FLOWSERVE

USER INSTRUCTIONS

Installation
Operation
Maintenance

MX/QX Series B PROFIBUS DP Field Unit with Redundant Communication

PROFIBUS®

Experience In Motion

CONTENTS

TABLES

FIGURES

1 Introduction

1.1 Purpose

This manual explains how to install and operate the Flowserve Limitorque MX/QX PROFIBUS field unit, referred to as the MX (Multi-turn)/QX (Quarter-turn) PB (PROFIBUS) field unit. Actuators containing the PB field unit may be connected by shielded twisted-pair, or shielded two-wire cable to form a PROFIBUS communication system network. The name PROFIBUS is derived from Process Fieldbus. The PROFIBUS communication system is a digital, serial, two-way open bus system that supports a variety of communication rates. The MX/QX PB unit supports a communication rate up to 1.5 Mbit/sec. This system allows a network host station such as a distributed control system (DCS) or a programmable logic controller (PLC) to control and monitor the actuators, including the acquisition of status and alarm data from each MX/QX.

1.2 How to Use this Manual

Each section provides the MX/QX PB user with information on installing and operating the MX/QX PB field unit.

Section 1. **Introduction** The introduction details user safety and knowledge requirements, system capabilities, and features.

Section 2. **System Components and Installation** The system components section focuses on the description of the PROFIBUS system hardware and software components, and provides details for installing and configuring a field unit.

Section 3. **Software** The software section provides details regarding the software that the MX/QX PB uses to communicate.

Section 4. **Application Notes** This section provides some helpful hints about using the MX/QX PB with PLCs.

Section 5. **Frequently Asked Questions** This section addresses the most commonly asked questions about the PROFIBUS DP boards.

Section 6. **Glossary** The glossary contains a terminology list of abbreviations, acronyms, and their descriptions.

1.3 User Safety

Safety notices in this manual detail precautions the user must take to reduce the risk of personal injury and damage to the equipment. The user must read and be familiar with these instructions before attempting installation, operation, or maintenance. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, warranty void, or operational difficulty. The user must follow all applicable local and state safety regulations.

Safety notices are presented in this manual in three forms:

WARNING: Refers to personal safety and alerts the user to potential danger. Failure to follow warning notices could result in personal injury or death.

CAUTION: Directs the user's attention to general precautions that, if not followed, could result in personal injury and/or equipment damage.

NOTE: Highlights information critical to the user's understanding of the actuator's installation and operation.

1.4 User Knowledge

It is recommended that the user read this manual in its entirety before the MX/QX PB field unit is installed and operated.

The user needs to have a fundamental knowledge of electronics and an understanding of valve actuators and digital control systems. Refer to the Glossary for information regarding the terms used throughout this manual.

The following websites have documents on PROFIBUS and electric actuators:

www.PROFIBUS.com
www.flowserve.com
www.iec.ch

For PROFIBUS technology, installation, and cabling information, refer to the following documents:

- PROFIBUS DP Specification, IEC 61158 Type 3 and IEC 61784.
- PROFIBUS Slave Redundancy Specification, Version 1.2, November 2004, PROFIBUS International Order No. 2.212.
- Profibus Design Guideline, Version 1.13, May 2015, PROFIBUS International Order No. 8.012.
- Profibus Assembly Guideline, Version 1.14, May 2015, PROFIBUS International Order No. 8.022.
- Profibus Commissioning Guideline, Version 1.0.9, May 2015, PROFIBUS International Order No. 8.032.

1.5 MX/QX PB System Capabilities and Features

Flowserve Limitorque's MX/QX PROFIBUS (PB) field unit conforms to the open fieldbus standard EN50170. It is suitable for use on PROFIBUS and uses a twisted-pair or two-conductor shielded cable for connection to the network. A PROFIBUS device is an intelligent device within the actuator that can send multiple variables to the control system over a high-resolution and distortion-free digital communication network. The device provides control and self-test capabilities, which allow abnormal conditions to be easily and immediately identified before an unplanned shutdown.

The MX/QX PB unit may command its actuator to: open, stop, close, move to a set position, perform an emergency shutdown operation, read and control relays, monitor analog inputs and position, and monitor modes and alarms. Commands to the unit come over the network from the master network host station, which may be a Personal Computer (PC), Distributed Control System (DCS), Programmable Logic Controller (PLC), or some other microprocessor-based device. The master is defined as an active network node which means that it has addressing, and read and write privileges to slave devices that are assigned to it.

A typical MX/QX PB DP system is shown in Figure 1 in a Master/Slave Configuration, Figure 2 shows a typical PROFIBUS DP network with Flying redundancy, single line option in a single master configuration, Figure 3 shows a typical PROFIBUS DP network with Flying redundancy, two line option in a single master configuration, and Figure 4 shows a typical MX/QX PB DP Redcom network with the System redundancy option in a dual master system. The figures show external termination but these may be eliminated if the on-board termination is enabled.

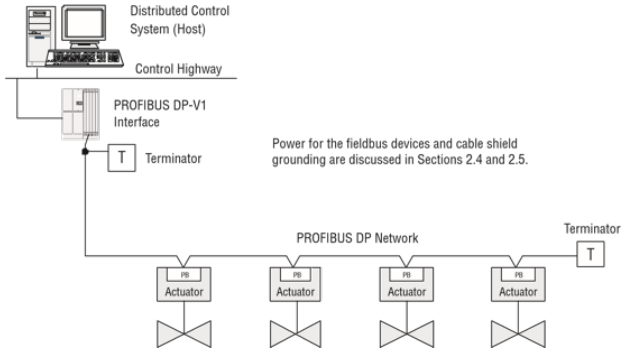


Figure 1 - Typical PROFIBUS DP Network with DCS or PLC as the Host System

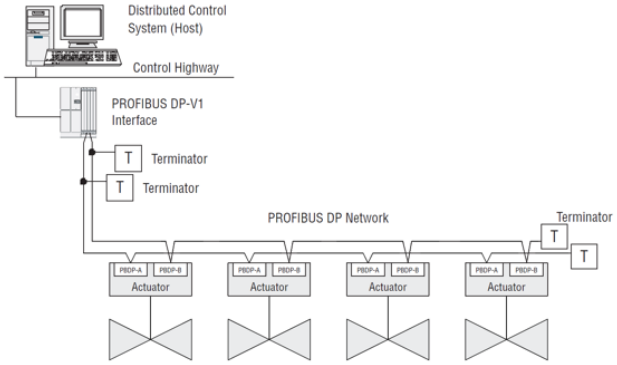


Figure 3 - Typical PROFIBUS DP Network with Flying (two line) Redundancy Option (Single Master)

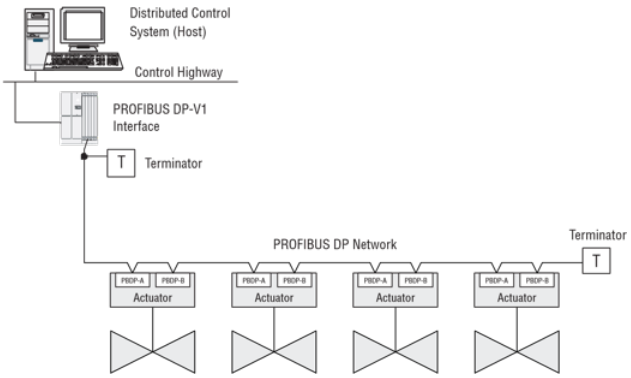


Figure 2 - Typical PROFIBUS DP Network with Flying (single line) Redundancy Option (Single Master)

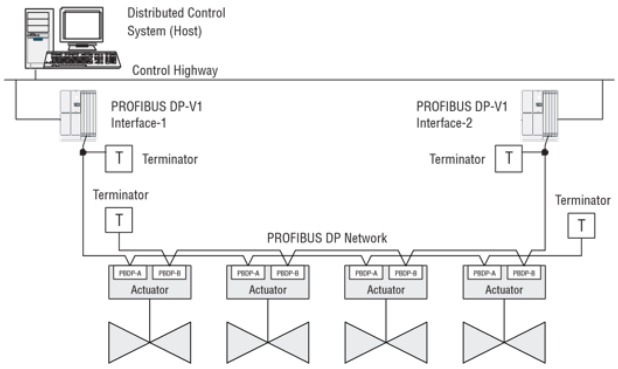


Figure 4 - Typical PROFIBUS DP Redcom Network with System Redundancy (Dual Master)

1.5.1 General Network Specification

System Specifications:

- Communicates using the PROFIBUS DP protocol.
- PROFIBUS DP is V1 compliant.
- Employs high-speed communication.
- Complies with EN50170 fieldbus standard.
- DP Physical Layer with RS-485.

Network Specification:

Several topologies are available including point-to-point, bus, tree, ring, or a combination of these. Network features include:

- PROFIBUS DP high-speed communications up to 1.5 Mbit/sec.
- Master/slave communications.
- Multiple-master network systems.
- Redundant PROFIBUS DP with single or multiple-master communications.

MX/QX Field Unit Specification:

The field unit mounts inside the actuator, is software controlled, and has the following features:

- Input and Output.
- Device descriptions - describes device and parameters.
- Network communication - compliant with EN50170.
- Configurable by user - locally and via network.

PROFIBUS Master Specification:

The PROFIBUS master is the network system host, and can be a PC, DCS, PLC, or some other microprocessor-based device. The master is defined as the network node that has addressing, and read/write privileges to slave devices that are assigned to it. A PROFIBUS network can have more than one master, but one, and only one, token is active at a given time. The token provides the right to access the transmission medium, as is passed between the active nodes (masters) with a token telegram. The master host station acts as the bus arbiter, and does the following:

- Recognizes and adds new devices on the link.
- Removes non-responsive devices from the link.
- Distributes a priority-driven token for unscheduled cyclic transmissions between masters.
- Ensures cyclic data transferred on a periodic basis.
- Issues requests for process data from the field devices.
- Issues commands to the field devices.

High Speed Data Exchange - Startup Sequence

- Power ON / Reset - Power on / Reset of master or slave.
- Parameterization - download of parameters into the field device (selected during configuration by the user).
- I/O Configuration - download of I/O configuration into the field device (selected during configuration by the user).
- Data Exchange - cyclic data exchange (I/O Data) and field device reports diagnostics.

Device Configuration Tool Requirements

Generally, the device configuration tool can be executed independently of the control system configuration tool. The general requirements are as follows:

A PROFIBUS DP network is inserted as an object of a control system project (or independent project).

- Within that network, a device is logically attached along with object name, PROFIBUS DP address, and how many objects are to be attached.
- Editing this device will allow the user to select the type of device (actuator, sensor, etc.).
- The configuration tool will then display the extended parameters with initial values.
- These parameters may be uploaded from the device to display the actual values (if a network connection is possible).
- New values can be entered and then downloaded to the device through the network connection.
- There will also be a method for monitoring the online parameter values.

2 System Components and Installation

2.1 Introduction

This section is an overview of the components used in the PROFIBUS system and their integration with the MX/QX actuator. The MX/QX PB field unit is installed in the control compartment of the actuator as shown in Figures 5 and 6. The PROFIBUS network cable from the host control station connects to the fieldbus unit at the actuator terminal block.

The Network Cabling section of this chapter is broken into two sections, PROFIBUS DP and PROFIBUS DP Redcom.

Refer to Section 2.3.2 for detailed wiring connections.

2.1.1 MX/QX PB Field Unit

The MX/QX PB field unit interface board is installed in the actuator controls compartment (Figure 21). The MX/QX PB DP version is shown in Figure 5, and the MX/QX PB Redcom version is shown in Figure 6. Each unit permits the actuator to be controlled as a slave by one or more master host stations over their respective PROFIBUS network. The MX/QX PB DP Redcom version supports two forms of redundancy:

a. Flying redundancy provides slave hardware redundancy in the form of a primary and backup channel installed on the PB DP Redcom board. This form is commonly utilized in applications where a single master is present.

b.System redundancy provides for both slave hardware redundancy, in the form of a primary and backup channel installed PB DP Redcom board, and cable redundancy in the form of dual masters connected to the primary and backup channels.

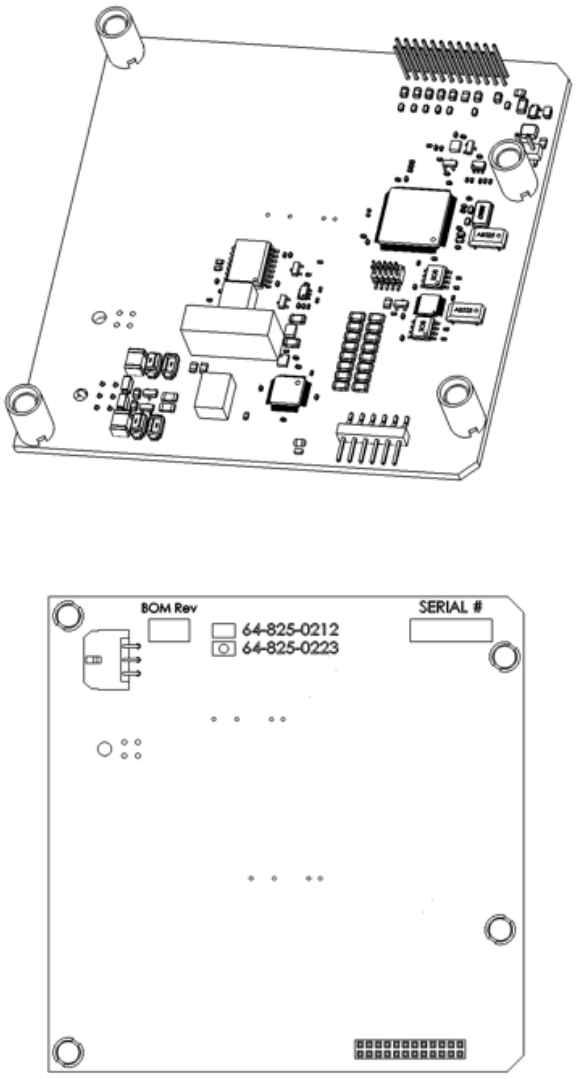
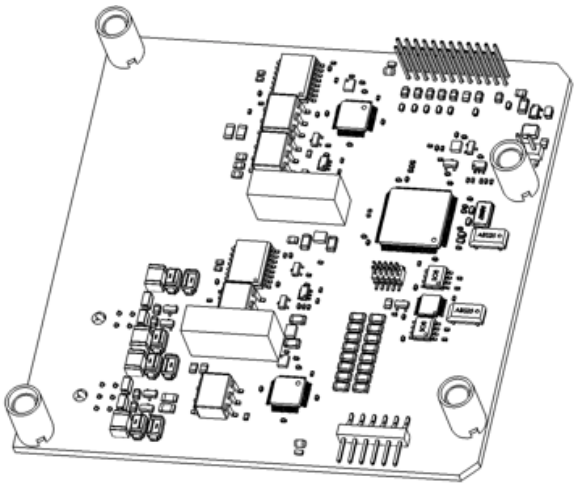


Figure 5 - MX/QX PB DP Field Unit (single channel), Part Number 64-825-0223



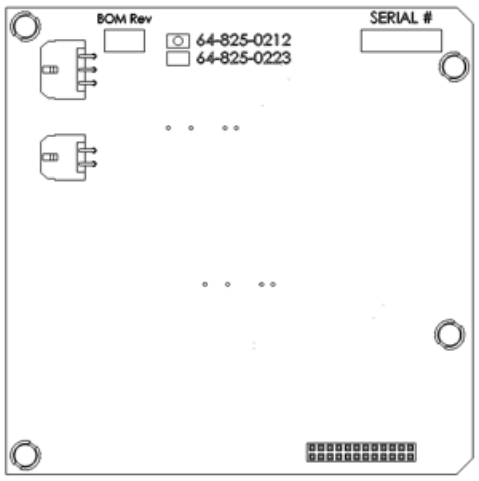


Figure 6 - MX/QX PB DP Redcom Field Unit (dual channel), Part Number 64-825-0212

The following commands and feedback information are transmitted through this unit:

- OPEN, CLOSE, and STOP commands.
- ESD (Emergency Shutdown) commands.
- Go-to-position commands.
- Redundancy switch-over commands (Profibus DP Redundancy option).
- Position feedback.
- Actuator status, alarm, and diagnostic messages.
- User analog input feedback.
- Discrete input feedback.
- Discrete output relays.

2.1.2 Network Host Station

The PROFIBUS master is considered to be the network host station, which is typically a DCS, PC, PLC or other microprocessor-based PROFIBUS-compliant device. In a mono-master network, the network host device is the only active network node. This is common in a standard Master-Slave PROFIBUS network. In a multi-master network, there are two or more active nodes. This is managed in a token ring, where the token, a uniquely structured message, circulates continuously among the active network nodes. In the case of multiple Masters, only one Master has read/write privileges to its Slaves (passive nodes) at any one time, and the control token is passed continuously in ascending order to all other active network nodes.

2.1.2.1 Token Bus and Token Passing in a Multi-Master Network

During the bus initialization and startup, the bus access control creates the token ring by recognizing the active network nodes in ascending order. The bus access control automatically determines the addresses of all active nodes on the bus, and records them together with its own node address, creating a List of Active Stations.

The Lowest Station Address (LSA) begins with the active token, allowing it to fetch and send data messages to its passive slaves (referred to as polling). At completion of its request frame (polling telegram), and acknowledgement or response frame returned from the slave, the token is passed to the Next Station (NS) with a token telegram. The active node from which the node was passed is called the Previous Station (PS). This continues until the token is being passed from the Highest Station Address (HSA). At completion of the HSA polling telegram, the token is passed to the LSA. The List of Active Stations is required during network operation to remove a faulty active node, or to add a node, without disturbing data on the bus.

2.1.2.2 Token Rotation Time

The time required for the rotation of the token to all active nodes is the token rotation time. The Time Target Rotation (TTR) is adjustable, and is used to specify the maximum allowed time of one rotation.

2.1.2.3 Bus Cycle Time

Based on the number of slaves attached to each master and the amount of data to be transferred, a Bus Cycle Time is calculated by the master. This is the amount of time required for a master to poll all slaves. This, along with the Token Rotation Time, makes PROFIBUS network access deterministic.

2.1.3 Network Cabling for PROFIBUS DP

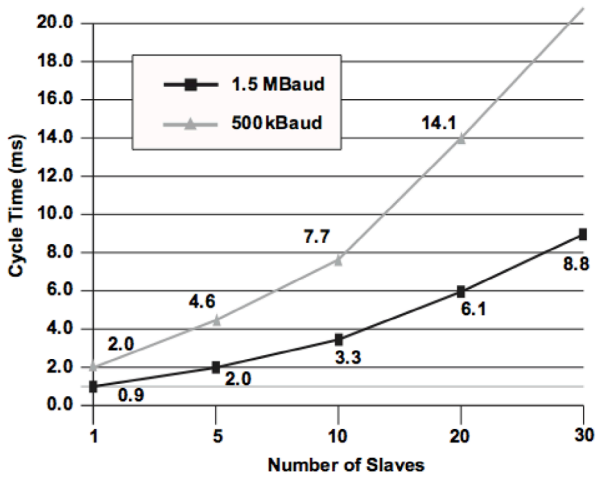


Figure 7 - Typical Cycle Time (Each Station with 2 Bytes I/O)

Network cabling should be in accordance with PROFIBUS Decentralized Periphery (DP) guidelines. To achieve immunity to electromagnetic interference, ensuring high data integrity, certain cables and guidelines are recommended. Additionally, the following items should be taken into account when planning the network:

- Transmission rate – Within a network, only one transmission rate can be used; the MX/QX PB DP works at baud rates up to 1.5 Mbps.
- The level of Master and Slave redundancy, if any.
- The required number of nodes.
- The type of network components needed – terminals, connectors, connecting cables, termination.
- The type of cable to be used and its characteristics.
- The number of segments and/or repeaters.
- The overall span of the network – adding repeaters and long cable lengths can increase transmission time.
- Cable termination – active termination resistors are required at the ends of all segments.
- In general, the following rules apply for PROFIBUS networks:
- The higher the baud rate, the shorter the distance allowed between nodes.
- The higher the baud rate, the shorter the maximum distance of a segment.
- The higher the baud rate, the shorter the maximum distance of an entire network.

These distance rules (or limitations) are based on the physical characteristics of the RS-485 topology and are not a limitation of the PROFIBUS protocol. If the distance required between two stations or the total network distance is greater than allowed by the PROFIBUS specifications for copper cable, a conversion to fiber-optic cable may be required. Figure 8 shows the baud rate versus copper cable distance using PROFIBUS.

Table 1 provides the guidelines for maximum segment length versus baud rate.

Table 1- Maximum Segment Length

Baud Rate	9600 to 187.5K	500K	1.5M
Maximum Segment Length (meters)	1,000	400	200

Table 2 provides the guidelines for maximum network length versus baud rate (assuming the use of up to 9 repeaters).

Table 2 - Total Network Length (with up to nine repeaters)

Baud Rate	9600 to 187.5K	500K	1.5M
Total Network Length (meters)	10,000	4,000	2,000

NOTE: The maximum lengths are estimates and depend on the condition of the actual cable.

- Table 3 and Table 4 detail the various types of cable which can be used for network cabling. For additional guidelines, see the following publications:
- PROFIBUS Networks SIMATIC NET 6GK1970-5CA20-0AA1.
- PROFIBUS Technical Guideline for PROFIBUS-DP/FMS, Version 1.0, September 1998; PROFIBUS Guideline, Order No. 2.112.
- There are different types of electrical data transfer cables:
- Standard bus cable.
- Standard bus cable with halogen-free sheath (type FRNC).
- Cable with PE sheath for use in the food and drug manufacturing industries.
- Direct buried cable with additional protective sheath for buried service.
- Trailing cable – This is a special cable type which is used where parts of the machine move occasionally or continuously.
- Festooned cable – Comparable to a trailing cable, but has an additional strain relief element.

NOTE: Cable must meet the requirements as listed in Table 3 to ensure reliable network communications.

Table 3 - Recommended PROFIBUS DP Cable Parameters

Characteristic at 3-20 MHz (ohms)	135 - 165
Operating capacitance (pF/m)	< 30
Loop resistance (ohms/km)	≤ 110
Core diameter (mm)	> 0.64
Core cross-section (mm^2)	> 0.34

Table 4 - Recommended PROFIBUS DP Cable Types

FC Standard Cable (Siemens AG)	6XV1 830-0EH10
FRNC Cable (Siemens AG)	6XV1 830-0CH10
FC Food Cable (Siemens AG)	6XV1 830-0GH10
FC Ground Cable (Siemens AG)	6XV1 830-3FH10
FC Trailing Cable (Siemens AG)	6XV1 830-3EH10
Festoon Cable (Siemens AG)	6XV1 830-3GH10
PROFIBUS Data Cable (Belden Wire and Cable)	3079A/3076F
PROFIBUS DP Cable (Moeller GmbH)	ZB4-900-KB1
PROFIBUS DP Cable (Kerpenwerk GmbH)	7422/7436
PROFIBUS DP Cable (ABB Automation GmbH)	NDC110-NO

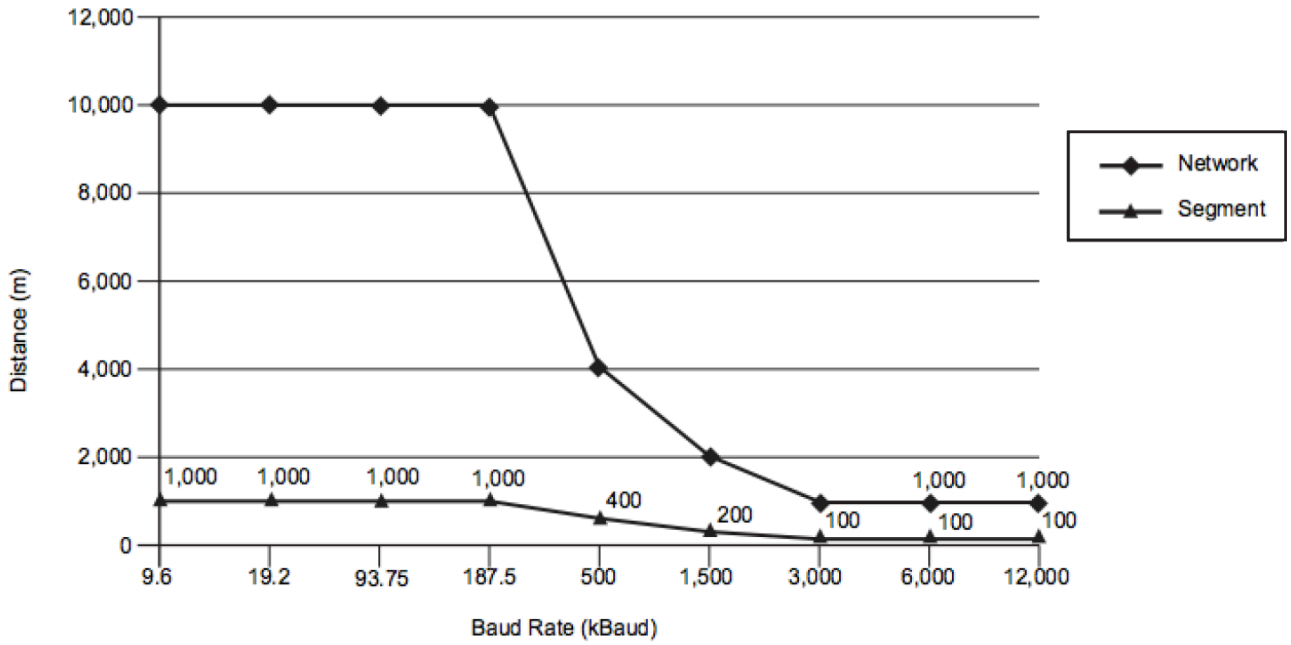


Figure 8 - Copper PROFIBUS Distance vs. Baud Rate Chart

- There are several topologies available for both redundant and non-redundant PROFIBUS networks:
- Point-to-point – A single cable from master to slave.
- Daisy chain – A single cable daisy chained in and out of each field unit device. End of segment devices only have one incoming cable.
- Tree – Cables and electronic devices (such as repeaters or link modules) are used to branch out from different points.
- Ring – Often implemented with fiber-optic cable which forms a circle or ring when used with Optical Link Modules. This topology yields redundancy so that any single component fault or cable break does not affect the network (except for the component).
- Combination of the above.

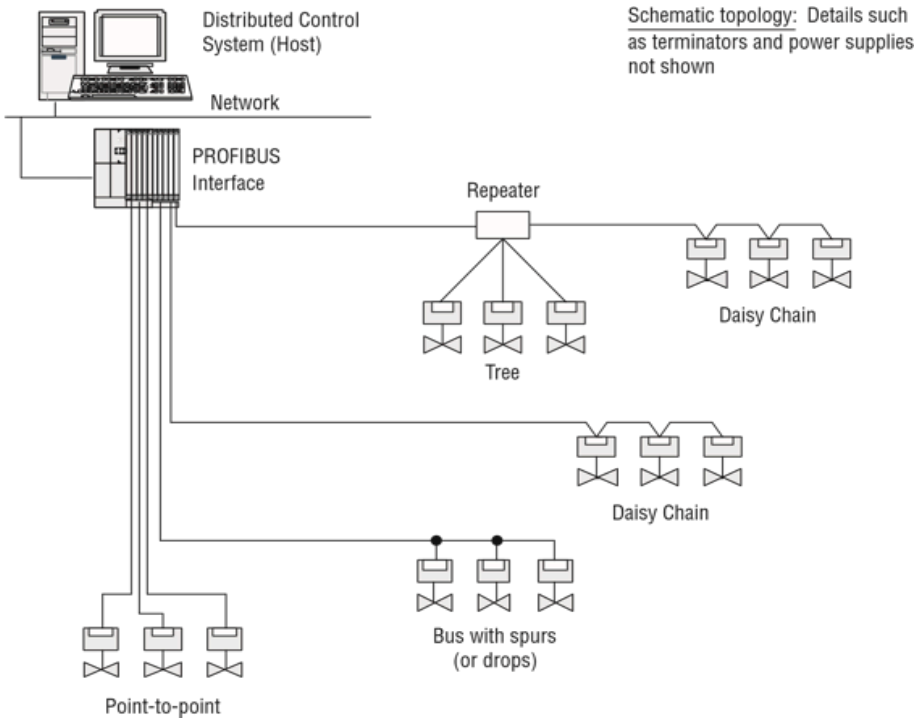


Figure 9 - Cable Topologies

2.1.3.1 Cable Shielding and Grounding for PROFIBUS DP

For best performance, PROFIBUS DP cables should be shielded. Per PROFIBUS Technical Guidelines, the cable shield should be connected at the beginning and end of the segment. Alternatively, a 10-12 AWG ground wire may be run to each MX/QX.

In Figure 10, the grounding point is shown at the junction of the field devices and at each field device.

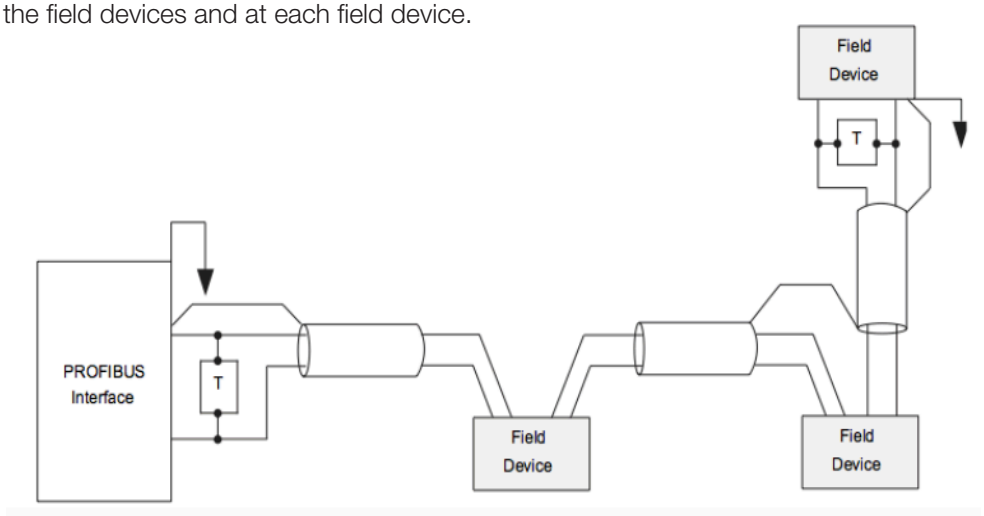


Figure 10 - Use of Shielded Cable in PROFIBUS DP

2.2 Other Network Components

In addition to the network cables, the following components may be used in the PROFIBUS network. Each network is designed based on its application and therefore may not require all of these components.

- Bus Terminal Blocks/Junction Box – Provides multiple connections to the bus (network).
- Active Bus Terminal – Provides active termination so that other stations may be powered down for service without affecting the network.
- Connectors – Enable connections to junction boxes, terminators or other connectors. Useful in installations where devices will be periodically disconnected or when a device is only going to be temporarily disconnected. Some PROFIBUS connectors also include termination resistors for line termination.
- Couplers – Provide one or several connection points to a network segment.
- Repeaters – The PROFIBUS Physical Layer (RS-485) dictates that no more than 32 nodes can exist in a shielded twisted-pair (copper) segment. A node is defined as any station, active or passive, that is connected to the network. Media converters (copper to fiber-optic, fiber-optic to copper) and repeaters do not have PROFIBUS addresses and, therefore, are not included in the 126 possible addressable nodes.

RS-485 repeaters may be used to extend the recommended distance of a segment and “reform” the signal to full voltage levels. Repeaters are included in the total number of allowable nodes per segment; therefore, a segment that begins with a repeater and ends with a repeater may have 30 nodes between them. The maximum number of repeaters allowed in a PROFIBUS network is nine.

- Terminators – Used at each end of a PROFIBUS segment to prevent signal reflections.
- Power Supplies – Different types of power supplies can be used in a PROFIBUS network:
- Non-intrinsically safe power supply.
- Standard linear or switching power supply used with a power conditioner.
- Intrinsically safe power supply (9-32 VDC).

For cable connecting information on these components, refer to the following:

- Installation Guidelines for PROFIBUS – FMS/DP Version 1.0, PROFIBUS International Order No.112.

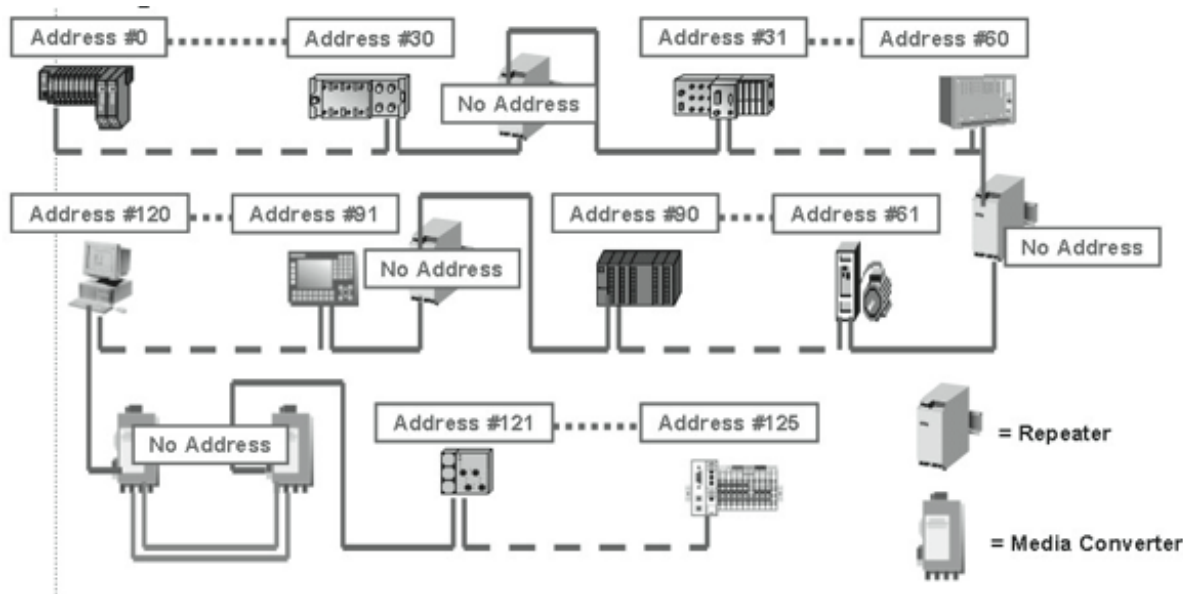


Figure 11 - PROFIBUS DP Segment

2.3 Site and Network Cable Preparation

2.3.1 Site Preparation

Prepare the installation site and associated equipment for operation of the MX/QX PB-controlled actuators as follows:

1. Prepare a detailed site plan consisting of the following:
   - Actuator locations and tag numbers.
   - Junction boxes and terminal strip locations and tag numbers.
   - Terminators and power supplies/conditioners, and repeaters.
2. Provide free access to the MX/QX control panel and terminal block for setup, configuration, and troubleshooting.
3. Prepare the cable and label all wires. See Section 2.3.2.
4. Install power and control wires in separate conduits.
5. Install and verify earth grounds. The cable shields should be tied together. Ground the bus shield at the end of each segment. The MX/QX PB unit should not connect either conductor of the cable to ground at any point in the network. Refer to Section 2.1.3.1.

NOTE: An effective local earth ground is defined as a low impedance (less than 5 ohms) path to either:

- A ground electrode placed in the close vicinity of the actuator, free of any ground loop currents OR
- A safety ground, free of ground loop currents, running from the actuator back to the system ground electrode. If the signal wiring is run on aerial cable where it may be exposed to high-energy electrostatic discharge (such as lightning), a low impedance path to ground which is capable of high current must be provided a short distance from the actuator as described above OR
- A power distribution grid identifying the impact of power isolation to a particular actuator or group of actuators.

2.3.2 Network Cable Preparation

Care must be taken during cable preparation:

- When stripping the insulation, use wire strippers that do not nick the wire.
- Use crimp ferrules to prevent stranded wires from getting loose and shorting to other wires.
- Use vibration-resistant wiring terminals that hold the ferrule securely.

2.3.2.1 Network Cable Connection to the MX/QX PB Unit

The field device is connected to the PROFIBUS network through the MX/QX terminal block.

The PROFIBUS DP network cable is connected to the terminal block as shown in Figure 12, Figure 13, or Figure 14.

NOTE: The MX/QX PB DP device is sensitive to polarity. Cable polarity should be maintained through all connection points.

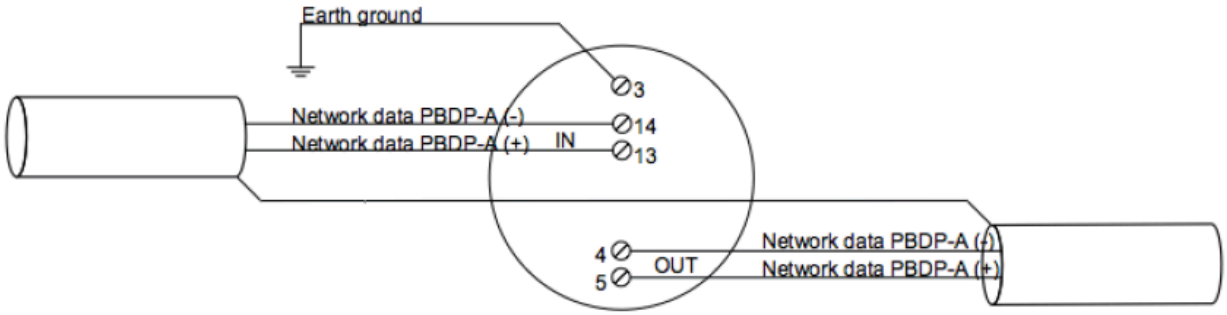


Figure 12 - PROFIBUS DP, p/n 64-825-0223, Connection to Terminal Blocks

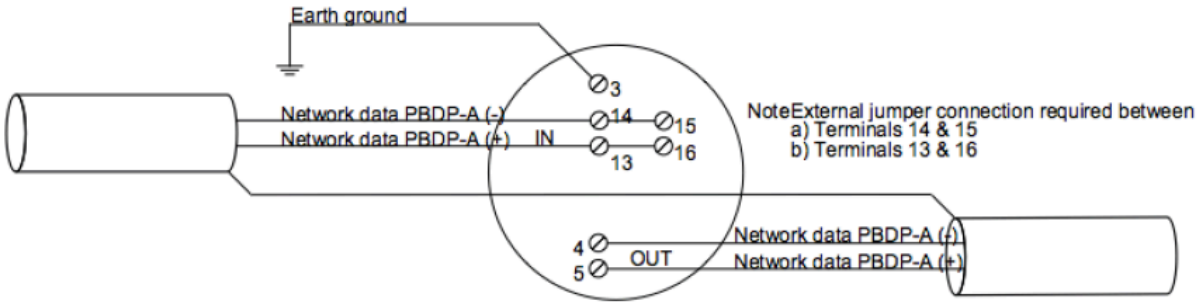


Figure 13 - PROFIBUS DP Redcom, p/n 64-825-0212, Connections (Flying Redundancy, single line, with single master

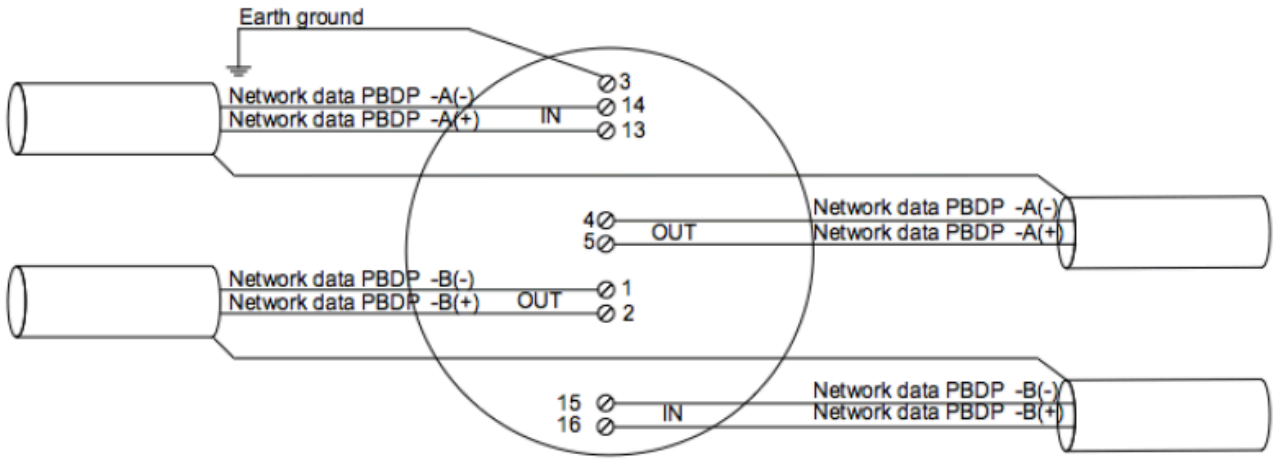


Figure 14 - PROFIBUS DP Redcom, p/n 64-825-0212, Connections (Flying, two line, or System Redundancy options)

- Shielded twisted-pair cables in compliance to PROFIBUS standards must be used.
- Shields are connected to earth ground. PB/DP connects at the ends of each segment.
- Clean earth-ground connection (less than 5 ohms) provides noise protection and a clear, safe path for surge currents.

Prepare the network cable for connection to the MX/QX terminals as follows:

CAUTION: Strip stranded conductors carefully, do not damage the strands. This will weaken the conductor and can cause the conductor to break. This type of damage may not be apparent and failure can occur without warning.

1. Remove two to three inches (5 to 8 cm) of the outer jacket of the cable as shown in Figure 15. Do not cut or nick the shield or the insulated conductors.

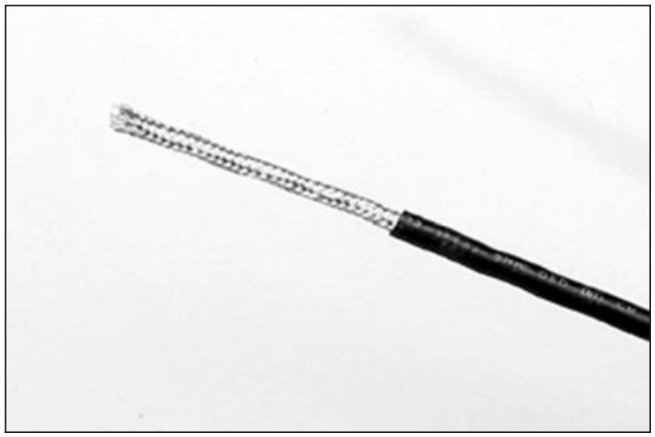


Figure 15 - Removing Outer Plastic Jacket

NOTE: Excess cable should be cut and removed, not coiled or looped, to prevent noise induction into the network.

2. Separate the cable parts. Unbraid the shield and peel back the shield to the same point where the outer jacket was removed as shown in Figure 16.

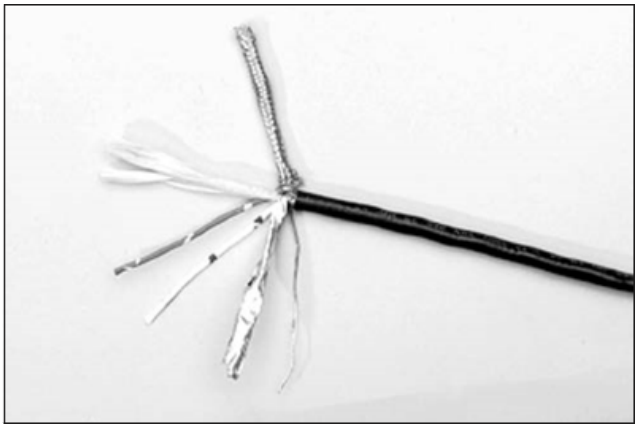


Figure 16 - Separating Cable Parts

3. Cut away the foil shield. Strip the insulation from the conductors approximately 0.4 inch (1 cm) as shown in Figure 17.

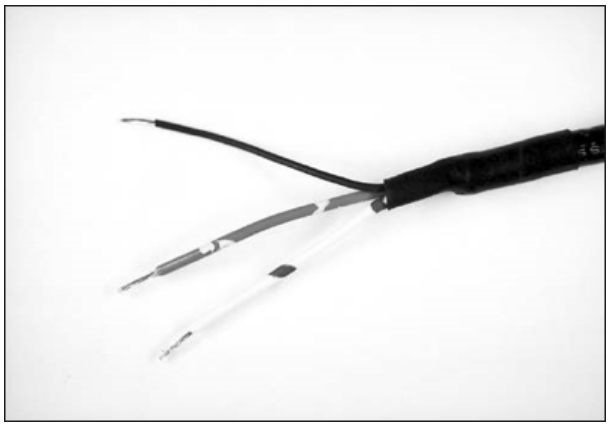


Figure 17 - Stripping Conductors

4. Apply heat-shrink tubing to insulate the braided shield and to provide stress relief to the cable as shown in Figure 18.

CAUTION: Do not melt the insulation during the application of heat-shrink tubing.

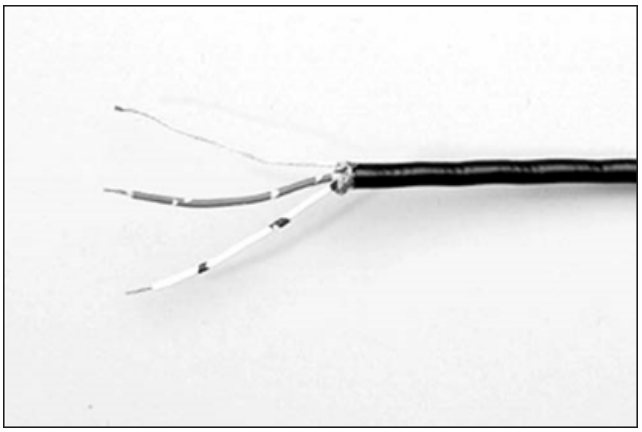


Figure 18 - Insulating Braided Shield

5. Install ring tongue connectors as shown in Figure 19.

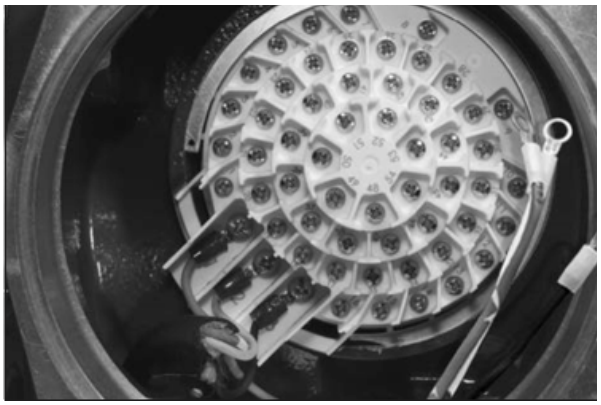


Figure 19 - Ring Tongue Connections

NOTE: Flowserve recommends the use of Thomas and Betts #RZ22-6 for optimum results.

6. Connect the network cables to the MX/QX terminal block as shown in Figure 20.

Table 5 - Terminal Block Connections

Terminal Block Number	DP Connection
1	PBDP-B (-) Out
2	PBDP-B (+) Out
3	Surge/Ground
4	PBDP-A (-) Out
5	PBDP-A (+) Out
13	PBDP-A (+) In
14	PBDP-A (-) In
15	PBDP-B (-) In
16	PBDP-B (+) In

NOTE: Flowserve recommends the use of Thomas and Betts #RZ22-6 for optimum results.

NOTE: Ground each segment of the cabling at each field device unit. See Section 2.1.3.1. Verify the actuator is properly grounded.

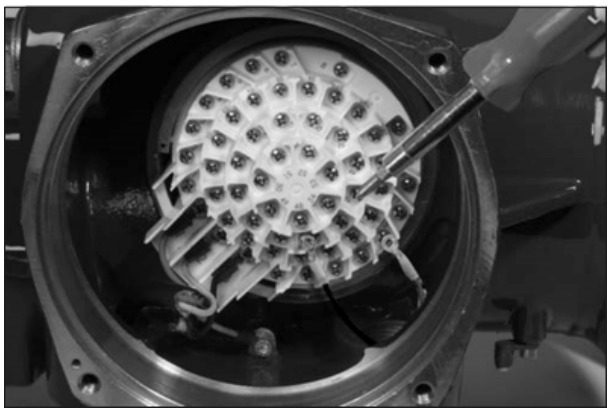


Figure 20 - Connecting Network Cable to the MX/QX Terminal Block

7. Connect the cable shields to each other inside the unit. Do not connect them to the unit in any way. The network shield should be grounded at the end of each segment. For surge suppression, Terminal 3 must be tied to earth ground in both DP applications.

2.3.2.2 Network Cable Connection to the Host System

For instructions on connecting to the host system, see the applicable host system/station. There are several topologies for the network detailed in Installation Guideline for PROFIBUS-DP/FMS, Version 1.0, September 1998.

2.3.3 MX/QX PB Device Installation

The MX/QX PB board is located in the electrical housing of the actuator unit. The PB board has four standoffs and mounts on top of the main processor board as shown in Figure 21. An optional Input/Output (I/O) board may also be present. The PB and I/O boards may be inserted in any order on top of the main processor board.

Figure 21 - MX/QX PB DP and Option Boards Mounted to MX/QX Main Board

2.4 MX/QX PB Device Setup

The MX/QX PB option enables the actuator to be controlled by a PROFIBUS communications signal. If the option has been purchased, it is automatically enabled.

NOTE: If the PB option has not been purchased, the screens for changing PB will not be available. To add the option, please consult Flowserve at LimitorqueService@flowserve.com or by calling 434-528-4400.

Figure 22 illustrates the setup sequence for the single channel MX/QX PB DP field unit. For proper operation, either Position Mode or Open/Close Mode must be selected.

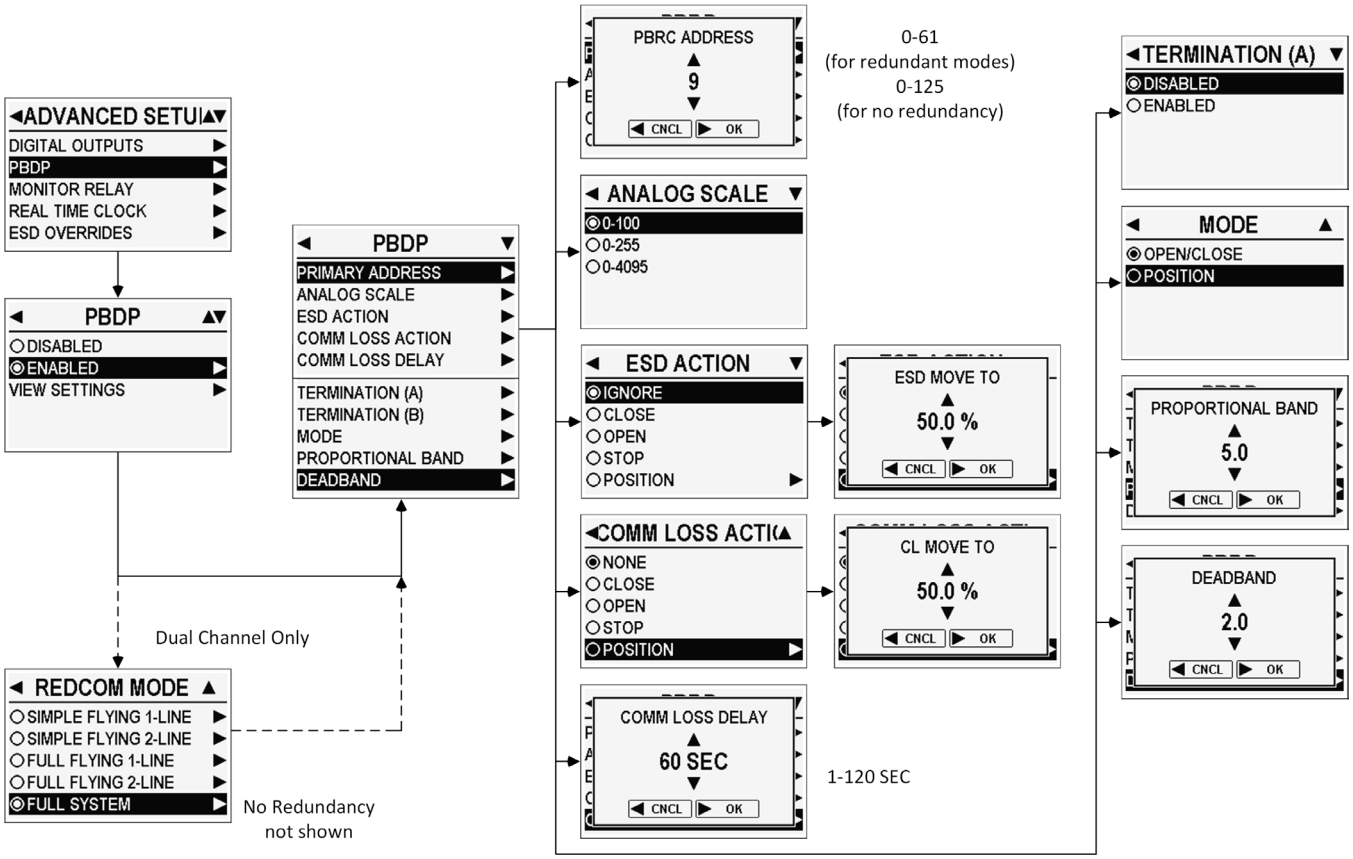


Figure 22 - MX/QX PB DP Setup Sequence for Single Channel (p/n 64-825-0223) Boards

Follow these steps to enter and configure the setup mode:

1. Proceed through the setup to “QUICK SETUP” menu, SELECT to move to password input, and then to the “PBDP” option.
2. SELECT “PBDP” menu to proceed to the ENABLE/ DISABLE menu option. SELECT ENABLED to progress through configuration options.
3. For Profibus DP Redcom boards (p/n 64-825-0212), the menu will then show the “REDCOM MODE” display. SELECT from the following redundancy modes: Non-redundant, Simple Flying Redundant with no line redundancy, Simple Flying Redundant with line redundancy, Full Flying Redundant with no line redundancy, Full Flying Redundant with line redundancy, and Full System Redundant. For single channel Profibus DP boards (64-825-0223), the mode will always be non-redundant, and this menu option is not shown.
4. The unit will display the remaining PBDP options: Primary Address, Analog Scale, ESD Action, Comm Loss Action, Comm Loss Delay, Termination (A), Termination (B for dual channel boards only), Mode, Proportional Band, and Deadband.
5. From the “PBRC ADDRESS” menu, using the rotary knob, find the correct address and use SELECT knob to return to “PBDP” menu.
6. From the “ANALOG SCALE” menu, SELECT the scale range.
7. From the “ESD ACTION” menu, SELECT the Emergency Shutdown action. If POSITION is chosen as the ESD action, the “ESD MOVE TO” menu is displayed next. Use the rotary knob to change the desired percentage open position and use SELECT knob to enter and return to “PBDP” menu.
8. From the “COMM LOSS ACTION” menu, SELECT the Communication Loss action. Options are: IGNORE, STOP, OPEN, CLOSE, and POSITION. If POSITION is chosen as the communication loss action, the “CL MOVE TO” is displayed next. Use the rotary knob to change the desired percentage open position and use SELECT knob to enter and return to “PBDP” menu.
9. From the “COMM LOSS DELAY” menu, SELECT the communication loss action time.
10. From the “TERMINATION (A)” menu, SELECT the enabling/disabling of the built-in termination capabilities for the channel A network. “TERMINATION (B)” will be an available menu if you have a dual channel board.
11. From the “MODE” menu, SELECT the actuator mode between OPEN/CLOSE and POSITION. In OPEN/CLOSE mode, the host can only fully open or fully close the valve.
12. From the “PROPORTIONAL BAND” menu, use the rotary knob to change the desired percentage for proportional band. Proportional band can only be as low as 0.5% plus the Deadband value. SELECT knob to enter and return to “PBDP” menu.
13. From the “DEADBAND” menu, use the rotary knob to change the desired percentage for deadband. Deadband can only be as low as 0.5% for MX 3 phase units, and 0.1 for QX, QXM, and MX 1 phase units. SELECT knob to enter and return to “PBDP” menu.

2.4.1 Proportional Band

Proportional band is the range of errors between the position and demand signal that will produce reduced speed (pulsing). The default value is 5%.

To change from the default value, select NO until the required value is displayed. The value is adjustable between 1% and 100%, in 0.1% increments.

2.4.2 Deadband

The default deadband value is 2%. For error signals less than this, no motion occurs.

The deadband should be wide enough to prevent “hunting” of the actuator, but as low as possible to give adequate response to changes in the error signal. To change from the default, select NO to adjust the value between 0.5% for MX 3PH, 0.1% for MX1PH and QX and 50%, in 0.1% increments to suit the application.

2.4.3 Valve Data

Valve data may be stored in the MX/QX PB parameter 35 in Table 13 for use by the host system.

2.5 MX/QX PB Device Description, Capabilities, and Device Type Manager File Installation

2.5.1 MX/QX PB Device Description

A Configuration File (a GSD or EDD file) describes the communication objects in a PROFIBUS device. In the host system, the configuration device can use Electronic Device Description (EDD) files or GSD file to configure a PROFIBUS system without having the device online. Some host systems need both EDD and GSD files. Refer to your host system and software documentation for the files that are needed. Please contact Flowserve Limitorque for EDD files.

The GSD (characteristics) files are downloaded from the PROFIBUS or Flowserve websites into the host system. These files are required by the host system for proper configuration and addressing. There are two different GSD files:

FLNR0F4C.GSD for Profibus DP boards (p/n 64-825-0223, single channel)

FLSV0F4C.GSD for Profibus DP Redcom boards (p/n 64-825-0212, dual channel)

The PROFIBUS website is www.profibus.com and the Flowserve website is www.flowserve.com.

Literature and GSD files can be found found on the Flowserve website or by searching Profibus DP Redcom at Flowserve.com.

2.5.2 MX/QX PB Device Type Manager

The Device Type Manager (DTM) provides an interface between its specific application software and a Network Host Station's Field Device Tool (FDT) frame. The DTM can be integrated into FDT frame applications to allow users to perform offline and online parameterization, configuration, and status and diagnostic retrieval. A separate GSD file download is unnecessary when using the DTM.

The DTM file can be downloaded from the Flowserve website or by searching for Limitorque ValveSight at Flowserve.com.

2.6 Installation Verification

2.6.1 Network Cabling Installation Verification

After installation is complete and prior to operation, inspect the network cable and its connection to each field device.

NOTE: Units should be disconnected from power. The network should be disconnected from the host device.

Check for the following:

1. There should not be:

- Nicks in the insulation – this can cause a short to the grounded shield.
- Cut strands in a stranded conductor – this can cause a poor connection and eventually an open circuit.
- Cable armor shorted to the cable shield/drain wire. This may not be at ground potential and could be subject to lightning surges.

2. Shield/drain wires grounded only at one point in the segment to avoid ground loop problems.
3. Ground/earth connections should be at true ground potential and effective at all times. See Section 2.3.1 for details.

2.6.2 MX/QX PB Device Installation Verification

Verify the field device is installed as follows:

1. Enter the "MAIN MENU" as detailed in the MX or QX Installation and Operation Manual, MX - VAIOM000071 or QX - AIIOM000517, respectively.
2. In the "MAIN MENU," use the rotary knob to SELECT "ADVANCED DIAGNOSTICS."
3. Next SELECT to enter "STATUS INFORMATION."
4. Using the rotary knob scroll down to SELECT "HARDWARE."
5. For a PBDP field unit, there should be a line reading PBDP - OK. If FAULT appears, there may be an issue with your board. Contact Flowserve at LimitorqueService@flowserve.com or by calling 434-528-4400.

2.6.3 MX/QX PB Device and MX/QX PB Redcom Device Differentiation

To verify which PBDP board (single channel p/n 64-825-0223 or dual channel p/n 64-825-0212), is installed, use the menu as follows:

6. In the "MAIN MENU," use the rotary knob to SELECT "ADVANCED DIAGNOSTICS."
7. Next SELECT to enter "STATUS INFORMATION."
8. Using the rotary knob scroll down to SELECT "IDENTIFICATION."
9. For a PBDP field unit, using the rotary knob scroll down and there should be a line reading PBDP Revision. If NOT AVAILABLE appears, there may be an issue with your board. Contact Flowserve at LimitorqueService@flowserve.com or by calling 434-528-4400.
   a. For the single channel Profbus DP board, p/n 64-825-0223, the second line will read "ID=6"
   b. For the dual channel Profbus DP board, p/n 64-825-0212, the second line will read "ID=5"
10. To return to the normal display, move the red knob to REMOTE.

2.7 Configuration Confirmation

Field device operation cannot be verified until the complete PROFIBUS system is operational. However, routine checks can be performed to verify many functions.

2.7.1 Checking Connections

Verify that all connections, including network data wires, shield ground, discrete inputs, discrete outputs, analog inputs and analog outputs are in accordance with MX/QX wiring diagrams and MX/QX PB device diagrams in Section 2.3.

2.7.2 View Settings

Refer to the MX or QX Installation and Operation Manual, VAIOM000071 or AIIOM000517, respectively, to access the "VIEW QUICK SETUP" menu. Verify the settings as follows:

1. From the "VIEW QUICK SETUP" display, use the rotary knob to select "PBDP."
2. From the "PBDP" menu, verify STATUS is ENABLED.
3. If the MX/QX contacts are to be controlled via the network to control external equipment, BACK out of "PBDP" menu.
4. Use the rotary knob to SELECT "DIGITAL OUTPUTS" menu.
5. Verify which contact you have the function set for NETWORK control.

2.7.3 Checking the Normal Display

Place the selector switch in LOCAL or REMOTE position. The valve position will be indicated at the top of the display. For a PB DP field unit, STATUS OK, PBDP COMM LOSS, CHAN-A PRIMARY, CHAN-B PRIMARY or PLC OFFLINE should be indicated at the bottom of the display.

2.7.3.1 STATUS OK

If STATUS OK is displayed, then the field device is sufficiently powered and communicating with the host system. This may cycle to CHAN-A PRIMARY, CHAN-B PRIMARY, or PLC OFFLINE.

2.7.3.2 CHAN-A PRIMARY

The text CHAN-A PRIMARY will alternate with STATUS OK when the host on the channel A network is actively controlling the actuator. This applies to both single channel (p/n 64-825-0223) dual channel (p/n 64-825-0212) boards.

2.7.3.3 CHAN-B PRIMARY

For Profibus DP Redcom boards (p/n 64-825-0212) with redundancy enabled, the text CHAN-B PRIMARY will alternate with STATUS OK when the host on the channel B network is actively controlling the actuator. This does not apply to single channel (p/n 64-825-0223) boards.

2.7.3.4 PLC OFFLINE

When the network cyclic traffic detected, the text PLC OFFLINE will alternate with STATUS OK to indicate when the host is offline (in STOP or configuration modes).

2.7.3.5 PROFIBUS COMM LOSS

This text is display when data exchange tokens from the host cannot be detected. This could be due to a number of factors, including problems with the host/master station and/or the network. Check all local connections and configurations. If these are correct and the PROFIBUS COMM LOSS is still displayed, then the solution to this problem must await full system commissioning.

2.7.3.6 PBRC BOARD / HARDWARE FAILURE

If PBRC BOARD and HARDWARE FAILURE status messages begin to display (the two messages will alternate about every second), the PROFIBUS network board is not responding or has failed. Check the "ADVANCED DIAGNOSTICS" in Section 2.6.2 as a starting point to diagnose the issue.

3 Software

3.1 Profibus Protocol

The fieldbus system uses the PROFIBUS fieldbus protocol to communicate over the PROFIBUS network with other PROFIBUS devices. The signals are encoded using the Non-Return to Zero (PROFIBUS DP) technique. The signals are called synchronous serial because the clock information is embedded in the serial stream. The protocol uses built-in error checking rules when processing data.

3.2 Cyclic Modules

The PROFIBUS DP network board supports cyclic (DPV0) and acyclic (DPV1) communications. The cyclic information is configurable by selecting a module with the desired information set as shown in Table 6. The cyclic module number is selected in the host system's network configuration manager that utilizes the GSD file. The default module is '1' and it provides all available information to the system. A different module may be used to selectively provide less information and the network configuration manager tool may display the GSD abbreviation when entering this information.

Table 6 - Cyclic Modules

Module		1	2	3	4	5	6	7	8	9	10	11	12	13
Parameters	Setpoint (Target, Move-to value)	√	√	√	√	√	√	√	√	√		√	√	√
	Actuator Command	√		√	√	√		√	√	√	√	√		√
	Relay Command	√						√		√		√		
	Actuator Position	√		√	√	√	√			√	√	√		√
	Actuator Torque	√		√	√	√	√			√	√	√		√
	Actuator Status (Table 7)	√	√	√	√	√	√	√	√	√	√	√	√	√
	Actuator Faults (Table 8)	√	√	√	√	√	√	√	√	√	√	√	√	√
	Actuator Indications (Table 9)	√				√	√	√	√	√	√	√		
	User IO (Table 10)	√			√			√	√		√	√		
	Network Status (Table 11)	√	√	√	√	√	√	√	√	√	√	√	√	√
	AD Indicators											√	√	√
GSD Abbreviation		ALL ALL	SP+AS+AF+NS	SP+AC –AI-UIO	SP+AC –AI	SP+AC –UIO	SP –UIO	ALL –AP-AT	SP+AC –AP-AT	ALL –UIO	AC ALL	ALL -AD_1+AD_2	SP AS+AF+NS+AD_1+AD_2	SP+AC -AI-UIO+AD_1+AD_2

Table 7 - Actuator Status

Bit	Description
0	Opened
1	Closed
2	Opening
3	Closing
4	Stopped In Mid Travel
5	Knob In Remote
6	Knob In Local
7	Knob In Stop
8	Local ESD Active
9	Network ESD Active
10	Open Inhibit Active
11	Close Inhibit Active
12	CSE In Local Stop
13	Open Contactor
14	Close Contactor
15	PST Active

Table 8 - Actuator Faults

Bit	Description
0	Monitor Relay Energized
1	Valve Jam
2	Manual Move
3	Over Torque
4	Motor Over Temperature
5	Phase Lost
6	Encoder Fault
7	Contactor Fault
8	Motor Controller Fault
9	Mainboard Memory Fault
10	Knob Fault
11	Reserved
12	Reserved
13	Reserved
14	Reserved
15	HC/UI Comm Loss

Table 9 - Actuator Indications

Bit	Description
0	Encoder Warning
1	Motor Temperature Warning
2	Phase Reverse
3	Line Frequency Too Low
4	Line Voltage Too Low
5	Open Torque Timer Expired
6	Close Torque Timer Expired
7	Mainboard Analog Input Lost
8	Analog Board-1 Analog Input Lost
9	Menu Knob Fault
10	Analog Board-1 Fail
11	Analog Board-2 Fail
12	Digital Output Board-1 Fail
13	Digital Output Board-2 Fail
14	AD Indicator Active

Table 10 - User I/O

Bit	Description
0	S1
1	S2
2	S3
3	S4
4	R5
5	R6
6	R7
7	R8
8	User 0 - Default ESD
9	User 1 - Default Open Inhibit
10	User 2 - Default Close Inhibit
11	User 3 - Stop
12	User 4 - Open
13	User 5 - Close
14	Reserved
15	CSE At User 2

Table 11 - Network Status

Bit	Description
0	Opened
1	Closed
2	Opening
3	Closing
4	Stopped In Mid Travel
5	Knob In Remote
6	Knob In Local

3.3 DPV0 Parameters

The PROFIBUS DP network board can also be configured via DPV1 and has the following available parameters as shown in Table 12.

Parameters 1 to 11 will be in the Ext_User_Prm_Data within the GSD so they can be configured by DPV0 users. This allows basic configuration at startup by GSD initialization only if 'Permit GSD Configuration' is changed to 0 (permit). Otherwise, the configuration of these parameters will be via PDM/EDDL or DTM or the Main board SETUP menu with 'Permit GSD Configuration' left as 1 (don't allow GSD write).

Table 12 – DPV0 Parameters

Bit	Type	Access	Parameter Name	Description
1	U8	R/W	GSD_CONFIG	**Permit GSD Configuration** 0 = Param # 2 to 11 write using GSD USER_PARAM only. 1 = Param # 2 to 11 don't allow GSD write, use EDDL, SETUP Menus or DTM to configure.
2	U8	R/W	REDUNDANCY_MODE	**Redundancy Mode** 0 = Non redundant mode. 1 = Simple flying without line redundancy. 2 = Simple flying with line redundancy. 3 = N/A 4 = Full flying without line redundancy. 5 = Full flying with line redundancy. 6 = Full system redundancy.
3	U8	R/W	NW_ANALOG_SCALE	**Network Analog Scaling** 0 = Analog Scale: 0 to 100. 1 = Analog Scale: 0 to 255. 2 = Analog Scale: 0 to 4095. 3 = N/A 4 = Future (Analog Scale: 0 to 65535).

Bit	Type	Access	Parameter Name	Description
4	U8	R/W	NW_ESD_ACTION	**Network Emergency Shutdown Action** 0 = ESD Action: Ignore. 1 = ESD Action: Stop. 2 = ESD Action: Close. 3 = ESD Action: Open. 4 = ESD Action: Position.
5	Float	R/W	NW_ESD_POSITION	**Network Emergency Shutdown Position** Minimum value: 0.0 Maximum value: 100.0 (multiply by ten when pass to main)
6	U8	R/W	NW_COMM_LOSS_ ACTION	**Communication Loss Action** 0 = Comm Loss Action: None. 1 = Comm Loss Action: Stop. 2 = Comm Loss Action: Close. 3 = Comm Loss Action: Open. 4 = Comm Loss Action: Position.
7	Float	R/W	NW_COMM_LOSS_ POSITION	**Communication Loss Position** Minimum value: 0.0 Maximum value: 100.0 (multiply by ten when pass to main)
8	U8	R/W	NW_COMM_LOSS_ DELAY	**Communication Loss Delay** 1 to 120 (seconds)
9	U16	R/W	PROFIBUS_ CONTROL	**Termination, Actuation mode, Precision and Force command** Bit 0: Clear = Profibus DP channel-A termination set to Disabled. Set = Profibus DP channel-A termination set to Enabled. Bit 1: Clear = Profibus DP channel-B termination set to Disabled. Set = Profibus DP channel-B termination set to Enabled. Bit 2: Clear = Actuation mode set to Open/Close. Set = Actuation mode set to Position. Bit 3: Clear = Precision xxx%. Set = Precision xxx.x%. Bit4: Set = Force Switchover (edge triggered from 0 to 1).
10	Float	R/W	DEADBAND	**Deadband** Minimum value: 0.1 for QX and 0.5 MX3PH and 0.1 MX1PH QX units. Maximum value: 50.0 or Proportional band value minus 0.5 whichever is less. Deadband must always be less than Proportional Band.
11	Float	R/W	PROPORTIONAL_ BAND	**Proportional Band** Minimum value: Deadband value plus 0.5 (must always be > deadband). Maximum value: 100.0

3.4 DPV1 Parameters

All of the following parameters are accessible via acyclic communication. Additionally parameters from 21 to 30 are also accessible via cyclic communication.

Table 13 – DPV1 Parameters

Bit	Type	Access	Parameter Name	Member	Description
12	U32	R/W	NE107_FAILURE_ MASK		**NE107 Failure Mask** This sets the bit patterns that will trigger the associated indication. See Table 16 for bit definitions.
13	U32	R/W	NE107_FUNCTION_ CHECK_ MASK		**NE107 Function Check Mask** This sets the bit patterns that will trigger the associated indication. See Table 17 for bit definitions.
14	U32	R/W	NE107_OUT_OF_ SPEC_MASK		**NE107 Out of Specification Mask** This sets the bit patterns that will trigger the associated indication. See Table 18 for bit definitions.
15	U32	R/W	NE107_MAINT_ REQUEST_ MASK		**NE107 Maintenance Request Mask** This sets the bit patterns that will trigger the associated indication. See Table 19 for bit definitions.
16	U8	R	NE107_ INDICATIONS		**NE107 Indications** This is a bit mask to indicate the presence of NE107 information: Bit 0 set = Device OK Bit 1 set = Failure Information present Bit 2 set = Function Check Information present Bit 3 set = Out of Spec Information present Bit 5 set = Maintenance Information present
17	U32	R	NE107_FAILURE_ INFO		**NE107 Failure Information** See Table 16 for bit definitions.
18	U32	R	NE107_ FUNCTION_ CHECK_ INFO		**NE107 Function Check Info** See Table 17 for bit definitions.
19	U32	R	NE107_OUT_OF_ SPEC_INFO		**NE107 Out of Spec Information** See Table 18 for bit definitions.
20	U32	R	NE107_MAINT_ REQUEST_ INFO		**NE107 Maintenance Request Info** See Table 19 for bit definitions.
21	U16	R/W	ACT_SETPOINT		**Setpoint (Target, Move-to value)** Minimum value: 0. Maximum value: Analog scale maximum value.
22	U16	R/W	ACT_COMMAND		**Actuator Command** 0 = No command. 1 = Stop command. 2 = Close command. 3 = Open command. 4 = Stop network ESD. 5 = Start network ESD

#	Type	Access	Parameter Name	Member	Description
23	U16	R/W	NW_CTRL_RLY_COMMAND		**Network controlled relay commands** Bit 0 clear: De-energize S1 or R1 relay. Bit 0 set: Energize S1 or R1 relay. Bit 1 clear: De-energize S2 or R2 relay. Bit 1 set: Energize S2 or R2 relay. Bit 2 clear: De-energize R3 relay. Bit 2 set: Energize R3 relay. Bit 3 clear: De-energize R4 relay. Bit 3 set: Energize R4 relay. Bit 4 clear: De-energize R5 relay. Bit 4 set: Energize R5 relay. Bit 5 clear: De-energize R6 relay. Bit 5 set: Energize R6 relay. Bit 6 clear: De-energize R7 relay. Bit 6 set: Energize R7 relay. Bit 7 clear: De-energize R8 relay. Bit 7 set: Energize R8 relay. Bit 15 clear: Indicates bits 0-7 are unknown. Clear this bit when not changing any bits 0 through 7. Bit 15 set: Indicates bits 0-7 are valid. Set this bit whenever changing any bits 0 through 7.
24	U16	R	ACT_POSITION		**Current Position**
25	U16	R	ACT_TORQUE		**Current Torque**
26	U16	R	ACT_STATUS		**Actuator Status** See Table 7
27	U16	R	ACT_FAULTS		**Actuator Faults** See Table 8
28	U16	R	ACT_INDICATIONS		**Actuator Indications** See Table 9
29	U16	R	USER_IO		**User I/O** See Table 10
30	U16	R	NW_STATUS		**NW Status** See Table 11
31	U16	R	CYCLIC_DATA_CFG		**Cyclic Exchange Configuration** Minimum value: 0. Maximum value: 10.
32	U8[4]	R	INTERFACE_VERSIONS	SOFTWARE_REVISION	**Profibus DP board software revision number**
	U16	R		HARDWARE_REVISION	**Profibus DP board hardware revision number**
	U8[4]	R		DP_STACK_REVISION	**Profibus DP board communication stack revision number**
	U16	R		SOFTWARE_RELEASE_NUMBER	**Profibus DP board software release number**
	U8[4]	R		BOOTLOADER_REVISION	**Profibus DP board bootloader revision number.**
33	char[16]	R	ACT_INFO	ACT_MANUFACTURER	**Actuator Manufacturer**
	U8	R		ACT_TYPE	**Actuator Type**
	U8	R		ACT_ID	**Actuator Identifier**
	char[32]	R		ACT_MODEL_NUMBER	**Actuator Model Number**
	char[8]	R		ACT_SERIAL_NUMBER	**Actuator Serial Number**
	char[22]	R		ACT_QA_DATA	**Actuator QA Data**
34	U32	R	ACT_SERVICE_TIME		**Actuator Service Time**

#	Type	Access	Parameter Name	Member	Description
35	char[16]	R/W	VALVE_INFO	VALVE_ MANUFACTURER	**Valve Manufacturer**
	U8	R/W		VALVE_TYPE	**Valve Type** 0 = Undefined 1 = Linear 2 = Rotary 255 = Other
	char[16]	R/W		VALVE_MODEL_ NUMBER	**Valve Model Number**
	char[16]	R/W		VALVE_SERIAL_ NUMBER	**Valve Serial Number**
	char[16]	R/W		VALVE_MAINTENANCE_DATE	**Valve Maintenance Date** Format: DD-MMM-YYYY
36	U8	R	REMOTE_INPUT_MODE		**Remote Input Mode** 0x01 = Multi-control 0x02 = Digital control only 0x04 = Network control only 0x08 = Analog control only
37	U16	R	ACT_SOFTWARE_OPTIONS		**Actuator optional software features** 0x0001 = Two speed timer 0x0002 = Modutronic 0x0004 = Custom Input Mode 0x0008 = Custom Local 0x0010 = Extended Mod Range 0x0020 = Over Torque Slip 0x0040 = SIL Standard 0x0080 = SIL Enhanced
38	U16	R	ACT_HARDWARE_OPTIONS		**Actuator optional hardware features** 0x0001 = AO Board 1 0x0002 = AO Board 2 0x0004 = N/A 0x0008 = DO Board 2 0x0010 = AI Board 1 0x0020 = AI Board 2 0x0040 = PROFIBUS DP Slave Redundancy 0x8000 = Artic Unit
39	U16	R	MB_ANALOG_IN_0		**Main Board Analog In Value**
40	U16	R	OB_ANALOG_IN_1		**Analog Option Board 1 Analog In Value**
41	U16	R	OB_ANALOG_IN_2		**Analog Option Board 2 Analog In Value**
42	U16	R	OB_ANALOG_OUT_1		**Analog Option Board 1 Analog Out Value**
43	U16	R	OB_ANALOG_OUT_2		**Analog Option Board 2 Analog Out Value**
44	U16	R	POWER_SUPPLY_INFO	SUPPLY_VOLTAGE	**Supply Input Voltage in Volts**
	U32	R		SUPPLY_FREQUENCY	**Supply Input Frequency in Hertz** This is only valid on MX actuators and not QX.
45	Float	R	COMPARTMENT_ TEMPERATURE		**Compartment Temperature** -55 °C to +130 °C max range of sensor
46	U8	R/W	COMPARTMENT_ TEMPERATURE_UNIT		**Supported units C, F and K.** 0 = Degree Centigrade. 1 = Degree Fahrenheit. 2 = Kelvin.
47	Float	R	MOTOR_TEMPERATURE		**Motor Temperature** -60 °C to +200 °C max range of sensor
48	U8	R/W	MOTOR_TEMPERATURE_ UNIT		**Supported units C, F and K.** 0 = Degree Centigrade. 1 = Degree Fahrenheit. 2 = Kelvin.

#	Type	Access	Parameter Name	Member	Description
49	U8	R/W	SEATING_MODE		**Torque or Position seating** Bit 0 for CLOSE seating: Clear: Position seating. Set: Torque seating. Bit1 for OPEN seating: Clear: Position seating. Set: Torque seating.
50	U8	R/W	TORQUE_SW_TIMER_CFG	TIMER_ENABLED	**Timer enables** Bit 0 for CLOSE timer: Clear: Disabled Set: Close Timer Enabled Bit 1 for OPEN timer: Clear: Disabled Set: Open Timer Enabled
	U8	R/W		CLOSE_TIMER_VALUE	**Close Timer Value** Range: 1 to 15 seconds
	U8	R/W		OPEN_TIMER_VALUE	**Open Timer Value** Range: 1 to 15 seconds
51	U8	R/W	QX_OPERATING_TIME_CFG	CLOSE_STROKE_TIME	**Stroke time in close direction**
	U8	R/W		OPEN_STROKE_TIME	**Stroke time in open direction**
52	U8	R/W	TORQUE_CFG	CLOSE_TRQ_SETTING	**Close Torque Setting**
	U8	R/W		OPEN_TRQ_SETTING	**Open Torque Setting**
	U8	R/W		TRQ_BOOST_SETTING	**Torque Boost Setting**
53	U32	R/W	ESD_OVERRIDE_CFG		**ESD Override Configurations** Byte 0: Bit 0: Clear: Inhibit overrides ESD. Set: ESD overrides inhibit. Bit 1: Clear: Motor over temperature overrides ESD. Set: ESD overrides motor over temperature. Bit 2: Clear: Knob in stop overrides ESD. Set: ESD overrides knob in stop. Bit 3: Clear: Local control overrides ESD. Set: ESD overrides local control. Bit 4: Clear: Over torque overrides ESD. Set: ESD overrides over torque. Bit 5: Clear: Lost phase overrides ESD. Set: ESD overrides lost phase. Bit 6: Clear: Valve jam overrides ESD. Set: ESD overrides valve jam.

#	Type	Access	Parameter Name	Member	Description
53	U32	R/W	ESD_OVERRIDE_CFG		Bit 7: Clear: Oil over temperature overrides ESD. Set: ESD overrides oil over temperature. Byte 1: Bit 0: Clear: Torque switch timer overrides ESD Set: ESD overrides torque switch timer Bits 2-5: Available for future use Bit 6: Clear: ESD uses 2-speed timer settings. Set: ESD ignores 2-speed timer settings. Bit 7: Clear: Network ESD overrides ESD Set: ESD overrides network ESD Byte 2: Bit 0: Clear: Motor fault overrides ESD Set: ESD overrides motor fault Bit 1: Clear: Motor controller fault overrides ESD Set: ESD overrides motor controller fault. Bit 2: Clear: Line voltage too low/high overrides ESD Set: ESD overrides line voltage too low/high. Bits 3-7: Available for future use Byte 3: Bits 0-7: Available for future use
54	U8	R/W	PARTIAL_STROKE_ TEST_ REQUEST	PST_COMMAND	**PST Command** 0 = None. 1 = PST start command. 2 = PST stop command. 3 = Request last PST results. See the FAQ section on how to run a PST test.
	Float	R/W		PST_TARGET_POSITION	**PST Target Positon in % Open** Range: 0.0 to 100.0
55	U8	R	PARTIAL_STROKE_ TEST_ RESPONSE	PST_STATUS	**PST Status** 0 = Not started. 1 = In progress. 2 = Completed. 3 = Stop command sent by user.
	U8	R		PST_RESULT	**PST Result** 0 = Not started. 1 = Waiting. 2 = Passed. 3 = Failed.
	U8	R		PST_MAX_TORQUE	**Highest Measured Torque during PST**

#	Type	Access	Parameter Name	Member	Description
56	U32	R	FAULT_HISTORY	FAULT_1_TIME_STAMP	**Actuator Fault History**
	U16	R		**FAULT_1**	FAULT_#_TIME_STAMP: Seconds since 1/1/1970
	U32	R		FAULT_2_TIME_STAMP	FAULT_#: Actuator Fault Bits
	U16	R		**FAULT_2**	
	U32	R		FAULT_3_TIME_STAMP	
	U16	R		**FAULT_3**	
	U32	R		FAULT_4_TIME_STAMP	
	U16	R		**FAULT_4**	
	U32	R		FAULT_5_TIME_STAMP	
	U16	R		**FAULT_5**	
	U32	R		FAULT_6_TIME_STAMP	
	U16	R		**FAULT_6**	
	U32	R		FAULT_7_TIME_STAMP	
	U16	R		**FAULT_7**	
	U32	R		FAULT_8_TIME_STAMP	
	U16	R		**FAULT_8**	
	U32	R		FAULT_9_TIME_STAMP	
	U16	R		**FAULT_9**	
	U32	R		FAULT_10_TIME_ STAMP	
	U16	R		**FAULT_10**	
57	U16	R	CLOSE_TORQUE_VALUES	CLS_TRQ_VALUE_1	**Torque Value 1 at 0%** (Torque values are valid at the end of the close stroke)
	U16	R		CLS_TRQ_VALUE_2	**Torque Value 2 at 10%**
	U16	R		CLS_TRQ_VALUE_3	**Torque Value 3 at 20%**
	U16	R		CLS_TRQ_VALUE_4	**Torque Value 4 at 30%**
	U16	R		CLS_TRQ_VALUE_5	**Torque Value 5 at 40%**
	U16	R		CLS_TRQ_VALUE_6	**Torque Value 6 at 50%**
	U16	R		CLS_TRQ_VALUE_7	**Torque Value 7 at 60%**
	U16	R		CLS_TRQ_VALUE_8	**Torque Value 8 at 70%**
	U16	R		CLS_TRQ_VALUE_9	**Torque Value 9 at 80%**
	U16	R		CLS_TRQ_VALUE_10	**Torque Value 10 at 90%**
	U16	R		CLS_TRQ_VALUE_11	**Torque Value 11 at 100%**
58	U16	R	OPEN_TORQUE_ VALUES	OPN_TRQ_VALUE_1	**Torque Value 1 at 0%** (Torque values are valid at the end of the open stroke)
	U16	R		OPN_TRQ_VALUE_2	**Torque Value 2 at 10%**
	U16	R		OPN_TRQ_VALUE_3	**Torque Value 3 at 20%**
	U16	R		OPN_TRQ_VALUE_4	**Torque Value 4 at 30%**
	U16	R		OPN_TRQ_VALUE_5	**Torque Value 5 at 40%**
	U16	R		OPN_TRQ_VALUE_6	**Torque Value 6 at 50%**
	U16	R		OPN_TRQ_VALUE_7	**Torque Value 7 at 60%**
	U16	R		OPN_TRQ_VALUE_8	**Torque Value 8 at 70%**
	U16	R		OPN_TRQ_VALUE_9	**Torque Value 9 at 80%**
	U16	R		OPN_TRQ_VALUE_10	**Torque Value 10 at 90%**
	U16	R		OPN_TRQ_VALUE_11	**Torque Value 11 at 100%**

#	Type	Access	Parameter Name	Member	Description
59	U16	R	TQ_STATUS	MB_TQ_C_AVG_LAST	**Last average close torque**
	U16	R		MB_TQ_O_AVG_LAST	**Last average open torque**
	U16	R		MB_TQ_O_PEAK_LAST	**Last peak open torque**
	U16	R		MB_TQ_O_BREAKOUT_ LAST	**Last breakout open torque**
	U16	R		MB_TQ_C_BREAKOUT_ LAST	**Last breakout close torque**
	U16	R		MB_TQ_O_ENDING_ LAST	**Last ending open torque**
	U16	R		MB_TQ_C_ENDING_ LAST	**Last ending close torque**
	U16	R		MB_TQ_C_PEAK_LAST	**Last peak close torque**
	U16	R		MB_TQ_O_PEAK_REF	**Reference peak open torque**
	U16	R		MB_TQ_O_BREAKOUT_REF	**Reference breakout open torque**
	U16	R		MB_TQ_C_BREAKOUT_REF	**Reference breakout close torque**
	U16	R		MB_TQ_O_ENDING_REF	**Reference ending open torque**
	U16	R		MB_TQ_C_ENDING_REF	**Reference ending close torque**
	U16	R		MB_TQ_C_PEAK_REF	**Reference peak close torque**
60	U16	R	TP_STATUS	START_POSITION	**Start position**
	U16	R		STOP_POSITION	**Stop position**
	U16	R		NUMBER_OF_SAMPLES	**Number of samples**
	U16	R		MAX_TORQUE_MID_ RANGE	**Maximum Torque**
	U16	R		MAX_TORQUE_ POSITION	**% Open where max torque occurred**
	U16	R		AVG_TORQUE	**Average Torque**
	U16	R		STOP_TORQUE	**Torque at stopped**
	U16	R		MAX_TORQUE_BOT	**Maximum torque at beginning of travel**
	U16	R		MAX_TORQUE_EOT	**Maximum torque at end of travel**
61	Float	R/W	SETPOINT_CUTOFF_ DEC		**Setpoint Cutoff Decrement in % Open** Range: 0 to 100%
62	Float	R/W	SETPOINT_CUTOFF_ INC		**Setpoint Cutoff Increment in % Open** Range: 0 to 100%
63	Float	R/W	TRAVEL_LIMIT_LOWER		**Travel Limit Lower in % Open**
					Range: 0 to 100%
64	Float	R/W	TRAVEL_LIMIT_UPPER		**Travel Limit Upper in % Open**
					Range: 0 to 100%
65	U32	R	OPERATIONAL_DATA	MOTOR_RUN_TIME	**Motor Run Time**
	U32	R		MANUAL_OPERATIONS	**Manual Operations**
	U32	R		CLOSE_CYCLES	**Close Cycles**
	U32	R		OPEN_CYCLES	**Open Cycles**
	U32	R		DRIVE_SLEEVE_TURNS	**Drive Sleeve Turns**
	U32	R		STROKE_TIME	**Stroke Time**
66	U32	R	CLOSE_CONTACTOR_ OPERATIONS		**Close Contactor Operation Count**
67	U32	R	OPEN_CONTACTOR_ OPERATIONS		**Open Contactor Operation Count**
68	U16	R	LIMIGARD_HEALTH		**LimiGard Health Bits (MX only)** 0x0001 = Stuck relay contacts 0x0002 = CW asserted but relay drive transistor failed 0x0004 = CW asserted but relay contact not closed 0x0008 = CW not asserted but relay drive transistor asserted in error 0x0010 = CW not asserted but relay contact closed in error 0x0020 = CCW asserted but relay drive transistor failed 0x0040 = CCW asserted but relay contact not closed 0x0080 = CCW not asserted but relay drive transistor asserted in error 0x0100 = CCW not asserted but relay contact closed in error 0x0200 = ENABLE asserted but relay drive transistor failed 0x0400 = ENABLE asserted but relay contact not closed 0x0800 = ENABLE not asserted but relay drive transistor asserted in error 0x1000 = ENABLE not asserted but relay contact closed in error 0x2000 = CW & ENABLE asserted but CW contactor not present 0x4000 = CCW & ENABLE asserted but CCW contactor not present 0x8000 = Monitor relay tripped

#	Type	Access	Parameter Name	Member	Description
69	U32	R	MX_ENCODER_HEALTH	MX_PRIMARY_ ENCODER	**MX Encoder Health Bits** See Table 20
	U32	R		MX_SECONDARY_ ENCODER	**MX Encoder Health Bits** See Table 21
70	U8	R	QX_ENCODER_HEALTH	QX_PRIMARY_ ENCODER	**QX Primary Encoder Health Bits** 0x01 = Controller Error 0x02 = Parity Error 0x04 = Linearity Fault 0x08 = Overflow Fault 0x10 = Compensation Incomplete 0x20 = Communication Fault 0x40 = Jump Fault 0x80 = Offset Fault
	U8	R		QX_SECONDARY_ ENCODER	**QX Secondary Encoder Health Bits** 0x01 = Controller Error 0x02 = Parity Error 0x04 = Linearity Fault 0x08 = Overflow Fault 0x10 = Compensation Incomplete 0x20 = Communication Fault 0x40 = Jump Fault 0x80 = Offset Fault
71	U16	R	MOTOR_CONTROLLER_ HEALTH		**Motor Controller Health Bits (QX and MX single phase)** 0x0001 = Motor Voltage Low 0x0002 = IRAM Over Temperature 0x0008 = Hall Critical 0x0010 = Hall Limping 0x0020 = IRAM Fault 0x0040 = Hardware Torque Over Limit 0x0080 = COP Fault 0x0200 = Communication Fault 0x0400 = Voltage Too High
72	U8	R/W	STD_RELAYS_CFG	S1_FUNCTION	**S1 Function** See Table 22
	U8	R/W		S1_CONTACT_TYPE	**S1 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		S1_POSITION	**S1 Position** 0.0 to 100.0
	Float	R/W		S1_POSITION_START	**S1 Position Start** 0.0 to 100.0
	Float	R/W		S1_POSITION_STOP	**S1 Position Stop** 0.0 to 100.0
	U8	R/W		S2_FUNCTION	**S2 Function** See Table 22
	U8	R/W		S2_CONTACT_TYPE	**S2 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		S2_POSITION	**S3 Position** 0.0 to 100.0
	Float	R/W		S2_POSITION_START	**S2 Position Start** 0.0 to 100.0
	Float	R/W		S2_POSITION_STOP	**S2 Position Stop** 0.0 to 100.0
	U8	R/W		S3_FUNCTION	**S3 Function** See Table 22
	U8	R/W		S3_CONTACT_TYPE	**S3 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		S3_POSITION	**S3 Position** 0.0 to 100.0
	Float	R/W		S3_POSITION_START	**S3 Position Start** 0.0 to 100.0
	Float	R/W		S3_POSITION_STOP	**S3 Position Stop** 0.0 to 100.0
	U8	R/W		S4_FUNCTION	**S4 Function** See Table 22
	U8	R/W		S4_CONTACT_TYPE	**S4 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		S4_POSITION	**S4 Position** 0.0 to 100.0
	Float	R/W		S4_POSITION_START	**S4 Position Start** 0.0 to 100.0
	Float	R/W		S4_POSITION_STOP	**S4 Position Stop** 0.0 to 100.0
	U32	R/W		SM_SETTINGS	**RM Settings** Bit 0 = Knob in Local Bit 1 = Knob in Stop Bit 2 = Over Torque Bit 3 = Inhibit Signal Bit 4 = ESD Signal

#	Type	Access	Parameter Name	Member	Description
73	N/A	N/A	Reserved	N/A	N/A
	U8	R/W		DO_BRD_2_ENABLED	0 = Disabled 1 = Enabled
	U8	R/W		R5_FUNCTION	**R5 Function** See Table 22
	U8	R/W		R5_CONTACT_TYPE	**R5 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		R5_POSITION	**R5 Position** 0.0 to 100.0
	Float	R/W		R5_POSITION_START	**R5 Position Start** 0.0 to 100.0
	Float	R/W		R5_POSITION_STOP	**R5 Position Stop** 0.0 to 100.0
	U8	R/W		R6_FUNCTION	**R6 Function** See Table 22
	U8	R/W		R6_CONTACT_TYPE	**R6 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		R6_POSITION	**R6 Position** 0.0 to 100.0
	Float	R/W		R6_POSITION_START	**R6 Position Start** 0.0 to 100.0
	Float	R/W		R6_POSITION_STOP	**R6 Position Stop** 0.0 to 100.0
	U8	R/W		R7_FUNCTION	**R7 Function** See Table 22
	U8	R/W		R7_CONTACT_TYPE	**R7 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		R7_POSITION	**R7 Position** 0.0 to 100.0
	Float	R/W		R7_POSITION_START	**R7 Position Start** 0.0 to 100.0
	Float	R/W		R7_POSITION_STOP	**R7 Position Stop** 0.0 to 100.0
	U8	R/W		R8_FUNCTION	**R8 Function** See Table 22
	U8	R/W		R8_CONTACT_TYPE	**R8 Contact Type** 1 = Close (NC) 2 = Open (NO) 3 = Blinker NO 4 = Blinker NC
	Float	R/W		R8_POSITION	**R8 Position** 0.0 to 100.0
	Float	R/W		R8_POSITION_START	**R8 Position Start** 0.0 to 100.0
	Float	R/W		R8_POSITION_STOP	**R8 Position Stop** 0.0 to 100.0

#	Type	Access	Parameter Name	Member	Description
				STATUS	**Board Status** 0 = Disabled 1 = Enabled
				FUNCTION	**Function** 1 = APT 2 = ATT
	U8	R/W		OFFSET	**Offset** 1 = 4 to 20mA DC 2 = 0 to 20mA DC 3 = 1 to 5V DC 4 = 0 to 5V DC 5 = 2 to 10V DC 6 = 0 to 10V DC
	U8	R/W		POLARITY	**Polarity** 1 = High value at open/max 2 = High value at close/min
	U8	R/W		ATT_SCALE	**ATT Scaling** 1 = Unit torque 2 = User setting
76	U8	R/W	AO_BOARD_2_CFG	STATUS	**Board Status** 0 = Disabled 1 = Enabled
	U8	R/W		FUNCTION	**Function** 1 = APT 2 = ATT
	U8	R/W		OFFSET	**Offset** 1 = 4 to 20mA DC 2 = 0 to 20mA DC 3 = 1 to 5V DC 4 = 0 to 5V DC 5 = 2 to 10V DC 6 = 0 to 10V DC
	U8	R/W		POLARITY	**Polarity** 1 = High value at open/max 2 = High value at close/min
	U8	R/W		ATT_SCALE	**ATT Scaling** 1 = Unit torque 2 = User setting
77	U8	R/W	TWO_SPEED_TIMER_CLOSE_CFG	STATUS	**Timer Status** 0 = Disabled 1 = Enabled
	Float	R/W		START_POSITION	**Start Position** 0.0 to 100.0
	Float	R/W		STOP_POSITION	**Stop Position** 0.0 to 100.0
	Float	R/W		ON_TIME	**On Time** 1.0 to 20.0. Increments by 0.5
	U8	R/W		OFF_TIME	**Off Time** 1 to 200. Increments by 1

#	Type	Access	Parameter Name	Member	Description
78	U8	R/W	TWO_SPEED_TIMER_OPEN_ CFG	STATUS	**Timer Status** 0 = Disabled 1 = Enabled
	Float	R/W		START_POSITION	**Start Position** 0.0 to 100.0
	Float	R/W		STOP_POSITION	**Stop Position** 0.0 to 100.0
	Float	R/W		ON_TIME	**On Time** 1.0 to 20.0. Increments by 0.5
	U8	R/W		OFF_TIME	**Off Time** 1 to 200. Increments by 1
79	U8	R/W	DATE_AND_TIME	DAY	**Day** Range: 1 to 31
	U8	R/W		MONTH	**Month** Range: 1 to 12
	U16	R/W		YEAR	**Year** Range: 0 to 65535
	U8	R/W		HOUR	**Hour** Range: 0 to 23
	U8	R/W		MINUTES	**Minutes** Range: 0 to 59
	U8	R/W		SECONDS	**Seconds** Range: 0 to 59
80	Float	R	SETPOINT_DEVIATION		**Deviation** **-100 to 100**
81	U8	R	NUMBER_OF_ACTIVE_ ACT_ FAULTS		**Total number of bits set in parameter ACT_FAULTS** Range: 0 to 16
82	U16	R	LATEST_ACT_FAULT		**Most Recent Actuator Fault Bit** See Table 8 for bit definitions
83	U8	R/W	SERVICE_REQUEST	COMMAND	**Service Command** 0 = None 1 = Request Travel Histogram
	U16	R/W		ARGUMENT	**Command Argument**
84	U8[32]	R	BULK_DATA		**Bulk Data(Travel Histogram Response)**
85	U8	R/W			**Reserved for future use**
86	U8	R/W			**Reserved for future use**
87	U8[32]	R			**Reserved for future use**

3.5 Advanced Diagnostic Parameters

The MX/QX Series B actuators come equipped with a lot more diagnostic capabilities compared to the Series A products. The diagnostics come in the form of actuator status, graphs, logs, and deviation warnings. To see the full capabilities of the actuators advanced diagnostics, refer to the MX or QX Installation and Operation Manual, VAIOM000071or AIIOM000517, respectively.

Registers or Parameters to access the advanced diagnostic data may differ from network to network. For Profibus, how to use the parameters to access the objects needed will be addressed in this section. However, the objects themselves are identical for each network and are outlined in our "Network Advanced Diagnostic Objects" AIIOM000698. It is recommended to read the IOM to understand how to access the objects and what data is available with each one.

3.5.1 Parameters

All of the following parameters are accessible via acyclic communication.

3.5.2 Read Object

When it is determined which object from the "Network Advanced Diagnostic Objects" AIIOM000698 you would like to read, perform the following steps using the parameters from Section 3.6.1. Additional information on accessing the objects can be found in the "Network Advanced Diagnostic Objects" IOM.

1. Write cmd_req parameter with appropriate object ID and command options.
2. Poll the rsp_status parameter for request completion.
3. Read the rsp_dcnt parameter to obtain the number of response registers.
4. Read the rsp_data parameters as required to obtain the response data.

Table 14 - Advanced Diagnostic Parameters

Index	Param	Data Type	Octets	Definition	Notes
88	cmd_req	U16	2	Command Request Register	11-bit object ID allows 2048 object ID's
89	cmd_dcnt	U16	2	Command Data Count	Used when writing config objects
90	cmd_ data_a[120]	U16	240	Command Data Registers	Data varies per object ID, max of 125 regs
91	cmd_data_b[5]	U16	10	Command Data Registers	Data varies per object ID, max of 125 regs
92	future	U16	100	Future Index Space	Presently unused and reserved for future
93	diag ind status	U16	8	Diag Indicator Bits	AD indicator parameter
94	rsp_status	U16	1	Response Status Register	11-bit ID matching request, 3-bit status
95	rsp_dcnt	U16	1	Response Data Count	Non-zero value indicates the number of response data bytes available for read in response data registers.
96	rsp_ data_a[120]	U16	240	Response Data Registers	Data varies per object ID, max 512 regs.
97	rsp_ data_b[120]	U16	240		
98	rsp_ data_c[120]	U16	240		
99	rsp_ data_d[120]	U16	240		
100	rsp_data_e[32]	U16	64		

3.6 I&M Parameters

The field unit supports the following identification and maintenance (I&M) as per the PROFIBUS specification.

Table 15 - I&M0 Parameters

#	Type	Access	Parameter Name	Description
255	U8[10]	R	HEADER	
	U16	R	MANUFACTURER_ID	This is the assigned ID as assigned by the PROFIBUS business office.
	S8[20]	R	ORDER_ID	Contains the complete order number or at least a relevant part that allows unambiguous identification of the device.
	S8[16]	R	SERIAL_NUMBER	This is a unique production number even for devices with the same hardware, software, or firmware edition
	U16	R	HARDWARE_ REVISION	Characterizes the edition of the hardware only
	U8[4]	R	SOFTWARE_ REVISION	Characterizes the edition of the software or firmware.
	U16	R	REV_COUNTER	Marks a change of hardware or its parameters.
	U16	R	PROFILE_ID	An identification provided by PROFIBUS & PROFINET International (PI).
	U16	R	PROFILE_ SPECIFIC_TYPE	This parameter offers further information about profile-specific details according to the respective definitions of the application profile.
	U8[2]	R	IM_VERSION	This parameter indicates the implemented version of I&M functions.
	U16	R	IM_SUPPORTED	This parameter indicates the availability of I&M records.

3.7 NE107 Bit Information

Table 16 - NE107 Failure Bits

Bit	Meaning
0	Motor Over Temperature
1	Over Torque
2	Valve Jam
3	Lost Phase
4	Encoder Fault
5	Contactor Fault
6	Knob Fault
7	Mainboard EEPROM Fault
8	Mainboard Flash Memory Fault
9	Mainboard RAM Fault
10	Oil Temperature Too High (Arctic Units)
11	MC Motor Volt Too Low
12	MC Motor Volt Too High
13	MC IRAM Fault
14	MC IRAM Over Temperature
15	MC Hall Critical
16	MC Hall Limping
17	MC Communication Loss
18	MC Thermistor Communication Loss
19	Monitor Relay Energized
20	SPI To Mainboard Failure
21	PROFIBUS DP Board Failure
22	PROFIBUS DP Communication Loss Timeout
23	PROFIBUS DP Channel-A Failure
24	PROFIBUS DP Channel-B Failure
25	MC Hardware Torque Over Limit
26	MC Cop Fault

Table 17 - NE107 Function Check Bits

Bit	Meaning
0	Knob In Local
1	Knob In Stop
2	Open Torque Timer Expired
3	Close Torque Timer Expired
4	Manual Move
5	Open Torque Switch
6	Close Torque Switch
7	Open Position Limit
8	Close Position Limit
9	Local ESD Active
10	Network ESD Active
11	Open Inhibit Active
12	Close Inhibit Active
13	PST Active
14	PROFIBUS DP Channel-A Primary
15	PROFIBUS DP Channel-B Primary

Table 18 - NE107 Out of Specification Bits

Bit	Meaning
0	Identical Limits
1	Phase Reverse
2	Line Voltage Too Low
3	Line Frequency Too Low
4	Mainboard mA Input Signal Lost
5	Analog Board-1 mA Input Signal Lost
6	Analog Board-2 mA Input Signal Lost
7	Analog Board-1 mA Output Signal Lost
8	Analog Board-2 mA Output Signal Lost

Table 19 - NE107 Maintenance Request Bits

Bit	Meaning
0	Encoder Warning
1	Motor Temperature Warning
2	Analog Board-1 Fault
3	Analog Board-2 Fault
4	Digital Output Board-1 Fault
5	Digital Output Board-2 Fault
6	AD Indicator Active
7	Rated Vibration Limit Exceeded

3.8 Encoder Health Bits

Table 20 - MX Encoder Health[0]

Value	Signal	Remarks
0x00000001	D102/Q102 Fault	Wheel 0
0x00000002	Reserved always 0 (D101/Q101)	
0x00000004	Reserved always 0 (D130)	
0x00000008	D103/Q103 Fault	Wheel 1
0x00000010	D104/Q104 Fault	
0x00000020	D105/Q105 Fault	
0x00000040	D106/Q106 Fault	Wheel 2
0x00000080	D107/Q107 Fault	
0x00000100	D108/Q108 Fault	
0x00000200	D109/Q109 Fault	Wheel 3
0x00000400	D110/Q110 Fault	
0x00000800	D111/Q111 Fault	
0x00001000	D112/Q112 Fault	Wheel 4
0x00002000	D113/Q113 Fault	
0x00004000	D114/Q114 Fault	
0x00008000	D115/Q115 Fault	Wheel 5
0x00010000	D116/Q116 Fault	
0x00020000	D117/Q117 Fault	
0x00040000	D118/Q118 Fault	Wheel 6
0x00080000	D119/Q119 Fault	
0x00100000	D120/Q120 Fault	
0x00200000	D121/Q121 Fault	Wheel 7
0x00400000	D122/Q122 Fault	
0x00800000	D123/Q123 Fault	
0x01000000	D124/Q124 Fault	Wheel 8
0x02000000	D125/Q125 Fault	
0x04000000	D126/Q126 Fault	
0x08000000	D127/Q127 Fault	Wheel 9
0x10000000	D128/Q128 Fault	
0x20000000	D129/Q129 Fault	
0x40000000	Reserved always 0	
0x80000000	Reserved always 0	

Table 21 - MX Encoder Health[1]

Value	Signal	Remarks
0x00000001	D2/Q2 Fault	Wheel 0
0x00000002	Reserved always 0 (D1/Q1)	
0x00000004	Reserved always 0 (Q130)	
0x00000008	D3/Q3 Fault	Wheel 1
0x00000010	D4/Q4 Fault	
0x00000020	D5/Q5 Fault	
0x00000040	D6/Q6 Fault	Wheel 2
0x00000080	D7/Q7 Fault	
0x00000100	D8/Q8 Fault	
0x00000200	D9/Q9 Fault	Wheel 3
0x00000400	D10/Q10 Fault	
0x00000800	D11/Q11 Fault	
0x00001000	D12/Q12 Fault	Wheel 4
0x00002000	D13/Q13 Fault	
0x00004000	D14/Q14 Fault	
0x00008000	D15/Q15 Fault	Wheel 5
0x00010000	D16/Q16 Fault	
0x00020000	D17/Q17 Fault	
0x00040000	D18/Q18 Fault	Wheel 6
0x00080000	D19/Q19 Fault	
0x00100000	D20/Q20 Fault	
0x00200000	D21/Q21 Fault	Wheel 7
0x00400000	D22/Q22 Fault	
0x00800000	D23/Q23 Fault	
0x01000000	D24/Q24 Fault	Wheel 8
0x02000000	D25/Q25 Fault	
0x04000000	D26/Q26 Fault	
0x08000000	D27/Q27 Fault	Wheel 9
0x10000000	D28/Q28 Fault	
0x20000000	D29/Q29 Fault	
0x40000000	Reserved always 0	
0x80000000	Reserved always 0	

3.9 Relay Control Functions

Table 22 - Relay Control Functions for S1 to S4, R5 to R8

Value	Relay Control Function	Remarks
1	Closed	
2	Opened	
3	Position	Trip if >= user position setting
4	Closing	Even when paused in 2-Speed
5	Opening	Even when paused in 2-Speed
6	Stopped	
7	Moving	Even when paused in 2-Speed
8	Local selected	Local control
9	Motor over temperature	
10	Over torque	
11	Manual override	
12	Valve jammed	
13	Close torque switch	
14	Open torque switch	
15	Stop selected	
16	Lost phase	
17	ESD signal	
18	Close inhibit	
19	Open inhibit	
20	Analog input lost	
21	Remote selected	
22	LimiGard active	
23	Hardware failure	
24	CSE control	
25	Network controlled	
26	Standard PST Active	
27	Standard PST Passed	
28	Standard PST Failed Target	
29	Standard PST Failed Return	
30	Multi-Position 1	Custom input 4 and at M1 pos.
31	Multi-Position 2	Custom input 4 and at M2 pos.
32	Motor starts per hour exceeded	
33	At Home	QX360 only
34	At Port 1	QX360 only
35	At Port 2	QX360 only
36	At Port 3	QX360 only
37	At Port 4	QX360 only
38	At Port 5	QX360 only
39	At Port 6	QX360 only
40	At Port 7	QX360 only
41	Network Communication Loss	
42	Local Operation	
43	Remote Operation	
44	RUN LOAD HIGH	MX 1PH only
45	DPTS OPEN	
46	DPTS CLOSE	
47	POSITION RANGE OPEN	Must set range
48	POSITION RANGE CLOSE	Must set range
49	USER INDICATORS	Advanced Diags Deviations

4 Application Notes

These application notes are provided as a helpful guide when updating from MXa Legacy boards to MXb Redcom boards only. Please verify the actual data with your site and follow all safety and procedural guidelines by Siemens and your organization when following these notes.

4.1 Mapping I/O Data from Legacy MXa DP Board

The following information may be useful for users who want to replace a legacy Profibus DP board (p/n 64-825-0046-4) with a new Profibus DP board (p/n 64-825-0212 or 64-825-0223).

Since the new Profibus DP board does not use various function blocks as described in the process automation profile, it is quite easy for the user to access device I/O data using the new DP board as described below:

Analog output function block of legacy DP board: The following analog output data can be written to the actuator using the parameter and module numbers as described in Section 3.2:

Parameter	Module
Setpoint, Index 21.	Module numbers 1, 2, 3, 4, 5, 6, 7, 8 and 9 provide access to this writeable parameter.

Legacy DP Board	MXb DP Board
• Data type is a 32 bit floating point (4 bytes) and a quality byte (1 byte). Total 5 bytes.	• Data type is an unsigned 16 bit integer (2 bytes). Total 2 bytes.
• Quality byte essential for operation.	• Quality byte not applicable
• Uses slot 1 with byte offset 0.	• Uses index 21.

Discrete input function blocks of legacy DP board:
The following discrete input data can be read from the actuator using the parameters and module numbers as described in section 3.2:

Parameter	Module
Actuator Status (Table 7), Index 26.	All 10 module numbers from 1 to 10 provide access to this read only parameter.
Actuator Faults (Table 8), Index 27.	All 10 module numbers from 1 to 10 provide access to this read only parameter.
Actuator Indications (Table 9), Index 28.	Module numbers 1, 5, 6, 7, 8, 9 and 10 provide access to this read only parameter.
User IO (Table 10), Index 29.	Module numbers 1, 4, 7, 8 and 10 provide access to this read only parameter.
Network Status (Table 11), Index 30.	All 10 module numbers from 1 to 10 provide access to this read only parameter.

Legacy DP Board	MXb DP Board
• Data type is an unsigned 8 bit integer (1 byte) and a quality byte (1 byte). Total 2 bytes for each discrete input function block. • Quality byte essential for operation. • Uses slot 2, 3, 4 and 5 with byte offset 0 in each slot.	• Each parameter data type is an unsigned 16 bit integer (2 bytes). • Quality byte not applicable. • Discrete input information available via parameters with index numbers mentioned in above table.

Discrete output function blocks of legacy DP board:
The following discrete output data can be written to actuator using the parameters and module numbers as described in Section 3.2:

Parameter	Module
Actuator Command, Index 22. Provides ability to send both type discrete output commands; close/stop/open and emergency shutdown commands to actuator.	Module numbers 1, 3, 4, 5, 7, 8, 9 and 10 provide access to this writeable parameter.
Relay Command, Index 23. Provides ability to send relay control commands to actuator.	Module number 1, 7 and 9 provide access to this writeable parameter.

Legacy DP Board	MXb DP Board
• Data type is an unsigned 8 bit integer (1 byte) and a quality byte (1 byte). Total 2 bytes for each discrete output function block.	• Each parameter data type is an unsigned 16 bit integer (2 bytes each parameter). • Quality byte not applicable.
• Quality byte essential for operation. • Uses slot 6 and 7 with byte offset 0 in each slot.	• Discrete output information available via parameters with index numbers mentioned in above table.

Analog input function block of legacy DP board:
The following analog input data can be read from actuator using the parameters and module numbers as described in Section 3.2:

Parameter	Module
Actuator Position, Index 24.	Module numbers 1, 3, 4, 5, 6, 9 and 10 provide access to this read only parameter.
Actuator Torque, Index 25.	Module numbers 1, 3, 4, 5, 6, 9 and 10 provide access to this read only parameter.

Legacy DP Board	MXb DP Board
• Data type is a 32 bit floating point (4 bytes) and a quality byte (1 byte). Total 5 bytes.	• Each parameter data type is an unsigned 16 bit integer (2 bytes each parameter).
• Quality byte essential for operation.	• Quality byte not applicable.
• Uses slot 8 with byte offset 0.	• Analog input information available via parameters with index numbers mentioned in above table.

4.2 Siemens Step 7 SIMATIC Manager

Flowserve has tested the Profibus DP boards with Siemens Step 7 SIMATIC Manager, version 5.5, and noted the following aspects:

- Network profiles 'DP' and 'Universal (DP/FMS)' with default bus parameters worked with the Profibus DP boards.

4.3 Siemens S7 300 Systems

Flowserve has tested the Profibus DP (p/n 64-825-0223) and Profibus DP Redcom (p/n 64-825-0212) boards with the CPU315-2 DP (6ES7 315-2AH14-0AB0) and noted the following aspects:

- Non-redundant and simple Flying redundant modes worked. Full Flying and System redundancy modes were not supported.
- Switchover times for Flying redundancy (1 line and 2 line) occurred under 500ms.

4.4 Siemens S7 400 H Systems

Flowserve has tested the Profibus DP Redcom (p/n 64-825-0212) board with the CPU412-5 H PN/DP (6ES7 412-5HK06-0AB0) and noted the following aspects:

- System redundancy mode worked with switchover times under 500ms.

4.5 Control Parameter Hierarchy

In several of the cyclic modules, both Setpoint and Actuator Command parameters are available. However, their application differs based on the operational modes of the actuator (position or open/close). The table below illustrates when these parameters are interpreted or not.

Cyclic Module	Parameters	Operation when in Position Mode	Operation when in Open/Close Mode
1	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
2	Setpoint (Target)	Accepted	Ignored
	Actuator Command	N/A	N/A
3	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
4	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
5	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
6	Setpoint (Target)	Accepted	Ignored
	Actuator Command	N/A	N/A
7	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
8	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
9	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
10	Setpoint (Target)	N/A	N/A
	Actuator Command	ESD start/stop only	Accepted
11	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted
12	Setpoint (Target)	Accepted	Ignored
	Actuator Command	N/A	N/A
13	Setpoint (Target)	Accepted	Ignored
	Actuator Command	ESD start/stop only	Accepted

5 Frequently Asked Questions

1. Can two single channel Profibus DP boards (p/n 64-825-0223) be used instead of one Profibus DP Redcom dual channel board (p/n 64-825-0212) in the same unit?

   No. The necessary internal Redstate communications only occur on the dual channel Profibus DP Redcom board (p/n 64-825-0212). If two single channel Profibus DP boards (p/n 64-825-0223) are installed, they will compete for the same internal resources and the unit will malfunction.

2. How can I tell which Profibus DP board is installed in the actuator?

   Refer to Section 2.6.3 to use the knobs and the front panel LCD to determine which boards are installed.

3. What is the difference between the single channel and dual channel boards?

   Although the single channel (p/n 64-825-0223) board and the dual channel (p/n 64-825-0212) share the same printed circuit board and firmware, the dual channel is populated with the extra electronic parts to form a redundant channel.

4. What is the difference between the single channel GSD file and the dual channel GSD file?

   The single channel GSD file and the dual channel GSD files are very similar with these notable differences:

   - *The single channel GSD file will only allow configuration for one Profibus DP network. It does not allow for redundant connections, switchover, or any of the redundancy modes. Options for redundancy modes have been removed to allow for easier configuration.*
   - *The dual channel GSD file will work for both boards. However, any redundancy settings applied to a single channel board (p/n 64-825-0223) will not work and may cause network problems.*

5. What is the difference between the simple and full Flying redundancy?

   In full Flying redundant mode, the Profibus DP Redcom board (p/n 64-825-0212) fully supports the Redstate diagnostic extensions to the DPV1 protocol. In simple Flying redundant mode, these diagnostic extensions are not included in the communications and allows systems without diagnostic capability to operate without producing nuisance errors. Note that System redundancy requires full Redstate diagnostics.

6. What is the difference between the single-line and dual-line Flying redundant modes?

   Although the basic operation of Flying redundant mode is the same, the way the lines are terminated are different when termination is enabled via the software options. In single-line mode, the software termination settings follow the primary and backup channel determination and will switch depending on which channel becomes primary. In dual-line (two-line) mode, the software termination settings are applied to channel A and B and do not switch based on which channel becomes primary.

7. How is the address set for the second channel?

   The channel address setting is done automatically. In Flying redundant mode, the backup address is the primary address plus 64. For example, if the primary address is 7, the backup address is 71. Note that the address number follows the primary channel and not the physical channel (A or B). In System redundant mode, the backup channel address is the same as the primary channel address.

8. When should I use the on-board termination?

   The on-board termination should be enabled when:

   - *Only when the actuator is the last device on the Profibus network, and*
   - *When external terminal is not available or used.*

   By default, on-board termination is disabled. Termination should only be used at the Profibus network endpoints.

9. What is a Partial Stroke Test (PST) and how do I initiate one?
   - *A Partial Stroke Test (PST) moves the actuator, usually by a very small amount, to ensure correct operation of the device and valve. This is typically needed for actuator/ valves that have been idle for a long period of time.*
   - *To initiate a PST, first set the target position into the structure in parameter 54 (Table 13) and also set the 1 for the command value. Send the parameter to the actuator and it will move to the target position and then return to the (previous) commanded position. The status and result can be obtained by reading parameter 55.*

10. What version of the PDM is required?

    At the time of this writing, the firmware has been tested successfully with versions 6.1 and 8.1.

11. What versions of firmware are required?

    MXb Host Controller Board Application Firmware 2211M00 or greater.

    PROFIBUS DP Redcom board Firmware V2.0.0 or greater.

6 Glossary

Communications Protocol A standard for transferring data between intelligent devices, such as a Master Station, Distributed Control System, Programmable Logic Controller, or a computer.

DCS Distributed Control System: geographically distributed intelligent control devices communicating over a digital network (bus).

DP Decentralized Periphery: a PROFIBUS protocol used for high-speed transmission of user data; commonly used between a host station and distributed input/output devices at the field level.

Electronic Device Descriptions (EDD) A device-specific configuration file that provides a description of the configuration parameters in the MX/QX to the host engineering tool.

EIA Electronic Industries Association: an organized body of manufacturers that sets interface standards for the electrical and electronic industry. See RS-232C and RS-485.

Function Blocks A standard graphical representation of the control and measurement tasks that take place in the field devices, used for easy system configuration.

GSD File A device-specific configuration file that is used by the PROFIBUS Master to configure and communicate with the PROFIBUS device.

Host A computer, DCS, PLC or other microprocessor-based system that is in command of operations of the devices on its network.

Master An active host device that controls all communication to/from the MX/QX PB device.

MX Flowserve Limitorque abbreviation for Multi-turn Electronic Actuator.

MX/QX PB The intelligent PROFIBUS board residing in the Flowserve Limitorque actuator that communicates with the master host station and controls the actuator. There is a separate board for PROFIBUS DP and PROFIBUS PA.

PA Process Automation: a PROFIBUS protocol based on PROFIBUS DP used for high-speed transmission of user data, but with transmission techniques that ensures intrinsic safety and powers the field devices over the bus.

PB Flowserve Limitorque abbreviation for PROFIBUS.

Parallel Data Transmission The transmission of digital data bits in parallel over serial wire. Compare to serial data transmission.

PLC Programmable Logic Controller: an intelligent microprocessor-based replacement for relay logic systems; used for a broad range of process and machinery control industrial applications.

Polling When a PROFIBUS master possesses the token, it then services its set of slaves. The slaves are given permission to respond (access the network) when polled by the master.

Process Device Configuration Tool A software configuration tool used to parameterize the extended parameter set of Process Devices.

PROFIBUS (PROcess FIeldBUS) An open standard for process and fieldbus systems. PROFIBUS defines the functional, electrical and mechanical characteristics of a bit-serial fieldbus system.

PROFIBUS is a data communication network which interconnects PROFIBUS-compatible automation systems and field devices on the cell and field levels of an automation environment. PROFIBUS networks can use the communications protocols “DP” (Decentralized Periphery), “FMS” (Fieldbus Message Specification – not supported by the MX/QX device), and “PA” (Process Automation).

QX QX Flowserve Limitorque abbreviation for Quarter-turn Electronic Actuator.

Redcom An abbreviation for Redundant Communications.

Repeater An electronic device that allows the RS-485 (PROFIBUS) copper wire transmission media to be extended over larger distances.

RS-485 An EIA standard for half duplex, serial data transmission use in multipoint, or parallel, communication systems.

Serial Data Transmission The transmission of digital data bits sequentially over a transmission medium. Compare to parallel data transmission.

Segment A section of the PROFIBUS network that has stations attached. There are limitations to the length of the segments based on baud rate and station loading.

Slave The MX/QX PB is a passive slave device. It receives commands from the master and sends process data and diagnostic information to the master when requested by the master.

Termination The ends of each copper segment of PROFIBUS must be terminated, that is, placing a termination resistor between the two conductors that match the characteristic impedance of the wire to dissipate the signal and prevent reflections.

Token A bit pattern that is passed between active stations that gives that station (such as a PROFIBUS master) the explicit right to access the network. In the case of a PROFIBUS master, the station will service its set of slaves.

Topology The physical description of the arrangement of stations on a network. Topologies include point-to-point, bus, tree, and ring.

Twisted Pair A serial, digital data communications medium incorporating two wires twisted together to minimize interference from nearby noise sources.

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AIIOM000718-00 (EN/A4) November 2022