 0; 1: Tacho 1 Default: Tacho 1
2	Tracking filter 1 0: Enable; 1: Disabled Default: Enabled
3	Tracking filter 1 0: Tacho 0; 1: Tacho 1 Default: Tacho 1
4	Tracking filter 2 0: Enable; 1: Disabled Default: Enabled
5	Tracking filter 2 0: Tacho 0; 1: Tacho 1 Default: Tacho 1
6	Tracking filter 3 0: Enable; 1: Disabled Default: Enabled
7	Tracking filter 3 0: Tacho 0; 1: Tacho 1 Default: Tacho 1

Table 145 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute Get requests to certain attributes require data to be requested from the auxiliary module itself. If that module is not present/active on the bus, an embedded server error is returned in response to the request.

Behavior

In general:

- You can configure up to four tracking filters per channel.
- They can be configured to track any particular order, including non-integer values.
- The filter has a constant Q behavior, so it changes or adapts to speed.
- Any combination of the two tacho inputs can be used across a channel.

Some restrictions / special considerations do apply for specific measurements and applications.

For **Aero-derivative application** types (80 and 83) the following fixed assignment must be configured:

- order 0 set to T0 and 1x
- order 1 set to T1 and 1x

This provides fixed (5 Hz) bandwidth tracking filters for the gas generator 1x and power turbine 1x. It is not necessary to specially configure the Mode or Filter Definition parameters to achieve this result.

The **Not-1X measurement** setting implements:

- order 0 at 1x (either tacho can be used)
- configure the order and the overall (0) to use the same measurement units

The Not-1X measurement then provides the difference between the Overall (1) measurement and the first order result.

The Not 1X measurement data is presented in the same detection type as the order measurement, it does not rely on the overall (1) being configured similarly.

The Not-1X measurement can if desired provide a ‘Not-2x’ indication, by simply changing the order configuration of the first tracking filter on any particular channel. The 'Not-1X' is calculated whenever the first tracking filter is enabled, irrespective whether it is configured for order 1 (1x).

Dynamix TSC Module Object

The TSC Module Object (class code 0x394) defines the setup for the Tacho Signal Conditioning expansion module and interaction of this expansion module with the main module.

Table 146 - Object Instances

Instance ID	Description
0	TSC Module Class Instance
1	Instance 1 defines setup of TSC module input 0
2	Instance 2 defines setup of TSC module input 1

Table 147 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	NV	Vendor ID	UINT		
9	Get	NV	Device Type	UINT		
10	Get	NV	Product Code	UINT		
11	Get	NV	Firmware Revision	STRUCT	Retrieves Firmware Revision of the TSC expansion module.	
			Major Version	USINT		
			Minor Version	USINT		
12	Get	V	Expansion Module Status	WORD	Coded information on TSC expansion module operational status.	TSC status
13	Get	NV	Serial Number	UDINT		
14	Get	NV	Product Name	SHORT_STRING		
15	Get	V	Transducer Status	WORD	Coded information on transducer (0/1) operational status.	
17	Get	NV	Auxiliary Link-Time Out	UNIT	Link time out	Fixed at 1000 ms (1 s)
18	Get	V	Mode Control	BYTE	Allows additional detection modes, supports future capability such as reverse rotation detection.	Fixed at zero.

The proceeding NV status relates to nonvolatile storage in the auxiliary module, not in the main module.s

Table 148 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	TSC Measured Speed Output	REAL	Actual Speed considering number of pulses per revolution.	RPM
2	Get	V	Individual Transducer Status	BYTE	Individual transducer-operating status information.	
Sensor Type Configuration				Group of 4 configuration attributes.		
16	Get	V	Input Sensor Type	USINT	Definition of input source that configures required inputs and signal conditioning.	Selection options
17	Get	V	Input Name	SINT[32]	Physical channel name identifier.	32 characters
24	Get	V	Sensor Power Supply	SINT	Bit-coded configuration for tacho power supply configuration.	TX power supply options
25	Get	V	Sensor Target, Pulses Per Rev	INT	The number of signal pulses per revolution of the shaft.	1…255
Trigger Configuration				Group of 3 configuration attributes.		
32	Get	V	Trigger Mode	SINT	Potential support for auto threshold detection on the TSC module.	0: Configured threshold 1: Auto detection (when implemented)
33	Get	V	Trigger Threshold	INT	Trigger detection threshold voltage that is specified in mV	Range: -32000…32000 (±32V)
34	Get	V	Trigger Slope/Edge	SINT	Definition of trigger detection slope.	0: Positive 1: Negative
Sensor OK Detection				Group of 5 configuration attributes.		
40	Get	V	Sensor OK Definition	BYTE	TX OK Definition that drives the appropriate OK line of the tacho bus.	Configuration options
41	Get	V	Sensor OK High Threshold	INT	High-voltage threshold for the Sensor OK monitoring window.	mV Range: -24000…24000
42	Get	V	Sensor OK Low Threshold	INT	Low voltage threshold for the Sensor OK monitoring window	mV Range: -24000…24000
43	Get	V	High RPM Threshold	REAL	High RPM Threshold for the Sensor OK monitoring window.	RPM Range: 50…30000
44	Get	V	Low RPM Threshold	REAL	Low RPM Threshold for the Sensor OK monitoring window.	RPM Range: 0.5…29000
TSC Output Configuration				Group of 2 configuration attributes.		
48	Get	V	Tacho Bus and TSCX terminal connections, output 0	SINT	Define processed signal type to be output on the Tacho bus and terminal output 0.	0: 1/rev signal 1: multi-pulse (raw) signal Fixed at 0.
49	Get	V	TSCX terminal connections, output 1	SINT	Define processed signal type to be output via terminal interface.	0: 1/rev signal 1: multi-pulse (raw) signal Fixed at 0.

Attribute Semantics

TSC Module Status

The Auxiliary TSC module reports its status as part of the normal exchanges with the main module.

The bit assignments are as follows.

Bit	Description
0	Auxiliary module not responding
1	Auxiliary module configured
2	MSP code (CRC) fault
3	MSP high temperature
4	Link fail
5	Halt active
6	MSP RAM fault
7	MSP RAM access error

Bits 0…7 are common to all types of auxiliary module, bits 8 to 15 are specific to type.

The auxiliary module controls Bits 1…15, the main module sets bit 0.

If bit 0 is set, the remaining bits do not reflect the current auxiliary module status.

If communication with an expansion module is lost, then the main module sets a status bit to indicate an expansion bus fault. If communication are restored, then normally the fault indication clears. However, if a configuration activity has failed, then the fault indication remains set until a successful reconfiguration is completed. Normally this reconfiguration is achieved by downloading the configuration from the controller to the host main module.

Bit	Description
8	Reserved for reverse rotation detected
9	Reserved for zero speed detected
10	Speed 0 is estimated
11	Speed 1 is estimated
12	+25V5 supply fail
13	-25V5 supply fail
14	Tacho 0 sensor fail
15	Tacho 1 sensor fail

Tacho Input Types

Following sensor types are supported for connection to Tacho Signal Conditioning expansion module.

Value	Description
0	OFF
1	TTL Signal Input
2	NPN Proximity Switch
3	PNP Proximity Switch
4	Eddy Current Probe System
5	Self-generating magnetic Probe

TX Power Setup

Following transducer power-supply options apply per transducer output.

Value	Description
0	OFF
1	+CV (+24V / 25 mA voltage regulated output)
2	-CV (-24V / 25 mA voltage regulated output)

TX OK Definition

Following options define the source/conditions for reporting a tachometer Not OK condition.

Bit	Description
0	Outside voltage window
1	Outside RPM window
2	SC module fault
3…7	Reserved

Bit setting of 1 defines inclusion of the specified condition, reserved bits, and non-desired configuration options are set to 0.

Multiple bit selections are valid, logical combination is OR.

0x00 value defines no tacho transducer OK monitoring.

In general, the TSC module continues to try to provide a signal to the various tacho outputs in spite of a detected failure. For example, a class attribute 17 configures the timeout value that the module uses to assess the link quality. A link timeout only causes an indication of the fault, any active tacho outputs, and their OK status continues to be maintained. Bit 2 in the proceeding table, is provided to allow the facility for a TX not OK to be set in case an internal TSC module fault is detectable.

Table 149 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix Tacho and Speed Measurement Object

The Tacho and Speed Measurement Object (class 0x395) defines the configuration of tacho and speed signals as processed at main module level.

One instance is linked to each available tachometer channel.

Table 150 - Object Instances

Instance ID	Description
0	Tacho and Speed Measurement Class Instance
1	Instance 1 represents measurement setup and data for tachometer input 0 and associated speeds
2	Instance 2 represents measurement setup and data for tachometer input 1 and associated speeds

Table 151 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	-	Tacho Signal Status	BYTE	Tacho signal enable and OK status	Bits 0…1 indicate tacho enabled status (1 = enabled) Bits 2…3 indicate tacho OK status (1 = fault)

Table 152 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Speed	REAL	Speed that is based directly on the tacho source (equates to a fixed multiplier of 1).	RPM
2	Get	V	Factored Speed	REAL	Processed speed output (based on a configured multiplier).	RPM
3	Get	V	Speed - max	REAL	maximum speed (attribute 1) RPM since power cylce or last reset of stored value.	RPM
4	Get	V	Speed - ROC	REAL	Rate of change of the (attribute 1) speed output.	RPM/min
Basic Tacho/Speed Configuration				Group of 5 configuration attributes.		
16	Get	V	Tacho Source	SINT	Choice of source: local terminal inputs, tacho bus, I/O data, or OFF.	Selection options
17	Get	V	Tacho OK Source	SINT	Choice of OK source when using the local tacho inputs.	OK source options
18	Get	V	Tacho Name	SINT[32]	Tacho descriptive name.	32 characters
19	Get	V	Speed Multiplier	REAL	Definition of multiplier for the factored Speed measurement.	Default of 1. Range: 0.01…100

Table 152 - Instance Attributes

21	Get	V	Tacho Trigger Slope/Edge	SINT	main module has configurable edge detection.	0: Positive 1: Negative
			Rate of Change of Speed		Group of 2 configuration attributes.	
24	Get	V	ROC Delta Time	REAL	Delta Time: The time between speed values that are used to evaluate the rate of change	Range: 0.1…20 s Default of 0.5 s
25	Get	V	ROC TC	REAL	The time constant that is applied to the measured speed values before they are used for ROC assessment	Range: 0.1…20 s Default of 0.2 s (are not normally > ROC delta time)

Trigger threshold for the main module is fixed at 2.5V.

Attribute Semantics

Tacho Source Selection

This selection defines which source to use for this tacho and speed processing input.

Value	Description
0	OFF
1	Local TTL Tacho Input 0
2	Local TTL Tacho Input 1
3	Tacho Bus 0
4	Tacho Bus 1
5	mapped to I/O data Speed 0 (Fixed source locations for data and OK status)
6	mapped to I/O data Speed 1 (Fixed source locations for data and OK status)
Higher Values	Reserved

0x00 defines this Tacho as disabled, multiple sources not allowed.

Selection allows theoretically that an equal source can be used for both object instances.

Tacho OK Source Selection

For the main tacho sources (Bus 0, Bus 1, I/O 0 and I/O 1) a dedicated Tacho OK provision is made and is selected automatically.

For the Local Tacho inputs however, it is sometimes possible to provide an OK signal using a local logic input.

The Tacho OK source selection can be used to configure whether this feature is enabled or not.

To use the corresponding logic input as an OK indication, set the OK source equal to the Tacho source.

Examples:

Tacho source selection 1

- Tacho OK source selection = 1 (uses local Logic Input 0)
- Any other value results in permanent Tacho OK state.

Tacho source selection 2

- Tacho OK source selection = 2 (uses local Logic Input 1)
- Any other value results in permanent Tacho OK state.

When the local Logic Inputs are being used as described in the previous examples, leave open for a Tacho OK state and short the appropriate input to trigger a Tacho Fail condition.

Table 153 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x05	x	x	Reset	Reset the peak hold speed (RPM - max)
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Behavior

The module can process two independent tacho signals from a range of sources.

For 'simple' TTL signals, the main module is equipped with two local tacho inputs. Trigger threshold for these inputs is fixed at 2.5V

For more complex signals, a TSCX module can be used. This option provides the possibility of tacho transducer power, support for a range of transducer types, variable trigger threshold, and multiple event per revolution signals. Conditioned tacho signals (TTL and one event per revolution) can then be made available to multiple main modules via the tacho bus. A TSCX module is also required to support cross module synchronization; that is the advanced (On-demand) data, which are synchronized across multiple modules. Where a TSCX module is being used, help ensure that the main module tacho edge detection (the preceding attribute 21), matches that configured for the TSCX module.

After power-up or configuration download, the speed value is held at zero rpm until four tacho pulses have been processed. This process is used particularly to avoid an initial 'ghost' pulse that can cause a spurious maximum speed value to be stored. Similarly while the Tacho OK indication is 'Fail', although the measured speed value continues to update the storage of any new maximum speed is prevented. To avoid that in the transition period from OK to Fail, or Fail to OK, a spurious new maximum speed value is captured the following measures are also implemented:

- New maximum speed evaluations are implemented on slightly historic speed values (around 0.5 seconds old)
- Evaluations are inhibited for around 1 second and four tacho events following a Tacho Fail to
- OK transition

Although the preceding process cannot completely eliminate the possibility that a faulty tacho probe or loose wire can trigger spurious maximum speed values, it is designed to minimize the likelihood of this happening.

Where no tacho signals are available, the module can accept two speed values as part of the controller output data. While these cannot support tracking filters, they can (if nominated as a 'tacho' source) drive speed-related FFT bands.

For redundant tacho mode, refer to the Module Control Object, attribute 24.

Dynamix Measurement Alarm Object

The measurement alarm object (class code 0x396) defines configuration of two-stage individual measurement alarms and provides access to the associated alarm status. Defined measurement alarms can be used as input for logical alarms (voted) and/or be used as non-latching intermediate virtual alarm status.

Class attributes and services allow for alarm history information.

Table 154 - Object Instances

Instance ID	Description
0	Measurement Alarm Class Instance
1…24	Alarm Measurement object instances 1…24

Unused instances exist and are accessible but have a disabled state.

Table 155 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Active Instances	DWORD	Defines the active measurement alarms.	Bit coding (24 used)
9	Get	V	Common Alert	BOOL	Boolean status indicating presence of at least one alert condition.	
10	Get	V	Common Danger	BOOL	Boolean status indicating presence of at least one danger condition.	
11	Get	V	Common TX Fail	BOOL	Boolean status indicating presence of at least one TX Fail condition.	
12	Get	V	Alarm History	STRUCT	Array of events (Time Stamp, measurement output, alarm status) representing last x number of entries. A change in the alarm status triggers an entry.	

Table 156 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Individual Alarm Status	BYTE/WORD	Bit coded individual measurement alarm status.	Status options
General Alarm Configuration				Group of 6 configuration attributes.		
16	Get	V	Alarm Enable	SINT	Boolean function indicating if the alarm is enabled (and defined).	0: Not enabled 1: Enabled
17	Get	V	Alarm Measurement Identifier	INT	Defines source of measurement alarm.	Source selection
18	Get	V	Alarm Name	SINT[32]	A name to identify this alarm instance.	32 characters
19	Get	V	Alarm Form	SINT	Defines form of alarm.	Alarm form option
20	Get	V	Alarm Type	SINT	Defines behavior regarding TX OK state.	Alarm type options
21	Get	V	Alarm Processing Mode	SINT	Defines alarm processing mode to be Normal, Adaptive, or Profile.	Alarm processing options
Alarm Thresholds				Group of 8 configuration attributes.		
24	Get	V	Low Alert Threshold	REAL	Defines low alert threshold limit that is used for Under Threshold and Window alarm types.	Range: -49000…48000
25	Get	V	High Alert Threshold	REAL	Defines high alert threshold limit that is used for Over Threshold and Window alarm types.	Range: -48000…49000
26	Get	V	Low Danger Threshold	REAL	Defines low danger threshold limit that is used for Under Threshold and Window alarm types.	Range: -50000 …49000
27	Get	V	High Danger Threshold	REAL	Defines high danger threshold limit that is used for Over Threshold and Window alarm types.	Range: -49000…50000
32	Get	V	Hysteresis	SINT	The amount on the safe side of a threshold by which the value must recover to clear the alarm.	Range: 0…20 %
33	Get	V	Delay/Sustain Time (Alert)	DINT	Duration that a measurement alarm input must be continuously present before being reported as an Alert alarm event	Individual delays are an integer in ms Range: 0…65500
34	Get	V	Delay/Sustain Time (Danger)	DINT	Duration that a measurement alarm input must be continuously present before being reported as a Danger alarm event.	Individual delays are an integer in ms Range: 0…65500

Table 156 - Instance Attributes

35	Get	V	Alarm Multiplier	REAL	Indicates how the thresholds are adjusted when the alarm (threshold) multiplier function is invoked.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
Adaptive Monitoring				Group of 11 configuration attributes.		
40	Get	V	Adaptive Monitoring Source	INT	The data source for the control variable.	Source selection
41	Get	V	Range 1 - Upper Control Value	REAL	Defines first range area upper limit of control value.	Range: 0…50000
42	Get	V	Range 1 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for first range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
43	Get	V	Range 2 - Upper Control Value	REAL	Defines second range area upper-limit of control value.	Range: 0…50000
44	Get	V	Range 2 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for second range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
45	Get	V	Range 3 - Upper Control Value	REAL	Defines third range area upper-limit of control value.	Range: 0…50000
46	Get	V	Range 3 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for third range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
47	Get	V	Range 4 - Upper Control Value	REAL	Defines fourth range area upper-limit of control value.	Range: 0…50000
48	Get	V	Range 4 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for fourth range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…to 100
49	Get	V	Range 4 - Upper Control Value	REAL	Defines fifth range area upper-limit of control value.	Range: 0…50000

Table 156 - Instance Attributes

50	Get	V	Range 4 - Alarm Multiplier	REAL	Defines applicable alarm multiplier for fifth range area.	1: in effect disabled >1: alarm less likely <1: alarm more likely Range: 0.01…100
Profile Mode				Group of 4 configuration attributes.		
64	Get	V	Profile mode - Reference for Low Alert Threshold	SINT	I/O Alarm Tag Reference defining dynamic low alert alarm threshold	Range: 0…15 No hysteresis support
65	Get	V	Profile mode - Reference for High Alert Threshold	SINT	I/O Alarm Tag Reference defining dynamic high alert alarm threshold	Range: 0…15 No hysteresis support
66	Get	V	Profile mode - Reference for Low Danger Threshold	SINT	I/O Alarm Tag Reference defining dynamic low-danger alarm threshold	Range: 0…15 No hysteresis support
67	Get	V	Profile mode - Reference for High Danger Threshold	SINT	I/O Alarm Tag Reference defining dynamic high-danger alarm threshold	Range: 0…15 No hysteresis support

Attribute Semantics

Individual Alarm Status

Individual alarm status code can represent one or more of the following conditions:

- Bit 0 - Alert usage enabled
- Bit 1 - Danger usage enabled
- Bit 2 - Adaptive mode
- Bit 3 - Profile mode
- Bit 4 - Multiplier configured
- Bit 5 - Multiplier active
- Bit 6 - Alert status
- Bit 7 - Danger status

Alarm Form

The following selection choices define the measurement alarm form.

Table 157 - Alarm Form

Value	Description
0x00	(0) - Over Threshold
0x01	(1) - Outside Window
0x02	(2) - Under Threshold
0x03	(3) - Inside Window

Alarm Type

The following options define measurement alarm behavior that is related to transducer status (TX OK).

Table 158 - Alarm Type

Value	Description
0x00	TX OK Considered - requires TX OK status to report alarm condition
0x01	TX OK Monitored - forces an alarm when TX status is NOK
0x02	TX OK Not Considered - Don't care about TX OK state

Alarm Processing Mode

The following alarm processing modes are supported per alarm output:

Table 159 - Alarm Processing Mode

Value	Description
0x00	(0) - Normal, use of fixed alarm level
0x01	(1) - Adaptive Monitoring, allow Onboard module configuration for 5ea different alarm level threshold sets that are linked to speed or other parameter
0x02	(2) - Profile Alarming, where the alarm profile is external from the main module configuration and are communicated using the I/O table

In adaptive alarming mode, a control variable is defined and the magnitude of that variable dictates a factor that is applied to the configured alarm thresholds. This action is applied in a number of discrete bands or ranges, which are defined in attributes 41…50. The control variable is often speed, but can be selected from among any measurement available to the module, refer attribute 40.

An illustrative example, which is based on speed and use of all five available ranges is as follows:

- Range 1 < **500** rpm
- Range 2 500 to
- **1000** rpm
- Range 3 1000 to
- **1500** rpm
- Range 4 1500 to
- **2000** rpm
- Range 5 > 2000 rpm

The upper control value for each range is shown in bold (Range 5 doesn't have an upper limit). For each of the five ranges, a separate alarm threshold factor can be applied.

Hysteresis

Hysteresis is defined here as a percentage rather than a fixed deadband value:

- For threshold alarms, the deadband is the stated percentage of the threshold.
- For window alarms, the deadband is the stated percentage of the range of the window (high - low).

The following are examples of hysteresis.

- An (over) threshold alarm of 10, hysteresis 10%, gives hysteresis threshold at 9 (10% of the threshold, away from the threshold)
- An (outside) window alarm of 0 to 10, hysteresis 10%, gives hysteresis thresholds at 1 and 9 (10% of the window range, away from each threshold)
- An (outside) window alarm of -10 to 10, hysteresis 5%, gives hysteresis thresholds at -9 and 9 (5% of the window range, away from each threshold)

Source Selection

Based on the 4 DWORD bit allocations that are used for defining what data is contained in the Trend, Transient, and Controller Input assemblies.

Table 160 - Source Selection

Index	DWORD 0	Index	DWORD 1	Index	DWORD 2	Index	DWORD 3
0	Overall (0) Channel 0	32	Order (2) Phase Channel 0	64	FFT Band (20)	96	Factored Speed 0
1	Overall (0) Channel 1	33	Order (2) Phase Channel 1	65	FFT Band (21)	97	Factored Speed 1
2	Overall (0) Channel 2	34	Order (2) Phase Channel 2	66	FFT Band (22)	98	Axial Differential Expansion Channel-Pair 0
3	Overall (0) Channel 3	35	Order (2) Phase Channel 3	67	FFT Band (23)	99	Axial Differential Expansion Channel-Pair 1
4	Overall (1) Channel 0	36	Order (3)Mag Channel 0	68	FFT Band (24)	100	Ramp Differential Expansion Radial Channel-Pair 0
5	Overall (1) Channel 1	37	Order (3)Mag Channel 1	69	FFT Band (25)	101	Ramp Differential Expansion Radial Channel-Pair 1
6	Overall (1) Channel 2	38	Order (3)Mag Channel 2	70	FFT Band (26)	102	Rod Drop Channel 0
7	Overall (1) Channel 3	39	Order (3)Mag Channel 3	71	FFT Band (27)	103	Rod Drop Channel 1
8	DC(V) Channel 0	40	Order (3) Phase Channel 0	72	FFT Band (28)	104	Rod Drop Channel 2
9	DC(V) Channel 1	41	Order (3) Phase Channel 1	73	FFT Band (29)	105	Rod Drop Channel 3
10	DC(V) Channel 2	42	Order (3) Phase Channel 2	74	FFT Band (30)	106	
11	DC(V) Channel 3	43	Order (3) Phase Channel 3	75	FFT Band (31)	107	
12	Order (0)Mag Channel 0	44	FFT Band (0)	76	Not 1X Channel 0	108	
13	Order (0)Mag Channel 1	45	FFT Band (1)	77	Not 1X Channel 1	109	
14	Order (0)Mag Channel 2	46	FFT Band (2)	78	Not 1X Channel 2	110	
15	Order (0)Mag Channel 3	47	FFT Band (3)	79	Not 1X Channel 3	111	

Table 160 - Source Selection

Index	DWORD 0	Index	DWORD 1	Index	DWORD 2	Index	DWORD 3
16	Order (0) Phase Channel 0	48	FFT Band (4)	80	DC Channel 0	112	
17	Order (0) Phase Channel 1	49	FFT Band (5)	81	DC Channel 1	113	
18	Order (0) Phase Channel 2	50	FFT Band (6)	82	DC Channel 2	114	
19	Order (0) Phase Channel 3	51	FFT Band (7)	83	DC Channel 3	115	
20	Order (1)Mag Channel 0	52	FFT Band (8)	84	S maxMag Channel Pair 0	116	
21	Order (1)Mag Channel 1	53	FFT Band (9)	85	S maxMag Channel Pair 1	117	
22	Order (1)Mag Channel 2	54	FFT Band (10)	86	S max Phase Channel Pair 0	118	
23	Order (1)Mag Channel 3	55	FFT Band (11)	87	S max Phase Channel Pair 1	119	
24	Order (1) Phase Channel 0	56	FFT Band (12)	88	Shaft Absolute pk-pk Channel Pair 0	120	
25	Order (1) Phase Channel 1	57	FFT Band (13)	89	Shaft Absolute pk-pk Channel Pair 1	121	
26	Order (1) Phase Channel 2	58	FFT Band (14)	90	Speed 0	122	
27	Order (1) Phase Channel 3	59	FFT Band (15)	91	Speed 1	123	
28	Order (2)Mag Channel 0	60	FFT Band (16)	92	Speed 0 maximum	124	
29	Order (2)Mag Channel 1	61	FFT Band (17)	93	Speed 1 maximum	125	
30	Order (2)Mag Channel 2	62	FFT Band (18)	94	Speed 0 Rate of Change	126	
31	Order (2)Mag Channel 3	63	FFT Band (19)	95	Speed 1 Rate of Change	127	

Table 161 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Behavior

An instance of the Measurement Alarm Object is used to assign alarming behavior to a selected measurement.

The source measurement can be selected from any one of the measurements that the module makes available.

The different instances are used to include various measurements in the alarm scheme. Alternatively, multiple instances can refer to the same measurement where multiple behaviors are required (differing thresholds as an example).

Once the measurement alarm instances have been defined, they are available to use in the Voted Alarm Object. Then logical combinations of up to four measurement alarms can be defined.

The alarm type, the measurement alarm behavior pertaining to transducer status (TX OK), determines how TX OK state is integrated into the voting logic. Considering then just the individual measurement alarm contribution to the voted alarm or the simplest voted alarm logic, 1oo1:

- TX OK Considered - Alarm IF ([Measurement in alarm] AND [TX OK])
- TX OK Monitored - Alarm IF ([Measurement in alarm] OR [TX Fail])
- TX OK Not Considered - Alarm IF [Measurement in alarm]

It is the enabled outputs of the Voted Alarm Object that provide the 'actual alarms' that can be assigned to relay outputs.

Dynamix Voted Alarm Object

This voted/complex alarm object defines the configuration of multiple input voted measurement alarms, the resulting alarm behavior, and provides access to the associated logical alarm status.

Class attributes and services allow for alarm history information.

Table 162 - Object Instances

Instance ID	Description
0	Voted Alarm Class Instance
1…13	Voted Alarm object instances 1…13

Unused instances exist and are accessible but have a disabled state.

Table 163 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Instances	WORD	Defines the enabled voted alarm instances.	Bit coding (13 used)
9	Get	V	Common Alert	BOOL	Boolean status indicates the presence of at least one alert condition.	
10	Get	V	Common Danger	BOOL	Boolean status indicating presence of at least one danger condition.	
11	Get	V	Common TX Fail	BOOL	Boolean status indicates the presence of at least one TX Fail condition.	
12	Get	V	First Out Alarm	STRUCT	Record of first logical alarm event (Time Stamp, measurement output, alarm status) logged after reset of First Out alarm option.	
13	Get	V	Alarm History	STRUCT	Array of events (Time Stamp, measurement output, alarm status) representing last x number of entries. A change in the alarm status triggers an entry.	
16	Get	V	Trip Inhibit/ Bypass Source	BYTE	Source definition for Trip Inhibit/Bypass	Source selection
17	Get	V	Alarm Reset Source	BYTE	Source definition for Reset function	Source selection

Class Attribute Semantics

Source Selection

The following sources can be identified as inputs for Trip Inhibit/Bypass and Reset functionality.

Table 164 - Class Attribute - Source Selection

Bit	Description
0	Logic Input 0 - Module Hardware Digital Input
1	Logic Input 1 - Module Hardware Digital Input
2	Input I/O
3	Alarm Service Request
4…7	Reserved

Multiple selections identify OR functionality of specified inputs.

Applies to all Voted alarms and all Relays.

Where a logic input is being used, left open they are 'inactive', close/connect the pair of terminals to action a reset or an inhibit action.

That action is maintained for as long as the connection is made.

Table 165 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Voted Alarm Status	WORD	Bit coded individual voted alarm status.	Status options
Alarm Usage and Behavior				Group of 4 configuration attributes.		
16	Get	V	Alarm Usage	BYTE	What measurement alarm outputs are used. None used = OFF.	Alarm usage options
17	Get	V	Alarm Name	SINT[32]	A name to identify this voted alarm instance.	32 characters
18	Get	V	Alarm Behavior	SINT	Latching or non-latching.	Alarm behavior options
19	Get	V	Alarm Type	SINT	Any output designated fail-safe or Alarm Type Options non-fail-safe.	Alarm type options
Alarm Voting Logic				Group of 5 configuration attributes.		
24	Get	V	Alarm Logic Configuration	SINT	The high-level voting scheme that is used for the logical alarm processing.	Voted logic schemes

Table 165 - Instance Attributes

25	Get	V	Alarm Input 0	SINT	Measurement Alarm instance reference that is used for input 0.	Range: 1…24
26	Get	V	Alarm Input 1	SINT	Measurement Alarm instance reference that is used for input 1.	Range: 1…24
27	Get	V	Alarm Input 2	SINT	Measurement Alarm instance reference that is used for input 2.	Range: 1…24
28	Get	V	Alarm Input 3	SINT	Measurement Alarm instance reference that is used for input 3.	Range: 1…24
Alarm Multiplier				Group of 2 configuration attributes.		
32	Get	V	Alarm Multiplier Control	BYTE	Trigger Source and Enable/Disable.	AM control options
33	Get	V	Alarm Multiplier ON Time	DINT	The time that the alarm (threshold) multiplier is applied after the control is toggled.	ms Range: 0…65500
Speed Gating				Group of 4 configuration attributes.		
40	Get	V	Speed Gating Control	SINT	Speed gating data source selection with Enable/Disable control.	Speed gating sources
41	Get	V	Speed Gating Detection	SINT	Selection of threshold or window detection methods.	Speed range condition options
42	Get	V	Lower Speed Threshold	REAL	Low speed threshold definition.	RPM Range: 4…19000
43	Get	V	Higher Speed Threshold	REAL	High-speed threshold definition.	RPM Range: 5…20000
Logic Gating				A configuration attribute.		
48	Get	V	Logic Gating Source	WORD	Source definition for the logic gating trigger data, including OFF	Logic gating source options
Logic Control				A configuration attribute.		
56	Get	V	Logic Control Source	WORD	Source definition for the logic control trigger data	Refer logic gating source options but note that only one logic control source is allowed.

Attribute Semantics

Voted Alarm Status

Voted Alarm instance has up to three outputs that can be used (Alert, Danger, and TX OK). The Voted alarm status is bit orientated as follows, with a 'common' four bits then further sets of 4 bits for the Alert, Danger, and TX Fail outputs:

Table 166 - Voted Alarm Status

Bit	Description
0	Latching
1	Bypass/Inhibit Active
2	SPM active
3	Spare
4	Alert output state (1 = alarm conditions met)
5	Alert output disabled
6	Alert alarm state (1 = alarm)
7	Alert is a first out alarm
8	Danger output state (1 = alarm conditions met)
9	Danger output disabled
10	Danger alarm state (1 = alarm)
11	Danger is a first out alarm
12	TX Fail output state (1 = alarm conditions met)
13	TX Fail output disabled
14	TX Fail alarm state (1 = alarm)
15	TX Fail is a First out alarm

Alarm Usage

The following options define the output type of the voted alarm condition.

Table 167 - Alarm Usage

Bit	Description
0	Alert
1	Danger
2	TX Fail
3…7	Reserved

0x00 defines disabled Voted Alarm, multiple settings are allowed noting that the same voted logic is applied within and only within each output type.

Alarm Behavior

These options defined the functionality of the logical alarm output.

Table 168 - Alarm Behavior

Value	Description
0x00	(0) - Non-Latching - alarm follows actual status
0x01	(1) - Latching - alarm output retains the alarm condition, once activated, until a reset is issued while the current active safe/OK level applies

Alarm Multiply Control

The following sources can be identified as input for Alarm Multiply (SPM) trigger.

Table 169 - Apply Multiply Control

Bit	Description
0	Logic Input 0 - Module hardware digital input
1	Logic Input 1 - Module hardware digital input
2	Controller SPM 0
3	Controller SPM 1
4	Alarm Multiply Service Request (SPM 0)
5	Alarm Multiply Service Request (SPM 1)
6…7	Reserved

0x00 defines disabled Alarm Multiply function, multiple settings identify OR functionality of specified inputs.

To avoid that the SPM control can be left active, the module initiates the alarm threshold multiplier on a change of state of the control. It does not initiate on the state itself. The SPM action then times out after the time specified in the configuration has elapsed. If the control state changes further, within the timer period the SPM action continues and the timer is refreshed/restarted.

When being used, set the multiplier 'ON time' (attribute 33) to a non-zero value otherwise the feature is disabled.

Alarm Types

The following high-level functionality can be defined.

Table 170 - Alarm Types

Value	Description
0x00	0) - Non-Fail-Safe - If assigned to a relay, in the alarm condition the relay coil would be energized
0x01	(1) - Fail-Safe - If assigned to a relay, in the alarm condition the relay coil would be de-energized

Voting Logic

Defines the high-level voting construction that is used for the logical alarm processing. Supported high-level modes that are based on X out of Y logic and limited, more complex combinations.

Table 171 - Voting Logic

Value	Description
0x00	(0) 1oo1
0x01	(1) 1oo2
0x02	(2) 2oo2
0x03	(3) - 1oo3
0x04	(4) - 2oo3
0x05	(5) - 3oo3
0x06	(6) - 1oo4
0x07	(7) - 2oo4
0x08	(8) - 3oo4
0x09	(9) - 4oo4
0x60	(96) - 1oo2 AND 1oo2
0x61	(97) - 2oo2 OR 2oo2
0x62	(98) - 1oo2 AND 2oo2
0x63	(99) - 2oo2 AND 1oo2

Speed Gating Source

Following sources can be identified as the source of the speed gating.

Table 172 - Speed Gating Source

Value	Description
o	OFF
1	Tacho/Speed 0
2	Tacho/Speed 1
3	Factored speed from Tacho 0
4	Factored speed from Tacho 1
Higher Values	Reserved

0x00 defines Speed gating is disabled, multiple sources not allowed.

Speed Range Condition

Defines speed-range assessment type.

Speed Range Condition

Value	Description
0x00	(0) - High-Level Greater than high range
0x01	(1) - Low Level Lower than low range
0x02	(2) - In Window Within defined low and high range
0x03	(3) - Out Window Outside defined low and high range

Logic Gating Source

Bit	Description
0	Local Logic Input 0
1	Local Logic Input 1
2	Logic Gating Service Request (0)
3	Logic Gating Service Request (1)
4…7	Reserved
8	gate0_control in the controller output table
9	gate1_control in the controller output table

0x00 defines Logic gating as disabled

Up to three sources are allowed with multiple configured sources and logic applied.

Logic Gating and Control Sense

Default behavior is logic gating/control is true when:

- Local Logic Input is low (based on logic input being pulled high)
- Logic control bit is high (1)

Assuming single defined source, OR logic situations.

Table 173 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x05	x	x	Reset	Reset the peak hold speed (RPM - max)
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

No Object Specific Services are supported.

Behavior

The Voted Alarm Object provides for logical combinations of up to 4, referenced, measurement alarms (instance attributes 25…28 refer). The alarm logic scheme name (and logic description) applies to attributes in order, so that:

> X out of Y (where both X and Y are from 1 to 4) refers to attributes 25…28, unused attributes are ignored.

and for more complicated logic:

> 1oo2 AND 1oo2 is where the first pair refers to attributes 25 and 26 and the second pair to attributes 27 and 28.

The alarm type, the measurement alarm behavior that is related to transducer status (TX OK), determines how TX OK state is integrated into the voting logic. 2oo2 illustrates an example of how that is reflected in the final logic (so using Alarm inputs 0 and 1):
- TX OK Considered - Alarm IF ([Alarm input 0 in alarm] AND [Associated TX OK] AND [Alarm input 1 in alarm] AND [Associated TX OK])
- TX OK Monitored - Alarm IF ((([Alarm input 0 in alarm] AND [Other TX Fail]) OR ([Alarm input 1 in alarm] AND [Other TX Fail]) OR ([Alarm input 0 in alarm] AND [Alarm input 1 in alarm]) OR [Both TX Fail])
- TX OK Not Considered - Alarm IF ([Alarm input 0 in alarm] AND [Alarm input 1 in alarm])

It is allowable for each measurement alarm to have another behavior pertaining to transducer status. However, to avoid complicating the example, it is assumed in the proceeding paragraph that both measurement alarms have the same type.

Each Voted Alarm Object has up to three outputs, which are individually enabled when required (Alert, Danger, dedicated TX OK). It is the enabled outputs of the Voted Alarm Object that provide the 'actual alarms' that can be assigned to relay outputs.

The (dedicated) TX OK output combines the relevant TX Status results in the selected logic scheme. It does not pay any attention to measurement alarm type setting (TX OK Considered, Monitored, or Not Considered).

Dynamix Normal CM Data Object

This configures the Normal CM (Condition Monitoring) Data object (class 0x398). This data is dynamic data (TWF and FFT) which is captured as part of the Trend and Alarm and Transient*Data capabilities of the module. 'Live' data can also be requested direct from this object.

Available services allow for data requests for Normal CM data according to requester specifications.

Table 174 - Object Instance

Instance ID	Description
0	Normal CM Data Class Instance
1…4	Instances 1…4 are respectively assigned to measurement channels 0…3

Table 175 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
16	Get	V	Synchronization Enable	SINT	A cross module synchronization control.	Future use Set at zero
17	Get	V	Waveform/FFT Storage Format	BYTE	Control of the way FFT/ TWF data is stored Onboard the module.	Storage options Fixed at 0x11

Table 176 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
TWF and Common Parameters				Group of 6 configuration attributes.		
16	Get	V	Enable	BYTE	Type of Normal CM data to be enabled.	Enable control
17	Get	V	Signal Source	SINT	Defines the data source. Same for both TWF and FFT.	Source selection options
18	Get	V	Number of Averages	SINT	Default is FFT averaging unless waveform averaging is enabled in attribute 16,.	Averages: 1, 2, 3, 6, 12, 23, 45, 89, or 178
19	Get	V	Measurement Units	ENGUNITS	Set the measurement units that are based on selected data source.	Engineering units options
20	Get	V	Associated Tacho Source	SINT	Tacho source selection.	For tacho events
21	Get	V	Waveform Record Length	SINT	Defines the number of samples in the Normal CM, waveform.	Index: 0…5
FFT Specific Configuration				Group of 3 configuration attributes.		

Table 176 - Instance Attributes

25	Get	V	FFT Line Resolution	SINT	Defines the FFT line resolution that is used in the Normal CM, FFTs.	FFT resolution options
26	Get	V	FFT Window Function	SINT	Definition of window function for FFT signal processing.	FFT window options
28	Get	V	FFT Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)

Attribute Semantics

Waveform FFT Storage Format

A bit wise control for the storage of the Normal CM Data.

Table 177 - Waveform FFT Storage Format

Bit	Description
0	FFT as Float
1	FFT as 16 bit
2	FFT as 8 bit
3	Reserved
4	Waveform as Float
5	Waveform as 16 bit
6	Waveform as 8 bit
7	Reserved

Single setting applies to all stored Normal CM data (Trend, Alarm, and Transient) for all channels.

This parameter has been made available within the configuration such as to permit (future) Smart memory allocation.

Currently the internal storage is fixed as float (shown in bold previously and represented as a return value of 0x11).

TWF/FFT data is always returned as IEEE Float/Real values across the network.

Enable

A bit wise enable for the Normal CM Data.

Table 178 - Normal CM Data

Bit	Description
0	FFT
1	Waveform
2	Waveform Averaging
3…7	Reserved

Waveform averaging is only a valid selection if or when the Normal CM data source is set to the Alternate path and that is configured for synchronous sample generation. Refer also the Channel Set up Object.

The Normal CM Data enable affects not only the data available via this object, but the data available to the Trend, Alarm and Transient Data objects:

Normal CM Data enable control, enables the type of dynamic data available to the downstream Objects In the downstream storage objects, dynamic data storage can be disabled per channel

(Trend/Data Manager) or by SU/CD (Transient) Normal (Live) Data is still available if dynamic data storage is disabled in the Trend/Data Manager (and Transient)

Source Selection

The Normal CM data can be taken before any filtering (1), from the alternate path (4) or from a choice of two locations (2, 3) on the main signal processing path.

Table 179 - Source Selection

Index	Description
0x01 (1)	**Pre-Filter** - before application-specific filters
0x02 (2)	**Mid-Filter** - Selected mid Filter identifies inclusion of application Low Pass Filter
0x03 (3)	**Post-Filter** - Selected post Filter identifies inclusion of both application Low and High Pass Filter including potentially enabled integration stage.
0x04 (4)	**Alternate path** - a CM, alternate processing, path available when so configured in the Channel Set Up Object

Measurement Units

Actual selection of Measurement engineering units are a subset of the master engineering units list. It is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Source of Speed Data

Any one of the following can be identified as the speed reference for Normal CM data.

Value	Description
0	Tacho/Speed 0
1	Tacho/Speed 1

Waveform Record Length

Index	0	1	2	3	4	5
Samples	256	512	1024	2048	4096	8192

Number of samples = 256 * (2^(Index))

FFT Resolution

Defines the FFT line resolution that is used for the Normal CM data FFT. For Advanced CM data, another line resolution can be requested.

Index	FFT Resolution
0x00 (0)	100 lines
0x01 (1)	200 lines
0x02 (2)	400 lines
0x03 (3)	800 lines
0x04 (4)	1600 lines

Transient dynamic data is generally specified by the Normal CM data object, noting however that it is limited to a maximum of an 800 line FFT and 2048 point TWF. Normal CM data can be set to higher lines/samples and this setting reflects in Trend and Alarm data but stored Transient Data is 800 line FFT and 2048 point TWF).

FFT Window Options

Following window processing options are selectable.

Index	FFT Window
0x00 (0)	Normal/Rectangular
0x01 (1)	Flat-Top
0x02 (2)	Hanning
0x03 (3)	Hamming

Table 180 - Averages

Index	Number of Averages
0x00 (0)	1
0x01 (1)	2
0x02 (2)	3
0x03 (3)	6
0x04 (4)	12
0x05 (5)	23
0x06 (6)	45
0x07 (7)	89
0x08 (8)	178

Table 181 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 182 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	-	-	Reserved	Reserved
0x4C	-	x	Normal CM Data Record Request	Data types consisting of multiple bytes are transferred in little endian format (least significant byte first). Also, a data communication session starts at the first service request and ends after the final response of the exchange or after timeout of 30 seconds.

0x4C CM Record Request

Normal CM data is retrieved using a series of request/response unconnected messages. One service is used to both start and continue with a session. The first request initiates the session and subsequent requests return values that are returned by the service. When the packet count down value returned reaches 0, the session is completed.

The instance and attribute can be set to 1, but they are ignored.

The host sends the following CM Record Request Parameters as part of an 0x4C service request.

Table 183 - CM Record Request Parameters

0	BufferSelect	INT	Specify the buffer to retrieve the data from: eFFT (2), eTWF (3), or eTACHO (4). The BufferSelect does not change during a session.
2	RequestedCount	UNIT	Set RequestedCount = 1 The RequestedCount does not change during a session.
4	SessionInstance	USINT	The SessionInstance is initially specified as 0, but on subsequent calls the SessionInstance returned in CM Record Response must be passed here.
5	ChannelSelect	BYTE	4 bits indicating the source channel. The ChannelSelect does not change during a session.
6	SpecialRequest	BYTE	3 bits are used: • Set SR_ mAG_PHASE (Bit 0) to request phase (see PHASE DATA page 296) and magnitude data from an FFT buffer, otherwise just magnitude data is returned. • Set SR_LIVE (Bit 1) to request/force 'live data' collection rather than receive the most recent data from the scheduled data acquisition. • IMPORTANT: Live data cannot be read concurrently by multiple users. If a 2nd host requests live data while the module is still serving an earlier request, the 2nd host will receive an error code 13. Bit 2 is not used. Set SR_FILTER (Bit 3) to request that if samples are decimated or synchronously resampled then only 50% of the configured FFT lines are to be returned. For further information, see FFT Data Filter (SR_FILTER) under Sampling Control in the Channel Setup Object.
7	Pad	BYTE	Used to align data to a 32 bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the CM Record Response must be passed here.

Phase Data

When the SR_mAG_PHASE bit is set the FFT's phase data, meaningful or not, is returned following the linear FFT data. However...

Selected sample data for any "Live" TWF/FFT always starts at the nearest sample to a tacho event irrespective of how the data is sampled (synchronous or asynchronous). So there is usable phase from both synchronous or asynchronously sampled data - in either case it should (reasonably) agree with tracking filter order phase - all it needs is the once per revolution signal.

On a TWF (if the signal were a simple 1x sinusoid), the phase will be visible as the angle from the start of the trace to the first positive peak. On an FFT phase values for every bin/line are provided as you would expect.

The Dynamic module incorporates phase corrections for any filter on the alternate path and for the main path LP filter. However, the Primary Path HP filter is non-linear phase and cannot practically be corrected for - so the POST FILTER data source should be avoided if phase data is important (to capture) and the HP filter is enabled (dependent on Measurement Type).

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The Dynamix 1444 as part of an 0x4C service response returns the following.

Table 184 - 0x4C Service Responses

Byte Offset within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to 3 instances are supported except when reading Live Data. See the IMPORTANT note the SpecialRequest structure above.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0…3 are valid channels.
2	Completed Records	UINT	This is incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UINT	For a given session the RecordSize returned here is fixed.
	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent CM Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) For all successful requests eSUCCESS (0) is returned, any other value ends the session.
16	Data Array	DWORD[50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows.

Table 185 - FFT (eFFT)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Can be used to calculate the bandwidth for the FFT.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	If Bit 0 is set, phase array follows the mag array in the returned data array. Otherwise, just the magnitude array is returned. Bits 1 & 2 indicate FFT scaling: 0 Peak, 1 Peak to Peak, 2 RMS Bit 3 is set if FFT Data Filter has been applied.
17	ucSpeedByte0	BYTE	RPM value of the referenced speed source for the FFT data. Actual RPM = Value/100 Value provided is a 24 bit (3 byte) integer. First (least significant) byte, bits 0…7.
18	ucSpeedByte1	BYTE	Second byte, bits 8…15
19	ucSpeedByte2	BYTE	Last byte, bits 16…23
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

If the FFT is a synchronous measurement then the RPM value is also provided in the SamplePeriodInSecs parameter. In that case, the two RPM values are identical.

Asynchronous Measurements

number_of_lines = if bit 0 of ***ucDataSelect*** is set, then
number_of_lines = ***ByteCount*** / 8, otherwise
number_of_lines = ***ByteCount*** / 4

If bit 3 of usDataSelect is set, then
number_of_lines = number_of_lines / 2

$$\text{FMAX (Hz)} = \frac{\text{number\_of\_lines} - 1}{\textbf{\textit{SamplePeriodInSec}} * 2.56 * \text{number\_of\_lines}}$$

Synchronous Measurements

number_of_lines = if bit 0 of ***ucDataSelect*** is set, then
number_of_lines = ***ByteCount*** / 8, otherwise
number_of_lines = ***ByteCount*** / 4

samples_per_rev = The first byte of the ***SamplePeriodInSec*** value

RPM_in_Hz = The last three bytes of the ***SamplePeriodInSec*** value

$$\text{number\_of\_orders} = \frac{(\text{number\_of\_lines} - 1) * \text{samples\_per\_rev}}{2.56 * \text{number\_of\_lines}}$$

$$\text{FMAX (Hz)} = \frac{(\text{number\_of\_lines} - 1) * \text{samples\_per\_rev} * \text{RPM\_in\_Hz}}{2.56 * \text{number\_of\_lines}}$$

FMAX (Hz) = number_of_orders * RPM_in_Hz

Table 186 - Waveform (eTWF)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and no of samples per revolution.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

Asynchronous Measurements

$$\text{TWF Period (sec)} = \frac{\textbf{\textit{SamplePeriodInSec}} * \textbf{\textit{ByteCount}}}{4}$$

Synchronous Measurements

$$\text{number\_of\_samples} = \frac{\textbf{\textit{ByteCount}}}{4}$$

samples_per_rev = The first byte of the ***SamplePeriodInSec*** value

RPM_in_Hz = The last three bytes of the ***SamplePeriodInSec*** value

$$\text{TWF Period (sec)} = \frac{\text{number\_of\_samples}}{\text{RPM\_in\_Hz} * \text{samples\_per\_rev}}$$

FFT and TWF data

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining 3 bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with 'data on the wire' of 0x 10DC7D05:
- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous can be known from the identifier field. This data has the following format:

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post filter)
5…6	Transfer path 1 data mode (bit 5 = 0 asynchronous, bit 5 = 1 synchronous then bit 6 indicates which tacho was used.
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	Reserved

Table 187 - Tacho (eTACHO)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
34	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

The identifier structure contains coded information recording the source (pertaining to filters), mode (asynchronous or synchronous), related tacho source, and engineering units for the data. If the mode is indicated as being synchronous, the SamplePeriodInSecs field contains the number of samples per revolution.

Behavior

Through the Object-specific service 0x4C, the Normal CM Object gives access to 'Live' Dynamic data. See the Data Manager Object for access to historical data (Trend and Alarm). See the Advanced CM Data Object for access to dynamically configurable analysis data (variable FFT lines, and so on) and the Transient Data Manager Object for access to stored transient event data.

Although in general, multi user access is supported by this object, the live data option is single user only. In such a case, error code 13 will be returned to any subsequent requestor [eLiveMeasurementInProgress] and that software will need to resubmit the request.

Normal CM Record Request - Recommendations for Network side implementation

The data is returned in multiple packets as an array of records of size RecordSize - it can be a significant amount of data depending on the extent of the data requested. The recommended way to handle this data transfer is to store the payload to a file for later retrieval.

It is recommended to store the first packet request and response packet to the file. Thereafter, store the record array payload that is contained within each subsequent packet. If this procedure is followed, the packet arrangement within the file would be as follows:

- RecordRequest Packet
- RecordResponse Packet (with first packet payload at the end)
  - Second Response Packet payload
  - Subsequent Response Packet payloads
- Last Response Packet payload

Instigate further sessions to retrieve data from any other required buffers or channels.

Retrieving any record from the file can then be accomplished as follows.

1. Open the file.
2. Read a record with size of Normal CM Record Request from the head of the file.
3. Access the BufferSelect variable to determine the type of record the file holds.
4. Read a record with size Normal CM Record Response from the file pointer.
5. Access the RecordSize variable to determine the size of the record.
6. Starting at the address of the first Record in the Data Array in the first Normal CM Record Response, index to any record by using the RecordSize to seek to the correct point in the file.
7. Then read out the record of size, RecordSize.

Dynamix FFT Band Object

The FFT Band Object (class code 0x399) defines the setup and holds the results for spectral bands that are calculated from Onboard FFT measurements. The FFT bands object provides a total 32 instances (an average of 8 per channel for a 4-channel protection module). The ability to select the source data for the FFT Band objects allows for future support for linking to Normal/Advanced CM data objects. Current support is for the Module Control object only (DSP-based FFT)

Table 188 - Object Instances

Instance ID	Description
0	FFT Band Class Instance
1…32	Instances 1…32 provide for flexible assignment of the FFT bands to any measurement channel (0…3 for a 4 channel protection module).

Table 189 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	Enabled Instances	DWORD	Bit-wise coding of enabled FFT Band instances (32 bits used).	Decoding information
9	Get	V	Channels with FFTBands	WORD	Bit wise coding of channels with FFT Bands (4 bits used).	0: No FFT bands that are allocated or 1: One or more FFT bands that are allocated to this channel
10	Get	V	Channel 0 - FFT Bands	DWORD	Active instances for measurement channel 0	0: This FFT band not allocated 1: This FFT band is allocated to this channel
11	Get	V	Channel 1 - FFT Bands	DWORD	Active instances for measurement channel 1	
12	Get	V	Channel 2 - FFT Bands	DWORD	Active instances for measurement channel 2	
13	Get	V	Channel 3 - FFT Bands	DWORD	Active instances for measurement channel 3	

Table 190 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Band RMS	REAL	Overall Band RMS measurement value.	
2	Get	V	Band max	REAL	maximum line/bin value in band.	RMS
3	Get	V	Band max Frequency	REAL	Frequency at which Band max occurs.	Hz / Order
6	Get	V	Band Value	REAL	One value from a choice of Band RMS, max, and Frequency, made by configuration.	
FFT Band Source				Group of 2 configuration attributes.		
16	Get	V	Channel Source	SINT	The channel FFT to which this band is applied.	Channel range 0…3 -128: OFF

Table 190 - Instance Attributes

17	Get	V	Data Source	SINT	The data source for FFT bands is set by the Module Control Object, attributes 73, 80, 87, and 94.	Fixed at 0
Demanded Band Frequency Limits				Group of 4 configuration attributes.		
18	Get	V	Source of Band Frequency Limits	SINT	Tacho related or fixed band limits in Hz	Band type
19	Get	V	Start Frequency	REAL	Definition of demanded band start frequency in Hz or orders (refer 18).	Start < Stop Start > 0 Range: 0.1…39000
20	Get	V	Stop Frequency	REAL	Definition of demanded band stop frequency in Hz or orders (refer 18)	Stop > Start Stop < Fmax Range: 0.2…40000
23	Get	V	Tacho Source for Band Limits	SINT	Tacho source for band limits	Tacho source
Transfer of Data to Controller				A configuration attribute.		
24	Get	V	FFT Band magnitude - Type	SINT	Which measurement data is transferred for this band (RMS, max, or Frequency).	0, 1, 2 Band RMS (default) max line/bin value Frequency of max line (Hz / order)

Attribute Semantics

Enabled Instances

The enable/disable state of the 32 instances, is available bit-wise from a DWORD, where at a bit level.

Table 191 - Enabled Instances

Value	Description
0	Disabled
1	Enabled

Disabled instances return error 0x08 (Service Not supported) when disabled instances are addressed with common services.

Table 192 - Band Type

Value	Description
0	Fixed bands in Hz
1	Order related bands

When 1, attribute 23 sets tacho source.

Source of Speed Data

Any one of the following can be identified as the speed reference.

Table 193 - Speed Reference

Value	Description
1	Tacho/Speed 0
2	Tacho/Speed 1
3	Factored speed from Tacho 0
4	Factored speed from Tacho 1
Higher Values	Reserved

Table 194 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix Advanced CM Data Object

The Advanced CM Data Object (class code 0x39A) defines the configuration of the Advanced CM TWF data acquisition. Available services allow for data requests for Advanced CM data according to requestor specifications, which can include various post-processing tasks, including FFT analysis.

Table 195 - Object Instances

Instance ID	Description
0	Advanced CM Data Class Instance
1…4	Instances 1…4 support advanced CM data for measurement channels 0…3

Table 196 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 197 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
TWF and Common Parameters				Group of 4 configuration attributes.		
16	Get	V	Source Selection	SINT	Defines the data source for both TWF and FFT.	Source selection options

Table 197 - Instance Attributes

17	Get	V	Measurement Units	ENGUNITS	Set the measurement units that are based on selected data source.	Engineering units options
18	Get	V	Associated Tacho Source	SINT	Tacho source selection.	For tacho events
19	Get	V	Waveform Record Length	SINT	Not used	

Attribute Semantics

Source Selection

The Advanced CM data can be read from the alternate processing path (4) or from a choice of locations on the main signal processing path:

Table 198 - Source Selection

Index	Description
0 or 1	**Pre-Filter** - before application-specific filters
2	**Mid-Filter** - after the Low Pass Filter
3	**Post-Filter** - after both application filters and any configured integration
4	**Alternate path** - can be asynchronously or synchronously sampled depending on channel set-up

Measurement Units

Actual selection of Measurement engineering units is a subset of the master engineering units list. The selection is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Table 199 - Associated Tacho Source

Value	Description
0x01	Tacho/Speed 0
0x02	Tacho/Speed 1
Higher Values	Reserved

Table 200 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 201 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Advanced CM Data Request	This service specifies the data processing that is being requested. Being 'on-demand', this service triggers that processing to take place.
0x4C	-	x	Advanced CM Data Record Request	This service is used to return the requested data.
0x4D	x	x	Advanced CM Data Session Reset	This service can be used to reset (finish early) the specified session instance. Only sessions that are associated with an advanced measurement is reset. The reset request includes the advanced session instance number from the last successful Advanced CM Data Request (0x4B) response.

Data types consisting of multiple bytes are transferred in little endian format (least significant byte first).

A data communication session starts at the first service request and ends after the final response of the exchange or after timeout of 30 seconds. Although three sessions are available, a reset remains good practice for freeing up resources for new Advanced Data transfer requests.

Expected flow would be as follows: Request - Data - Data - Data (as required) - Session Reset.

0x4B Advanced CM Data Request

Advanced CM data processing is started and the results are retrieved using a two-part set of commands that are sent as a series of request/response messages (using connected messages reduce messaging overhead).

An Advanced CM data request service is used to initialize and start a session. The desired parameters are passed to the system to begin the processing of the advanced CM data. The anticipated time for the processing to be completed is returned. After the processing time expires, the requestor can ask for the data using the second part of the command set.

The instance and attribute can be set to 1, but they are ignored.

The data that is sent with an Advanced CM data request is divided into two separate sections, the class section, and four instance sections. This process is similar to how EtherNet/IP classes are constructed with one class instance and multiple 'instance' instances.

The host sends the following Advanced CM Data Request Parameters as part of an 0x4B service request.

Table 202 - Advanced CM Data Request Parameters

Byte Offset within Structure	Structure Member	Data Type	Description
Class Instance			
0	Pad	USINT	-
1	Advanced Session Timeout	USINT	Seconds to have ownership of Advanced CM setup
2	Advanced Session Instance	UINT	Set to 0, unless restarting an existing (unexpired) request, where you'd pass in the Advanced Session Instance from the previous response
4	Sync Data Control	UINT	Used to request synchronized data from multiples modules
Instance 1 (Channel 0)			
6	Pad	WORD	Used to align data to a 32 bit boundary
9	Number of Averages	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
10	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
11	FFT Line Resolution	SINT	Identical control to that use in the Normal CM Data Object (0x30A), but with extra indices: • 5 (3200 lines) • 6 (6400 lines) • 7 (12800 lines)
12	FFT Window Function	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
13	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS]
14	Pad	INT	Used to align data to a 32 bit boundary.
Instance 2 (Channel 1)			
16	Enable	BYTE	A bit wise enable control.
17	Number of Averages	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
18	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
19	FFT Line Resolution	SINT	Identical control to that use in the Normal CM Data Object (0x30A), but with extra indices: • 5 (3200 lines) • 6 (6400 lines) • 7 (12800 lines)
20	FFT Window Function	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
21	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS]

Table 202 - Advanced CM Data Request Parameters

22	Pad	INT	Used to align data to a 32 bit boundary.
Instance 3 (Channel 2)			
24	Enable	BYTE	A bit wise enable control.
25	Number of Averages	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
26	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
27	FFT Line Resolution	SINT	Identical control to that use in the Normal CM Data Object (0x30A), but with extra indices: • 5 (3200 lines) • 6 (6400 lines) • 7 (12800 lines)
28	FFT Window Function	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
29	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS]
30	Pad	INT	Used to align data to a 32 bit boundary.
Instance 4 (Channel 3)			
32	Enable	BYTE	A bit wise enable control.
33	Number of Averages	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
34	Waveform Record Length	SINT	Defines the number of samples in the Advanced CM, waveform.
35	FFT Line Resolution	SINT	Record Length
36	FFT Window Function	SINT	Identical control to that use in the Normal CM Data Object (0x30A).
37	FFT Line Value Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS [0 Peak, 1 Peak to Peak, 2 RMS]
38	Pad	INT	Used to align data to a 32 bit boundary.

Table 203 - Record Length

Index	0	1	2	3	4	5	6	7	8
TWF Samples	256	512	1024	2048	4096	8192	16384	32768	65536
FFT Lines	100	200	400	800	1600	3200	6400	12800	25600

Enable

A bit wise enable control, per instance/channel.

Table 204 - Enable

Value	Description
0	FFT
1	Waveform
2	Waveform Averaging
3	FFT Averaging
4…7	Reserved

Waveform averaging is only a valid selection when waveform is enabled, the Advanced CM data source is set to the Alternate path and is configured for synchronous sample generation. Refer also the Channel Set up Object.

FFT Averaging is only a valid selection when FFT is enabled. If the FFT, Waveform, Waveform Averaging, and FFT Averaging bits are all set, Waveform Averaging is not performed while the other selections are performed.

It is possible to specify both FFT and Waveform for a channel. Waveform, Waveform Averaging, and FFT is also a valid combination. FFT, Waveform, and FFT Averaging is also a valid combination.

The Dynamix 1444 return the following as part of an 0x4B service response.

Table 205 - 0x4B Service Responses

Byte Offset within Structure	Structure Member	Data Type	Description
0	Processing Time	FLOAT	Anticipated time for the requested CM data processing to be completed (seconds). For queued requests (multi-session), processing time also includes anticipated wait time. In extreme cases the module is not able to calculate an accurate processing time as the estimate doesn't include any allowance for the acquisition time for additional samples that are needed. This is because in most circumstances, the internal sample buffers are sufficient to service the demand. However, when a long TWF (say 65536 samples) with two or more averages is requested, the internal circular buffer is used completely and additional samples need to be acquired at the specified sample rate. Especially in the case where a slow speed synchronous source is used, this sample acquisition time could be long. In such cases, the remote system can continue to poll the module for data until it becomes available or can reset/abandon the current session.
4	Status	DINT	Any of the following can be returned: • eUnrecognizedSession (1) • e maxSessionsReached (2) • ePacketCountOutOfSequence (3) • eInvalidBufferSelect(4) • eNoDataAvailable (5) • eGeneralError (6) • eDeniedRequestAlreadyInProgress (7) • eSessionAccessDenied* (8) • eAdvancedMeasurementRequestinProgress (9) • eRequestQueued (10) • eLiveMeasurementInProgress (13) * An eSessionAccessDenied status occurs when trying to change an advanced setup with the wrong Advanced Session Instance or before the timeout. For all successful requests eSUCCESS (0) is returned, any other value ends the session.
8	Synch Data Control	UINT	A synchronizing tacho event, reference for this request
10	Advanced Session Instance	UINT	Multi-session, session control

Sync Data Control

Synchronized Advanced Data can be requested from modules that share a TSCX module (use its tacho bus outputs). If the physical system is in place, no pre-configuration* is required for the cross-module synchronization. The scheme can be summarized as follows:

- the TSCX module regularly identifies a particular tacho pulse (approximately every 60 seconds)
- main modules on the tacho bus register this identification event and start/restart a tacho event count
- each tacho event is then similarly identified on the independent main modules (same count value is applied to the same tacho event)

To retrieve synchronized data, the following approach is used:

- an 0x4B service is sent with Sync Data Control set to zero (any of the modules)
- the module replies with Sync Data Control set to a specific value (a particular tacho event number)
- send an 0x4B service to the remaining modules with the specific Sync Data Control value that was received from the first request
- request the data itself with 0x4C services to all modules (see next section)

* Synchronization can be applied using either one of the two possible TSCX tacho signals but the associated Advanced CM tacho source setting on each of the channels/modules must reflect the same tacho signal.

An eDeniedRequestAlreadyInProgress status indicates that an earlier request is in progress and the data from that request has yet to be collected.

0x4C Advanced CM Data Record Request

This request is sent after the Advance CM data request has returned an anticipated processing time and that time has elapsed. If the request is made before the data is ready, a resource not available status code is returned. This can be used as a polling method if a timer is not used. When the data is ready, the data portion of the message contains the data, the other fields are also populated as defined, and the status code indicates success.

The instance and attribute can be set to 1, but they are ignored.

Table 206 - 0x4C Advanced CM Data Record Request

Byte Offset within Structure	Structure Member	Data Type	Description
0	Buffer Select	INT	Specify the buffer to retrieve the data from: eFFT (2), eTWF (3), or eTACHO (4).The BufferSelect does not change during a session.
2	RequestedCount	INT	Set RequestedCount = 1 The Requested Count does not change during a session.
4	SessionInstance	USINT	Functionality replaced by Advanced Session Instance.
5	ChannelSelect	BYTE	4 bits indicating the source channel. The ChannelSelect does not change during a session.
6	SpecialRequest	BYTE	Set SR_ mAG_PHASE (Bit 0) to request phase (see PHASE DATA page 296) and magnitude data from an FFT buffer, otherwise just magnitude data is returned. Bits 1 and 2 are not used. Set SR_FILTER (Bit 3) to request that if samples are decimated or synchronously resampled then only 50% of the configured FFT lines are to be returned. For further information, see FFT Data Filter (SR_FILTER) under Sampling Control in the Channel Setup Object.
7	Pad	BYTE	Used to align data to a 32 bit boundary.
8	PacketCountDown	DWORD	The PacketCountDown is initially specified as 0, but on subsequent calls the PacketCountDown returned in the CM Record Response must be passed here.
12	Advanced Session Instance	UINT	The Advanced Session Instance that is returned from the 0x4B Advanced CM Data request is included here.

Channel Select

Bit	0	1	2	3	4	5	6	7
Channel	0	1	2	3	Reserved			

The Dynamix 1444 returns the following as part of an *0x4C Advanced CM Data Record Request*.

Table 207 - 0x4C Advanced CM Data Record Request

Byte Offset within Structure	Structure Member	Data Type	Description
0	SessionInstance	USINT	The host copies the SessionInstance returned here into each subsequent CM Record Request. Up to 3 instances are supported.
1	DynamicChannel	USINT	Indicates the dynamic channel for this record. Channels 0…3 are valid channels.
2	Completed Records	UINT	This is incremented each time that another complete record has been transferred. There are often several packets per completed record.
4	RecordSize	UINT	For a given session the RecordSize returned here is fixed. RecordSize is in bytes and describes the appropriate Record Type Structure.
8	PacketCountDown	DWORD	The host copies the PacketCountDown returned here into each subsequent CM Record Request. When the PacketCountDown reaches 0, the session is complete and the final value in CompletedRecords is all that is transferred.
12	Status	DINT	Status codes: 0: eSUCCESS Returned after all successful requests. 1. eUnrecognizedSession 2. eMaxSessionsReached 3. ePacketCountOutOfSequence 4. eInvalidBufferSelect 5. eNoDataAvailable 6. eGeneralError 7. eDeniedRequestAlreadyInProgress 8. eSessionAccessDenied 9. eAdvancedMeasurementRequestinProgress When returned, the host can retry as often as required, until successful, although it is recommended to wait for the advised processing time before you begin polling. When a code 9 is returned, the PacketCountDown field indicates the current average count (progress towards the requested number of averages). 10. eRequestQueued Any code returned other than eSUCCESS (0) or eAdvancedMeasurementRequestinProgress (9) ends the session.
16	Data Array	DWORD[50]	Each record is an array of DWORDs of size RecordSize. This array of records can be large. It is the calling applications responsibility to handle these records appropriately. The DWORD type is just a placeholder for the actual types in the data structure that maps to this RecordArray. See the next section for details.

The Record Type Structures are as follows.

Table 208 - FFT (eFFT)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution can be used to calculate the bandwidth for the FFT.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	ucDataSelect	BYTE	If Bit 0 is set, phase array follows the mag array in the LineArray. Otherwise, just the magnitude array. Bits 1 & 2 indicate FFT scaling: 0 Peak, 1 Peak to Peak, 2 RMS. Bit 3 is set if FFT Data Filter has been applied.
17	Reserved1	BYTE	
18	Reserved2	UINT	
20	ByteCount	UDINT	The size of the following array in bytes.
24	LineArray	REAL	The array of FFT line amplitude data.

Note: Reference measurement tables on page 361.

Table 209 - Waveform (eTWF2)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	SamplePeriodInSecs	REAL	Time period between samples or speed and number of samples per revolution.
12	Identifier	DWORD	Data source, mode, tacho source, and measurement units.
16	RelativeTime	UDINT	A 24-bit (micro-second) counter-value for finely aligning data.
20	ByteCount	UDINT	The size of the following array in bytes.
24	SampleArray	REAL	The array of waveform data values (samples).

Reference measurement tables on page 362.

Table 210 - Tacho (eTACHO)

Byte Offset within Structure	Structure Member	Data Type	Description
0	TimestampNanoSec	UDINT	Subsecond accuracy.
4	TimestampSec	UDINT	Seconds since 1970.
8	Reserved	REAL	
12	Reserved	DWORD	
16	Reserved	UDINT	
20	ByteCount	UDINT	The size of the following array in bytes.
34	TimingArray	UDINT	The array of tacho time values (24 bit, micro-second counter).

For FFT and TWF data

For asynchronous data, the actual sample period is transferred (REAL format). For synchronous data, the same four bytes are used to transfer the number of samples per revolution and an indicative speed for the transferred data.

Number of samples per revolution occupies the first byte, the remaining 3 bytes are used for a scaled speed value (speed x 100). This format supports speed values to 167,772.15 rpm with a resolution of two decimal places.

Example with 'data on the wire' of 0x 10DC7D05:

- 0x 10 = 16 samples per revolution
- 0x 057DDC = 359,900
- RPM = 359,900/100 = 3599 rpm (60 Hz)

Whether the data is asynchronous or synchronous can be known from the identifier field. This has the following format:

Bits	Description
0…1	Measurement channel (0, 1, 2, 3) from which the data originates
2	Data source (Transfer path 0 or 1)
3…4	Transfer path 0 data source (0 pre-filter, 1 mid-filter, 2 post-filter)
5…6	Transfer path 1 data mode (bit 5 = 0 asynchronous, bit 5 = 1 synchronous, then bit 6 indicates which tacho was used)
7	Associated tacho source from the Normal CM Data Object
8…15	Measurement engineering units (index not CIP code)
16…31	The 16-bit tacho event counter (cross module synchronization scheme)

Example, where identifier lower 16 bits are 0x 0024

- 00 indicates that measurement unit is Volt
- Bits 2 & 5 are set to indicate path 1 is in use and synchronous sampling is enabled (so data is based on synchronous sampling)

Table 211 - 0x4D Advanced CM Data Session Reset, Service Request

Byte offset within structure	Structure Member	Data Type	Description
0	Advanced Session Instance	UINT	The Advanced Session Instance to be reset.
2	Pad	UINT	Used to align data to a 32 bit boundary

Response to an 0x4D service request is as follows:

Byte offset within structure	Structure Member	Data Type	Description
0	Status	DINT	Status codes: 0: eSUCCESS • Returned after all successful requests. 1. eUnrecognizedSession 2. eMaxSessionsReached 3. ePacketCountOutOfSequence 4. eInvalidBufferSelect 5. eNoDataAvailable 6. eGeneralError 7. eDeniedRequestAlreadyInProgress 8. eSessionAccessDenied • Is returned if trying to reset the advanced setup with the wrong Advanced Session Instance. 9.eAdvancedMeasurementRequestInProgress 10. eRequestQueued

Behavior

Through the Object-specific services 0x4B and 0x4C, the Advanced CM Data Object gives access to dynamically configurable analysis data (variable FFT lines, and so on). The service 0x4B configures/requests the desired processing be implemented, while the service 0x4C is used to request the resulting data.

One request can encompass multiple channels and data types to avoid the complication of varying record sizes the resulting data can be requested on one channel and data type per session basis.

See the Data Manager Object for access to historical data (Trend and Alarm), to the Normal CM Object for access to a 'Live' version of that data. Also see the Transient Data Manager Object for access to stored transient event data.

Advanced CM Data and Record Requests - Recommendations for Network Side Implementation

- DataRequest Packet
- DataResponse Packet (with estimated processing time)
- Wait
- First RecordRequest Packet
- First RecordResponse Packet

The data is returned in multiple packets as an array of records of size RecordSize. This can be a significant amount of data depending on the extent of the data requested. The recommended way to handle this data transfer is to store the payload to a file for later retrieval.

It is recommended to store the first packet request and response packet to the file. Thereafter, store the record array payload that is contained within each subsequent packet. If this procedure is followed, the packet arrangement within the file would be as follows:

- RecordRequest Packet
- RecordResponse Packet (with first packet payload at the end)
  - Second Response Packet payload
  - Subsequent Response Packet payloads
- Last Response Packet payload

Instigate further sessions to retrieve data from any other required buffers or channels. It is not necessary to reissue a fresh DataRequest.

Record retrieval from the file can then be accomplished as follows.

1. Open the file.
2. Read a record with size of Advanced CM Record Request from the head of the file.
3. Access the BufferSelect variable to determine the type of record the file holds.
4. Read a record with size Advanced CM Record Response from the file pointer.
5. Access the RecordSize variable to determine the size of the record.
6. Start at the address of the first Record in the Data Array in the first Advanced CM Record Response. Then index to any record by using the RecordSize to seek to the correct point in the file.
7. Read out the record of size, RecordSize.

Dynamix MUX Object

The MUX Object (class code 0x39B) defines and controls the multiplexing capability of the main module that is based on single or multiple configurations. Up to 3ea subchannels can be configured each based on one DSP stored configuration and each having up to 4ea time slots for which measurement channels can be enabled in either single or parallel mode. This is as long as the DSP can process each configuration option

Main setup for multiplexing operation using single configuration or multi-parameter mode is under high-level configuration control. This determines the number of subchannels and the allocation of channels to time slots. Settling and Data Acquisition times for the time slots are automatically set at minimum acceptable values that take account of signal processing requirements.

Table 212 - Object Instances

Instance ID	Description
0	MUX Class Instance
1	Instances 1 for subchannel A MUX configuration

Table 213 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
8	Get	V	MUX Configured	BOOL	Whether this configuration uses MUX.	
9	Get	V	Number of Enabled Subchannels	USINT	Enabled subchannels/ instances.	1
16	Get	V	Overall Cycle Time	REAL	Time that is taken to complete a MUX cycle.	

Table 214 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
Read Time Slot Configuration				Group of 9 configuration attributes.		
1	Get	V	Time Slot Channel Enables	WORD	Bit wise channel enables for time slots 1…3.	All 16 bits used
2	Get	V	Time Slot 0 DAQ Time	REAL	Time Slot 0 DAQ Time	s
3	Get	V	Time Slot 1 DAQ Time	REAL	Time Slot 1 DAQ Time	s
4	Get	V	Time Slot 2 DAQ Time	REAL	Time Slot 2 DAQ Time	s
5	Get	V	Time Slot 3 DAQ Time	REAL	Time Slot 3 DAQ Time	s
6	Get	V	Time Slot 0 Settling Time	REAL	Time Slot 0 Settling Time	s
7	Get	V	Time Slot 1 Settling Time	REAL	Time Slot 1 Settling Time	s
8	Get	V	Time Slot 2 Settling Time	REAL	Time Slot 2 Settling Time	s

Table 214 - Instance Attributes

9	Get	V	Time Slot 3 Settling Time	REAL	Time Slot 3 Settling Time	s
Time Slot Configuration				Group of 4 configuration attributes.		
16	Get	V	Time Slot 0 DAQ Time Multiplier	INT	Time Slot 0 DAQ Time Multiplier	Range: 1…255 Default: 1
17	Get	V	Time Slot 1 DAQ Time Multiplier	INT	Time Slot 1 DAQ Time Multiplier	Range: 1…255 Default: 1
18	Get	V	Time Slot 2 DAQ Time Multiplier	INT	Time Slot 2 DAQ Time Multiplier	Range: 1…255 Default: 1
19	Get	V	Time Slot 3 DAQ Time Multiplier	INT	Time Slot 3 DAQ Time Multiplier	Range: 1…255 Default: 1

Table 215 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Dynamix MUX Object

The Dynamix MUX Object (class 0x39B) defines and controls a multiplexing capability of a main module. The appropriate choice of the Module Type enables Multiplexing.

Multiplexing is not a means to connect different signals to the inputs. Rather it is to provide a method to allow use of all four channels when the sample rate requirement is greater than the module can perform continuously on four channels.

Table 216 - Object Instances

Instance ID	Description
0	Class Instance for the MUX Object
1	Instance 1

Table 217 - Object Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	The MUX object revision	-
8	Get	NV	MUX Configured	BOOL	Yes = this configuration uses MUX	1 = Yes
9	Get	NV	Number of enabled subchannels	USINT	Not Used	Fixed at 1
10	Get	-	Overall cycle time	REAL	Time to complete to MUX cycle	s (actual measured)

Table 218 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
-	-	-	Read Time Slot Configuration	-	-	-
1	Get	V	Time slot channel enables	WORD	Bit wise channel enables for time slots 0 to 3	All 16 bits used
2	Get	V	Time slot 0 DAQ time	REAL	Time slot 0 minimum DAQ time	s
3	Get	V	Time slot 1 DAQ time	REAL	Time slot 1 minimum DAQ time	s
4	Get	V	Time slot 2 DAQ time	REAL	Time slot 2 minimum DAQ time	s
5	Get	V	Time slot 3 DAQ time	REAL	Time slot 3 minimum DAQ time	s
6	Get	V	Time slot 0 Settling time	REAL	Time slot 0 Settling time	s
7	Get	V	Time slot 1 Settling time	REAL	Time slot 1 Settling time	s
8	Get	V	Time slot 2 Settling time	REAL	Time slot 2 Settling time	s
9	Get	V	Time slot 3 Settling time	REAL	Time slot 3 Settling time	s
-	-	-	Time Slot Configuration	-	Group of 4 configuration attributes	-
16	Get	V	Time Slot 0 DAQ time Multiplier	INT	Time Slot 0 DAQ time Multiplier	Default value: 1 Range: 1…255
17	Get	V	Time Slot 1 DAQ time Multiplier	INT	Time Slot 1 DAQ time Multiplier	Default value: 1 Range: 1…255
18	Get	V	Time Slot 2 DAQ time Multiplier	INT	Time Slot 2 DAQ time Multiplier	Default value: 1 Range: 1…255
19	Get	V	Time Slot 3 DAQ time Multiplier	INT	Time Slot 3 DAQ time Multiplier	Default value: 1 Range: 1…255

Attribute Semantics

The module calculates instance attributes 2…9 to ensure that the channel pair is active long enough for valid measurements (overall, TWF, and FFT) to be made. That DAQ (data acquisition) time represents the minimum that is required. If desired, you can then extend that time by use of the configured multipliers, attributes 16…19.

Table 219 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Behavior

Multiplexing provides a means of utilizing all 4-channels of a module in a situation where the required processing can only be implemented on two or less channels at a time. Examples are gSE or 40 kHz modes where only one channel pair can be active due to the high sample rate and signal processing required. By using 'Paired channels' Multiplexing mode the module automatically switches between channel pairs, which makes measurements as each pair becomes active (note that module transducer power is not switched).

In paired mode the time slots are allocated as follows:

- Time slot 0 - channels 0/1
- Time slot 1 - channels 2/3
- Time slot 2 - channels 0/1
- Time slot 3 - channels 2/3

Based on the configured Normal CM data requirements (and other considerations as appropriate), the module advises and implements the minimum DAQ (Data Acquisition) Time to allow those measurements to be properly serviced. As Advanced CM data is based on ad-hoc, on-demand requests (potentially for higher number of lines, different averaging) this is not automatically catered for. If it is planned to send more demanding Advanced CM Data requests, then this is allowed by suitably increasing the time multiplier to a value greater than 1 (attributes 16…19).

The module maintains circular sample buffers of much greater depth than required for the longest TWF or highest line FFT, this depth is used to advantage in Multiplexing and Cross Module Synchronization modes. Likewise there are large circular buffers for corresponding Tacho Times. The (size) relationship between these two buffers is 16:1. For example, a full set of Tacho Times is available whenever the sample rate (synchronous or asynchronous) is equivalent to at least 16 samples per revolution.

For multiplexed measurements it is possible for the available Tacho Times to not always provide full coverage for the sample data. This occurs when low frequency / slow speed measurements, where fewer than 16 samples per revolution and the full extent of the circular sample buffers is used. This can lead to errors in the speed measurement.

Individual mode is also implemented, where each channel is allocated to its own individual time slot. As this provides little operational advantage over paired mode, the latter is recommended for all multiplexing applications.

Dynamix Relay Module Object

The Relay Module Object (class code 0x39C) configures the relay outputs of the associated relay expansion modules (1…3 units per host main module each serving 4ea mechanical relays).

The object defines the setup for the Relay Output expansion modules and the interaction of these expansion modules with the main module. The same host module can accommodate up to three Relay Output modules. There is an object instance per module.

When one or more Relay modules are included in a system, not only must the configuration aspects of this object be addressed, but the presence of each module must also be flagged by appropriate setting of the Module Control Object, class attribute 16 (Configured Auxiliary Modules).

Table 220 - Object Instances

Instance ID	Description	Address Switch Settings
0	Relay Module Class Instance	
1	First Relay Expansion Module	SWI-SW2 as 0…1
2	Second Relay Expansion Module	SWI-SW2 as 1…0
3	Third Relay Expansion Module	SWI-SW2 as 1…1

A base switch address setting of (00) is illegal for a relay module and causes it to display a critical error (solid red Status Indicator).

Table 221 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.

Table 222 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
4	Get	NV	Firmware Revision	STRUCT	Retrieves Firmware Revision of the Relay expansion module.	Firmware Revision information
4	Get	NV	major Version	USINT		
4	Get	NV	Minor Version	USINT		
5	Get	V	Expansion Module Status	WORD	Coded information on Relay Module operational status.	Relay Module status
6	Get	NV	Serial Number	UDINT		
7	Get	NV	Product Name	SHORT_STRING		1444-RELX00-04RB
Individual Relay Status				Group of 4 configuration attributes.		
8	Get	V	Relay 0 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
9	Get	V	Relay 1 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
10	Get	V	Relay 2 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
11	Get	V	Relay 3 Status	BYTE	Bit Coded Output Alarm Relay Status	Relay status decoding
Relay Configuration				Group of 4 configuration attributes.		
17	Get	V	Relay 0 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
18	Get	V	Relay 1 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
19	Get	V	Relay 2 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
20	Get	V	Relay 3 Source	SINT	Link to corresponding voted alarm object (instance and output type)	Relay source decoding
21	Get	V	Auxiliary Link timeout	INT	Link timeout	200 ms for open compliance 100 ms otherwise
22	Get	V	Relay Drive Test Enable	BYTE	Bit coded, relay drive test enables.	Test enable
23	Get	V	Relay 0 Drive Test Interval	INT	Test interval.	ms
24	Get	V	Relay 1 Drive Test Interval	INT	Test interval.	ms
25	Get	V	Relay 2 Drive Test Interval	INT	Test interval.	ms
26	Get	V	Relay 3 Drive Test Interval	INT	Test interval.	ms
32	Get	V	Relay 0 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control
33	Get	V	Relay 1 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control

Table 222 - Instance Attributes

34	Get	V	Relay 2 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control
35	Get	V	Relay 3 Auto Relay Control	BYTE	Configuration of relay behavior in case of detected fault condition, which is based on associated voted alarm.	Relay control
Relay Configuration				Group of 4 configuration attributes.		
36	Get	V	Relay 0 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
37	Get	V	Relay 1 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
38	Get	V	Relay 2 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
39	Get	V	Relay 3 User Relay Control	BYTE	User configuration Relay Control of relay behavior in case of detected fault condition.	Relay control
40	Get	V	Relay 0 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control
41	Get	V	Relay 1 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control
42	Get	V	Relay 2 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control
43	Get	V	Relay 3 Relay Control	BYTE	Actual behavior of relay in case of detected fault condition.	Relay control

NV status relates to nonvolatile storage in the auxiliary module, not the main module.

Attribute Semantics

Relay Module Status

Each Auxiliary Relay module reports its status as part of the normal exchanges with the main module. The bit assignments are as follows.

Table 223 - Relay Module Status

Bit	Description
0	Auxiliary Module Not Responding
1	Auxiliary Module Configured
2	MSP Code (CRC) Fault
3	MSP High Temperature
4	Link Fail
5	Halt Active
6	MSP RAM Fault
7	MSP RAM Access Error

Bits 0…7 are common to all types of auxiliary module, bits 8…15 are specific to type.

The auxiliary module controls Bits …15; the main module sets bit 0.

If bit 0 is set, the remaining bits do not reflect the current auxiliary module status.

If communication with an auxiliary module are lost, then the main module sets a status bit to indicate an auxiliary bus fault. If communication are restored, then normally the fault indication clears, noting however, if a configuration activity has failed, then the fault indication remains set until a successful reconfiguration is completed. Normally this reconfiguration is achieved by downloading the configuration from the controller to the appropriate main module

If the main module is not configured to expect a particular auxiliary module, that module's status is always reported as zero. This status applies equally to the status data obtained via an object attribute request and to the status data in the I/O data exchange. Object attribute requests for data such as Auxiliary module firmware revision only require that the auxiliary module is present and communicating.

Bit	Description
8	Relay 0 Is Not Inhibited
9	Relay 1 Is Not Inhibited
10	Relay 2 Is Not Inhibited
11	Relay 3 Is Not Inhibited
12	Relay 0 Drive Error
13	Relay 1 Drive Error
14	Relay 2 Drive Error
15	Relay 3 Drive Error

In the unlikely event the auxiliary module is found to be in Boot Loader mode (not running operation firmware), the main module sets the auxiliary module status to a special code: Decimal: 65,534, Hexadecimal: 0xFFFE, Binary: 11111111 11111110.

Although the auxiliary module is responding, it is in a non-operational state and is classed as a failure from the perspective of a Fault Relay.

Relay Status decoding

The relay status uses two bits to communicate whether the relay is assigned (or off) and whether it is energized or not:

- bit 0 - assigned
- bit 1 - energized

Examples of expected values:

- value 0 - Off and de-energized
- value 1 - assigned and de-energized
- value 3 - assigned and energized

Relay Control

Bit-wise setting controlling how the relay behaves under fault circumstances.

Table 224 - Relay Control

Bit	Description
0	main Module Fault
1	Auxiliary Module Fault
2	Auxiliary Bus Communication Fail
3	E/IP Communication Failure
4	Tacho Fault
5	Reserved
6	Reserved
7	Latching

The status of bits 1 and 2 reflect conditions detectable by the auxiliary module itself, and the remainder rely on the main module.

There are three parameters using these bit definitions.

Parameter	Description
Auto Relay Control	This follows the logic that when associated with a fail-safe voted alarm a main/ auxiliary module fault also activates the relay (so the appropriate bits are set). Otherwise it is zero. Read only to the user.
User Relay Control	This allows the user to select from a number of faults that can also be considered.
Relay Control	This is a bit-wise logical AND of the Auto and User controls. This is what is implemented and is read only to the user.

The objective being that more faults that the relay reacts to can be added (above those implicit in the Voted Alarm selection) or dedicate the relay only to the indication of certain selected faults.

Relay control (like voting logic) is implemented by the main module instructing the auxiliary module on how to set its relay outputs in any particular circumstance. However, to guard against the situation where a main module or link failure prevents proper instruction reaching it, on detecting a communication link failure the auxiliary module sets any fail-safe relays to their alarm state (de-energized). This function is an automatic/autonomous action by the auxiliary module.

Table 225 - Relay Source Decoding

Bit	Description
0	OFF
1…13	Voted Alarm Instance 1…13 Output Type: Alert
14…16	Reserved
17…29	Voted Alarm Instance 1…13 Output Type: Danger
30…32	Reserved
33…45	Voted Alarm Instance 1…13 Output type: TX OK
Higher Values	Reserved
126	Dedicated, Bypass Active Relay
127	Dedicated, Fault Relay, Relay Control Determines Faults

As the special functions (126 and 127) are not the result of Voted alarms, there is no definition of type - suggest fail-safe is adopted for these. Local Relay Control also includes a Latching bit, to give a latching control to these special functions.

0x00 defines the relay as disabled, multiple sources not allowed.

Relay Drive Test Enable

Relay drive test enable and settings are automatic based on higher-level configuration like SIL and Voted alarm allocations.

Bits 0…3 for relays 0…3, bit value is set to 1 if the test is enabled.

When enabled the test period configured in reflected in attributes 23, 24, 25, 26.

The routine relay drive circuit test applies only to fail-safe applications - where the drive can be momentarily de-energized.

Failure of a routine drive circuit test is flagged in the status information that is returned via the main module.

Table 226 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Get requests to certain attributes require data to be requested from the auxiliary module itself. If that module is not present/active on the bus, an embedded server error is returned in response to the request.

Dynamix Current Output Module Object

The Current Output Module Object (class code 0x39D) configures the 4…20 mA current outputs of the single supported current output expansion module.

This object defines the setup for the Current Output expansion module and interaction of this expansion module with main module.

Table 227 - Object Instances

Instance ID	Description
0	Current Output Module Class Instance
1	Instance 1 - Current Output 0
2	Instance 2 - Current Output 1
3	Instance 3 - Current Output 2
4	Instance 4 - Current Output 3

Table 228 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
11	Get	NV	Firmware Revision	STRUCT	Retrieves Firmware Revision of the current output module.	Firmware Revision information
11	Get	NV	Major Version	USINT		
11	Get	NV	Minor Version	USINT		
12	Get	V	Expansion Module Status	WORD	Coded information on TSC Analog Output Module operational status.	Analog Output Module
13	Get	NV	Serial Number	UDINT		
14	Get	NV	Product Name	SHORT_STRING		1444-AOFX-00-04RB
15	Get	V	Current Module Control	BYTE	Configuration of generic current output module behavior in case of detected fault condition.	Set to zero Use only instance attribute 24, configurable per output channel.
16	Get	NV	Auxiliary Link-Time Out	UINT	Link timeout.	Fixed at 1000 ms (1s)

NV status relates to nonvolatile storage in the auxiliary module, not the main module.

Table 229 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Current Output Value	REAL	Provides processed current output value in mA	
2	Get	V	Source Measurement Value	REAL	Provides actual measurement value in engineering units	
General				Group of 3 configuration attributes.		
16	Get	V	Current Output Enable	SINT	Current output enable control.	0: Not enabled 1: Enabled
17	Get	V	Current Output Measurement Identifier	INT	Defines source of 4…20 mA signal	Source selection
18	Get	V	Current Output Name	SINT[32]	A name to identify this output instance	32 characters
Output Scaling				Group of 3 configuration attributes.		
19	Get	V	20 mA Output Scaling	REAL	Definition of measurement value that is associated with 20 mA.	Range: -40000…50000
20	Get	V	4 mA Output Scaling	REAL	Definition of measurement value that is associated with 4 mA.	Range: -50000…40000 Default: 0
24	Get	V	Current Output Not OK Configuration	SINT	The current output set when a fail condition is detected (TX Fail of associated channel, auxiliary bus failure, auxiliary module self-check fail)	Not OK configuration

Module address is fixed, as is the link between instances and current outputs.

Attribute Semantics

Current Module Status

The auxiliary output module reports its status as part of the normal exchanges with the main module. The bit assignments are as follows.

Instance ID	Description
0	Auxiliary Module Not Responding
1	Auxiliary Module Configured
2	MSP Code (CRC) Fault
3	MSP High Temperature
4	Link Fail
5	Halt Active
6	MSP RAM Fault
7	MSP RAM Access Error

Bits 0…7 are common to all types of auxiliary module, bits 8 to 15 are specific to type.

The auxiliary module controls Bits …15, and the main module sets bit 0.

If bit 0 is set, the remaining bits do not reflect the current auxiliary module status.

Bit	Description
8	Output 0 Is Not Inhibited
9	Output 1 Is Not Inhibited
10	Output 2 Is Not Inhibited
11	Output 3 Is Not Inhibited
12	Reserved
13	Reserved
14	Reserved
15	Reserved

In the unlikely event the auxiliary module is found to be in Boot Loader mode (not running operation firmware), the main module sets the auxiliary module status to a special code: Decimal: 65,534, Hexadecimal: 0xFFFE, Binary: 11111111 11111110.

Although the auxiliary module is responding, it is in a non-operational state and is classed as a failure from the perspective of a Fault Relay.

Table 230 - Not OK Configuration

Bit	Description
0	No Action
1	Force Low (2.9 mA)
2	Force High (21 mA)

Table 231 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Get requests to certain attributes require data to be requested from the auxiliary module itself. If that module is not present/active on the bus, an embedded server error is returned in response to the request.

Dynamix Module Control Object

The Module Control Object (class code 0x39) provides module-level controls, which are implemented in one instance.

DSP/NetX refer to the two onboard processors: the digital signal processor and the "NetX", communication and condition monitoring auxiliary processor.

Table 232 - Object Instances

Instance ID	Description
0	Module Control Class Instance

Table 233 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current object revision.	Current revision.
Auxiliary Modules				A group of 2 configuration attributes.		
2	Get	V	Detected Auxiliary Modules	BYTE	Bit-wise indication of detected auxiliary modules.	Auxiliary modules
16	Get	V	Configured Auxiliary Modules	BYTE	Bit-wise configuration of expected auxiliary modules.	Auxiliary modules
18	Get	-	NetX CPU Usage	UINT	Percentage CPU in use	0 to 10,000 = 0 to 100%
19	Get	-	Module Mode	BYTE	Current Module Mode/ Running Status	0 start-up, 1 run, 2 program mode
20	Get	NV	NetX Firmware Build	SHORT-STRING	Build Date (ASCII string)	for example, length 0x0B 56, 65, 70, 20, 31, 37 Sep 17 20, 32, 30, 31, 34 2014
21	Get	NV	DSP Firmware Build	UDINT	Build Version	for example, 10034 is V1.00.34

Table 233 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
22	Get	-	DSP Configuration CRC	UINT	16-bit CRC for the DSP and Auxiliary relevant configuration	Will be unchanged if configuration changes are limited to CM features
23	Get	-	NetX/DSP Error Status	DWORD	DSP: bits 0…15 NetX: bits 16…31	Normal (no error) status = 0 Bit 0 - DSP Not responding Bit 1 - DSP in boot loader mode Bit 2 - Configuration process failed to complete Bit 16 - Corrupt object file detected
Main Module Tacho				A configuration attribute.		
24	Get	V	Tacho Mode	SINT	Individual or Redundant Mode	0: Individual else Redundant Tacho Mode
Main Module Opto Outputs 0/1				A group of 2 configuration attributes.		
32	Get	V	Opto Output 0 Allocation	SINT	Source configuration for this Opto-isolated output.	Opto source
33	Get	V	Opto Output 1 Allocation	SINT	Source configuration for this Opto-isolated output.	Opto source
Main Module Local Onboard Relay				A logical grouping of parameters.		
39	Get	V	Auto Local Relay Control	BYTE	Configuration of local relay behavior in case of detected fault condition, which is based on associated voted alarm.	Returns 0 if relay source is not a voted alarm Relay control
40	Get	NV	User Local Relay Control	BYTE	User configuration of local relay behavior in case of detected fault condition.	Relay control
41	Get	NV	Local Relay Control	BYTE	Actual behavior of local relay in case of detected fault condition.	Relay control
42	Get	V	Relay Source	SINT	Link to corresponding voted alarm object (instance and output type).	Relay source decoding
43	Get	V	Relay Drive Test Enable	BOOL	Whether the relay drive circuit is being routinely tested.	Automatic on SIL/Fail-safe setting
44	Get	V	Relay Drive Test Interval	UINT	Test interval.	ms
64	Get	V	Redundant Power Supply	SINT	Whether the module is being powered redundantly.	0: Not redundant 1: Redundant
Channel 0 DSP FFT				Group of 7 configuration attributes.		
72	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
73	Get	V	Signal Source	SINT	Defines the data source.	Source
74	Get	V	Measurement Units	ENGUNITS		Measurement units
75	Get	V	Line Resolution	SINT		Fixed at 1600 lines
76	Get	V	Window Function	SINT	Definition of window function used.	Window
77	Get	V	Number of Averages	SINT	FFT averaging.	Averages

Table 233 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
78	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)
Channel 1 DSP FFT				Group of 7 configuration attributes.		
79	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
80	Get	V	Signal Source	SINT	Defines the data source.	Source
81	Get	V	Measurement Units	ENGUNITS		Measurement units
82	Get	V	Line Resolution	SINT		Fixed at 1600 lines
83	Get	V	Window Function	SINT	Definition of window function used.	Window
84	Get	V	Number of Averages	SINT	FFT averaging.	Averages
85	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)
Channel 2 DSP FFT				Group of 7 configuration attributes.		
86	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
87	Get	V	Signal Source	SINT	Defines the data source.	Source
88	Get	V	Measurement Units	ENGUNITS		Measurement units
89	Get	V	Line Resolution	SINT		Fixed at 1600 lines
90	Get	V	Window Function	SINT	Definition of window function used.	Window
91	Get	V	Number of Averages	SINT	FFT averaging.	Averages
92	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)
Channel 3 DSP FFT				Group of 7 configuration attributes.		
93	Get	V	Enable	SINT	An enable control. Only enable if FFT bands are required from this channel.	0: Disable 1: Enable
94	Get	V	Signal Source	SINT	Defines the data source.	Source
95	Get	V	Measurement Units	ENGUNITS		Measurement units
96	Get	V	Line Resolution	SINT		Fixed at 1600 lines
97	Get	V	Window Function	SINT	Definition of window function used.	Window
98	Get	V	Number of Averages	SINT	FFT averaging.	Averages
99	Get	V	Line Value Detection/Scaling	SINT	Allows line/bin values to be returned scaled as Peak, Peak to Peak, or RMS.	0: Peak 1: Peak to Peak 2: RMS (default)

Attributes 72…79 (Channel 0…3 DSP FFT) refer to the FFT function of the DSP that is executed exclusively to calculate FFT Band data (Object 0x399 refers). The FFT calculated in the DSP is not served externally, stored internally or used for any other purpose than the FFT Band function.

Attribute Semantics

Auxiliary Modules

Bit-wise setting/indication of the expected/detected auxiliary modules.

Table 234 - Auxiliary Modules

Bit	Description
0	Relay Output Module 0
1	Relay Output Module 1
2	Relay Output Module 2
3	4…20 mA Analog Output Module
4	Tacho Signal Conditioner
5…7	Reserved

'Detected' auxiliary modules is limited to expected modules that are detected.

Unexpected auxiliary modules will not be communicated with and therefore are always undetected.

Redundant Tacho Mode

When redundant tacho mode is enabled, the two configured tacho sources (for tacho 0 & 1) serve as redundant sources for each other.

Example:

- Tacho 0 is detected as being in a Not OK state, so it is automatically switched to Tacho 1 source.
- If Tacho 0 source is OK, then Tacho 1 state is checked and if Not OK is switched to Tacho 0 source

Note the following:

- The switching process does not change the underlying configuration
- As a tacho source 'switch' has been implemented, both tacho signals appear OK
- Bit 23 of the Channel/TX/Speed, Status DWORD 4 flags that a tacho source has been actively switched.

Local Relay Control

Bit-wise setting controlling how the local relay behaves under fault circumstances.

Table 235 - Local Relay Control

Bit	Description
0	main Module Fault
1	Auxiliary Module Fault
2	Auxiliary Bus Communication Fail
3	E/IP Communication Failure
4	Tacho Fault
5	Reserved
6	Reserved
7	Latching

There are three parameters using these bit definitions.

Parameter	Description
Auto Local Relay Control	This follows the logic that when associated with a fail-safe voted alarm a main module fault also activate the relay (so the appropriate bits are set). Otherwise it is zero. Read only to the user.
User Local Relay Control	This allows selection from a number of faults that can also be considered.
Local Relay Control	This is a bit-wise logical AND of the Auto and User controls. This is what is implemented and is read only to the user. The objective being that more faults that the relay reacts to can be added (above those implicit in the Voted Alarm selection) or dedicate the relay only to the indication of certain selected faults.

Table 236 - Relay Source Decoding

Bit	Description
0	OFF
1…13	Voted Alarm Instance 1…13 Output Type: Alert
14…16	Reserved
17…29	Voted Alarm Instance 1…13 Output Type: Danger
30…32	Reserved
33…45	Voted ALARM INSTANce 1…13 Output type: TX OK
Higher Values	Reserved
126	Dedicated, Bypass Active Relay
127	Dedicated, Fault Relay, Local Relay Control

As the special functions (126 and 127) are not the result of Voted alarms, there is no definition of type - suggest fail-safe is adopted for these. Local Relay Control also includes a Latching bit, to give a latching control to these special functions.

0x00 defines the relay as disabled, multiple sources not allowed.

Opto Output Source

An index that allows for source selection.

Table 237 - Opto Output Source

Bit	Description
0	OFF
1…13	Voted Alarm Instance 1…13 Output Type: Alert
14…16	Reserved
17…29	Voted Alarm Instance 1…13 Output Type: Danger
30…32	Reserved
33…45	Voted ALARM INSTANce 1…13 Output type: TX OK
48	Local TTL Tacho Input 0
49	Local TTL Tacho Input 1
50	Tacho Bus 0
51	Tacho Bus 1
52	Tacho Bus OK 0
53	Tacho Bus OK 1
54	Local Logic Input 0
55	Local Logic Input 1
56	TX 0 Fault
57	TX 0 Fault
58	TX 0 Fault
59	TX 0 Fault
127	Module Status/OK

Indices 48...53 are routed directly in hardware, all other selections are actively controlled, based on the state of the source selected.

The local relay control allows for Module Fault to be to some extent, configurable on a per relay basis. Index 127 follows the first definition of module fault (first relay, so usually the main module relay configuration).

The designated opto output is inactive in the following circumstances:

- OFF
- No alarm
- Tacho OK
- Logic input open
- TX OK
- Module Status OK

Note therefore that as inactive equals shelf state, they are non-fail safe.

For the local tacho inputs, the opto is inactive when the input signal is high (above the 2.5V threshold).

For the TSCX tacho inputs the opto is inactive when the input signal is LOW (below the configured threshold).

Source Selection

The DSP FFT can be sourced from one of the first four sources or the last one when those particular processing elements are configured as active (Channel set up Object).

Index	Source
0x00 (0)	**ADCOUT** - select ADC output stream (raw sampled data)
0x01 (1)	**Pre-Filter** - before application-specific filters (and potentially after application-specific signal pre-processing)
0x02 (2)	**Mid-Filter** - Selected mid Filter identifies inclusion of application Low Pass Filter
0x03 (3)	**Post-Filter** - Selected post Filter identifies inclusion of both application Low and High Pass Filter including potentially enabled integration stages
0x04 (4)	**Alternate path** - a CM, alternate processing, path available when so configured in the Channel set up Object

Measurement Units

Actual selection of Measurement engineering units are a subset of the master engineering units list. It is based on active measurement application for the applicable measurement channel (related to sensor type and signal processing).

Index	FFT Resolution
0x04 (4)	1600 lines

Index	FFT Window
0x00 (0)	Normal/Rectangular
0x01 (1)	Flat Top
0x02 (2)	Hanning
0x03 (3)	Hamming

Index	Number of Averages
0x00 (0)	1
0x01 (1)	2
0x02 (2)	3
0x03 (3)	6
0x04 (4)	12
0x05 (5)	23
0x06 (6)	45
0x07 (7)	89
0x08 (8)	178

Table 238 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 239 - Object Specific Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x4B	x	x	Set Module Time	Allows a module time date to be set (in the absence of a system time from the network). Data: UINT32 - seconds since 1970 UINT32 - nanoseconds

Identity Object

The Identity Object (class code 0x01) provides identification and general information about the device. The first instance identifies the whole device.

It is used for electronic keying and by applications wishing to determine what devices are on the network.

Table 240 - Object Instances

Instance ID	Description
0	Identity Class Instance
1	Instance 1 of the Identity object

Class Attributes

The Identify Object supports the following Class Attributes:

Table 241 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines revision of Identify Object	Current revision: 1
2	Get	V	maximum Instance	UINT		1
6	Get	V	maximum Class Attribute	UINT		7
7	Get	V	maximum Instance Attribute	UINT		102

Table 242 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Vendor ID	UINT		1 (RA)
2	Get	NV	Device Type	UINT		109
3	Get	NV	Product Code	UINT		72
4	Get	NV	major Revision	USINT		Firmware revision. See semantics
			Minor Revision	USINT		
5	Get	V	Status	WORD		
6	Get	NV	Serial Number	UDINT		
7	Get	NV	Product Name	SHORT_STRING		"1444 Dynamix"
8	Get	V	State	USINT		
9	Get	NV	Conf. Consist. Value	UINT		
101	Get	NV	Hardware Revision	USINT	major Revision	See semantics
				USINT	Minor Revision	
102	Get	NV	Sub Minor Revision	UDINT	Sub Minor Revision	> 0

Attribute Semantics

Firmware Revision

Identity Object instance attribute 4 (and vendor-specific attribute 102) refer directly to the netX (communication) processor firmware revision but also reflect an overall version identification for a firmware release. A breakdown of the associated Firmware Revisions included in a release is tabulated in the following table.

Release	netX	DSP	Auxiliary Relay	Auxiliary 4-20mA	Auxiliary TSCX
2.001.2	2.001.2	1.01.02	3.10	3.10	3.10
2.001.7	2.001.7	1.01.08	3.10	3.10	3.13

Hardware Revision

Identity Object instance attribute 101 is a vendor-specific attribute that is used to identify the hardware revision. The correlation between that revision and the product label is tabulated in the following table.

Hardware revision (major/minor/sub-minor)	Product label
6.3	A

Table 243 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x01	x	x	Get_Attributes_All	Returns the contents of the specified attributes
0x05	x	x	Reset	Invokes the reset service for the device
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Message Router Object

The Message Router Object (class code 0x02) provides a messaging connection point through which a client can address a service to any object class or instance residing in the physical device.

This object is part of the standard Hilscher netX100 EIP protocol stack.

No attributes are implemented and no services are supported.

Assembly Object

The Assembly Object (class code 0x04) binds attributes of multiple objects, which allows data to or from each object to be sent or received over one connection.

Assembly Objects can be used to bind input data or output data. I/O data connections are established between an Originator (O) and a Target (T) where in this case, O is the controller and T is this module. Output data is sent in the O-T direction and Input data is sent in the T-O direction. The input data assembly therefore comprises measurements that are made by the module while the output data assembly is used for control data being sent to the module.

Table 244 - Object Instances

Instance ID	Description
0	Class Instance for the Assembly Object
100	Instance 1 defines one, input data assembly option (O- T)
101	Instance 2 defines one, output data assembly option (T - O)

Table 245 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines the current revision of the Assembly Object	Current: 2
2	Get	V	Maximum Instance	UINT		101

Table 246 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
3	Get	-	Data	STRUCT	The input or output data	-
4	Get	V	Size	UINT	The assembly (data) size	Number of bytes

Attribute Semantics

Member List

See I/O Message Formats

Note: Set access for Output data is not allowed as a security measure to prevent disruption of controlled modules.

Table 247 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

File Object

The File object holds the EDS (Electronic Data Sheet) file of the device.

Table 248 - Object Instances

Instance ID	Description
0	Class Instance of the CIP Time Sync Object0 Class Instance
200	Module EDS file

Table 249 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
3	Get		Number of Instances	UINT	Number of instances present	0…65535
32	Get		Directory:	Array of STRUCT	Attribute 3 indicates the array depth.	For the EDS instance
			Instance Number	UINT		0xC8
			Instance Name	STRINGI		EDS and Icon Files
			File Name	STRINGI		EDS.txt

Table 250 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get		State			
2	Get		Instance name		STRINGI	EDS and Icon Files
3	Get		Instance Format Version	UINT		1
4	Get		File Name	STRINGI		EDS.txt
5	Get		File Revision	USINT	major/Minor	As within the EDS file
6	Get		File Size	UDINT		Bytes
7	Get		File Checksum	INT		
8	Get		Invocation Method	USINT		255 - Not Applicable
9	Get		File Save Parameters	BYTE		0
10	Get		File Type	USINT		1 - Read Only
11	Get		File Encoding Format	USINT		0 - Binary

Attribute Semantics

State

0 - Nonexistent

1 - No file loaded

2 - Fled loaded

3 - Transfer Upload Initiated

4 - Transfer Download Initiated

5 - Transfer Upload in Progress

6 - Transfer Download in Progress

7 - Storing

8...255 - Reserved

Table 251 - Common Services

Service Code	Implementation	Instance	Service Name	Description of Service
	Class			
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute

Table 252 - Object Specific Services

Service Code	Implementation	Instance	Service Name	Description of Service
	Class			
0x4B	-	x	Initiate Upload	Start a file upload
0x4F	-	x	Upload Transfer	Performs a file transfer upload

Time Sync Object

The Time Sync Object (class code 0x43) provides a CIP interface to the IEEE 1588 Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems. This is commonly referred to as the Precision Time Protocol or PTP.

Table 253 - Object Instances

Instance ID	Description
0	Class Instance of the CIP Time Sync Object
1	Active instance of the CIP Time Sync Object

Table 254 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Revision of Object	Revision 3
2	Get		maximum Instance	UINT	One Instance is supported	1

Table 255 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get/Set	NV	PTPEnable	BOOL		Default = 1/Enabled
2	Get		IsSynchronized	BOOL		1: Synchronized
3	Get		SystemTimeMicroseconds	ULINT		Microseconds
4	Get		SystemTimeNanoseconds	ULINT		Nanoseconds
5	Get		OffsetFromMaster	LINT		Nanoseconds
6	Get/Set		maxOffsetFromMaster	ULINT		Nanoseconds
7	Get		MeanPathDelayToMaster	LINT		Nanoseconds
8	Get		Grand MasterClockInfo	STRUCT		
				USINT[8]	ClockIdentity	Encoded MaC ADDR.
				UINT	ClockClass	0…255 (0: best)
				UINT	TimeAccuracy	Index values

Table 255 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
				UINT	OffsetScaledLogVariance	lower = best
				UINT	CurrentUtcOffset	seconds
				WORD	TimePropertyFlags	
				UINT	TimeSource	Atomic, GPS, Radio
				UINT	Priority1	
				UINT	Priority2	
9	Get		ParentClockInfo	STRUCT		
				USINT[8]	ClockIdentity	Encoded MAC ADDR.
				UINT	PortNumber	
				UINT	ObservedOffsetScaledLogVarianc e	
				UDINT	ObservedPhaseChangeRate	
10	Get		LocalClockInfo	STRUCT		
				USINT[8]	ClockIdentity	Encoded MAC ADDR.
				UINT	ClockClass	0…255 (0: best)
				UINT	TimeAccuracy	Index values
				UINT	OffsetScaledLogVariance	
				UINT	CurrentUtcOffset	seconds
				WORD	TimePropertyFlags	
				UINT	TimeSource	Atomic, GPS, Radio
11	Get		NumberOfPorts	UINT		1
12	Get		PortStateInfo	STRUCT		
				UINT	NumberOfPorts	1
				ARRAY		
				UINT	PortNumber	
				UINT	PortState	Index 1… 9
13	Get	NV	PortEnableCfg	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				UINT	PortEnable	1: Enabled
14	Get/Set	NV	PortLogAnnounceIntervalCfg	STRUCT		
				UINT	NumberOfPorts	1
				ARRAY		
				UINT	PortNumber	
				UINT	PortLogAnnounceInterval	log base 2 seconds
15	Get/Set	NV	PortLogSyncIntervalCfg	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		

Table 255 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
				UINT	PortNumber	
				INT	PortLogSyncInterval	log base 2 seconds
18	Get/Set	NV	Do mainNumber	USINT		
19	Get		ClockType	WORD		
20	Get		manufactureIdentity	USINT(4)		
21	Get		ProductDescription	STRUCT		
				UDINT	Size	
				USINT[size]	Description	UTF-8 Unicode
22	Get		RevisionData	STRUCT		
				UDINT	Size	
				USINT[size]	Revision	UTF-8 Unicode
23	Get		UserDescription	STRUCT		
				UDINT	Size	
				USINT[size]	Description	UTF-8 Unicode
24	Get		PortProfileIdentityInfo	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				USINT[8]	PortProfileIdentity	
25	Get		PortPhysicalAddressInfo	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				USINT[16]	PhysicalProtocol	
				UINT	SizeOfAddress	
				USINT[16]	PortPhysicalAddress	
26	Get		PortProtocolAddressInf	STRUCT		
				UINT	NumberOfPorts	
				ARRAY		
				UINT	PortNumber	
				UINT	NetworkProtocol	E/IP = 1
				UINT	SizeOfAddress	
				USINT[16]	PortProtocolAddress	
27	Get		StepsRemoved	UINT	Local to Grandmaster	
28	Get		SystemTimeAndOffset	STRUCT		
				ULINT	SystemTimeAero	
				ULINT	SystemOffset	

Table 256 - Common Services

Service Code	Implementation	Instance	Service Name	Description of Service
	Class			
0x03	-	x	Get_Attributes_List	
0x04	-	x	Set_Attributes_List	
0x0E	x	x	Get_Attribute_Single	Returns the contents of the specified attribute
0x10	-	x	Set_Attribute_Single	Sets the specified attribute

Device Level Ring Object

The Device Level Ring Object (class code 0x47) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/updated in line with the latest stack released by Hilscher.

This object provides the mechanism to configure a network with ring topology according to the DLR (Device Level Ring) part of the EtherNet/IP specification.

Table 257 - Object Instances

Instance ID	Description
0	Class Instance of DLR Object
1	Active instance of DLR configuration instance

Table 258 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines the current revision of the DLR Object	Current revision:

Table 259 - Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Semantics of Values
1	Get	Network Topology	USINT	0: Linear 1: Ring
2	Get	Network Status	USINT	0: Normal 1: Ring Fault 2: Unexpected loop detected 3: Partial network fault 4: Rapid fault/restore cycle
10	Get	Active Supervisor Address	STRUCT	See standard
12	Get	Capability Flags	DWORD	Module does not provide ring supervisor or redundant gateway functions. Capability flag is fixed at 130.

Table 260 - Common Services

Service Code	Implementation	Instance	Service Name
	Class		
0x01	-	x	Get_Attributes_All
0x0E	x	x	Get_Attribute_Single

Quality of Service Object

The Quality of Service Object (class code 0x48) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/updated in line with the latest stack released by Hilscher.

Table 261 - Object Instances

Instance ID	Description
0	Class Instance of QOS Object
1	Instance 1 of the QOS Object

Table 262 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	USINT	Defines the current revision of the QOS Object	Current Revision: 1
2	Get	NV	maximum instance	USINT		1

Table 263 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute
1	Get	V	802.1Q Tag Enable	USINT	Virtual LAN Tagging
4	Get	V	DSCP Urgent	USINT	Differentiated Services Code Point
5	Get	V	DSCP Scheduled	USINT	
6	Get	V	DSCP High	USINT	
7	Get	V	DSCP Low	USINT	
8	Get	V	DSCP Explicit	USINT	

Table 264 - Common Services

Service Code	Implementation	Instance	Service Name	Description of Service
	Class			
0x0E	x	x	Get Attribute Single	
0x10	-	x	Set Attribute Single	

TCP/IP Interface Object

The TCP/IP Object (class code 0xF5) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/updated in line with the latest stack released by Hilscher.

The TCP/IP Interface Object provides the mechanism to configure a TCP/IP network interface of a device.

Examples of configurable items include the IP Address, Network Mask, and Gateway Address of the device.

Table 265 - Object Instances

Instance ID	Description
0	Class Instance of the TCP/IP Interface Object
1	Instance representing active TCP/IP Interface for the main module

Table 266 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Defines the current revision of the TCP/IP Interface Object	Current revision: 3
2	Get	V	Maximum Instance	UINT	Defines maximum number of available TCP/IP interface instances	1

Table 267 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Status	DWORD	Bits 0 -3 (value) • 0: Not configured • 1: Configuration based on BOOTP, DHCP, or NV stored configuration • 2: IP address based on the address switches (module base) Bits 4 and 5 relate to pending configuration changes in configuration attributes (see standard for details) Bit 6 - ACD Status is set when an address conflict is detected Bit 7 - ACD Fault is set when the current interface configuration cannot be used due to an ACD	
2	Get		Configuration Capability	DWORD	Bit 0 set: BOOTP client capable BIT 2 set: DHCP client capable Bit 4 set: Interface Configuration attribute is settable Bit 5 set: Hardware configurable (address switches) Bit 6 Not set: A change in the Interface Configuration attribute takes place immediately Bit 7 set: The module is ACD capable	0xB5 (10110101)
3	Get/Set		Configuration Control	DWORD		
4	Get		Physical Link Object	STRUCT		
5	Get/Set		Interface Configuration	STRUCT		
6	Get/Set		Host Name	STRING		
8	Get/Set		TTL Value	USINT	Multicast related	1…255

Table 267 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
9	Get/Set		Multicast Configuration	STRUCT	Multicast related	
10	Get/Set		Select ACD	BOOL	Address Conflict Detection	
11	Get/Set		Last Conflict Detected	STRUCT	Structure of 35 USINT	

Table 268 - Common Services

Service Code	Implementation		Service Name	Description of Service
	Class	Instance		
0x01	-	x	Get Attributes All	Returns the contents of the specified attributes
0x0E	x	x	Get Attribute Single	Returns the contents of the specified attribute
0x10	-	x	Set Attribute Single	Sets the specified attribute

Ethernet Link Object

The Ethernet Link Object (class code 0xF6) is part of the standard Hilscher netX100 EIP protocol stack. Before ODVA testing, this object is completed/ updated in line with the latest stack released by Hilscher.

The Ethernet Link Object maintains link-specific counters and status information for an Ethernet communication interface.

A request to access instance 1 of the Ethernet Link Object refers to the instance associated with the communication interface over which the request was received.

Table 269 - Object Instances

Instance ID	Description
0	Ethernet Link Class Instance
1	Instance representing port 1
2	Instance representing port 2

Table 270 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current revision of this Object	Current revision: 3
2	Get	V	maximum Instance	UINT		2
3	Get	V	Number of Instances	UNIT		2

Table 271 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get		Interface Speed	UDINT		0x64 (100 Mbps)
2	Get		Interface Flags	DWORD		
3	Get		Physical Address	STRUCT	Array of 6 USINT values	MAC address
4	Get		Interface Counters	STRUCT	Array of 11 UDINT values	
5	Get		Media Counters	STRUCT	Array of 12 UDINT values	
6	Get/Set		Interface Control	STRUCT	Two control bits are supported: Bit 0: Set for (802.3) auto negotiated enabled Bit 1 - Forced duplex mode, set for full-duplex (only applicable with autonegotiation disabled. If auto-negotiate is disabled, the Forced Interface Speed parameter indicates the speed at which the interface will operate in megabits per second. Examples for 10 mpbs the value will be 10.	
9	Get/Set		Administrative State		Enable/disable	1: Enable 2: Disable
10	Get		Interface Label	SHORT_STRING		port 1/port 2

Table 272 - Common Services

Service Code	Implementation	Instance	Service Name
	Class		
0x0E	x	x	Get Attribute Single
0x10	-	x	Set Attribute Single

Nonvolatile Storage Object

The Nonvolatile Storage Object (class code 0xA1) is a vendor-specific object that, on the Dynamix 1444, provides a means for firmware update using ControlFLASH software.

Table 273 - Object Instances

Instance ID	Description
0	NVS Class Instance
1	Instance 1 of the NVS object (NetX firmware)
2	Instanc2 of the NVS object (DSP firmware)

Table 274 - Class Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	NV	Revision	UINT	Current revision of this Object	Current revision: 3
2	Get	V	Maximum Instance	UINT	maximum instance number of an object that is created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.
3	Get	V	Number of Instances	UNIT	Number of object instances. The number of object instances at this class hierarchy level that is created at this class level of the device.	The number of object instances at this class hierarchy level.

Table 275 - Instance Attributes

Attribute ID	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
1	Get	V	Status	UNIT	Status of the NVS object.	Status
2	Get	V	major Instance Revision	USINT	Current major revision number of this NVS instance.	
			Minor Instance Revision	USINT	Current minor revision number of this NVS instance.	
3	Get	V	Size	UDINT	Number of bytes contained in this NVS instance.	
4	Get	V	Checksum	UDINT	Checksum/CRC or similar value that is embedded within the collection of bits.	Returns the checksum/CRC value

The Status attribute reports the status that is based on the state of an instance of the object. The assignment of values to 'r; Status' is as follows.

Value	Description
0	Nothing new/no update
1	Success on transfer
2	Success on programming
3	Failure on transfer
4	Failure on programming
5	Faulted

Table 276 - Common Services

Service Code	Implementation		Service Name
	Class	Instance	
0x0E	x	x	Get Attribute Single

Common Codes and Structures

Table 277 - Generic CIP Status Codes

Code	Name	Description
0x00 (0)	Success	Service was successfully performed by the object specified.
0x01 (1)	Connection failure	A connection-related service failed along the connection path.
0x02 (2)	Resource unavailable	Resources are needed for the object to perform the requested service were unavailable.
0x03 (3)	Invalid parameter value	See Status Code 0x20, which is the preferred value to use for this condition.
0x04 (4)	Path segment error	The path segment identifier or the segment syntax was not understood by the processing node. Path processing stops when a path segment error is encountered.
0x05 (5)	Path destination unknown	The path is referencing an object class, instance, or structure element that is not known or is not contained in the processing node. Path processing stops when a path destination unknown error is encountered.
0x06 (6)	Partial transfer	Only part of the expected data was transferred.
0x07 (7)	Connection lost	The messaging connection was lost.
0x08 (8)	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
0x09 (9)	Invalid attribute value	Invalid attribute data detected.
0x0A (10)	Attribute list error	An attribute in the Get Attribute List or Set Attribute List response has a non-zero status.
0x0B (11)	Already in requested mode/state	The object is already in the mode/state requested by the service.
0x0C (12)	Object state conflict	The object cannot perform the requested service in its current mode/state
0x0D (13)	Object already exists	The requested instance of object to be created already exists.
0x0E (14)	Attribute not settable	A request to modify a non-modifiable attribute was received.
0x0F (15)	Privilege violation	A permission/privilege check failed.
0x10 (16)	Device state conflict	The device's current mode/state prohibits the execution of the requested service.
0x11 (17)	Reply data too large	The data to be transmitted in the response buffer is larger than the allocated response buffer.

Table 277 - Generic CIP Status Codes

0x12 (18)	Fragmentation of a primitive value	The service specified an operation that is going to fragment a primitive data value, such as half a REAL data type.
0x13 (19)	Not enough data	The service did not supply enough data to perform the specified operation.
0x14 (20)	Attribute not supported	The attribute that is specified in the request is not supported.
0x15 (21)	Too much data	The service supplied more data than was expected.
0x16 (22)	Object does not exist	The object that is specified does not exist in the device.
0x17 (23)	Service fragmentation sequence not in progress	The fragmentation sequence for this service is not currently active for this data.
0x18 (24)	No stored attribute data	The attribute data of this object was not saved before the requested service.
0x19 (25)	Store operation failure	The attribute data of this object was not saved due to a failure during the attempt.
0x1A (26)	Routing failure, request packet too large	The service request packet was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service.
0x1B (27)	Routing failure, response packet too large	The service response packet was too large for transmission on a network in the path from the destination. The routing device was forced to abort the service.
0x1C (28)	Missing attribute list entry data	The service did not supply an attribute in a list of attributes that the service needed to perform the requested behavior.
0x1D (29)	Invalid attribute value list	The service is returning the list of attributes that are supplied with status information for those attributes that were invalid.
0x1E (30)	Embedded service error	A vendor-specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered. Use of this General Error Code only needs performed when none of the Error Codes that are presented in this table or within an Object Class definition accurately reflect the error.
0x1F (31)	Vendor-specific error	A vendor-specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered. Use of this General Error Code only needs performed when none of the Error Codes that are presented in this table or within an Object Class definition accurately reflect the error.
0x20 (32)	Invalid parameter	A parameter that is associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/or the requirements defined in an Application Object Specification.
0x21 (33)	Write-once value or medium already written	An attempt was made to write to a write-once medium (For example, WORM drive, PROM) that has already been written, or to modify a value that cannot be changed once established.
0x22 (34)	Invalid reply received	An invalid reply is received (For example, reply service code does not match the request Service Code, or reply message is shorter than the minimum expected reply size). This status code can serve for other causes of invalid replies.
0x23 (35)	Buffer overflow	The message received is larger than the receiving buffer can handle. The entire message was discarded.
0x24 (36)	Message-format error	The server does not support the format of the received message.
0x25 (37)	Key failure in path	The Key Segment that was included as the first segment in the path does not match the destination module. The object-specific status indicates which part of the key check failed.
0x26 (38)	Path size invalid	The size of the path that was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included.
0x27 (39)	Unexpected attribute in list	An attempt was made to set an attribute that is not able to be set currently.
0x28 (40)	Invalid member ID	The Member ID specified in the request does not exist in the specified Class/Instance/Attribute.
0x29 (41)	Member not able to be set	A request to modify a non-modifiable member was received.
0x2A (42)	Group 2 only server general failure	This error code can only be reported by DeviceNet Group 2 Only servers with 4K or less code space and only in place of Service not supported, Attribute not supported, and Attribute not able to be set.
0x2B (43)	Unknown Modbus error	A CIP to Modbus translator received an unknown Modbus Exception Code.

Table 277 - Generic CIP Status Codes

0x2C (44)	Attribute not attainable	A request to read a non-readable attribute was received.
0x2D (45)… 0xCF (207)	Reserved	Reserved
0xD0 (208)… 0xFF (255)	Reserved for Object Class and service errors	This range of error codes is used to indicate Object Class specific errors. Use of this range is only performed when none of the Error Codes that are presented in this table accurately reflect the error that was encountered.

General Code	Extended Code	Description
0x02	0x0201	The maximum number of class 3 connections are already in use
0x0F	0x0F01	Intrusive services are not allowed for unconnected messages
	0x0F02	A Set Attribute Single service is only allowed when there is an active class 3 connection that belongs to the module owner determined by the Vendor ID and the Device Serial Number
	0x0F03	User attempted to access a service that is limited to Class 1 access only
	0x0F04	User attempted to access a service that is only accessible if alarm inhibit is active
0x10	0x1001	An attempt to reconfigure the module was made while the module was already in program mode or in starting mode
	0x01002	A Set Attribute service on the Configuration Manager object was attempted while the module was in Program Mode or in Starting Mode
	0x1003	Intrusive services are not allowed on the Non-Volatile Storage Object (0xA1) unless the module is in an Out of Box state without an active class 1 connection
	0x1004	Dynamic data requests and special service requests are not allowed while the module is in Program Mode (while the module is being configured).
0x1E		Embedded service error. The requested inter-processor message exchange (NetX to DSP and/or to an auxiliary module) failed to complete so the requested data cannot be returned.
0x20	<0x1FFFFFFF	Invalid parameter in one or more configuration groups. Bits 0 to 28 represent groups 1 to 29, if a group is in error the appropriate bit is set to 0/cleared. Example: 0x1FFCFFFF 0x1FFFFFFF - 0x1FFCFFFF = 0x300000 As binary: 11 0000 0000 0000 0000 So: Groups 17/18

Engineering Units

The module supports a subset of the standard and custom CIP Engineering unit lists, appropriate to the selected Channel Application Type.

Table 278 - CIP Engineering Unit List

Value/ID	Index	Name	Description
0x1200	24	°C	Temperature measurement application types (There is no conversion between temperature units, separate application types apply to each).
0x1201	22	°F	
0x1202	23	K	
0x1300	16	psi	Dynamic pressure measurement application.
0x1307	14	bar	
0x1308	15	mbar	
0x1309	19	Pa	
0x130A	18	kPa	
0x0C00	17	MPa	

Table 278 - CIP Engineering Unit List

0x1500	12	m/s^2	Vibration acceleration measurement applications.
0x1502	37	$in./s^2$	
0x1504	10	g	
0x0B00	8	mm/s^2	
0x0B01	11	mg	
0x0A00	(10)	gSE	Spike energy measurement application.
0x1703	-	degree	Phase angle measurement (orders/S max).
0x1C00	20	A	Current measurement application types.
0x1C02	21	mA	
0x1F0F	-	RPM	Available only when the application uses one or more of the two available tacho inputs
0x0F01	-	RPM/min	
0x2200	4	m	Displacement measurement (all forms) including vibration and position assessments.
0x2203	5	mm	
0x2204	6	micron	
0x2207	2	in.	
0x0800	3	mil	
0x2B00	13	m/s	Vibration velocity measurement applications.
0x2B07	7	in./s	
0x0900	9	mm/s	Voltage measurement application types and sensor DC bias measurement for most other application types.
0x2D00	0	V	
0x2D01	1	mV	

The left most two characters of the units ID shown in the table indicate the class from which that unit of measurement originates. The relevant CIP Standard and Custom EU Classes are listed in Table .

Table 279 - Standard CIP Engineering Unit Classes

Value	Name
0x12	Temperature
0x13	Pressure
0x15	Acceleration
0x17	Angle
0x1C	Current
0x1F	Frequency
0x22	Length
0x2B	Velocity
0x2D	Voltage

Table 280 - Custom CIP Engineering Unit Classes

Value	Name
0x08	Length
0x09	Velocity
0x0A	Bearing Defect Units
0x0B	Acceleration
0x0C	Pressure
0x0F	Other

Table 281 - Data Types

Type	Description	Data
BOOL	Boolean	1 byte
SINT	Short Integer	1 byte: -128…127
INT	Integer	2 bytes: -32768…32767
DINT	Double Integer	4 bytes: -2^{31}…2^{31}-1
LINT	Long Integer	8 bytes: -2^{63}…2^{63}-1
USINT	Unsigned Short Integer	1 byte: 0…255
UINT	Unsigned Integer	2 bytes: 0…65535
UDINT	Unsigned Double Integer	4 bytes: 0…2^{32}-1
ULINT	Unsigned Long Integer	8 bytes: 0…2^{64}-1
REAL	Floating Point	4 bytes: IEEE 754
DATE	Date Only	2 bytes: 1972-01-01 + 65536 day…2151-06-06
TIME_OF_DAY (TOD)	Time of Day	4 bytes: 1 msec resolution
SHORT_STRING	Character String (1 byte per character, 1 byte length indicator)	1 byte count header + 1*count byte sequence
STRINGI	International Character String	Structure
BYTE	Bit String	8 bits
WORD	Bit String	16 bits
DWORD	Bit String	32 bits
ENGUNIT	Engineering Unit	

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1444-UM001B-EN-P - August 2015
Supersedes Publication 1444-UM001A-EN-P - December 2014

Copyright © 2015 Rockwell Automation, Inc. All rights reserved. Printed in the U.S.A.