FLOWSERVE

USER INSTRUCTIONS

MX/QX Profibus DP / PA Field Unit

FCD LMENIM2336-03 – 12/12

Installation
Operation
Maintenance

Experience In Motion

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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. Associated Documents This section provides a list of documents on related subjects for additional MX/QX and PROFIBUS system information.

Section 5. How to Order Parts This section provides part numbers and ordering contact information.

Appendix A – Wiring Diagram This section contains the detailed wiring connection information for the MX/QX field unit.

Appendix B – Feature Definitions This section contains the Flowserve Limitorque actuator Transducer Block I/O (Input/Output) channels and parameters.

Appendix C – PROFIBUS Function Block This section contains the PROFIBUS Function Block parameters and descriptions.

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:** Direct 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 and cabling information, refer to the following documents:

- PROFIBUS DP Specification, IEC 61158 Type 3 and IEC 61784.
- PROFIBUS Profile – PROFIBUS PA – Profile for Process Control Devices, Version 3.02, November 2008, PROFIBUS International Order No. 3.042.

- Installation Guidelines for PROFIBUS – FMS/DP Version 1.0, PROFIBUS International Order No. 2.112.
- Profibus Installation Guideline For Cabling and Assembly, Version 1.0.6, PROFIBUS International Order No. 8.022.
- Profibus Installation Guideline For Commissioning, Version 1.0.2, PROFIBUS International Order No. 8.032.
- Technical Guideline: PROFIBUS PA User & Installation Guideline, Version 2.2, February 2003.
- PROFIBUS Specification - Slave Redundancy Version 1.2, PROFIBUS International Order No. 2.212, November 2004.

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.

Additional features and capabilities are:

- The system reduces the cost of wiring and installation by using existing wiring and multi-drop connections, if it meets PROFIBUS requirements. It is also possible to have more than one PROFIBUS communication network on the same cabling.
- Multiple-master operations through the use of the PROFIBUS token being passed between masters (active nodes). Each master has its own set of slaves and may only write to those slaves.
- Master-slave operations where the master, active node, has the right to address, and send or fetch messages from the slaves (passive nodes).
- The devices are interoperable, as devices from different suppliers communicate with one another on the same network.

The PROFIBUS communication system supports up to 32 devices per segment, with up to 126 addressable devices with the use of repeaters.

Segmentation is used for the following reasons:

- Isolation is desired between two areas or buildings.
- Media conversion (copper to fiber or fiber to copper) is desired.
- The maximum of 32 nodes has been reached (31 + repeater).
- The maximum distance has been reached.
- It is desirable to "reform" the signal to full voltage levels (noisy environment).

The devices used to create a segment are Repeaters for copper networks, Optical Link Modules for glass or plastic-coated glass fiber-optic networks, and Optical Bus Terminals for plastic fiber-optic networks. Each of these devices provides either electrical or optical isolation between segments.

The MX/QX PB field unit fits in the actuator in the sealed electrical housing compartment. There are two different communication board options for the MX/QX PB field unit: MX/QX PB DP, which supports PROFIBUS DP (Decentralized Periphery) RS-485 physical layer and MX/QX PB PA, which supports PROFIBUS PA (Process Automation) IEC 1158 physical layer. The MX/QX PB DP field unit is available with Flying and System Redundancy.

PROFIBUS DP ensures high-speed data transmission of user data, and is designed especially for communication between a master host station and distributed devices at the field level.

PROFIBUS PA uses the expanded PROFIBUS DP protocol for data transmission and implements the PA profile that specifies the characteristics of the field device. This transmission technique ensures intrinsic safety and powers the field devices over the bus. PROFIBUS PA is designed for high-speed and reliable communications, with the ability to link sensors and actuators to a common fieldbus line, even in potentially explosive areas.

PROFIBUS PA devices can be integrated into PROFIBUS DP networks using segment couplers.

The adjustments to the MX/QX PB settings may be made locally at the actuator and over the PROFIBUS network using a DPV1 network configuration tool.

A typical MX/QX PB DP system is shown in Figure 1.1 in a Master/Slave Configuration, Figure 1.1a shows a typical PROFIBUS DP network with redundancy option in a single master configuration, Figure 1.1b shows a typical PROFIBUS DP network with redundancy option in a dual master configuration, and Figure 1.2 shows a typical MX/QX PB PA system.

Figure 1.1 – Typical PROFIBUS DP Network with DCS or PLC as the Host System

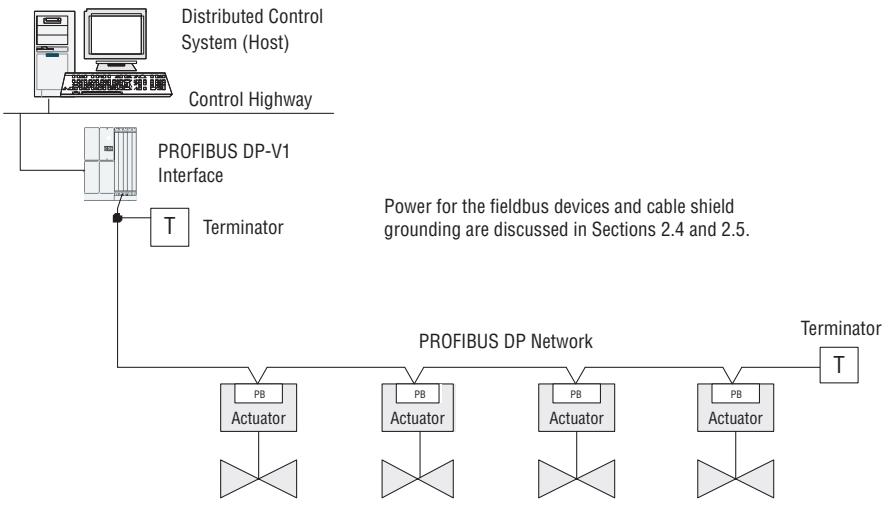


Figure 1.1a – Typical PROFIBUS DP Network with Redundancy Option (Single Master)

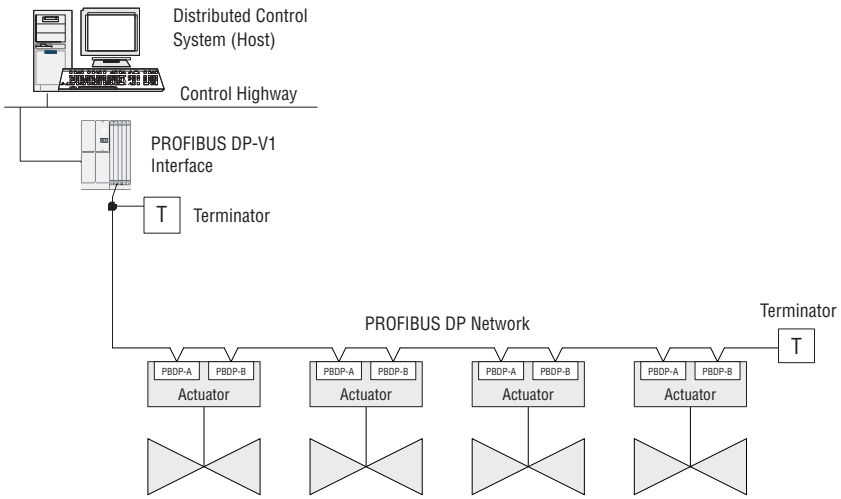


Figure 1.1b – Typical PROFIBUS DP Network with Redundancy Option (Dual Master)

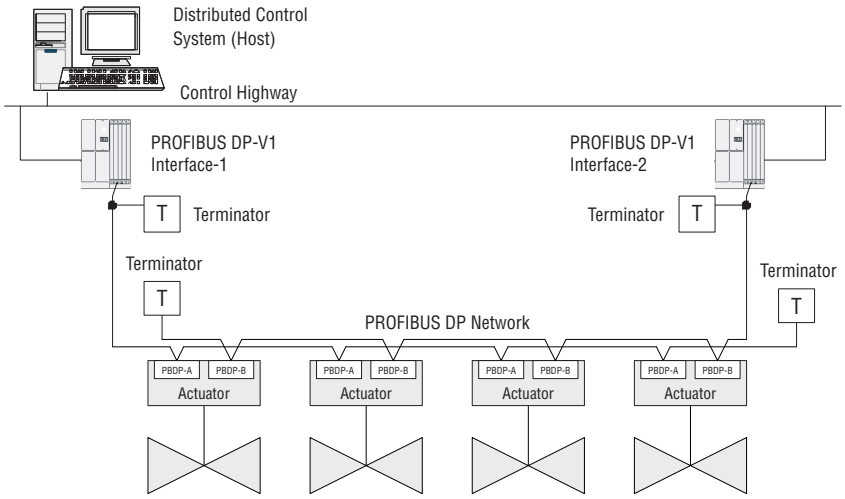
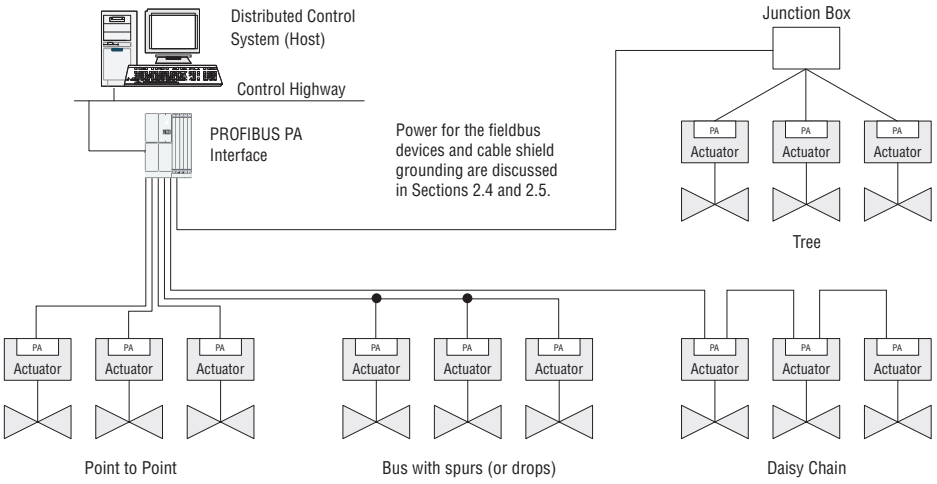


Figure 1.2 – Typical PROFIBUS PA Network with DCS or PLC as the Host System



1.5.1 General Network Specification

System Specifications:

- Communicates using the PROFIBUS DP or PROFIBUS PA protocol.
- PROFIBUS DP is V1 compliant.
- Employs high-speed communication.
- Complies with EN50170 fieldbus standard.
- PA Physical Layer with IEC1158-2.
- 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.
- PROFIBUS PA communications are 31.25kbits/sec (segment coupler side).
- 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 Function Blocks.
- 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.

NOTE: In the application profile definition, only Function Blocks may have cyclic parameters. Physical Blocks and Transducer Blocks do not have cyclic parameters. PROFIBUS DP/V1 is part of the requirement to access Acyclic parameters through the Function Block specification and is composed of a slot number and an index number. Acyclic services are performed between two data exchange cycles. A PROFIBUS Class 2 Master is required for acyclic data exchange (Function Blocks). An Electronic Device Descriptor File is used in the configuration tool of the Master to gain access to the Function Block parameters (refer to Chapter 3, Software).

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 or PA 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/PA 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 2.1a and 2.1b. 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 PA.

Refer to Appendix A for detailed wiring connections.

2.2 Hardware

Figure 2.1a – MX-05 Actuator

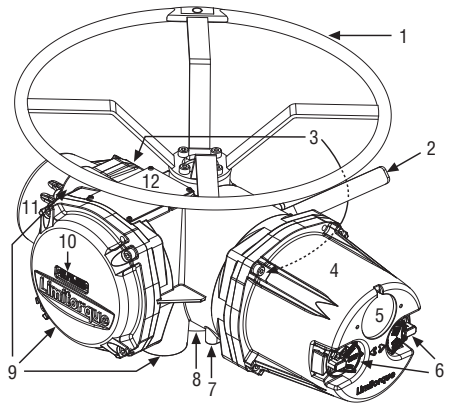
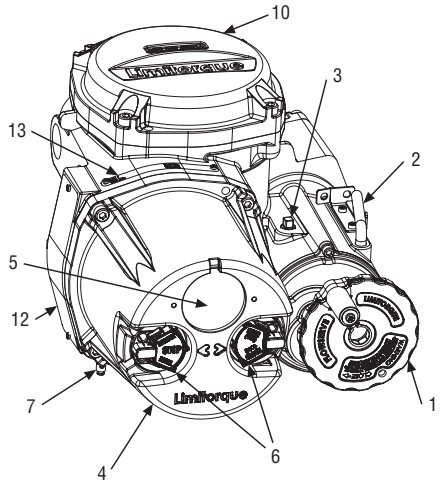
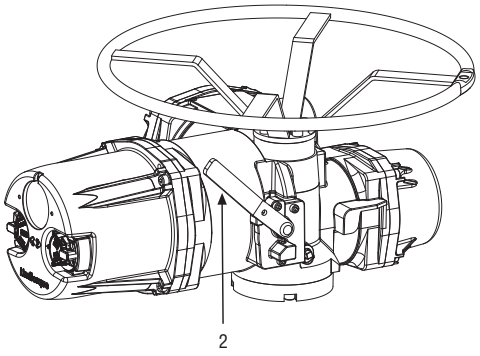
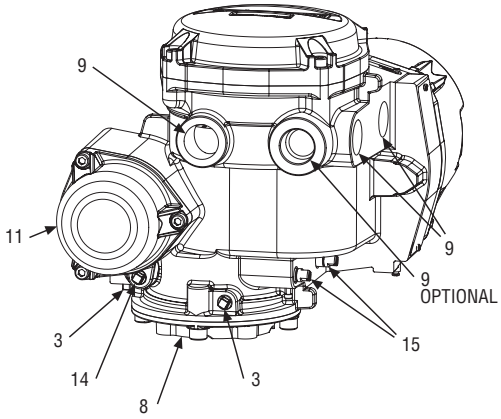


Figure 2.1b – QX-05 Actuator







Item	Description	Item	
1	Handwheel	1	Handwheel
2	Declutch lever	2	Declutch lever (QX-05)
3	Oil fills (dotted arrow depicts fill on declutch side)	3	Oil fill
4	Controls compartment (field unit location)	4	Controls cover
5	LCD display	5	LCD display
6	Control knobs	6	Control knob
7	Ground lug	7	Ground lug
8	Thrust/torque base	8	Baseplate
9	Conduit entries	9	Conduit entry
10	Terminal compartment	10	Terminal compartment
11	Electric motor	11	Motor
12	Nameplate	12	Certification nameplate
		13	Tag nameplate
		14	Oil plug
		15	Stem nut stops

2.2.1 MX and QX Actuators

The MX and QX actuators are designed for operation of ON-OFF and modulating valve applications. The MX is a multi-turn actuator, while the QX is a quarter-turn actuator.

Both the MX and QX include the following features:

- Non-intrusive setup.
- Separately sealed terminal compartment.
- Unique absolute encoder for valve position sensing (no battery required).
- 32-character LCD for indication and calibration.
- Enhanced electronic control, monitoring, and diagnostic capabilities with Built-In Self Test (BIST) and LimiGard™ technology.

NOTE: Recommended storage procedures are detailed in the MX and QX Maintenance and Spare Parts Manual LMENIM2314 and LMENIM3314 respectively. Failure to comply with recommended procedures will void the warranty. For longer-term storage, contact Flowserve for procedure and recommendations.

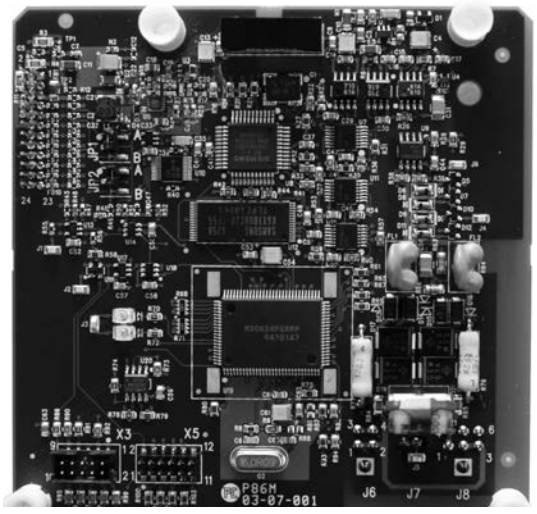
2.2.2 MX/QX PB Field Unit

The MX/QX PB field unit interface board is installed in the actuator controls compartment (Figure 2.1). The MX/QX PB DP version is shown in Figure 2.2, and the MX/QX PB PA version is shown in Figure 2.3. 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 version supports two forms of redundancy when two PB DP field unit boards are installed in a single actuator:

a. Flying redundancy provides slave hardware redundancy in the form of an active and standby PB DP field unit installed in each actuator. This form is commonly utilized in applications where a single master is present.

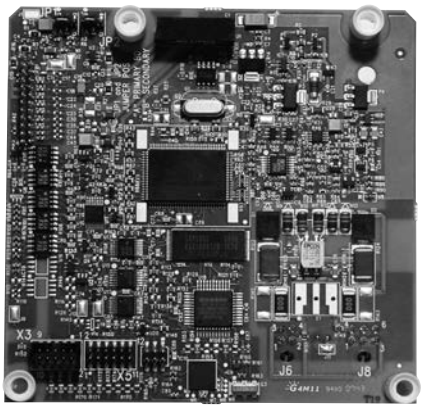
b. System redundancy provides for both slave hardware redundancy, in the form of an active and standby PB field unit installed in each actuator, and cable redundancy in the form of dual masters connected to the active and standby PB DP field units.

Figure 2.2 – MX/QX PB DP Field Unit



Note: Field unit board jumpers, JP1 and JP2, are set to “A” position on Primary board and “B” position on Redundant board.

Figure 2.3 – MX/QX PB PA Field Unit



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.

2.2.3 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.

2.2.3.1 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.

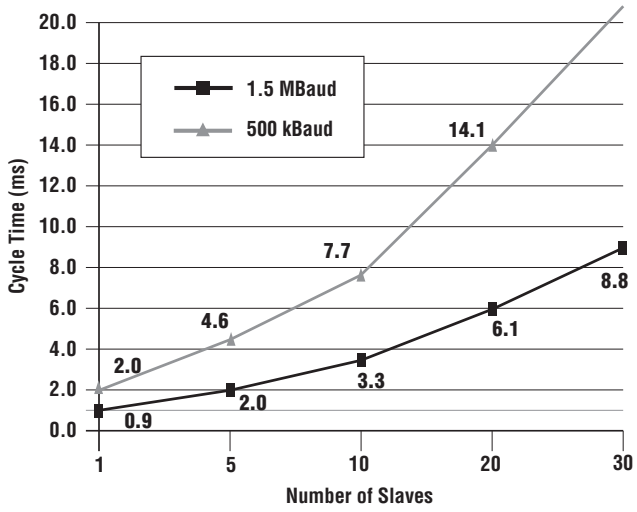
2.2.3.2 Token Rotation Time

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.

2.2.3.3 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.

Figure 2.4 – Typical Cycle Time (Each Station with 2 Bytes I/O)



2.2.4 Network Cabling for PROFIBIS DP

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 2.5 shows the baud rate versus copper cable distance using PROFIBUS.

Table 2.1 provides the guidelines for maximum segment length versus baud rate.

Table 2.1 – Maximum Segment Length

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

Table 2.2 provides the guidelines for maximum network length versus baud rate (assuming the use of up to 9 repeaters).

Table 2.2 – 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.

Tables 2.3 and 2.4 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 2.3 to ensure reliable network communications.

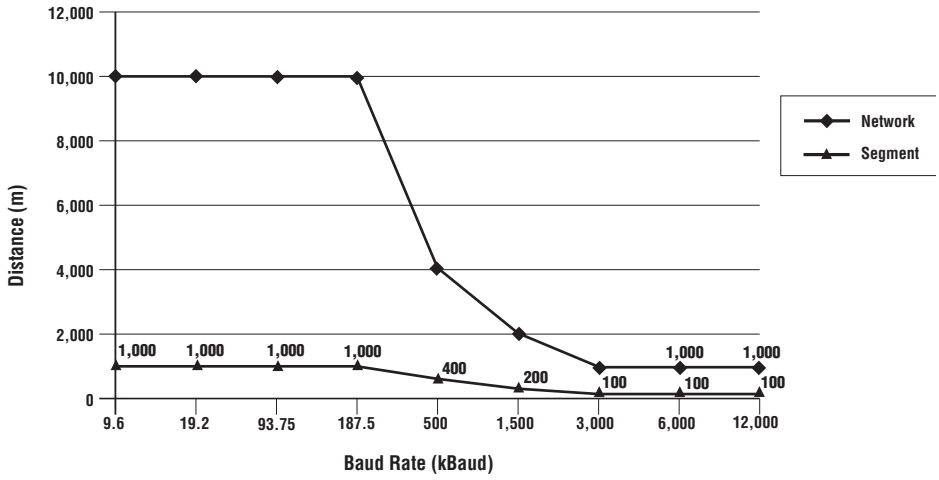
Table 2.3 – Recommended PROFIBUS DP Cable Parameters

Characteristic impedence 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 2.4 – 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 2.5 – Copper PROFIBUS Distance vs. Baud Rate Chart

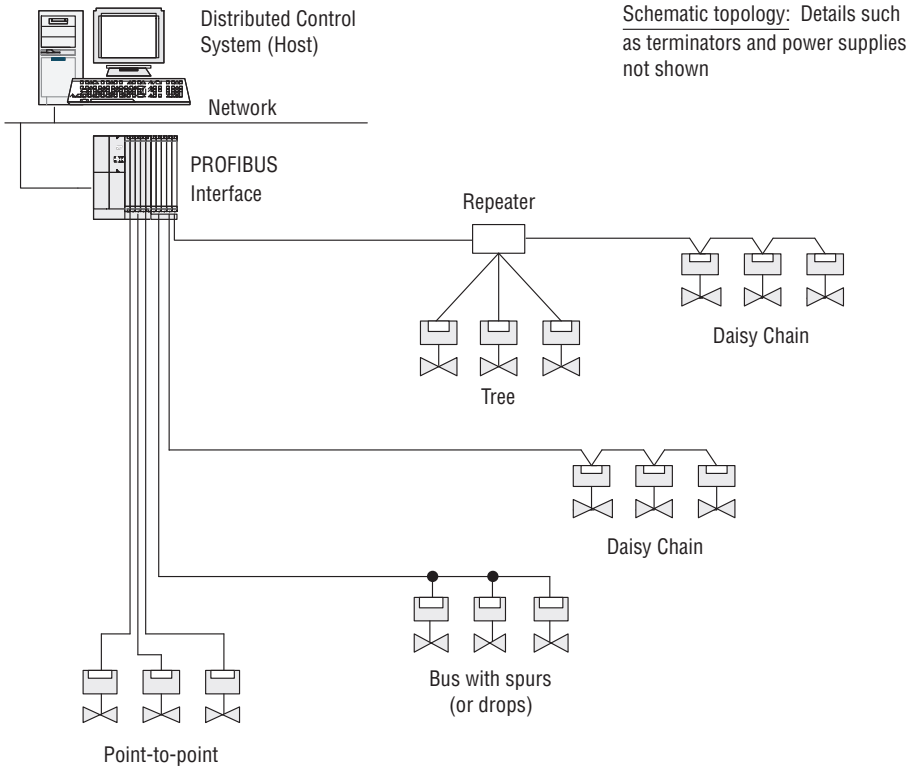


There are several topologies available for both redundant and non-redundant PROFIBUS networks:

- 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.

NOTE: Bus with Spurs, also referred to as stub lines, are not recommended by PROFIBUS as they can create parallel resistance and cause disturbances and reflections on the main trunk or bus line.

Figure 2.6 – Cable Topologies

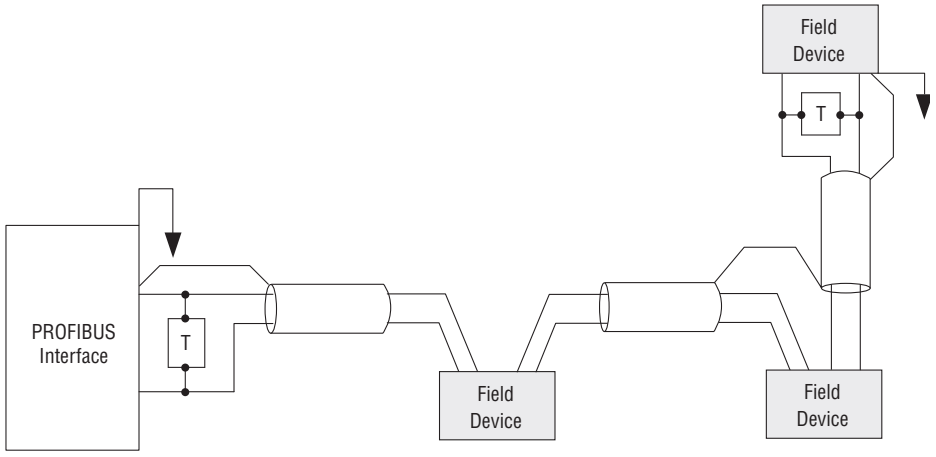


2.2.4.1 Cable Shielding and Grounding for PROFIBUS DP

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 2.7, the grounding point is shown at the junction of the field devices and at each field device.

Figure 2.7 – Use of Shielded Cable in PROFIBUS DP



2.2.5 Network Cabling for PROFIBUS PA

Network cabling should be in accordance with PROFIBUS Process Automation (PA) guidelines using twisted-pair shielded cable. The data line is normally also used to supply power to the field devices. PROFIBUS PA is a combination of the PROFIBUS-DP V1 protocol and the IEC 61158-2 transmission technique.

The following items should be taken into account when planning the network:

- Transmission rate – Within a network, only one transmission rate can be used; typical restrictions of PA are 31.25kbits/sec.
- 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.

Tables 2.5 and 2.6 detail the recommended cable parameters and various types of cable that can be used for network cabling. For additional guidelines, see the following publications:

- PROFIBUS Networks SIMATIC NET 6GK1970-5CA20-0AA1
- Technical Guideline – PROFIBUS PA User and Installation Guideline Version 2.2 February 2003, PROFIBUS Guideline Order No. 2.092

Table 2.5 – Recommended PROFIBUS PA Cable Parameters (Type A – shielded twisted-pair)

Characteristic impedence	100 ohms ±20%
Maximum capacitance	2 nF/km
Loop resistance	44 ohms/km
Conductor cross-sectional area	0.8 mm^2 (AWG 18)
Maximum length of network (including spurs)	1900 m

Table 2.6 – Recommended PROFIBUS PA Cable Types

PA, Ex and Non-Ex (ABB Automation Products GmbH)	NPC080-NO
PA, Ex and Non-Ex (ABB Automation Products GmbH)	NPC150-NO
PROFIBUS FC Process Cable (Siemens AG)	6XV1 830-5.H10
PROFIBUS Data Cable (Beldon Wire & Cable)	3079A & 3076F
UNITRONICS Bus PA (Lapp Kabel GmbH)	2170 235 1x2x1.0

Table 2.7 – Recommended Lengths of PROFIBUS PA Spurs (Stubs)

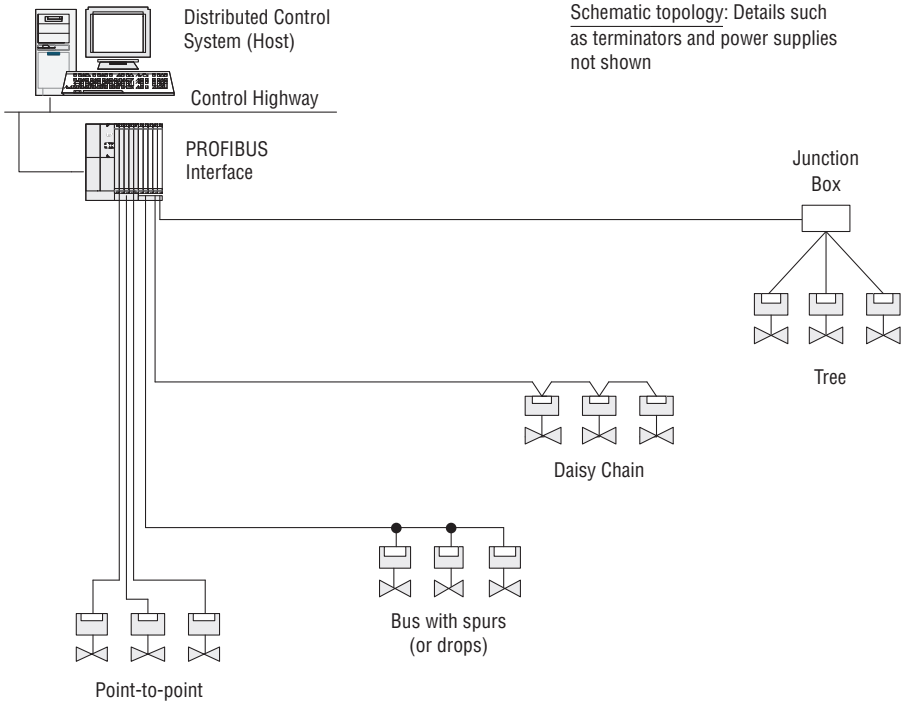
Number of Spur Cables	Length of Spur Cable Intrinsically Safe (m)	Length of Spur Cable Non-Intrinsically Safe (m)
19 to 24	30	30
15 to 18	30	60
13 to 14	30	90
1 to 12	30	120

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

There are several topologies for PROFIBUS networks:

- Daisy Chain – A single cable daisy chained in and out of each device. End devices only have one cable.
- Tree – Cables and electronic devices (such as repeaters or link modules) are used to branch out from different points.
- Star – Similar to a Tree configuration but the cables all originate from one centralized point that is comprised of electronic devices (such as repeaters or link modules).
- Combination of the above.

Figure 2.8 – PROFIBUS PA Cable Topologies

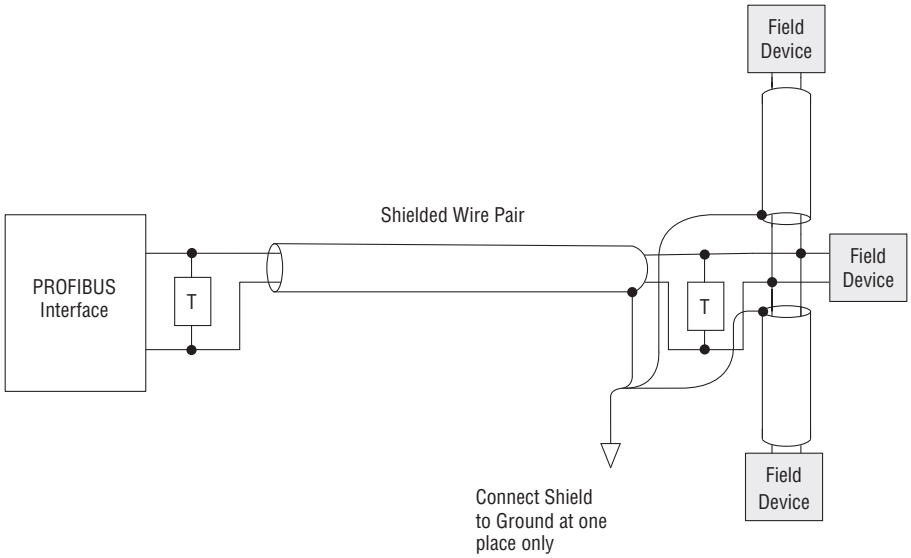


2.2.5.1 Cable Shielding and Grounding for PROFIBUS PA

For best performance, PROFIBUS PA cables must be shielded. When using shielded cable, connect each cable shield to the trunk shield, and connect the overall shield to the PROFIBUS power supply ground.

In Figure 2.9, the grounding point is shown at a connection point of power supply return.

Figure 2.9 – Use of Shielded Cable in PROFIBUS PA



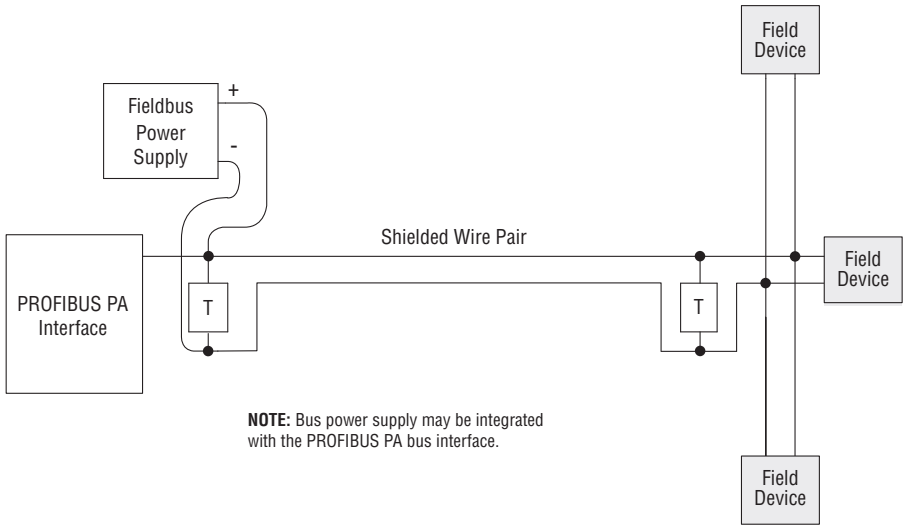
2.2.5.2 PROFIBUS PA Power Supply

The MX/QX PB/PA board requires a nominal 24 VDC (9-32 VDC) on the PA bus to power the MX/QX PB/PA board and make the actuator visible on the network. The required power supply is typically connected to a segment coupler to the bus, usually located at the host end of the cable. Validate the requirements of the segment coupler to determine actual power and voltage.

NOTE: If the actuator does not have three-phase power and the network is active, the MX/QX PB/PA board will report this condition to the host.

Figure 2.10 shows a typical PROFIBUS PA power supply arrangement.

Figure 2.10 – PROFIBUS PA Power Supply



2.3 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.

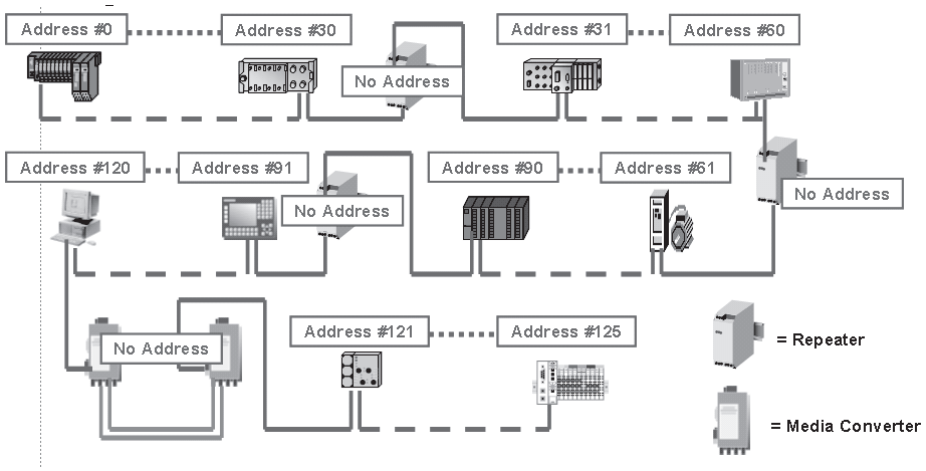
RS-485 repeaters may be used to extend the recommended distance of a segment and "reform" the signal to full voltage levels. Repeaters are included in the total number of allowable nodes per segment; therefore, a segment that begins with a repeater and ends with a repeater may have 30 nodes between them. The maximum number of repeaters allowed in a PROFIBUS network is nine. (Refer to Figure 2.11.)

- 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; nominal 24 VDC for PA).

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

- Installation Guidelines for PROFIBUS – FMS/DP Version 1.0, PROFIBUS International Order No. 2.112.
- Technical Guideline: PROFIBUS PA User & Installation Guideline, Version 2.2, February 2003.

Figure 2.11 – PROFIBUS DP Segments



2.4 Site and Network Cable Preparation

2.4.1 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 2.4.2.
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 Sections 2.2.4.1 and 2.2.5.1.

   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.

2.4.2 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.

2.4.2.1 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 2.12.

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

The PROFIBUS PA network cable is connected to the terminal block as shown in Figure 2.13.

NOTE: The MX/QX PB PA device is equipped with automatic polarity identification. It is not polarity sensitive.

Figure 2.12a – PROFIBUS DP Cable Connections to Terminal Blocks

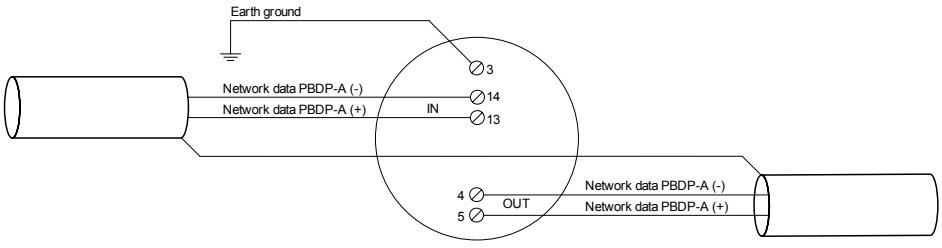


Figure 2.12b – PROFIBUS DP Cable Connections (Redundancy option with single master) to Terminal Blocks

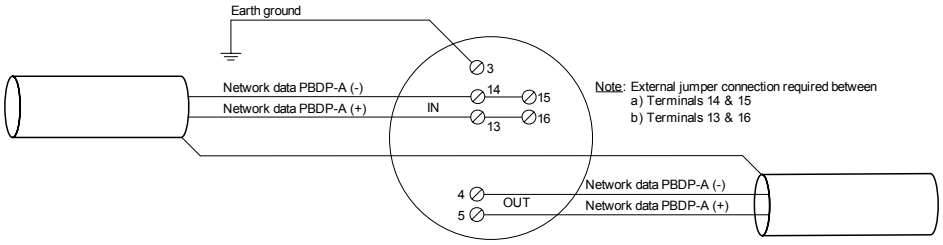


Figure 2.12c – PROFIBUS DP Cable Connections (Redundancy option with dual master) to Terminal Blocks

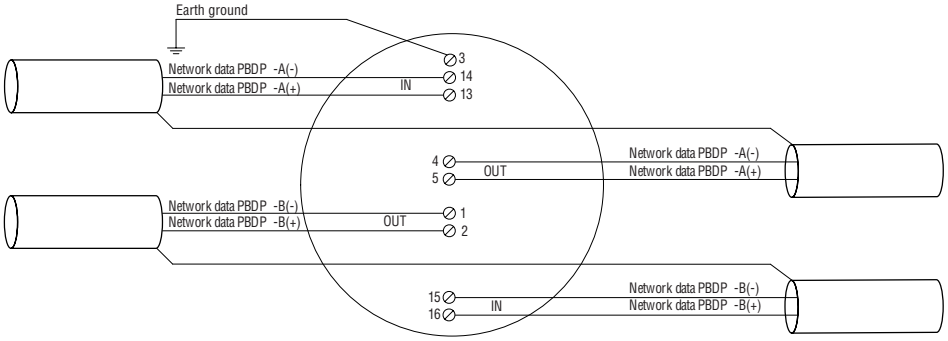
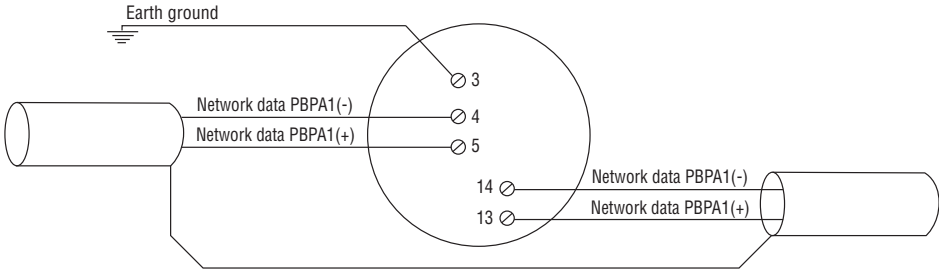


Figure 2.13 – PROFIBUS PA Cable Connections to Terminal Blocks



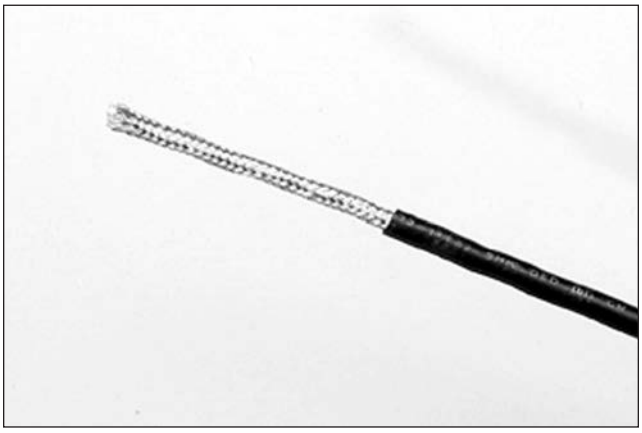
- Shielded twisted-pair cables in compliance to PROFIBUS standards must be used.
- Shields are connected to earth ground.
  PB/DP connects at the ends of each segment.
  PB/PA connects at only a single point in the segment.
- Clean earth-ground connection (less than 5 ohms) provides noise protection 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 2.14. Do not cut or nick the shield or the insulated conductors.

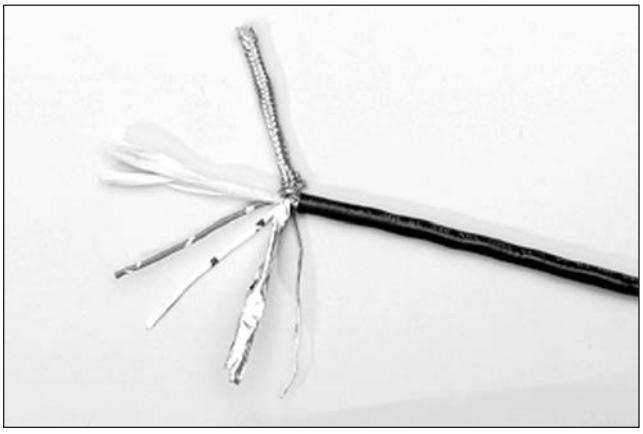
Figure 2.14 – Removing Outer Plastic Jacket



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

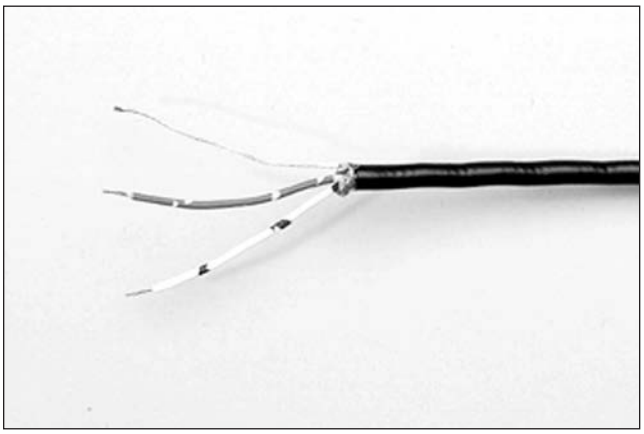
2. Separate the cable parts. Unbraid the shield and peel back the shield to the same point where the outer jacket was removed as shown in Figure 2.15.

Figure 2.15 – Separating Cable Parts



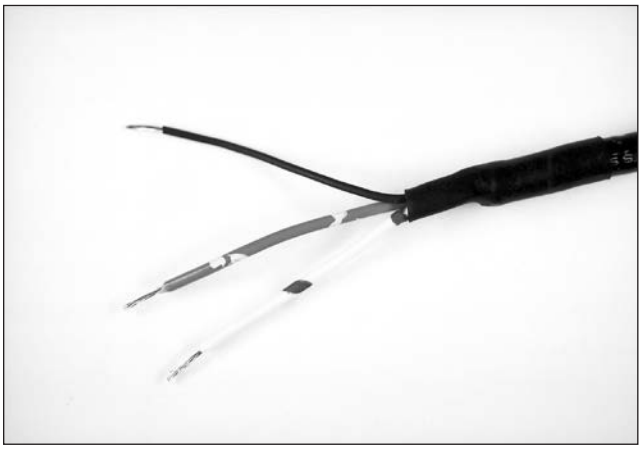
3. Cut away the foil shield. Strip the insulation from the conductors approximately 0.4 inch (1 cm) as shown in Figure 2.16.

Figure 2.16 – Stripping Conductors



4. Apply heat-shrink tubing to insulate the braided shield and to provide stress relief to the cable as shown in Figure 2.17.

Figure 2.17 – Applying Heat-Shrink Tubing

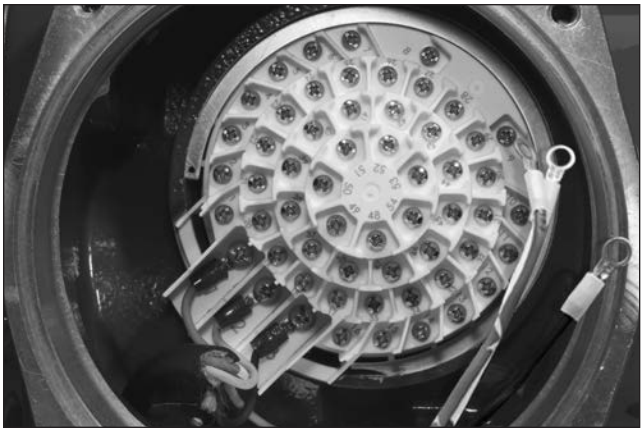


⚠ **CAUTION:** Do not melt the insulation during the application of heat-shrink tubing.

5. Install ring tongue connectors as shown in Figure 2.18.

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

Figure 2.18 – Ring Tongue Connectors



6. Connect the network cables to the MX/QX terminal block as shown in Figure 2.19.

Table 2.8 – Details of Terminal Block Cable Assignments

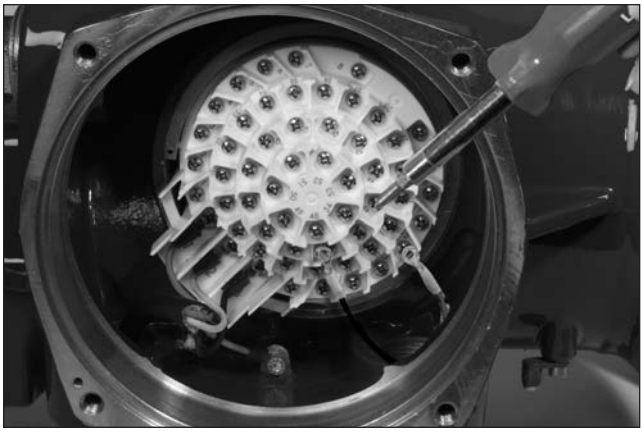
Terminal Block Number	DP Connection	PA Connection
1	PBDP-B (-) Out	N/A
2	PBDP-B (+) Out	N/A
3	Surge/Ground	Surge/Ground
4	PBDP-A (-) Out	PBPA1 (-)
5	PBDP-A (+) Out	PBPA1 (+)
13	PBDP-A (+) In	PBPA1 (+)
14	PBDP-A (-) In	PBPA1 (-)
15	PBDP-B (-) In	N/A
16	PBDP-B (+) In	N/A

NOTE: Terminal 3 must be connected to earth ground in each actuator for field unit surge suppression.

NOTE: Ground each segment of the cabling at each field device unit. See Section 2.2.4.1 and 2.2.5.1. Verify the actuator is properly grounded.

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 and PA applications.

Figure 2.19 – Connecting Network Cable to the MX/QX Terminal Block



2.4.2.2 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 and PROFIBUS PA User and Installation Guideline, Version 2.2, February 2003.

2.4.3 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 2.20. An optional redundant PB DP board or 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. For detailed installation instructions, refer to the MX or QX Maintenance and Spare Parts Manuals, LMENIM2314 or LMENIM3311, respectively.

Figure 2.20a – MX/QX PB DP Primary Board Mounted to MX/QX Main Board

Figure 2.20b – MX/QX PB DP Primary and Redundant Boards Mounted to MX/QX Main Board

Note: Field unit board jumpers, JP1 and JP2, are set to "A" position on Primary board and "B" position on Redundant board.

2.5 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 Limitorque service at (434) 528-4400.

Figure 2.21 – MX/QX PB DP Setup Sequence

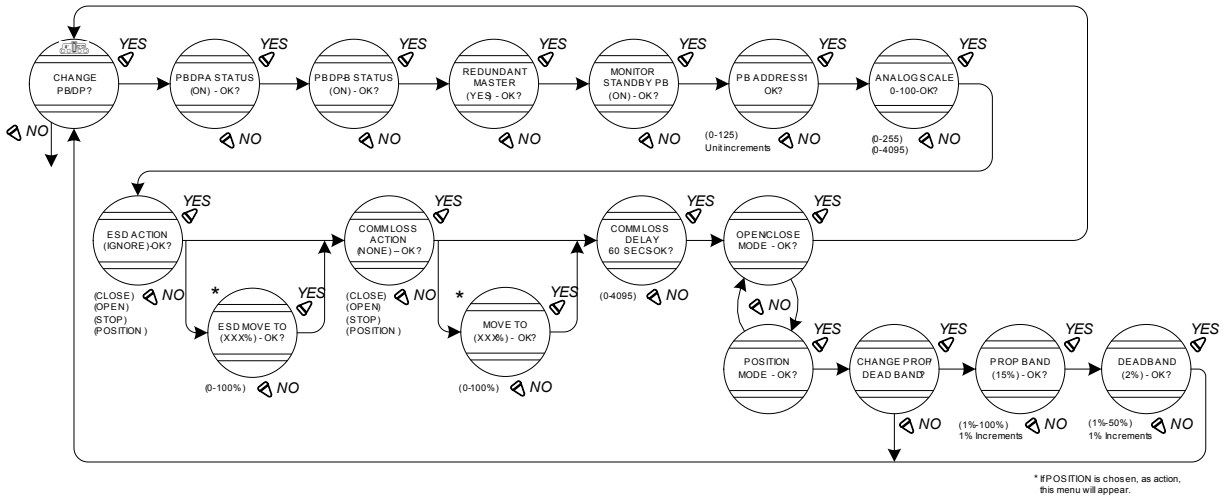


Figure 2.21 illustrates the setup sequence for the MX/QX PB DP field unit. For proper operation, either Position Mode or Open/Close Mode must be selected.

Follow these steps to enter and configure the setup mode:

1. Proceed through the Setup to the CHANGE PBDP? display.
2. Select YES to proceed to the PBDP-A STATUS (ON)-OK? display. PBDP-A Status enables the user to change from the default condition to turn on and off the digital control capability of the actuator.
3. Select YES to proceed to the PBDP-B STATUS (ON)-OK? display. PBDP-B Status enables the user to change from the default condition to turn on and off the redundant digital control capability of the actuator, if installed.
4. Select YES to proceed to the REDUNDANT MASTER (YES)-OK? display. Selecting REDUNDANT MASTER will allow for System Redundancy with two independent connections to Profibus masters. REDUNDANT MASTER must be set to NO for Flying Redundancy (single Profibus master connection).
5. If YES is selected, MONITOR STANDBY PB (ON)-OK? is displayed.
6. To allow the standby Profibus master to monitor the health of the actuator's standby PB DP board, select YES.

7. The unit will display PB ADDRESS 1–OK? If OK, select YES. If NO, select different address (1-125).
8. Select YES to proceed to the ANALOG SCALE display.
9. From ANALOG SCALE, if the default value of 0-100 is OK, select YES. If not, select NO.
10. If YES is selected, ESD ACTION (IGNORE) – OK? is displayed.
11. For ignoring ESD ACTION, select YES. For setting ESD ACTION, select NO. If POSITION is chosen as action, ESD MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.
12. If YES is selected, COMM LOSS ACTION (NONE) – OK? is displayed.
13. For no COMM LOSS ACTION, select YES. For setting COMM LOSS ACTION, select NO. If POSITION is chosen, as action, MOVE TO XXX% OPEN is displayed. Select NO to set desired position.
14. If YES is selected, COMM LOSS DELAY (60 SEC) – OK? is displayed.
15. For a 60-second delay, select YES. Otherwise, select NO until the required value is displayed.
16. If YES is selected, OPEN/CLOSE MODE-OK? is displayed.
17. For OPEN/CLOSE MODE, select YES. For POSITION MODE, select NO. In position mode, the host device can set the valve position to any desired value; in OPEN/CLOSE MODE the host can only fully open or fully close the valve. The user must locally configure one of these two modes.
18. Proceed to configure the proportional band and deadband as discussed in sections 2.5.1 and 2.5.2, respectively.

Figure 2.22 – MX/QX PB PA Setup Sequence

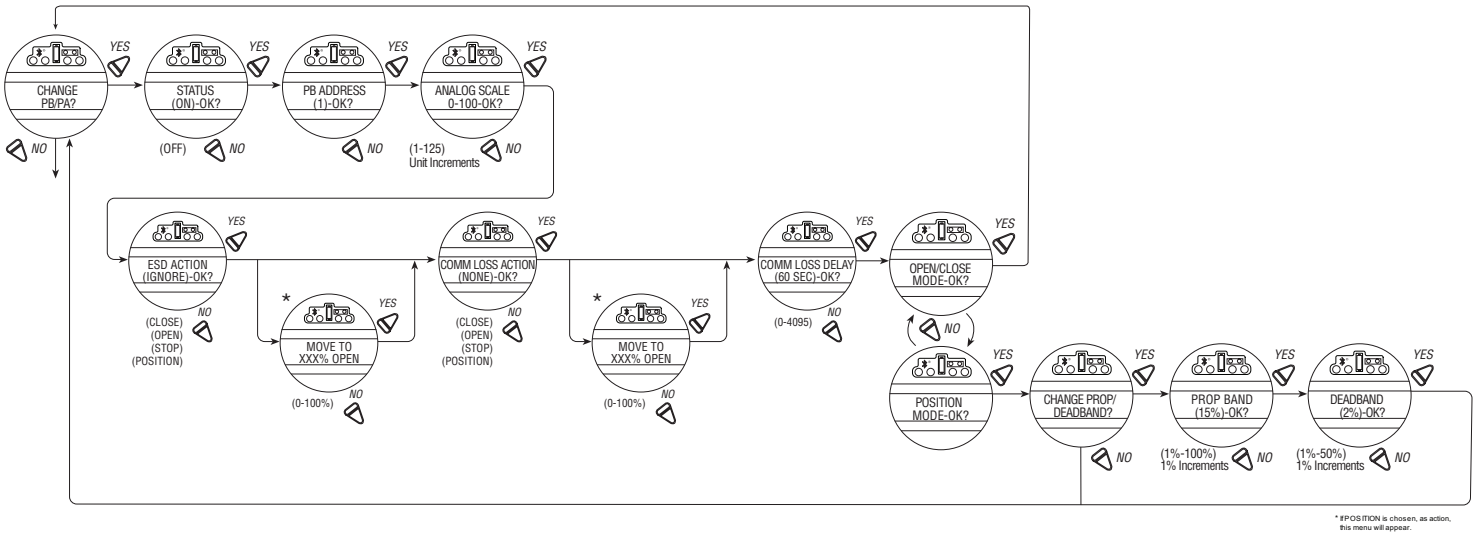


Figure 2.22 illustrates the setup sequence for the MX/QX PB PA. For proper operation, either Position Mode or Open/Close Mode must be selected.

Follow these steps to enter and configure the setup mode:

1. Proceed through the Setup to the CHANGE PB/PA? display.
2. Select YES to proceed to the STATUS (ON)-OK? display. PB Status enables the user to change from the default condition to turn on and off the digital control capability of the actuator.
3. The unit will display PB ADDRESS 1–OK? If OK, select YES. If NO, select different address (1-125).
4. Select YES to proceed to the ANALOG SCALE display.
5. From ANALOG SCALE, if the default value of 0-100 is OK, select YES. If not, select NO.
6. If YES is selected, ESD ACTION (IGNORE) – OK? is displayed.
7. For ignoring ESD ACTION, select YES. For setting ESD ACTION, select NO. If POSITION is chosen as action, ESD MOVE TO XXX% OPEN is displayed. Select NO to set desired position.
8. If YES is selected, COMM LOSS ACTION (NONE) – OK? is displayed.
9. For no COMM LOSS ACTION, select YES. For setting COMM LOSS ACTION, select NO. If POSITION is chosen, as action, MOVE TO XXX% OPEN is displayed. Select NO to set desired position.
10. If YES is selected, COMM LOSS DELAY (60 SEC) – OK? is displayed.
11. For a 60-second delay, select YES. Otherwise, select NO until the required value is displayed.
12. If YES is selected, OPEN/CLOSE MODE-OK? is displayed.
13. For OPEN/CLOSE MODE, select YES. For POSITION MODE, select NO. In position mode, the host device can set the valve position to any desired value; in OPEN/CLOSE MODE the host can only fully open or fully close the valve. The user must locally configure one of these two modes.
14. Proceed to configure the proportional band and deadband as discussed in the next sections.

2.5.1 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 15%.

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

2.5.2 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 1% and 50%, in 1% increments to suit the application.

2.5.3 Valve Data

Valve data may be stored in the MX/QX PB transducer block for use by the host system. Refer to Bulletin LMENIM2306 (MX) or LMENIM3306 (QX), respectively for instructions to edit data for the valve serial number, model and type.

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

2.6.1 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 CF files to configure a PROFIBUS system without having the device online. Some host systems need both EDD and CF files. Refer to your host system and software documentation for the files that are needed. Please contact Flowserve Limotorque for EDD files.

The GSD (characteristics) files are downloaded from the PROFIBUS website into the host system. These files are required by the host system for proper configuration and addressing.

The PROFIBUS website is: www.profibus.com

Alternatively, the files can be downloaded from the Flowserve website: www.flowserve.com.

2.6.2 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: www.flowserve.com.

2.7 Installation Verification

2.7.1 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.

2. Cable armor shorted to the cable shield/drain wire. This may not be at ground potential and could be subject to lightning surges.
3. Shield/drain wires grounded only at one point in the segment to avoid ground loop problems.
4. Ground/earth connections should be at true ground potential and effective at all times. See Section 2.4.1 for details.

2.7.2 MX/QX PB Device Installation Verification

Verify the field device is installed as follows:

1. Enter the Setup mode as detailed in the MX or QX Installation and Operation Manual, LMENIM2306 or LMENIM3306 respectively.
2. In the Setup mode, use the black control knob to select YES to the main menu selection VIEW DIAGNOSTICS?
3. Select YES to the display VIEW HARDWARE? The VIEW HARDWARE routine will enable some of the actuator components to be reviewed for integrity. These components are continuously monitored.
4. Select YES to scroll through the menu selections. For a PB PA field unit the display will eventually read PBPA (OK) – NEXT? For a PB DP field unit, the display will eventually read PBDP-A (OK) - Next? If a redundant PB DP field unit is installed, and board jumpers JP1 and JP2 are in the "B" position, the display will read PBDP-B (OK) - Next?

   NOTE: PB PA field unit: If the PB PA (OK) – NEXT? does not appear, verify PB PA bus power is applied. If PA bus power is applied, contact Flowserve for assistance. PB DP field unit: If the PBDP-A (OK)-NEXT? or PBDP-B (OK)-NEXT? (for redundant units) does not appear, verify field unit board jumper JP1 and JP2 settings are in "A" position for primary unit and "B" position for redundant unit.
5. To return to the normal display, use the red knob to select either LOCAL or REMOTE.

2.8 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.

2.8.1 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 2.4.

2.8.2 View Settings

Refer to the MX or QX Installation and Operation Manual, LMENIM2306 or LMENIM3306 respectively, to access the view settings menu. Verify the settings as follows:

1. From the VIEW SETTINGS display, scan to the VIEW PB/DP or VIEW PB/PA? display depending on which option is installed.
2. From the VIEW PB/DP or VIEW PB/PA? display, select YES and check that the PB/DP or PB/PA status is ON. This confirms that PB/DP or PB/PA is enabled.
3. If the MX/QX contacts are to be controlled via the network to control external equipment, from the VIEW PB/DP or VIEW PB/PA? display, select NO and obtain the VIEW STATUS AND ALARM CONTROL? display. Verify that the digital outputs, S-1 and S-2 are set for "Network" control.

2.8.3 Checking the Normal Display

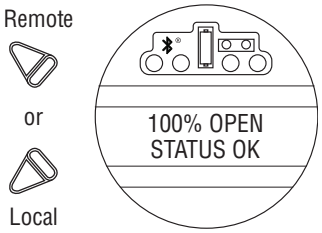
Place the selector switch in LOCAL or REMOTE position. The valve position will be indicated at the top of the display. For a PB PA field unit, STATUS OK or PB COMM LOSS should be indicated at the bottom of the display. For a PB DP field unit, STATUS OK or PBDP COMM LOSS should be indicated at the bottom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

2.8.3.1 STATUS OK

If STATUS OK is displayed, then the field device is sufficiently powered and communicating with the host system.

Figure 2.23 illustrates the field unit with a normal display.

Figure 2.23 – Normal Display, Field Unit is Communicating with Host



2.8.3.2 COMM LOSS

If PB COMM LOSS is displayed, no communication is occurring between the PB PA field unit and the Host. If PBDP COMM LOSS is displayed, no communication is occurring between the PB DP field unit and the Host. 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 PB COMM LOSS is still displayed, then the solution to this problem must await full system commissioning.

If PB COMM LOSS is displayed, bus power is present but no communication to the host exists. If HARDWARE FAIL is displayed, then the bus power is not present.

Figure 2.24a illustrates the PB PA field unit with a COMM LOSS display.

Figure 2.24a – No Communications

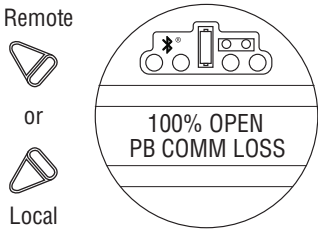
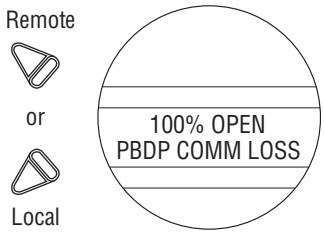


Figure 2.24b illustrates the PB DP field unit with a COMM LOSS display.

Figure 2.24b – No Communications

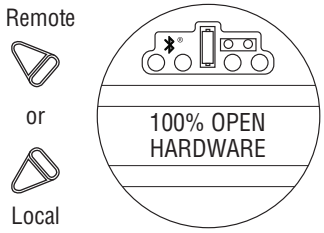


2.8.3.3 HARDWARE FAILURE

If HARDWARE FAILURE is displayed, either the device or the bus power supply has failed. Check the bus power supply voltage and the wiring connections.

Figure 2.25 illustrates the field unit with a BUS display.

Figure 2.25 – Hardware Failure, No Communication, Bus Power Lost



3 Software

3.1 PROFIBUS Protocol

This 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) and Manchester Biphase-L (PROFIBUS PA) 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 PROFIBUS Function, Transducer, and Physical Blocks

The MX/QX Actuator is designed to comply with the PROFIBUS PA Profile, Version 3.0. This profile provides the user with a standard interface for control and management.

This standard profile provides the following blocks for the network user. Details of each block are described in the following paragraphs.

- One Physical Block
- One Transducer Block
- Several Function Blocks

The Physical Block is used for general device management. A device contains only one Physical Block. Physical Blocks are usually used during commissioning and maintenance, and contain parameters such as:

- Manufacturer's Name
- Device Name (ID)
- Device Serial Number
- Identification and Maintenance (I&M) Functions

The **Transducer Block** is used to convert signals from the actuator hardware to a digital format usable by Function Blocks and the network host. It also conveys data from network users and Function Blocks, sending this data to the actual hardware.

Function Blocks contains two types of parameters. The first type, **Configuration** parameters, are used during commissioning to configure specifically what data the function block will use and how it will process the data before sending it to its final destination. These configuration parameters are sometimes called **Acyclic** parameters, because they are only read or written when needed.

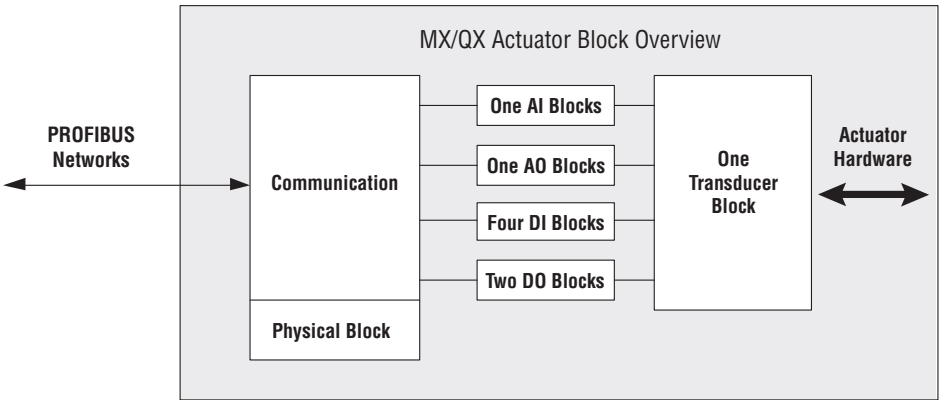
The second type of parameter in a Function block is the **Process** parameter type. These parameters provide the process data to the device or network user when the process is running. When the process is running these parameters are updated in a periodic cyclic manner and are therefore sometimes referred to as **Cyclic** data parameters.

The **Function Blocks** provide the network user with a standard interface for setting and obtaining process data in the device. Function blocks can be connected together through the host to perform the specific control functions of the process. The host device also monitors the function blocks to supervise the entire control system.

The figure below provides a block diagram view of the various standard “blocks” in the MX/QX actuator for use by the network user.

The Analog Output and Discrete Output function blocks accept commands from the network user and force the actuator to perform some kind of action, i.e., open, close, modulate, set network ESD, etc. The Analog Input and Discrete Input bunction blocks provide the network user with information from the actuator such as current position alarms, faults, etc. The following sections provide further details about each function block.

Figure 3.1 – MX/QX Actuator Block Overview



The following table provides generic descriptions of how the various blocks are used in the PROFIBUS Profile Version 3.0 standard.

Table 3.1 – Description of the Function Blocks

Function Block	Name	Number of Blocks	Description
Analog Input	AI	1	Processes field device measurements and makes them available to other function blocks; supports alarming, filtering, signal status, mode control, and simulation.
Analog Output	AO	1	Assigns an analog setpoint value to a field device through a transducer block I/O channel; supports mode control, signal status calculation, and simulation.
Discrete Input	DI	4	Processes a single discrete input from a field device and makes it available to other function blocks; supports alarming, signal status propagation, mode control, and simulation.
Discrete Output	DO	2	Processes a discrete setpoint and outputs it to a specified I/O channel to produce an output signal; supports mode control, output tracking, and simulation.
Transducer Block		1	A custom block to monitor and control the actuator; connects function blocks to actuator hardware.
Physical Block		1	A standard block to provide general management of the device.

Standard PROFIBUS parameters used in these blocks are listed in Appendix C.

Each Function Block contains a "Mode" parameter, defining the operating behavior of the function block. There are two main parts to the Mode parameter. The **Target** mode is the mode of operation desired by the network user. The **Actual** mode is the block's actual current mode.

The effect of mode on the operation of the Function Block is summarized as follows:

Out of Service (O/S) The block is not being evaluated. The output will maintain the last value or be a value defined by the user in the case of a power loss.

Local Override (LO) In the Local Override mode, the block output tracks the value of the input parameter.

Manual (Man) The block output is not being calculated. It is directly set by the network user.

Automatic (Auto) The block output is calculated using the input from the transducer block in the case of an input function block and using a setpoint value provided by the host or network user in the case of an output function block. For physical blocks and transducer blocks, this mode indicates that the block functions are enabled for operation.

Remote Cascade (RCas) The block setpoint is being set by the control application (host) through the remote cascade parameter RCAS_IN.

Execution of a function block, physical block or transducer block will be controlled by the mode parameter. Mode sub-index values are defined as follows:

1. Target – This is the mode requested by the operator. Only one mode from those allowed by the permitted mode parameter may be requested.
2. Actual – This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution.
3. Permitted – Defines the modes which are allowed for an instance of the block. The permitted mode is configured by the block design group, i.e., is defined for every block in the according data sheet. Any mode change request will be checked by the device to ensure that the request target is defined as a permitted mode.
4. Normal – This is the mode to which the clock should be set during normal operating conditions. This parameter may be configured and read by an interface device but is not used by the block algorithm.

3.3 Analog Input (AI) Function Block

The Analog Input (AI) Function Block (Figure 3.2) is a function block in the PROFIBUS Profile Version 3.0 standard. The AI block can process one of several possible process parameters and make it available to the network user. The output value from the AI block is in units of percent and contains a status indicating the quality of that process data. The actuator has several possible process parameters available in different channels. Use the channel number parameter in the function block to set which variable to obtain from the transducer block and present to the network user.

There is one AI block in the MX/QX actuator device and three possible channels of data to choose from:

Channel	Channel Name	Description
357	AI_POSITION_CHAN	Current valve position (percent)
358	AI_ANALOG_INPUT_1_CHAN	Value of 4-20 mA analog input 1 (percent)
359	AI_ANALOG_INPUT_2_CHAN	Value of 4-20 mA analog input 2 (percent)

Figure 3.2 – Summary of the Parameters of the Analog Input Function Block

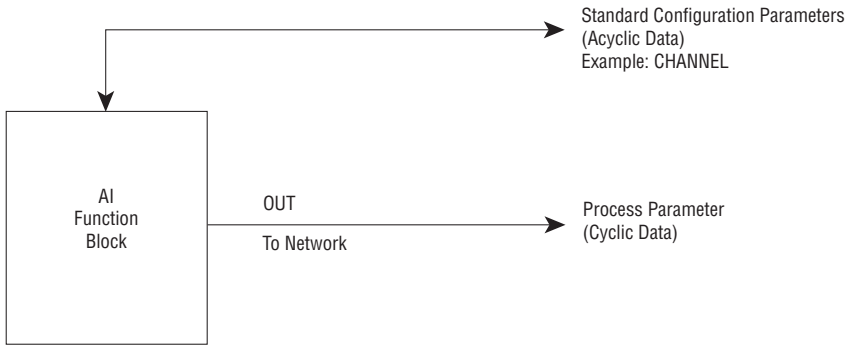
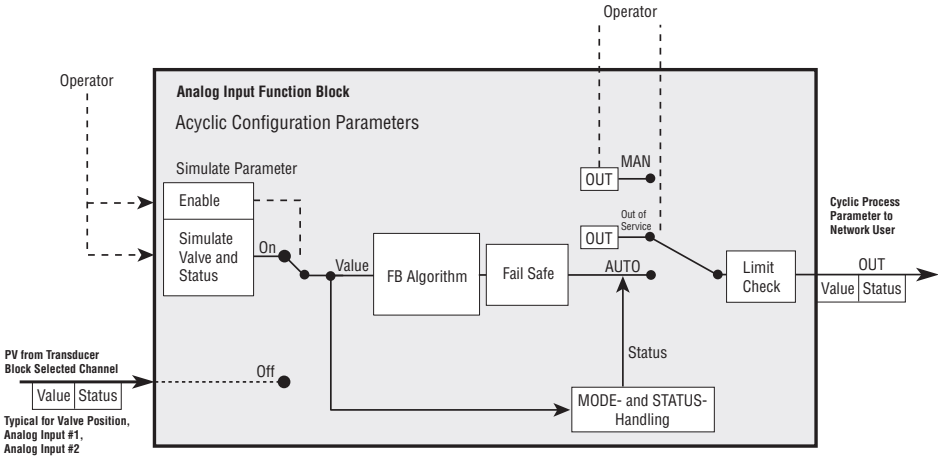


Figure 3.3 – Analog Input Block



The AI standard function block supports alarming, signal scaling, signal filtering, signal status calculation, mode control, and simulation per the PROFIBUS PA Profile, Version 3.0 specifications. In Automatic Mode, the block's output reflects the Process Variable (PV) Value and Status. In Manual Mode, the Output parameter may be set manually by the operator. Manual Mode is reflected by the output Status. The output Status can also be used to generate alarms.

Output

OUT (cyclic) is the block output value and status. It is a process parameter used during runtime and therefore is cyclic data.

Scaling

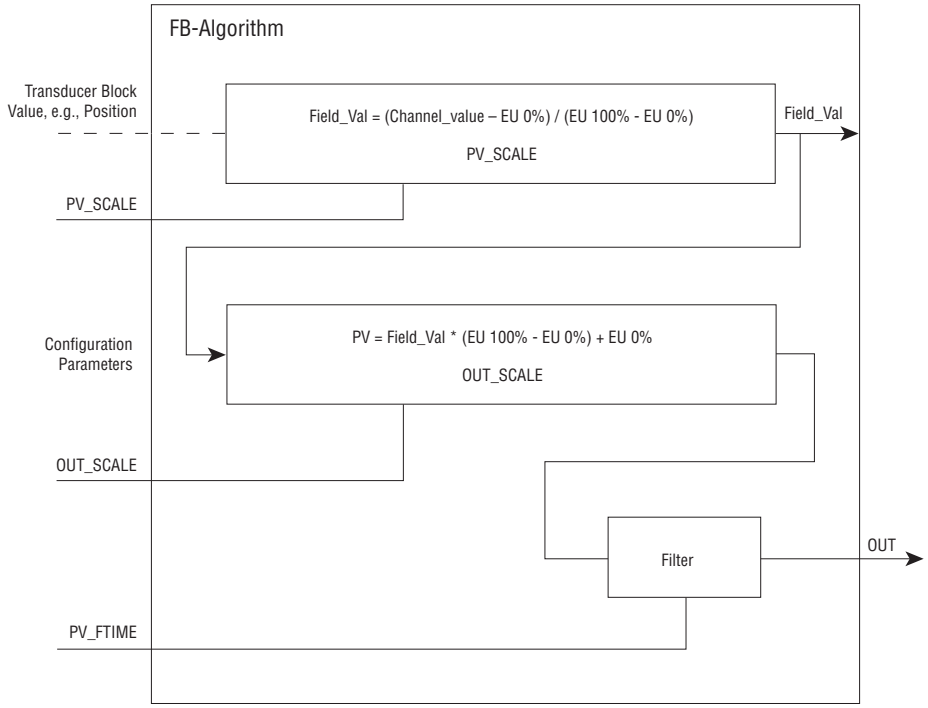
Conversion of the Process Variable into percent using the High and Low scale values. The engineering unit of PV_SCALE (acyclic) high and low scale values is directly related to the PV_UNIT (acyclic) of the configured transducer block (configured via the Channel parameter). The PV_SCALE high and low scale values follow the changes of the PV_UNIT of the related transducer block automatically, i.e., a change of the transducer block PV_UNIT causes no bump at OUT from the AI Block.

The function block parameter OUT_SCALE (acyclic) contains the values of the lower limit and upper limit effective range, the code number of the engineering unit of the Process Variable and the number of digits on the right-hand side of the decimal point.

Supported Modes of an AI Function Block

- Out of Service (O/S): The AI FB is not able to fulfill its functional calculations anymore (e.g. the parameter values in the non-volatile memory are not accessible after a reset).
- Manual (Man): The operator writes directly to the OUT parameter of the AI FB with a configuration tool.
- Automatic (Auto): The AI FB processes the value from the transducer block channel data according to all algorithms (scaling, filtering, status and mode calculation, limit checks).

Figure 3.4 – Analog Input Block Scaling and Filtering



Filter

The function block parameter PV_FTIME (acyclic) contains the time constant in seconds of the rise time of the FB output up to a value of 63.21% resulting from a jump on the input.

Fail-Safe

The parameter FSAFE_TYPE (acyclic) defines the reaction of the device if a fault is detected. The calculated ACTUAL MODE remains AUTO.

Fail-Safe	
0	Value FSAFE_VALUE is used as OUT.
1	Use of stored last valid OUT value.
2	OUT has the wrong calculated value and status.

FSAFE_VALUE (acyclic) is the default value for the OUT parameter, if a sensor electronic fault is detected due to transducer block communication problems with actuator hardware. The unit of this parameter is the same as OUT.

Channel

CHANNEL (acyclic) is the reference to the active transducer block which provides the measurement value to the function block.

Alarms (Acyclic)

- ALARM_HYS (Hysteresis) – If the process variable fluctuates around the Hi or Low limit values, it will generate many limit violations. It is therefore possible to trigger alarm only after crossing an adjustable hysteresis.
- HI_ALM, HI_HI_ALM, LO_ALM, and LO_LO_ALM – When the measured variable reaches or crosses these points, a time of day stamp is specified with these alarm parameters.

- LO_LIM, LO_LO_LIM, HI_LIM, and HI_HI_LIM – If the measured variable is equal or surpasses these limits, the limit bits in the Status byte of OUT and the FB parameter ALARM_SUM change to 1. The unit of this parameter is the same as the OUT parameter.
- ALARM_SUM – This parameter summarizes the status of the Function Block alarms.

Simulate (Acyclic)
For commissioning and test purposes, the input value from the transducer block going to the Analog Input function block can be simulated. That means the Transducer and AI-FB will be disconnected when simulation is enabled. The network user can provide the AI block with “fake” process data to test other portions of the system.

This feature requires the installation of a hardware jumper on the MX/QX PB unit, located on header X5, Pins 3-4.

3.4 Analog Output (AO) Function Block

The Analog Output (AO) block accepts a “command” value from the network user. This command value flows through the AO block algorithm. The AO block then provides this “command” data to the transducer block and the actuator takes some action based on this “command.” The function block also provides readback data, allowing the network user to configure closed loop control processes. The AO block supports mode control, signal limiting, rate limiting, signal status calculation, and simulation.

There is one AO block in the MX/QX actuator device. There is only one transducer block channel available for this Function Block to send “command” data to.

Channel	Channel Name	Description
344	AO_CNTRL_VALVE_FLOW_CHAN	Desired valve position percent

NOTE: Please note that the quality status bit must be set to “good”, prior to or while sending command data. This is required in order for the actuator to respond to AO block commands. See “Status Bit Definitions” section on page 70 for coding of quality status bits.

Figure 3.5 – Summary of the Parameters of the Analog Output Block

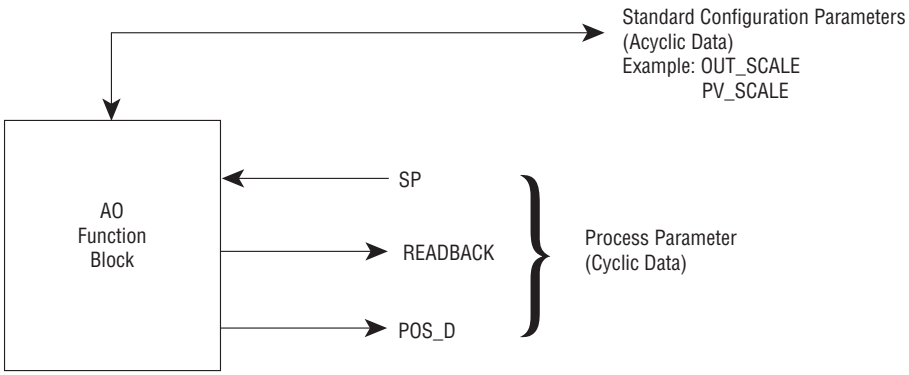
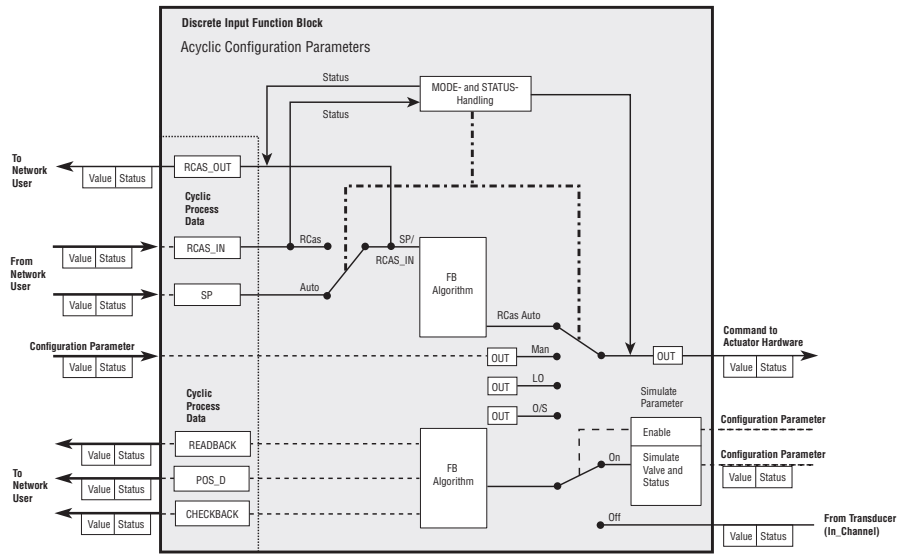


Figure 3.6 – Analog Output Function Block



Inputs

SP (cyclic) is the desired output value from an operator.

RCAS_IN (cyclic) is the desired output value from a remote station that is used when actual block mode is RCas.

IN_CHANNEL (acyclic) represents the transducer block channel number from which readback data originates and designates the actual position of the final control element. The data from this channel is read through the block READBACK algorithm.

OUT_CHANNEL (acyclic) represents the channel number to which the AO block will send its output "command" data.

INCREASE_CLOSE (acyclic) determines the direction of the positioner in mode RCAS and Auto.

INCREASE_CLOSE	
0	Rising (increasing of setpoint-input results in OPENING of the valve)
1	Falling (increasing of the setpoint-input results in CLOSING of the valve)

Outputs

The output of the function block can be set in three ways. When the block is in Manual Mode, the output can be set by the user with a configuration tool. The setpoint parameter is ignored during Manual Mode. In Automatic Mode, the output is set by the Setpoint value in engineering units. In Remote Cascade Mode, the setpoint comes from a remote computer/station. This variable is sent to the Transducer Block where some action will be taken.

RCAS_OUT (cyclic) is the function block setpoint in units of PV_SCALE and status, and is provided to a supervisory host for monitoring/back calculation and to allow action to be taken under limited conditions or mode change.

READBACK (cyclic) is the actual position of the final control element within the travel span (between OPEN and CLOSE position) in units of PV_SCALE.

POS_D (cyclic) is the current position of the valve (discrete):

POS_D	
0	Not initialized
1	Closed
2	Opened
3	Mid-travel

CHECK_BACK / CHECK_BACK_MASK (cyclic) is the detailed information of the device, bitwise coded with more than one message possible at once.

CHECK_BACK_MASK	
0	Not supported
1	Supported

Scaling
PV_SCALE (acyclic) converts the PV to engineering units of percent as the input value to the function block. It consists of the high and low scale values, engineering units code, and number of digits to the right of the decimal point.

OUT_SCALE (acyclic) is the conversion of the OUT of the function block in percent to OUT in engineering units as the output value of the function block. It consists of the high and low scale values, engineering units code, and number of digits to the right of the decimal point.

Supported Modes
The permitted modes of the AO block are Out of Service (O/S), Local Override (LO), Manual (Man), Automatic (Auto) and Remote Cascade (RCas).

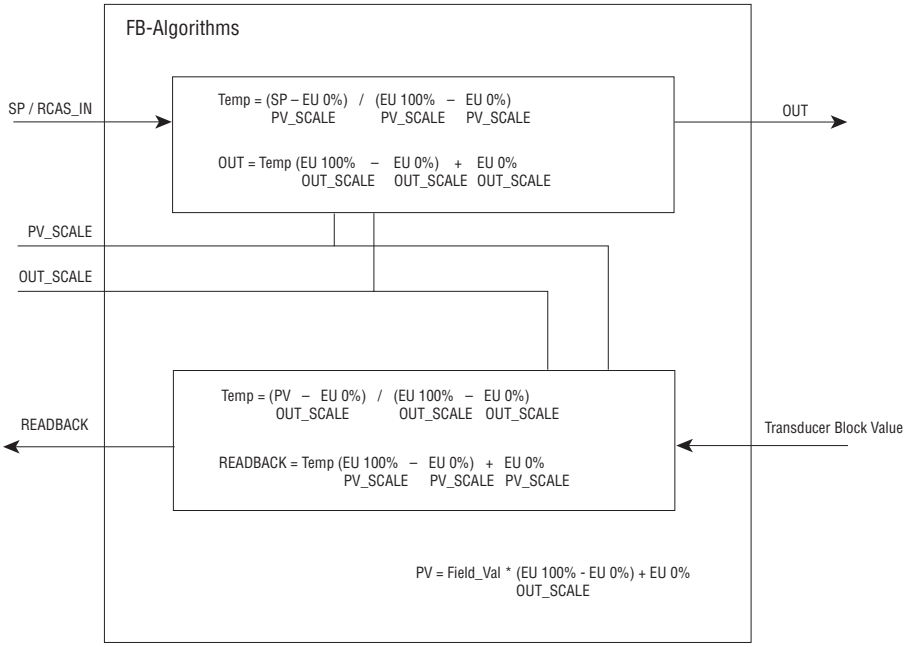
Simulate (acyclic)
For commissioning and test purposes, the input value from the transducer block going to the Analog Output function block can be simulated. That means the transducer and AO-FB will be disconnected when simulation is enabled. The network user can provide the AO block with “fake” process data to test other portions of the system.

This feature requires the installation of a hardware jumper on the MX/QX PB unit, located on header X5, Pins 3-4.

Fail-Safe
FSAVE_TIME (acyclic) is the time in seconds from detection of a failure of the actual used setpoint (SP = bad or RCAS_IN <> Good) to the action of the block if the condition still exists.

NOTE: A communication timeout changes the status of the transmitted setpoint to bad.

Figure 3.7 – Analog Output Block Scaling



FSAVE_TYPE (acyclic) defines the reaction of the device if failure of actual used setpoint is still detected after FSAVE_TIME or if the status of actual used setpoint is Initiate Fail Safe. The calculated ACTUAL MODE is AUTO respectively.

FSAVE_TYPE	
0	Value FSAVE_VALUE is used as setpoint, status of OUT = UNCERTAIN – Substitute Value.
1	Storing last valid setpoint, status of OUT = UNCERTAIN – Last usable Value or BAD – No communication, no LUV.
2	Actuator goes to fail-safe position defined by ACTUATOR_ACTION (only useful for actuators with spring return), status of OUT = BAD – non-specific.

FSAVE_VALUE (acyclic) is the setpoint used if FSAVE_TYPE = 0 and FSAVE is activated.

3.5 Discrete Input (DI) Function Block

The Discrete Input (DI) function block can process one of several possible process parameters in the actuator and make it available to the network user. The DI block supports signal inversion, mode control, signal status propagation, and simulation.

There are four DI blocks in the MX/QX actuator device, and seven channels. Each of these DI function blocks can be assigned to any one of the following channels:

Channel	Channel Name	Description
347	DI_POSITION_AND_BUS_MODE_CHAN	Valve status and control mode
348	DI_POSITION_CHAN	Valve status, moving/stopped
349	DI_ACTUATOR_FAULTS_1_CHAN	Mechanical and electrical faults 1
350	DI_ACTUATOR_FAULTS_2_CHAN	Mechanical and electrical faults 2
351	DI_ACTUATOR_ALARMS_CHAN	Emergency shutdown and inhibits
352	DI_DISC_USER_INPUT_CHAN	Discrete input from user
353	DI_READ_DISC_OUTPUT_CHAN	Read discrete output

Normally the block is used in Automatic Mode so that the Process Variable is copied to the Output. If necessary, the operator can change the mode to Manual, which disconnects the field signal and substitutes a manually entered value for the Output.

Inputs
The discrete input data comes from the transducer block, as selected by the CHANNEL (acyclic) parameter.

Outputs
OUT_D (cyclic) is the block discrete output and represents the process data obtained from the actuator hardware.

The INVERT (acyclic) option can be used to do a Boolean NOT function between the field value and the output. It indicates whether the input value of PV_D should be logically inverted before it is stored in the OUT_D parameter.

List of valid values:

INVERT	
0	Not inverted
1	Invert

Fail-Safe
The FSAFE_TYPE (acyclic) parameter defines the reaction of the device, if a fault is detected.

FSAFE_TYPE	
0	Value FSAFE_VALUE_D is used as OUT_D. Status – UNCERTAIN_Initial Value.
1	Use of stored last valid OUT_D value. Status – UNCERTAIN_LastUsableValue; if there is no valid value available, then UNCERTAIN_Initial_Value.
2	OUT_D has the wrong calculation value and status.

The FSAFE_VALUE_D (acyclic) parameter is the default value for the OUT_D parameter if a sensor electronic fault is detected (e.g., the Transducer Block is unable to communicate with the actuator hardware).

Supported Modes

Out of Service (O/S), Manual (Man), and Automatic (Auto) modes are supported. If Manual is allowed, the operator may write a value to OUT_D using a configuration tool.

Simulate (acyclic)

For commissioning and test purposes, the input value from the transducer block going to the Discrete Input function block can be simulated. That means the transducer and DI-FB will be disconnected when simulation is enabled. The network user can provide the DI block with “fake” process data to test other portions of the system.

This feature requires the installation of a hardware jumper on the MX/QX PB unit, located on header X5, Pins 3-4.

Figure 3.8 – Summary of the Parameters of the Discrete Input Function Blocks

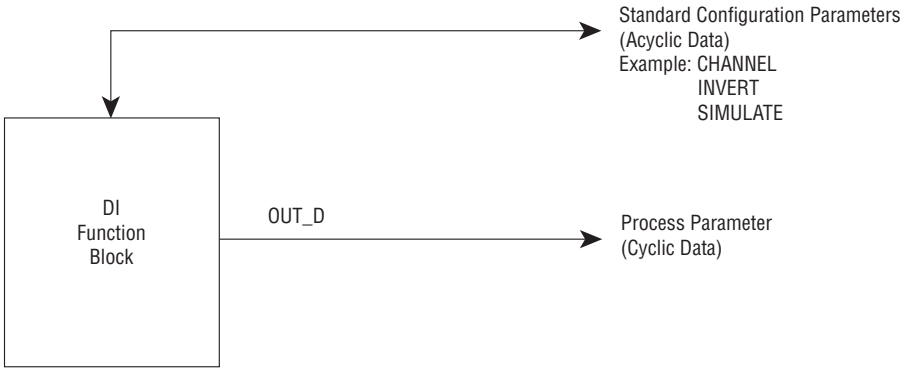
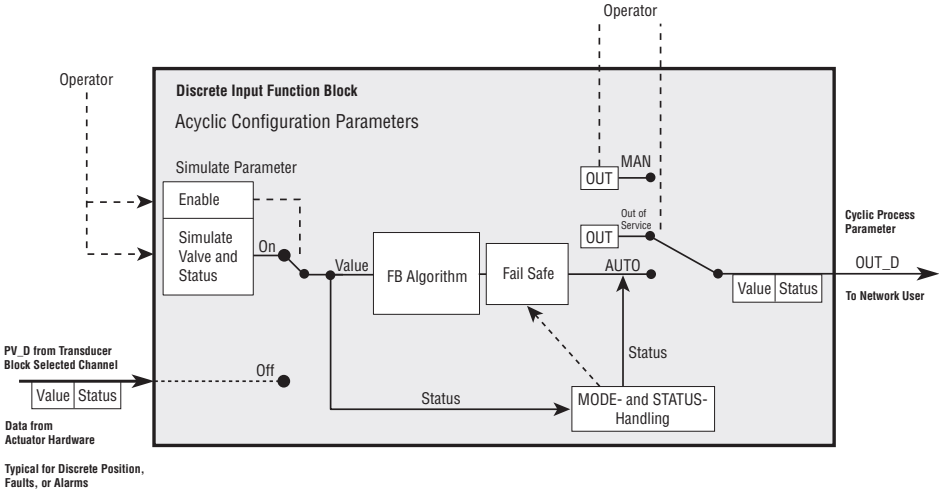


Figure 3.9 – Discrete Input Function Block



3.6 Discrete Output (DO) Function Block

The Discrete Output (DO) block accepts a "command" value from the network user. This command value flows through the DO block algorithm. The DO block then provides this "command" data to the transducer block, and the actuator takes some action based on this "command." The function block also provides readback data allowing the network user to configure closed-loop control processes. The DO block supports mode control and simulation.

There are two DO blocks in the MX/QX actuator device. Each DO function block can be assigned to one of the following channels:

Channel	Channel Name	Description
354	DO_POSITION_CHAN	Command Stop/Open/Close
355	DO_ESD_CHAN	Command Emergency Shutdown
356	DO_RELAY_CHAN	Command Energize Relays

NOTE: Please note that the quality status bit must be set to "good", prior to or while sending command data. This is required in order for the actuator to respond to DO block commands. See "Status Bit Definitions" section on page 70 for coding of quality status bits.

Figure 3.10 – Summary of the Parameters of the Discrete Output Function Block

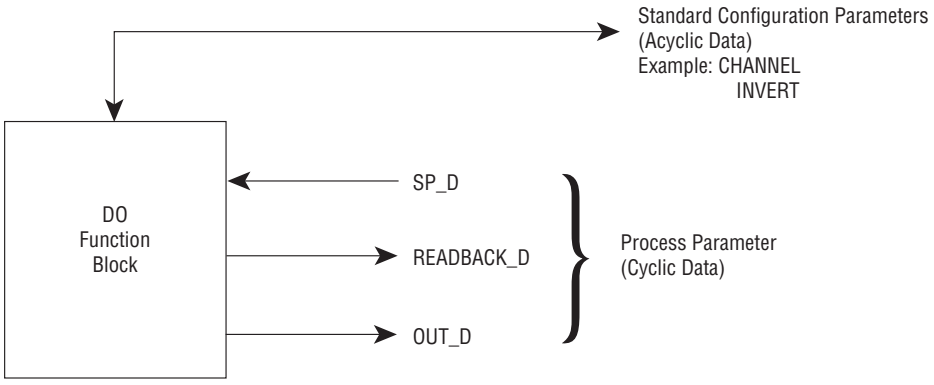
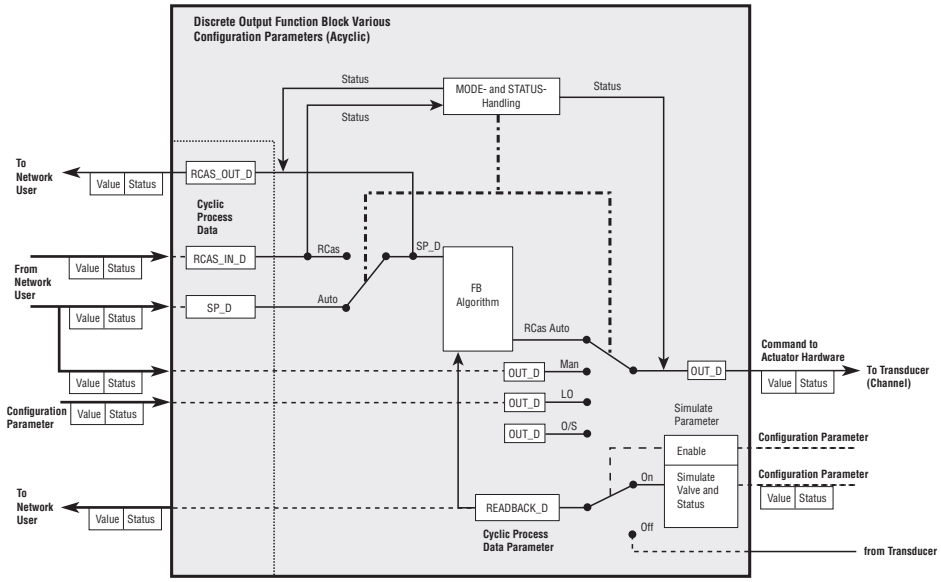


Figure 3.11 – Discrete Output Function Block



To set the DO block output command to the actuator, the operator first sets the mode of the block to define how the block obtains its output. In Auto mode, the setpoint is written to the block output. In Manual mode, the operator enters the Output directly using a configuration tool. In the Remote Cascade mode, the setpoint is determined by a host computer (Remote Station) that writes to the RCAS_IN_D input.

Inputs

RCAS_IN_D (cyclic) is the target setpoint and status provided by a supervisory host to the discrete output block used in MODE RCAS.

SP_D (cyclic) is the Setpoint of the function block used in MODE AUTO.

INVERT (acyclic) indicates whether the SP_D should be logically inverted before writing to OUT_D in mode AUTO or RCAS.

INVERT	
0	Not inverted
1	Invert

Outputs

The output of the function block and can be set in three ways. When the block is in Manual Mode, the output can be set by the user with a configuration tool. The setpoint parameter is ignored during Manual Mode. In Automatic Mode, the output is set by the Setpoint value in engineering units. In Remote Cascade Mode, the setpoint comes from a remote computer/station. OUT_D is sent to the Transducer Block where some action will be taken to control the actuator hardware.

RCAS_OUT_D (cyclic) is the function block setpoint and status provided to a supervisory host for monitoring/back calculation and to allow action to be taken under limited conditions or mode change.

CHECK_BACK_D (cyclic) contains detailed information of the device, bitwise coded. More than one message is possible at once.

CHECK_BACK_MASK is the definition of supported CHECKBACK information bits.

CHECK_BACK_MASK	
0	Not supported
1	Supported

READBACK_D (cyclic) represents the feedback data from the transducer block channel. This object indicates the position of the discrete valve and the sensor states.

Supported Modes
The permitted modes of the DO are Out of Service (O/S), LO (Local Override), Man (Manual), Auto (Automatic), and RCas (Remote Cascade).

Fail-Safe
FSAVE_TIME (acyclic) is the time in seconds from detection of a failure of the actual used setpoint (SP_D = bad or RCAS_IN <> Good) to the action of the block if the condition still exists.

NOTE: A communication timeout changes the status of the transmitted setpoint to bad.

FSAVE_TYPE (acyclic) defines the reaction of the device, if a failure of actual used setpoint is still detected after FSAVE_TIME or if the status of actual used setpoint is Initiate Fail Safe. The calculated ACTUAL MODE is AUTO respectively.

FSAVE_TYPE	
0	Value FSAVE_VALUE_D is used as setpoint status of OUT_D = UNCERTAIN – Substitute Value.
1	Storing last valid setpoint status of OUT_D = UNCERTAIN – Last usable Value or BAD – No communication, no LUV.
2	Actuator goes to fail-safe position defined by ACTUATOR_ACTION, status of OUT_D = BAD – non specific.

FSAVE_VALUE_D (acyclic) – OUT_D used if FSAVE_TYPE = 0 and FSAVE is activated.

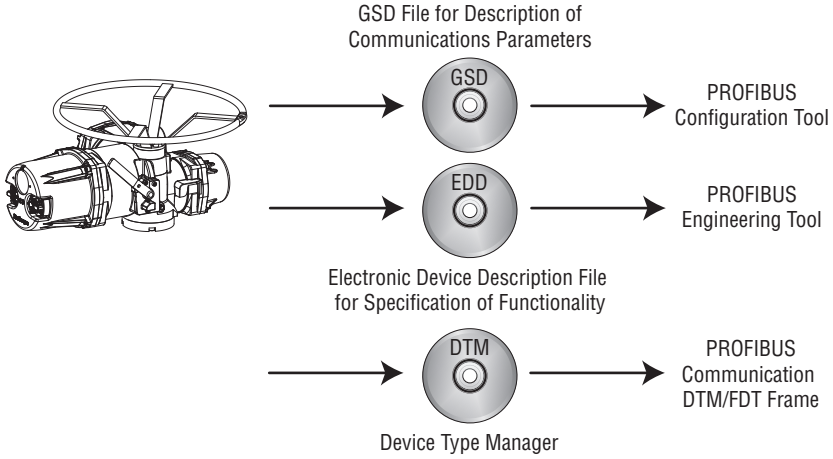
Simulate (acyclic)
For commissioning and test purposes, the input value from the transducer block going to the Discrete Output function block can be simulated. That means the transducer and DO-FB will be disconnected when simulation is enabled. The network user can provide the DO block with “fake” process data to test other portions of the system.

This feature requires the installation of a hardware jumper on the MX/QX PB unit, located on header X5, Pins 3-4.

3.7 Transducer Block

The transducer block is the interface between the function blocks and the actuator hardware. This block provides several channels for use by the function blocks to control and monitor the actuator. The MX/QX actuator uses a standard electric actuator transducer block as defined in the PROFIBUS Profile Version 3.0 specification. Additional parameters have been added to accommodate all of the additional features available in the MX/QX device. The tables in Appendix B give a full list of the available parameters.

Figure 3.12 – MX/QX PROFIBUS Configuration Requirements



3.8 GSD and Electronic Device Description, and DTM Files

PROFIBUS Configuration Tools use device-specific device database files called “GSD” files to configure PROFIBUS DP and PA devices. This simple text file (ASCII Format) provides information on cyclic parameters only. Within this file, bus timing parameters, baud rate capabilities, available cyclic data modules, and slot information specific for the MX/QX actuator device are described.

The configuration tool reads the GSD file and provides the network user with the available process data or cyclic data parameters. The user can choose to use the default configuration or specify their own configuration based on process needs. The configuration tool transfers the MX/QX PB configuration and parameter information to the PROFIBUS master. The master transfers the configuration with parameters to the slave (MX/QX PB) at power up or restart. The slave verifies and confirms the receipt of the parameters to the master.

Electronic Device Descriptions (EDDs) provide a description of the configuration parameters in the MX/QX PB to the host engineering tool. The EDDs are written in a standard Electronic Device Description Language (EDDL) which is readable by hosts that support the standard EDD language. This engineering tool is then made aware of all of the configuration parameters (acyclic data) in the MX/QX device. At this point the user can configure the block parameters to meet the needs of the runtime process.

Function Block definitions and their associated EDD description are organized into a hierarchy of common parameter sets depending on application area, device function, and manufacturing specific capabilities.

The Device Type Manager (DTM) provides an interface between its specific application software and a host’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.

4 Associated Documents

Additional information can be found in the following documents:

MX Actuator

- Quick Start-Up Instructions (MX Actuators) – Bulletin LMENIM2310
- MX Installation and Operation Manual – Bulletin LMENIM2306
- Protection, Control and Monitoring Features of MX/QX Electric Actuators – Bulletin LMENBR2300
- MX Maintenance and Spare Parts Manual – Bulletin LMENIM2314

QX Actuator

- Quick Start-Up Instructions (QX Actuators) – Bulletin LMENIM3310
- QX Installation and Operation Manual – Bulletin LMENIM3306
- Protection, Control and Monitoring Features of MX/QX Electric Actuators – Bulletin LMENBR2300
- QX Maintenance and Spare Parts Manual – Bulletin LMENIM3314

PROFIBUS

- PROFIBUS Profile – PROFIBUS PA – Profile for Process Control Devices, Version 3.02, November 2008, PROFIBUS International Order No. 3.042.
- Installation Guidelines for PROFIBUS – FMS/DP Version 1.0, PROFIBUS International Order No. 2.112.
- Profibus Installation Guideline For Cabling and Assembly, Version 1.0.6, PROFIBUS International Order No. 8.022.
- Profibus Installation Guideline For Commissioning, Version 1.0.2, PROFIBUS International Order No. 8.032.
- Technical Guideline: PROFIBUS PA User & Installation Guideline, Version 2.2, February 2003.
- PROFIBUS Specification - Slave Redundancy Version 1.2, PROFIBUS International Order No. 2.212, November 2004.

PROFIBUS documentation is available from their website: www.profibus.com.

5 How to Order Parts

To order parts or obtain further information about your Flowserve Limitorque MX/QX field unit, contact your local Flowserve distributor sales office, or:

Flowserve Corporation
Limitorque Actuation Systems
5114 Woodall Road
P.O. Box 11318
Lynchburg, VA 24506-1318

Phone (804) 528-4400

Fax (804) 845-9736

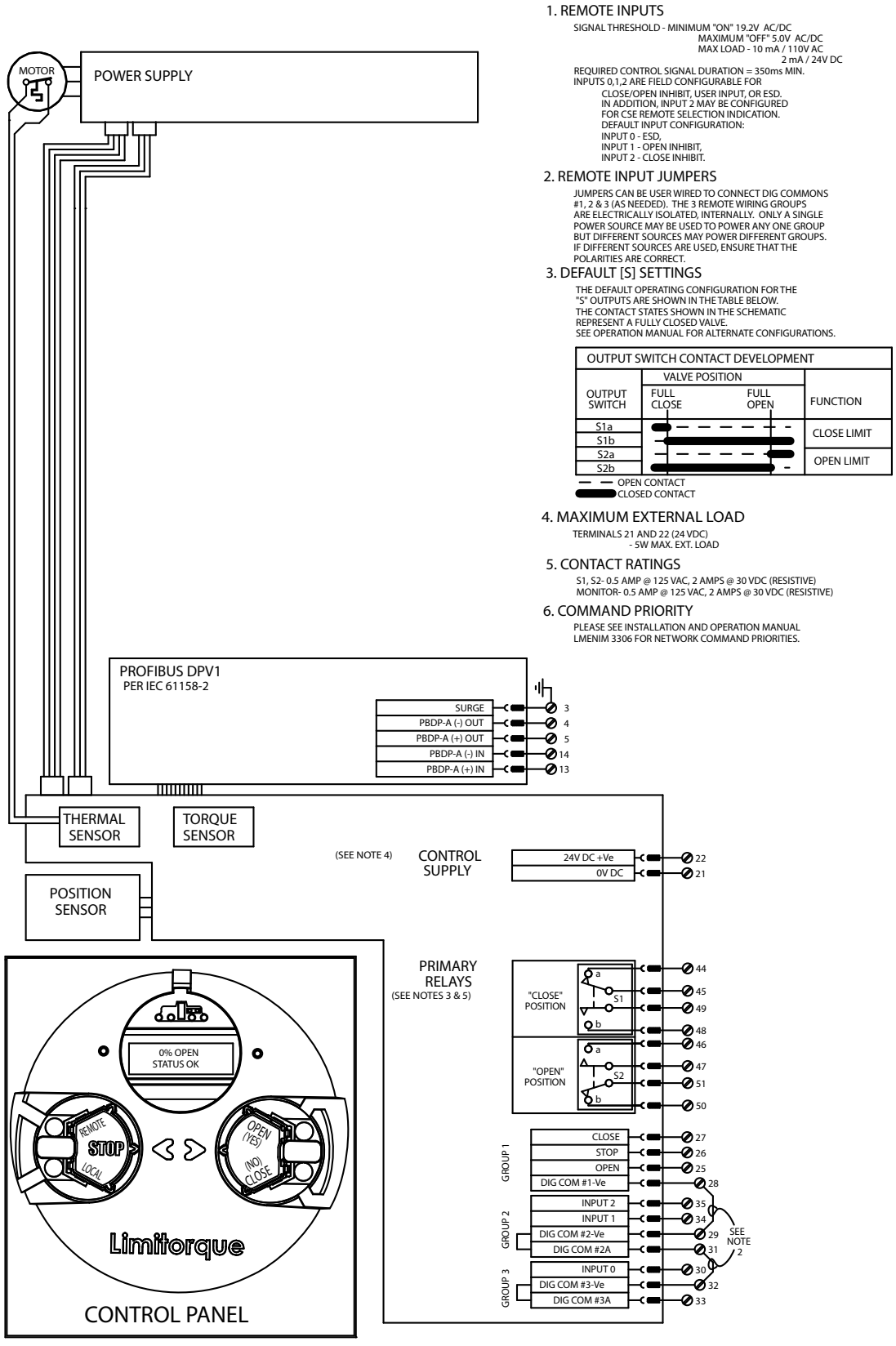
To find the Limitorque distributor or sales office near you, go to www.flowserve.com

All inquiries or orders must be accompanied by the following information supplied on the actuator nameplate:

1. Unit size
2. Order number
3. Serial number

A Appendix – Wiring Diagrams

PROFIBUS DPV1 Wiring Diagram



1. REMOTE INPUTS

SIGNAL THRESHOLD - MINIMUM "ON" 19.2V AC/DC
MAXIMUM "OFF" 5.0V AC/DC
MAX LOAD - 10 mA / 110V AC
2 mA / 24V DC

REQUIRED CONTROL SIGNAL DURATION = 350ms MIN.
INPUTS 0,1,2 ARE FIELD CONFIGURABLE FOR CLOSE/OPEN INHIBIT, USER INPUT, OR ESD. IN ADDITION, INPUT 2 MAY BE CONFIGURED FOR CSE REMOTE SELECTION INDICATION.
DEFAULT INPUT CONFIGURATION:
INPUT 0 - ESD,
INPUT 1 - OPEN INHIBIT,
INPUT 2 - CLOSE INHIBIT.

2. REMOTE INPUT JUMPERS

JUMPERS CAN BE USER WIRED TO CONNECT DIG COMMONS #1, 2 & 3 (AS NEEDED). THE 3 REMOTE WIRING GROUPS ARE ELECTRICALLY ISOLATED, INTERNALLY. ONLY A SINGLE POWER SOURCE MAY BE USED TO POWER ANY ONE GROUP BUT DIFFERENT SOURCES MAY POWER DIFFERENT GROUPS. IF DIFFERENT SOURCES ARE USED, ENSURE THAT THE POLARITIES ARE CORRECT.

3. DEFAULT [S] SETTINGS

THE DEFAULT OPERATING CONFIGURATION FOR THE "S" OUTPUTS ARE SHOWN IN THE TABLE BELOW.
THE CONTACT STATES SHOWN IN THE SCHEMATIC REPRESENT A FULLY CLOSED VALVE.
SEE OPERATION MANUAL FOR ALTERNATE CONFIGURATIONS.

OUTPUT SWITCH CONTACT DEVELOPMENT

OUTPUT SWITCH	VALVE POSITION: FULL CLOSE	VALVE POSITION: FULL OPEN	FUNCTION
S1a	●	– – – –	CLOSE LIMIT
S1b	●	●	
S2a	– – – –	●	OPEN LIMIT
S2b	●	– – – –	

– – OPEN CONTACT
● CLOSED CONTACT

4. MAXIMUM EXTERNAL LOAD

TERMINALS 21 AND 22 (24 VDC)
- 5W MAX. EXT. LOAD

5. CONTACT RATINGS

S1, S2- 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)
MONITOR- 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)

6. COMMAND PRIORITY

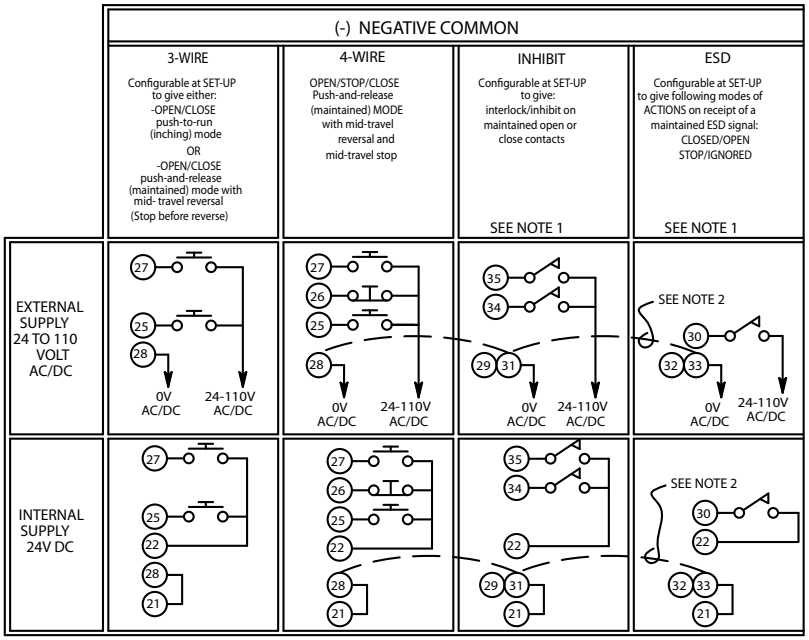
PLEASE SEE INSTALLATION AND OPERATION MANUAL LMENIM 3306 FOR NETWORK COMMAND PRIORITIES.

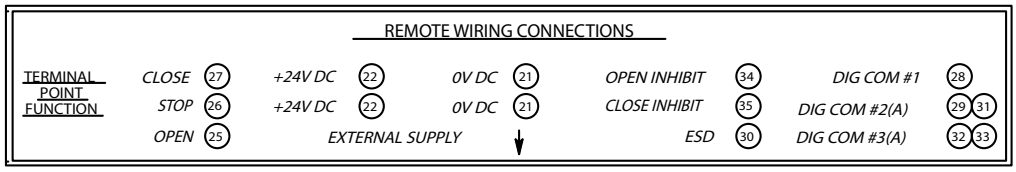
PROFIBUS DPV1 Wiring Diagram (con't.)

PROFIBUS DPV1

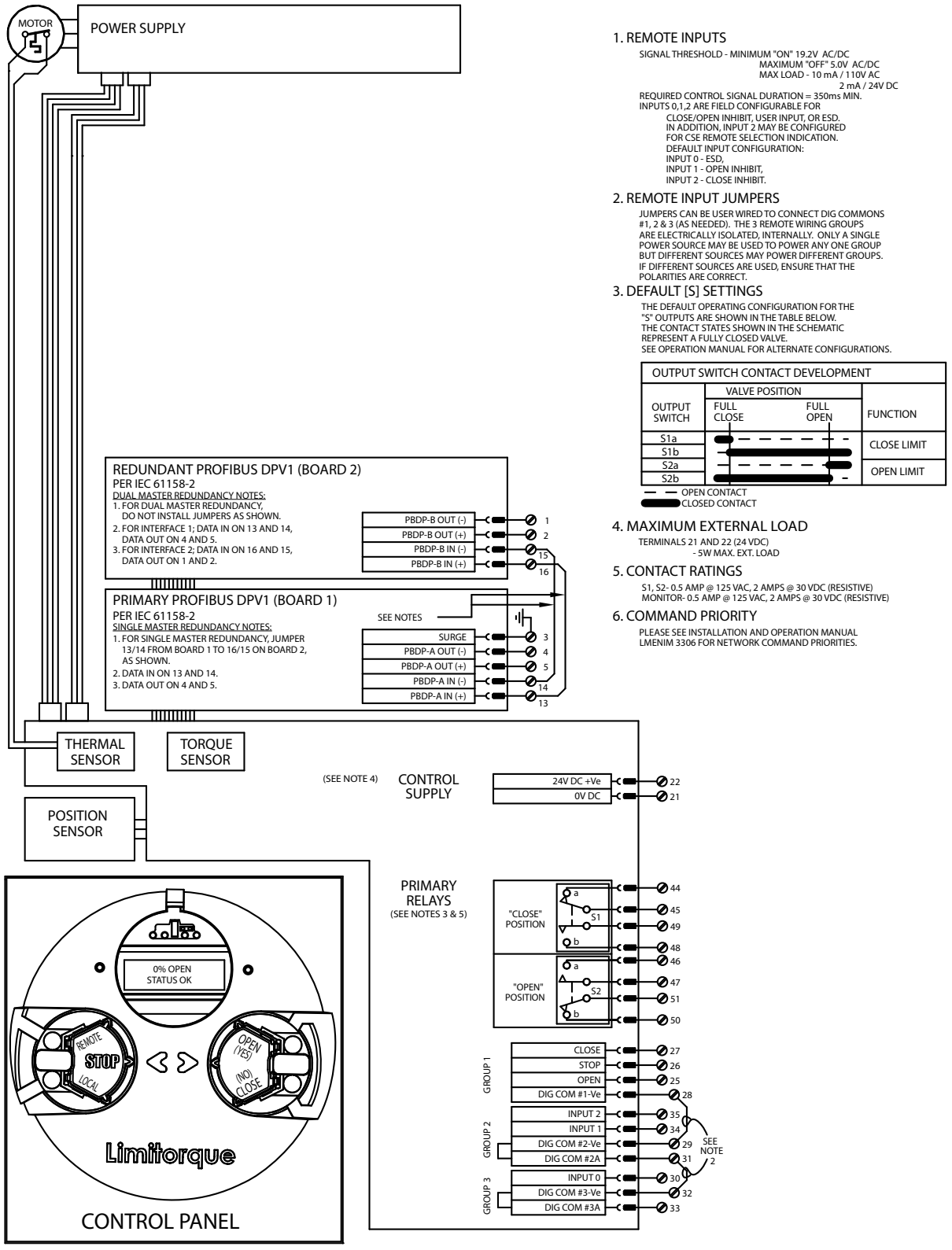
PROFIBUS JUMPERS JP1 AND JP2 MUST BE IN POSITION "A". CUSTOMER IS REQUIRED TO CONNECT WIRE BETWEEN TERMINAL 3 AND PREFERRED NETWORK GROUND, LOCATED ADJACENT TO THE TERMINAL BLOCK, FOR SURGE PROTECTION. SEE PROFIBUS DPV1/PA FIELD UNIT INSTALLATION AND OPERATION MANUAL FOR NETWORK CONNECTION DETAILS.

THE 6-PIN CONNECTOR WITH BLUE WIRES SHOULD BE CONNECTED TO J8 ON THE PROFIBUS BOARD.





Redundant PROFIBUS DPV1 Wiring Diagram



1. REMOTE INPUTS

SIGNAL THRESHOLD - MINIMUM "ON" 19.2V AC/DC
MAXIMUM "OFF" 5.0V AC/DC
MAX LOAD - 10 mA / 110V AC
2 mA / 24V DC
REQUIRED CONTROL SIGNAL DURATION = 350ms MIN.
INPUTS 0,1,2 ARE FIELD CONFIGURABLE FOR
CLOSE/OPEN INHIBIT, USER INPUT, OR ESD.
IN ADDITION, INPUT 2 MAY BE CONFIGURED FOR CSE REMOTE SELECTION INDICATION.
DEFAULT INPUT CONFIGURATION:
INPUT 0 - ESD,
INPUT 1 - OPEN INHIBIT,
INPUT 2 - CLOSE INHIBIT.

2. REMOTE INPUT JUMPERS

JUMPERS CAN BE USER WIRED TO CONNECT DIG COMMONS #1, 2 & 3 (AS NEEDED). THE 3 REMOTE WIRING GROUPS ARE ELECTRICALLY ISOLATED, INTERNALLY. ONLY A SINGLE POWER SOURCE MAY BE USED TO POWER ANY ONE GROUP BUT DIFFERENT SOURCES MAY POWER DIFFERENT GROUPS. IF DIFFERENT SOURCES ARE USED, ENSURE THAT THE POLARITIES ARE CORRECT.

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THE DEFAULT OPERATING CONFIGURATION FOR THE "S" OUTPUTS ARE SHOWN IN THE TABLE BELOW.
THE CONTACT STATES SHOWN IN THE SCHEMATIC REPRESENT A FULLY CLOSED VALVE.
SEE OPERATION MANUAL FOR ALTERNATE CONFIGURATIONS.

OUTPUT SWITCH CONTACT DEVELOPMENT			
OUTPUT SWITCH	VALVE POSITION FULL CLOSE	VALVE POSITION FULL OPEN	FUNCTION
S1a	●		CLOSE LIMIT
S1b		●	
S2a		●	OPEN LIMIT
S2b	●		

— — OPEN CONTACT
CLOSED CONTACT

4. MAXIMUM EXTERNAL LOAD

TERMINALS 21 AND 22 (24 VDC)
- 5W MAX. EXT. LOAD

5. CONTACT RATINGS

S1, S2- 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)
MONITOR- 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)

6. COMMAND PRIORITY

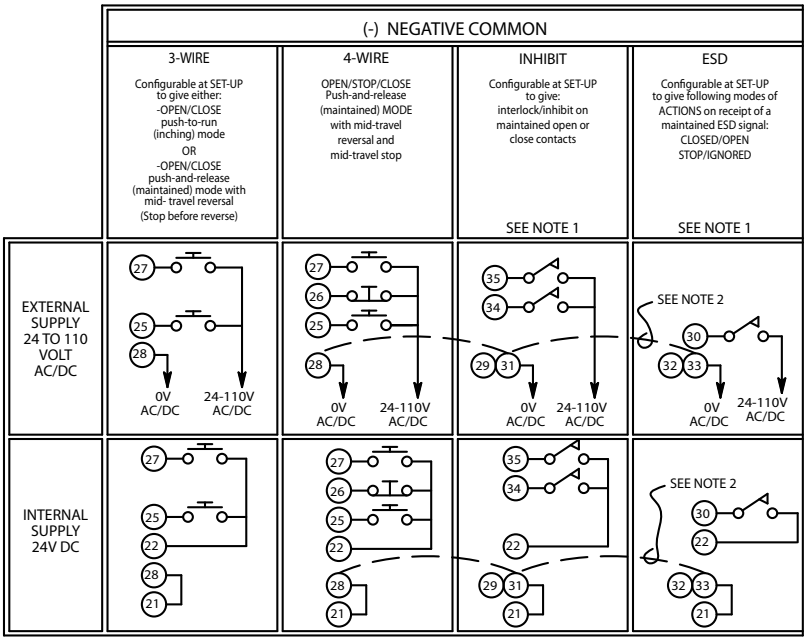
PLEASE SEE INSTALLATION AND OPERATION MANUAL LMENIM 3306 FOR NETWORK COMMAND PRIORITIES.

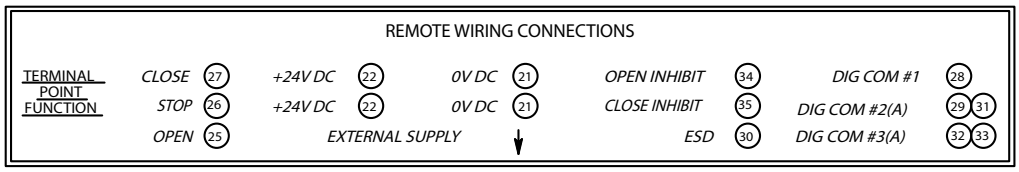
Redundant PROFIBUS DPV1 Wiring Diagram (con't.)

PROFIBUS DPV1

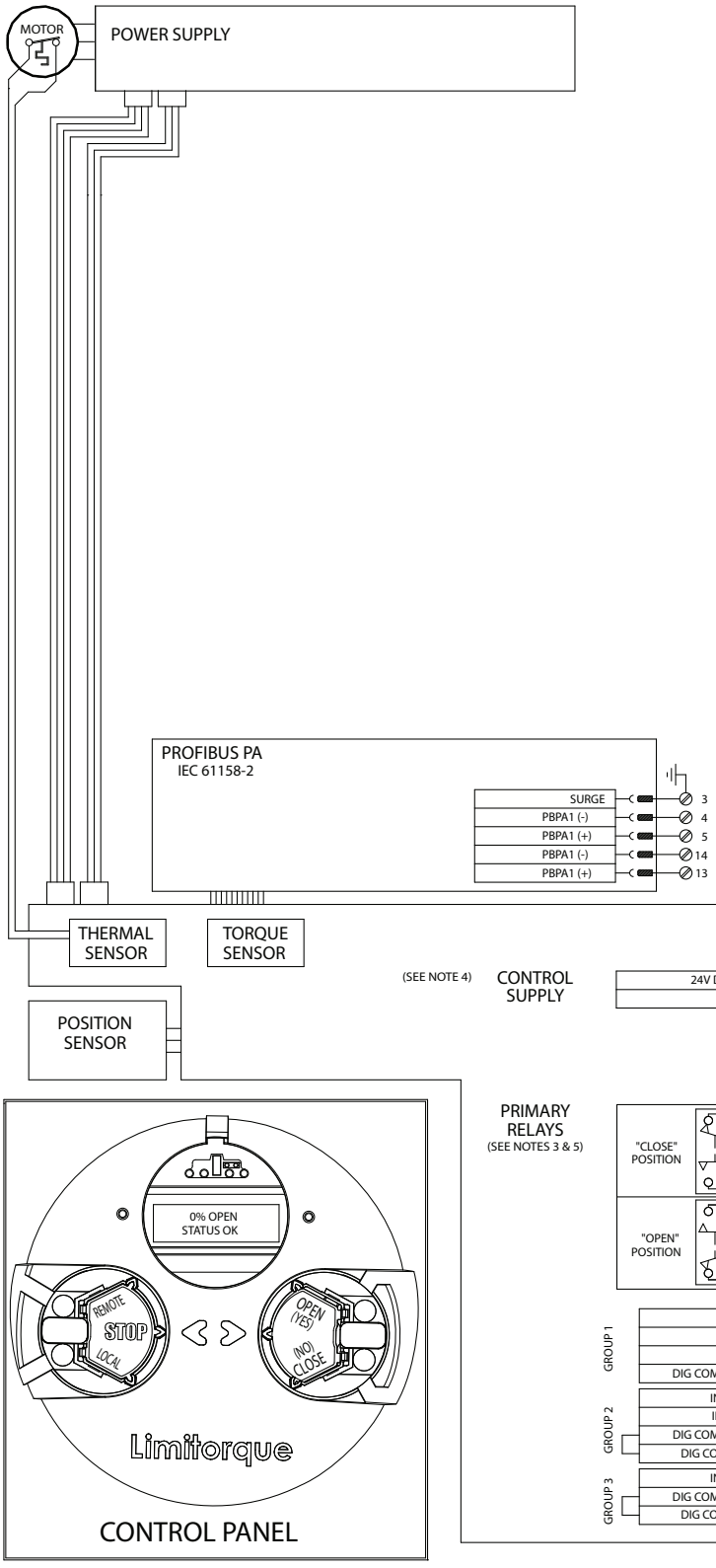
JUMPERS JP1 AND JP2 MUST BE IN POSITION "A" ON BOARD 1.
JUMPERS JP1 AND JP2 MUST BE IN POSITION "B" ON BOARD 2.
CUSTOMER IS REQUIRED TO CONNECT WIRE BETWEEN TERMINAL 3 AND PREFERRED NETWORK GROUND, LOCATED ADJACENT TO THE TERMINAL BLOCK, FOR SURGE PROTECTION. SEE PROFIBUS DPV1/PA FIELD UNIT INSTALLATION AND OPERATION MANUAL FOR NETWORK CONNECTION DETAILS.

THE 6-PIN CONNECTOR WITH BLUE WIRES SHOULD BE CONNECTED TO J8 ON BOARD 1. THE 4-PIN CONNECTOR WITH BLUE WIRES SHOULD BE CONNECTEDTO J6 ON BOARD 2.





PROFIBUS PA Wiring Diagram



1. REMOTE INPUTS

SIGNAL THRESHOLD - MINIMUM "ON" 19.2V AC/DC
MAXIMUM "OFF" 5.0V AC/DC
MAX LOAD - 10 mA / 110V AC
2 mA / 24V DC
REQUIRED CONTROL SIGNAL DURATION = 350ms MIN.
INPUTS 0,1,2 ARE FIELD CONFIGURABLE FOR
CLOSE/OPEN INHIBIT, USER INPUT, OR ESD.
IN ADDITION, INPUT 2 MAY BE CONFIGURED
FOR CSE REMOTE SELECTION INDICATION.
DEFAULT INPUT CONFIGURATION:
INPUT 0 - ESD,
INPUT 1 - OPEN INHIBIT,
INPUT 2 - CLOSE INHIBIT.

2. REMOTE INPUT JUMPERS

JUMPERS CAN BE USER WIRED TO CONNECT DIG COMMONS #1, 2 & 3 (AS NEEDED). THE 3 REMOTE WIRING GROUPS ARE ELECTRICALLY ISOLATED, INTERNALLY. ONLY A SINGLE POWER SOURCE MAY BE USED TO POWER ANY ONE GROUP BUT DIFFERENT SOURCES MAY POWER DIFFERENT GROUPS. IF DIFFERENT SOURCES ARE USED, ENSURE THAT THE POLARITIES ARE CORRECT.

3. DEFAULT [S] SETTINGS

THE DEFAULT OPERATING CONFIGURATION FOR THE "S" OUTPUTS ARE SHOWN IN THE TABLE BELOW.
THE CONTACT STATES SHOWN IN THE SCHEMATIC REPRESENT A FULLY CLOSED VALVE.
SEE OPERATION MANUAL FOR ALTERNATE CONFIGURATIONS.

OUTPUT SWITCH CONTACT DEVELOPMENT

OUTPUT SWITCH	VALVE POSITION FULL CLOSE	VALVE POSITION FULL OPEN	FUNCTION
S1a	●	– – – – – – –	CLOSE LIMIT
S1b	●	●	
S2a	– – – – – – –	●	OPEN LIMIT
S2b	●	–	

– – OPEN CONTACT
● CLOSED CONTACT

4. MAXIMUM EXTERNAL LOAD

TERMINALS 21 AND 22 (24 VDC)
- 5W MAX. EXT. LOAD

5. CONTACT RATINGS

S1, S2- 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)
MONITOR- 0.5 AMP @ 125 VAC, 2 AMPS @ 30 VDC (RESISTIVE)

6. COMMAND PRIORITY

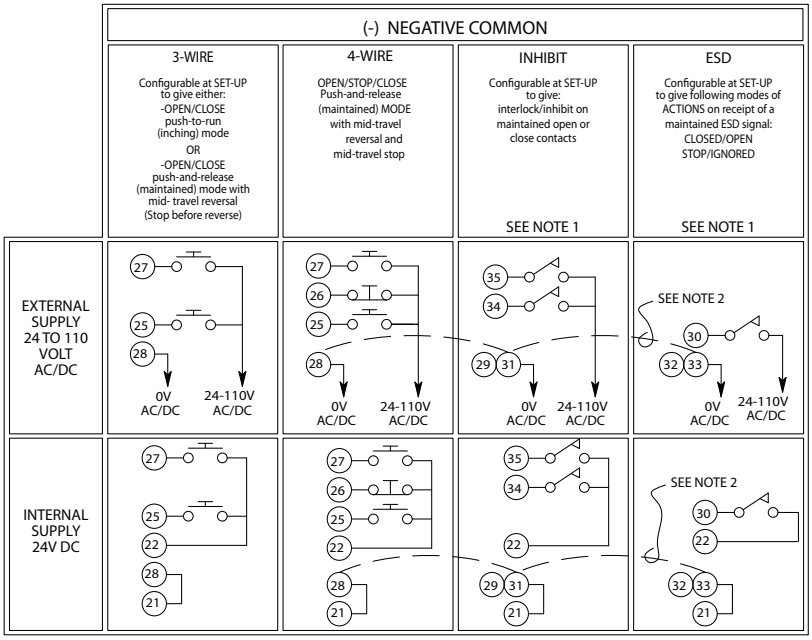
PLEASE SEE INSTALLATION AND OPERATION MANUAL LMENIM 3306 FOR NETWORK COMMAND PRIORITIES.

PROFIBUS PA Wiring Diagram (con't.)

PROFIBUS PA

PROFIBUS JUMPERS JP1 AND JP2 MUST BE IN POSITION "A". CUSTOMER IS REQUIRED TO CONNECT WIRE BETWEEN TERMINAL 3 AND PREFERRED NETWORK GROUND, LOCATED ADJACENT TO THE TERMINAL BLOCK, FOR SURGE PROTECTION. SEE PROFIBUS DPV1/PA FIELD UNIT INSTALLATION AND OPERATION MANUAL FOR NETWORK CONNECTION DETAILS.

THE 6-PIN CONNECTOR WITH BLUE WIRES SHOULD BE CONNECTED TO J8 ON THE PROFIBUS BOARD.



REMOTE WIRING CONNECTIONS

TERMINAL POINT FUNCTION								
	CLOSE	27	*+24V DC*	22	*0V DC*	21	*OPEN INHIBIT*	34	*DIG COM #1*	28
	STOP	26	*+24V DC*	22	*0V DC*	21	*CLOSE INHIBIT*	35	*DIG COM #2(A)*	29 31
	OPEN	25	*EXTERNAL SUPPLY*				*ESD*	30	*DIG COM #3(A)*	32 33

DRAWN DATE	Limitorque Actuation Systems, 5114 WOODALL ROAD, LYNCHBURG, VIRGINIA 24506-1318		
RAC 3/12/09	TITLE WIRING DIAGRAM		
CHECKED DATE	Profibus PA		
	OS		
APPROVED DATE	UNIT TYPE	DWG NO	REV SHEET 1 OF 1

B Appendix – Feature Definitions

Transducer Block I/O Channels

The following section defines the Transducer Block I/O channels available for use by the function blocks.

The transducer block for the MX/QX PB is located in Slot 9 of the device. Standard parameters start at Index 16 of the slot. Manufacturer-specific parameters begin with an offset index of 80; therefore, these parameters begin at index 96.

Transducer blocks are referenced by channel numbers. The references are parameters of the function block and are used to logically associate transducer and function block information. During block configuration, the value of the transducer block channel number may be configured for input and output function blocks.

All I/O channels contain one byte for Status.

Channel	Channel Name	Description
344	AO_CTRL_VALVE_FLOW_CHAN	Desired valve position %
347	DI_POSITION_AND_BUS_MODE_CHAN	Valve status and control mode
348	DI_POSITION_CHAN	Valve status, moving/stopped
349	DI_ACTUATOR_FAULTS_1_CHAN	Mechanical and electrical faults 1
350	DI_ACTUATOR_FAULTS_2_CHAN	Mechanical and electrical faults 2
351	DI_ACTUATOR_ALARMS_CHAN	Emergency shutdown and inhibits
352	DI_DISC_USER_INPUT_CHAN	Discrete input from user
353	DI_READ_DISC_OUTPUT_CHAN	Read discrete output
354	DO_POSITION_CHAN	Command Stop/Open/Close
355	DO_ESD_CHAN	Command Emergency Shutdown
356	DO_RELAY_CHAN	Command Energize Relays
357	AI_POSITION_CHAN	Current valve position (0-100%)
358	AI_ANALOG_INPUT_1_CHAN	Value of analog input 1 (0-100%)
359	AI_ANALOG_INPUT_2_CHAN	Value of analog input 2 (0-100%)

The actuator PROFIBUS control contains four discrete input (DI) bocks. However, as described below, there are seven DI channels to choose from, so three channels are inactive.

Details of the channels are shown in the following tables.

Channel 344 – Set Actuator Position (Index 104)

This channel, **AO_CTRL_VALVE_FLOW_CHAN**, is used to set the position of the actuator when it is locally configured to run in the Position mode.

Control valve is in units of 0-100%.

AO_CTRL_VALVE_FLOW_CHAN will only function when the actuator is in Position mode. Position mode is selected using the setup menus; refer to Bulletin LMENIM2306.

Channel 347 – Position and Bus Mode (Index 107)

This channel, **DI_POSITION_AND_BUS_MODE_CHAN**, makes actuator status information available to other function blocks. The status information describes the position of the actuator (open or closed) the direction of motion of the actuator (opening or closing), and the operating mode (Local, Remote, or Stop [off]).

Channel 347	
DI_POSITION_AND_BUS_MODE_CHAN	**Value**
Opened + Remote	0x21
Closed + Remote	0x22
Opening + Remote	0x24
Closing + Remote	0x28
Stop + Remote	0x30
Opened + Local	0x41
Closed + Local	0x42
Opening + Local	0x44
Closing + Local	0x48
Stop + Local	0x50
Opened + Stop	0x81
Closed + Stop	0x82
Opening + Stop	0x84
Closing + Stop	0x88
Stop + Stop	0x90

Channel 348 – Position Channel (Index 108)

This channel, **DI_POSITION_CHAN**, makes actuator status information available to other function blocks. The status information describes the position or direction of motion of the actuator, that is, either Opened, Closed, Opening, Closing, or Stop.

Channel 348	
DI_POSITION_CHAN	**Value**
Opened	0x01
Closed	0x02
Opening	0x04
Closing	0x08
Stop	0x10

Channel 349 – Actuator Faults 1 (Index 109)

This channel, **DI_ACTUATOR_FAULTS_1_CHAN**, makes actuator faults available to DI function blocks. The reported faults include:

- Valve jammed in motion due to a tripped torque switch.
- Valve was manually moved with the actuator handwheel.
- An over-torque condition while traveling.
- Loss of electrical phase.
- Thermal overload indicating the motor has overheated and the thermistor has opened.

Channel 349	
DI_ACTUATOR_FAULTS_1_CHAN	**Value**
Monitor Relay	0x01
Valve Jammed	0x02
Manual Moved	0x04
Over Torque	0x08
Phase Error	0x10
Motor Over Temp	0x20
Monitor Relay + Valve Jammed	0x03
Monitor Relay + Manual Moved	0x05
Monitor Relay + Over Torque	0x09
Monitor Relay + Phase Error	0x11
Monitor Relay + Motor Over Temp	0x21
Monitor Relay + Valve Jammed + Manual Moved	0x07
Monitor Relay + Valve Jammed + Phase Error	0x13
Monitor Relay + Valve Jammed + Motor Over Temp	0x23

Channel 350 – Actuator Faults 2 (Index 110)

This channel, **DI_ACTUATOR_FAULTS_2_CHAN**, makes actuator faults available to other function blocks. The reported faults include:

- Valve jammed in motion due to a tripped torque switch.
- Valve was manually moved with the actuator handwheel.
- An over-torque condition occurred while traveling in the open direction.
- An over-torque condition occurred while traveling in the close direction.
- Loss of electrical phase at the motor.
- Thermal overload indicating the motor has overheated and the thermistor has opened; time is required for the motor to cool and reset the thermistor.

Channel 350	
DI_ACTUATOR_FAULTS_2_CHAN	**Value**
Thermal Overload	0x01
Phase Error	0x02
Valve Jammed	0x04
Manual Moved	0x08
Open Torque Switch Fault	0x10
Close Torque Switch Fault	0x20
Thermal Overload + Manual Moved	0x09
Thermal Overload + Phase Error	0x03
Thermal Overload + Valve Jammed	0x05
Open Torque Switch Fault + Manual Moved	0x18
Close Torque Switch Fault + Manual Moved	0x28

Channel 351 – Actuator Alarms (Index 111)

This channel, **DI_ACTUATOR_ALARMS_CHAN**, makes actuator alarms available to other function blocks. The alarms include:

- Local emergency shutdown has occurred; the field unit will command the actuator to go to a pre-configured position, or stop, or ignore the ESD.
- Remote emergency shutdown has been received from the network host; the field unit will command the actuator to go to a pre-configured position, or stop, or ignore the ESD.
- Open inhibit is active.
- Close inhibit is active.

Channel 351	
DI_ACTUATOR_ALARMS_CHAN	**Value**
Local ESD Active	0x01
Remote ESD Active	0x02
Open Inhibit Active	0x04
Close Inhibit Active	0x08
Local ESD Active + Open Inhibit Active	0x05
Local ESD Active + Close Inhibit Active	0x09
Remote ESD Active + Open Inhibit Active	0x06
Remote ESD Active + Close Inhibit Active	0x0A
Open Inhibit Active + Close Inhibit Active	0x0C

Channel 352 – Discrete User Input (Index 112)

This channel, **DI_DISC_USER_INPUT_CHAN**, makes general-purpose contact inputs available to other function blocks. The functions in the table, such as ESD, must be configured to the OFF state locally in the MX/QX PB setup menus in order to use the inputs as general-purpose inputs. Functions, such as ESD, when configured to OFF, are not enabled. Refer to the following sections in MX Installation & Operation Manual, LMENIM2306, and QX Installation & Operation Manual, LMENIM3306:

- Section 4.15 – ESD – Emergency Shutdown
- Section 4.16 – Inhibits – Open/Close Inhibit
- Section 4.13 – Remote Control – Open/Close/Stop Pushbutton Inputs

This channel places each discrete input bit value to 0 if the discrete input is not enabled.

Channel 352			
DI_DISC_USER_INPUT_CHAN	**Terminal #**	**Alt Function**	**Value**
User Input Number 0	30	ESD Open	Bit 0
User Input Number 1	34	Open Inhibit	Bit 1
User Input Number 2	35	Close Inhibit	Bit 2
User Input Number 3	26	Stop PBS Input	Bit 3
User Input Number 4	25	Open PBS Input	Bit 4
User Input Number 5	27	Close PBS Input	Bit 5

Channel 353 – Read Discrete Output (Index 113)

This channel, **DI_READ_DISC_OUTPUT_CHAN**, allows the network user to monitor the state of two latching relays, S 1-2. These relays control external equipment, and the feedback inputs are available to other function blocks. The latching relays are configurable to be set when certain events happen, as discussed in Section 4.9, Status and Alarm Contacts in the MX Installation & Operation Manual, LMENIM2306, or QX Installation and Operation Manual, LMENIM3306. The relays can be configured to trip, for example, when the valve reaches the OPEN and CLOSED positions. This channel is formatted in bit string format such that each bit represents the readback of a single discrete output.

The configuration may be changed to Network Controlled, in which case the network user can change the state of the contacts over the network using Channel 356.

Channel 353			
DI_READ_USER_OUTPUT_CHAN	**Terminal #**	**Function**	**Value**
Discrete Output Number 1	44, 45	State of S1a	Bit 0
Discrete Output Number 2	46, 47	State of S2a	Bit 1
Discrete Output Number 3	48, 49	State of S1b	Bit 2
Discrete Output Number 4	50, 51	State of S2b	Bit 3

Channel 354 – Position (Index 114)

This channel, **DO_POSITION_CHAN**, provides three outputs to the actuator to either Stop, Open, or Close. It also provides three status readback values from the actuator, indicating:

- The actuator has stopped.
- The actuator is opening or opened.
- The actuator is closing or closed.

Discrete Output function block, DO_POSITION_CHAN, will only function when the actuator has been locally configured to be in Open/Close mode, as can be selected in the setup menus documented in the MX Installation & Operation Manual, LMENIM2306, or QX Installation and Operation Manual, LMENIM3306.

Channel 354	
DO_POSITION_CHAN	**Value**
Valid values to write to this block	
Stop	0x00
Open	0x01
Close	0x02
Readback on the DO_POSITION_CHAN	
Stop	0x00
Opening / Opened	0x01
Closing / Closed	0x02

Channel 355 – Emergency Shutdown (Index 115)

This channel, **DO_ESD_CHAN**, accepts values requesting that the network ESD be disabled or enabled. It also provides two status values, read back from the network ESD, indicating:

- The network ESD is not active.
- The network ESD is active.

Channel 355	
DO_ESD_CHAN	**Value**
Valid values to write to this block	
Disable Network ESD	0x00
Enable Network ESD	0x01
Force PBDP-A active slave	0x02
Force PBDP-B active slave	0x04
Clear force PBDP active slave	0x06
Readback on the DO_ESD_CHAN	
Network ESD NOT Active	0x00
Network ESD Active	0x01
PBDP-A is active slave & Network ESD NOT Active	0x02
PBDP-A is active slave & Network ESD Active	0x03
PBDP-B is active slave & Network ESD NOT Active	0x04
PBDP-B is active slave & Network ESD Active	0x05

Channel 356 – Relay Outputs (Index 116)

This channel, **DO_RELAY_CHAN**, provides seven outputs to control seven actuator relays, four of them latching and three non-latching. It also provides seven status values and readback of host-initiated values.

Channel 356	
DO_RELAY_CHAN	**Value**
Valid values to write to this block	
User Output S1a, S2a, S1b, S2b (standard) R1 – R4 (optional)	Bits 0-3
User Output R5 – R8 (optional)	Bits 4-7
Readback on the DO_RELAY_CHAN	
User Output S1a, S2a, S1b, S2b Relay Energized (standard) R1 – R4 Relay Energized (optional)	Bits 0-3
User Output R5 – R8 Relay Energized (optional)	Bits 4-7

NOTE: Relays must be configured for network control or data will be invalid.

Channel 357 – Actuator Position Channel (Index 117)

The valve position is in units of 0-100% of open.

Channel 358 – Analog Input 1 (Index 118)

The 4-20 mA user input is reported in units of 0-100%.

Channel 359 – Analog Input 2 (Index 119)

The 4-20 mA user input is reported in units of 0-100%.

PROFIBUS Function Block Cyclic Parameter Descriptions

The MX/QX PB device contains eight "slots." Each slot contains a specific block type. The host can configure which parameter in each of these blocks are used for cyclic data. Below are the slots and their associated block type with the default channel number for that block.

The module type for each slot is fixed, i.e., Slot 1 can only contain an Analog Output.

Slot Number	Slot Assignment	Factory Default Value	Channel Number
Slot 1	Analog Output	AO_CTRL_FLOW_CHAN	344
Slot 2	Discrete Input	DI_POSITION_AND_BUS_MODE	347
Slot 3	Discrete Input	DI_ACTUATOR_FUALTS_1_CHAN	349
Slot 4	Discrete Input	DI_ACTUATOR_FUALTS_2_CHAN	350
Slot 5	Discrete Input	DI_ACTUATOR_ALARMS_CHAN	351
Slot 6	Discrete Output	DO_POSITION_CHAN	354
Slot 7	Discrete Output	DO_ESD_CHAN	355
Slot 8	Analog Input	AI_POSITION_CHAN	357

NOTE: Any slot may be replaced with a "place holder" (EMPTY_MODULE) if no cyclic data from this block is desired.

Accessing the Cyclic Data at Runtime

The cyclic data that can be read or written by a host must be done using "consistency", that is, the data must be transferred in a fixed order. Refer to your host software manuals for proper consistent data transfer techniques.

Data Types

Structure Type	Definition
Floating Point (DS-33)	Consists of four bytes of value data and one byte of status data.
Discrete (DS-34)	Consists of one byte of value data and one byte of status data.

NOTE: The CHECKBACK parameters contain three bytes that are bitwise coded.

Status Bit Definitions

Reprinted from "PROFIBUS-PA Profile for Process Control Devices, Version 3.0."

Value & Status – Floating Point Structure

This data structure consists of the values and the state of the Floating Point parameters. These parameters can be inputs or outputs.

Data Type	Value & Status – Floating Point
Key Attribute	Index = 33
Attribute:	Number of Elements = 2
Attribute:	List of Elements (shown below)

E	Element Name	Data Type (Index)	Size
1	Value	Float - (8)	4
2	Status	Unsigned 8 - (5)	1

Coding of status

The definition of status attribute is the same for all parameters (input, output, and contained). There are four states of quality of the data, an enumerated set of sixteen sub-status values for each quality, and four states of limits placed on the data. Limit information is generated for all status attributes of all parameters having status. Quality bit #7 and #6 (for cascade mode) must be set to "good" in the second word of the data message while writing to AO and DO function blocks. See coding structure below for details.

Quality		Quality		Substatus		Limits		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
0	0							= bad
0	1							= uncertain
1	0							= good (Not Cascade)
1	1							= good (Cascade)

				Meaning at				*= bad*
0	0	0	0	0	0			= non-specific
0	0	0	0	0	1			= configuration error
0	0	0	0	1	0			= not connected
0	0	0	0	1	1			= device failure
0	0	0	1	0	0			= sensor failure
0	0	0	1	0	1			= no communication (last usable value)
0	0	0	1	1	0			= no communication (no usable value)
0	0	0	1	1	1			= out of service

				Meaning at				*= uncertain*
0	1	0	0	0	0			= non-specific
0	1	0	0	0	1			= last usable value
0	1	0	0	1	0			= substitute-set
0	1	0	0	1	1			= initial value
0	1	0	1	0	0			= sensor conversion not accurate

0	1	0	1	0	1			= engineering unit violation (unit not in the valid set)
0	1	0	1	1	0			= sub-normal
0	1	0	1	1	1			= configuration error
0	1	1	0	0	0			= simulated value
0	1	1	0	0	1			= sensor calibration

Meaning at								*= good (Non Cascade)*
1	0	0	0	0	0			= ok
1	0	0	0	0	1			= Update Event
1	0	0	0	1	0			= active advisory alarm (priority < 8)
1	0	0	0	1	1			= active critical alarm (priority > 8)
1	0	0	1	0	0			= unacknowledged update event
1	0	0	1	0	1			= unacknowledged advisory alarm
1	0	0	1	1	0			= unacknowledged critical alarm
1	0	1	0	0	0			= initiate fail safe
1	0	1	0	0	1			= maintenance required

Meaning at								*= good (Cascade)*
1	1	0	0	0	0			= ok
1	1	0	0	0	1			= initialization acknowledged
1	1	0	0	1	0			= initialization request
1	1	0	0	1	1			= not invited
1	1	0	1	0	0			= reserved
1	1	0	1	0	1			= do not select
1	1	0	1	1	0			= local override
1	1	0	1	1	1			= reserved
1	1	1	0	0	0			= initiate fail safe

Meaning of the bits 'Limits'

						0	0	= ok
						0	1	= low limited
						1	0	= high limited
						1	1	= constant

Continued

Invalid status values

Quality		Quality		Substatus		Limits		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	0	0	0	0	1	0	= good (Non Cascade)
1	1	0	0	0	0	1	0	= good (Cascade)
1	0	0	0	0	0	0	1	= good (Non Cascade)
1	1	0	0	0	0	0	1	= good (Cascade)

Reserved status values

Quality		Quality		Substatus		Limits		
Gr	Gr	QS	QS	QS	QS	Qu	Qu	
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	

								Meaning at	*= bad*
0	0	1	0	0	0	*	*		reserved
									…
0	0	1	1	1	1	*	*		reserved

								Meaning at	*= uncertain*
0	1	1	0	1	0	*	*		reserved
									…
0	1	1	1	1	1	*	*		reserved

								Meaning at	*= good (Non-Cascade)*
1	0	0	1	1	1	*	*		reserved
1	0	1	0	1	0	*	*		reserved
1	0	1	1	1	1	*	*		reserved

								Meaning at	*= good (Cascade)*
1	1	1	0	1	0	*	*		reserved
									…
1	1	1	1	1	1	*	*		reserved

Use of the status byte for profile compliant devices

0	0	0	1	0	0	0	1

Bad – sensor failure, low limited – lower physical range of the sensor reached

0	0	0	1	0	0	1	0

Bad – sensor failure, high limited – upper physical range of the sensor reached

1	0	0	0	1	0	0	1

Good (Non-Cascade), active advisory alarm, low limited –(e.g. LO_LIM of OUT is crossed)

1	0	0	0	1	0	1	0

Good (Non-Cascade), active advisory alarm, high limited (e.g. HI_LIM of OUT is crossed)

1	0	0	0	1	1	0	1

Good (Non-Cascade), active critical alarm, low limited (e.g. LO_LO_LIM of OUT is crossed)

1	0	0	0	1	1	1	0

Good (Non-Cascade), active critical alarm, high limited (e.g. HI_HI_LIM of OUT is crossed)

1	0	0	0	0	1	*	*

Good (Non-Cascade), Update Event – Parameter with S attribute changed

Module Key

Parameter	Data Structure
SP(short)	Output parameter from the host that consists of 5 bytes (DS-33 Float + Status).
SP(long)	Output parameter from the host that consists of 5 bytes (DS-33 Float + Status).
RCAS_IN	Output parameter from the host that consists of 5 bytes (DS-33 Float + Status).
RCAS_OUT	Input parameter to the host that consists of 5 bytes (DS-33 Float + Status).
READBACK	Input parameter to the host that consists of 5 bytes (DS-33 Float + Status).
POS_D	Input parameter to the host that consists of 2 bytes (DS-34 + Status).
CHECKBACK	Input parameter to the host that consists of 3 bytes.
OUT(short)	Input parameter to the host that consists of 5 bytes (DS-33 Float + Status).
OUT(long)	Input parameter to the host that consists of 5 bytes (DS-33 Float + Status).
OUT_D	Input parameter to the host that consists of 2 bytes (DS-34 + Status).
SP_D	Output parameter from the host that consists of 2 bytes (DS-34 + Status).
READBACK_D	Input parameter to the host that consists of 2 bytes (DS-34 + Status).
CHECKBACK_D	Input parameter to the host that consists of 3 bytes.
RCAS_IN_D	Output parameter from the host that consists of 2 bytes (DS-34 + Status).
RCAS_OUT_D	Input parameter to the host that consists of 2 bytes (DS-34 + Status).

Slot 1 – Analog Output Block

There are eight possible module configurations that can be inserted into this slot:

Parameter Key: (RIN = RCAS_IN, RB = READBACK, ROUT = RCAS_OUT, CB = CHECKBACK)

Slot 1 – Analog Output Block	
Module	SP(short)
	SP(long)
	RCAS_IN + RCAS_OUT
	SP + READBACK + POS_D
	SP + CHECKBACK
	SP + READBACK + POS_D + CHECKBACK
	RCAS_IN + RCAS_OUT + CHECKBACK
	SP + RIN + RB + ROUT + POS_D + CB

Slot 2 through 5 – Discrete Input Block

There is one possible module configuration that can be inserted into any of these four slots:

Slot 2 through 5 – Discrete Input Block	
Module	OUT_D

Slot 6 and 7 – Discrete Output Block

There are seven possible module configurations that can be inserted into any of the two slots:

Parameter Key:

(RB_D = READBACK, CB_D = CHECKBACK, ROUT_D = RCAS_OUT_D, RIN_D = RCAS_IN_D)

Slot 6 and 7 – Discrete Output Block	
Module	SP_D
	SP_D + RB_D
	SP_D + CB_D
	SP_D + RB_D + CB_D
	RIN_D + ROUT_D
	RIN_D + ROUT_D + CB_D
	SP_D + RB_D + RIN_D + ROUT_D + CB_D

Slot 8 – Analog Input Block

There are two possible module configurations that can be inserted into the slot:

Slot 8 – Analog Input Block	
Module	OUT(short)
	OUT(long)

Standard Parameters and Objects

Parameter	Description
Block Object (Index 16)	This object applies to every block and is placed before the first parameter. It contains the characteristics of the block, e.g., block type and profile number.
Static Revision Parameter (ST_REV) (Index 17)	The value of the static revision parameter may be used by a configuration device to determine if a block parameter(s) stored in static memory has changed in value. A change in a static parameter will cause the static revision parameter of the associated block to be incremented.
Tag Description Parameter (TAG_DESC) (Index 18)	The tag description is a user-supplied description of the block.
Strategy Parameter (STRATEGY) (Index 19)	The strategy parameter has a user-supplied value. This assigned value may be used in configuration or diagnostics as a key in sorting block information.
Alert_Key Parameter (ALERT_KEY) (Index 20)	The Alert_Key parameter has a user-assigned value which may be used in sorting alarms or events generated by a block.
Target Mode Parameter (TARGET_MODE) (Index 21)	The target mode attribute indicates what mode of operation is desired for the block. It is normally set by a control application or by an operator.
Mode Parameter (MODE_BLK) (Index 22)	The mode parameter is a structured parameter composed of the actual mode, the normal mode and the permitted mode. The actual mode is set by the block during its execution to reflect the mode during execution. The normal mode is the desired operating mode of the block. The permitted mode shows which changes of the target mode are valid for the specific block to the remote user.

Execution of a function block, physical block or transducer block will be controlled by the mode parameter. Mode sub-index values are defined as follows:

1. Target – This is the mode requested by the operator. Only one mode from those allowed by the permitted mode parameter may be requested.
2. Actual – This is the current mode of the block, which may differ from the target based on operating conditions. Its value is calculated as part of block execution.
3. Permitted – Defines the modes which are allowed for an instance of the block. The permitted mode is configured by the block design group, i.e., is defined for every block in the according data sheet. Any mode change request will be checked by the device to ensure that the request target is defined as a permitted mode.
4. Normal – This is the mode to which the clock should be set during normal operating conditions. This parameter may be configured and read by an interface device but is not used by the block algorithm.

Parameter	Description
Alarm Summary Parameter (ALARM_SUM) (Index 23)	The parameter alarm summary summarizes the status of up to 16 block alarms. For each alarm, the current states, unacknowledged states, unreported states and disabled states are maintained.

Actuator Transducer Block Custom Parameter Descriptions

Some parameters are optional and not used and thus are not included in this discussion. Some parameters are mandatory and are not used. These are included but noted as "not used."

Parameter	Transducer Block Description
ACTUATOR_ACTION (Index 79 – Not Used)	Fail-safe position for power-loss of the actuator.
ACTUATOR_MAN (Index 76)	Name of actuator manufacturer.
ACTUATOR_TYPE (Index 78)	Type of actuator: 0 = electropneumatic 1 = electric 2 = electrohydraulic 3 = others
DIAGNOSTIC_VALUES (Index 97)	Manufacturer-specific parameter that contains an array or 16 bit words: Array Index 0: Unused Array Index 1: Main Voltage Array Index 2: Actuator Position Array Index 3: Analog Input #1 Array Index 4: Analog Input #2
DOWNLOAD_ PARAMETER (Index 102 – Not Used)	Manufacturer-specific parameter.
FACTORY_DIAGNOSTIC (Index 101 – Not Used)	Manufacturer-specific parameter.
FEEDBACK_VALUE (Index 74)	The actual position of the final control element in units of OUT_SCALE.
LIN_TYPE (Index 41 – Not Used)	Type of Linearization.
POSITIONING_VALUE (Index 73)	The actual command variable for the final control elements in units of OUT_SCALE. Status BAD will drive the actuator to the fail-safe position defined by ACTUATOR_ACTION.
RATED_TRAVEL (Index 48)	Nominal stroke of the valve in units of OUT_SCALE.

Parameter	Transducer Block Description
SCALED_VALUES (Index 96)	Manufacturer-specific parameter that contains an array of three 16-bit words: Array Index 0: Bit 0 – APT (Analog Position Transmitter) APT Enabled = 1 APT Disabled = 0 Bit 1 – APT Polarity: 1 = high value 20 mA 0 = high value 4 mA Bit 2 – ATT (Analog Torque Transmitter) ATT Enabled =1 ATT Disabled = 0 Bit 3 – ATT Polarity: 1 = high value 20 mA 0 = high value 4 mA Bit 4 – DDC Offset: 1 = 4 mA 0 = 0 mA Bits 5-8 – Not Used Bits 9-10 – Scaling: 0 = 0-100 1 = 0-255 2 = 0-4,095 Bits 11-15 – Not Used Array Index 1: APT Modbus Register 3 (word) Array Index 2: ATT Modbus Register 4 (word)
SELF_CALIB_CMD (Index 49 – Not Used)	Initialization of a device-specific (manufacturer-specific) calibration procedure
SELF_CALIB_STATUS (Index 50 – Not Used)	Result of status of the device-specific calibration procedure.
SETP_CUTOFF_DEC (Index 54)	When the servo setpoint goes below the defined percent of span, the position goes to the limit position CLOSE.
SETP_CUTOFF_INC (Index 55)	When the servo setpoint goes above the defined percent of span, the position goes to the limit position OPEN.
TARGET_ERROR (Index 103 – Not Used)	Manufacturer-specific parameter.
TP_STATUS (Index 100)	Manufacturer-specific parameter that contains an array in 16-bit word format: Array Index 0: Unused Array Index 1: Start_Position Array Index 2: Stop_Position Array Index 3: Num_Samples Array Index 4: Max_Torque_Mid Array Index 5: Max_Torque_Position Array Index 6: Avg_Torque Array Index 7: Stop_Torque Array Index 8: Max_Torque_BOT Array Index 9: Max_Torque_EOT

Parameter	Transducer Block Description
TQ_STATUS (Index 99)	Manufacturer-specific parameter that contains an array in 16-bit word format: Array Index 0: Unused Array Index 1: MB_TQ_C_Avg_Last Array Index 2: MB_TQ_O_Avg_Last Array Index 3: MB_TQ_O_Peak_Last Array Index 4: MB_TQ_O_Breakout_Last Array Index 5: MB_TQ_C_Breakout_Last Array Index 6: MB_TQ_O_Ending_Last Array Index 7: MB_TQ_C_Ending_Last Array Index 8: MB_TQ_C_Peak_Last Array Index 9: MB_TQ_O_Peak_Ref Array Index 10: MB_TQ_O_Breakout_Ref Array Index 11: MB_TQ_C_Breakout_Ref Array Index 12: MB_TQ_O_Ending_Ref Array Index 13: MB_TQ_C_Ending_Ref Array Index 14: MB_TQ_C_Peak_Ref
TRAVEL_LIMIT_LOW (Index 63)	Lower limit of the valve position in percent of travel span.
TRAVEL_LIMIT_UP (Index 64)	Upper limit of the valve position in percent of travel span.
TRAVEL_RATE_DEC (Index 65 – Not Used)	Configurable time for full-span change (closing time of the valve) in seconds.
TRAVEL_RATE_INC (Index 66 – Not Used)	Configurable time for full-span change (opening time of the valve) in seconds.
VALVE_MAINT_DATE (Index 67)	Date of last valve maintenance.
VALVE_MAN (Index 75)	Name of valve manufacturer.
VALVE_SER_NUM (Index 80)	Serial number of the valve belonging to the positioner or electronic device.
VALVE_STATUS (Index 98)	Manufacturer-specific parameter that contains an array in 16-bit word format: Array Index 0: Requested relay channel value Array Index 1: Status Register – Modbus Register 9 Array Index 2: Fault Register – Modbus Register 10 Array Index 3: Digital Output Register – Modbus Register 11 Array Index 4: Digital Input Register #1 – Modbus Register 12 Array Index 5: Digital Input Register #2 – Modbus Register 13
VALVE_TYPE (Index 77)	Type of valve: 0 = linear moving valve, sliding valve 1 = rotary moving valve, part-turn 2 = rotary moving valve, multi-turn
FD_FIRMWARE_VERSION (Index 120)	Internal field device firmware version (Read-only USIGN16 Hex value).
TORQUE (Index 121)	Torque parameter record (Read-only). Members:

Data type	Description
USIGN8	CLOSE_SETTING value in percent of unit rating.
USIGN8	OPEN_SETTING value in percent of unit rating.
USIGN8	BOOST_SETTING value 1 = On, 2 = Off, 4 = Auto.
USIGN8	OUTPUT value in percent of unit rating.

Identification and Maintenance (I&M) Functions

As per "Profile Guidelines Part 1: Identification & Maintenance Functions Version 1.2 Oct-2009 Order # 3.502" PROFIBUS DP-V1 field unit supports access to device I&M data using MSAC2S services.

1) I&M0

I&M0 data can be accessed at DP-V1 absolute index 255 of slot 0 (Physical block).
I&M0 data record structure is described in the following table.

Member Parameter (Data Type)	Description
HEADER (OctetString[10])	Reserved. All bytes filled with ASCII value 32 (0x20) of space character.
MANUFACTURER_ID (USIGN16)	Manufacturer identification number of Flowserve assigned by PROFIBUS organization.
ORDER_ID (VisibleString[20])	First 10 bytes are filled with manufacturer specific 10 digit unit order identification number. Last 10 bytes are filled with ASCII value 32 or 0x20 of space character.
SERIAL_NUMBER (VisibleString[16])	Manufacturer specific 16 digit unique unit serial number consists of 8 digit QA stamp number + 8 digit QA date in the format YYYYMMDD.
HARDWARE_REVISION (USIGN16)	Encoded value of the hardware revision number of the PROFIBUS DP board. For example hexadecimal value 0x0100 indicates board hardware Rev 1.0
SOFTWARE_REVISION (1 Char + USIGN8[3])	This structure encodes the PROFIBUS DP board software revision number as described below: First character byte indicates the ASCII value 86 (0x56) of type recognition character 'V'. Second octet indicates the value of the functional enhancement digit. Third octet indicates the value of the bug fix digit. Fourth octet indicates the value of the internal change digit. For example record value {86, 3, 0, 0} indicates the PROFIBUS DP board software revision number is V3.0.0
REV_COUNTER (USIGN16)	Static revision counter. This counter keeps track of the number of write access to any static attributed parameter of the unit. This counter rolls over to 1 when it overflows.
PROFILE_ID (USIGN16)	PROFIBUS organization assigned profile identification number that is implemented by the slave unit.
PROFILE_SPECIFIC_TYPE (USIGN16)	Profile specific type value. Most significant byte indicates the BLOCK_OBJECT value and least significant byte indicates the PARENT_CLASS value of this slot.
IM_VERSION (USIGN8[2])	Encoded value indicates the version number of the PROFIBUS I&M functions specifications that is implemented by the slave unit. For example array elements value {1, 2} indicates I&M functions specification version number is 1.2
IM_SUPPORTED (USIGN16)	Bit enumerated value indicates the list of I&M functions supported by the slave unit. Bit0 = Profile specific I&M functions, Bit1 = I&M1 functions, Bit2 = I&M2 functions ... Bit15 = I&M15 functions. Bit value 0 = I&M function not supported, 1 = I&M function supported.

C Appendix – PROFIBUS Function Block

Acyclic Parameter Descriptions

Function blocks for the MX/QX PB are located in slots 1 through 8 of the device. The standard parameters of the function block begin at index 16 of the slot. The function block-specific parameters start at index 25 or 26 depending on the function block type.

Standard Function Block Parameters

Parameter	Description
BLOCK_OBJECT (Index 16)	This object contains the characteristics of the blocks.
ST_REV (Index 17)	The value of the static revision parameter may be used by a configuration device to determine if a block parameter(s) stored in static memory has changed in value. A change in a static parameter will cause the static revision parameter of the associated block to be incremented.
TAG_DESC (Index 18)	The tag description is a user-supplied description of the block.
STRATEGY (Index 19)	The strategy parameter has a user-specified value. This assigned value may be used in configuration or diagnostics as a key in sorting block information.
ALERT_KEY (Index 20)	The Alert_Key parameter has a user-assigned value which may be used in sorting alarms or events generated by a block.
TARGET_MODE (Index 21)	The target mode attribute indicates what mode of operation is desired for the block. It is normally set by a control application or by an operator through a human interface application. The input parameters are used by the algorithm in conjunction with the state of the function block application containing the block in order to determine if the algorithm can achieve the target mode of operation established for it.
MODE_BLK (Index 22)	The mode parameter is a structured parameter composed of the actual mode, the normal mode and the permitted mode. The actual mode is set by the block during its execution to reflect the mode used during execution. The normal mode is the desired operating mode of the block. The permitted mode shows which changes of the target mode are valid for the specific block to the remote user of the MODE_BLK parameter.
ALARM_SUM (Index 23)	The parameter alarm summary summarizes the status of up to 16 block alarms. For each alarm, the current states, unacknowledged states, unreported states and disabled states are maintained.
BATCH (Index 24)	The Batch parameter is a structured parameter composed of four elements – BATCH_ID, RUP (Recipe Unit Procedure), OPERATION, and PHASE. Only function blocks carry this parameter. The Batch parameter is necessary in a distributed fieldbus system to identify used and available channels, in addition to identify the current batch in case of alerts.

Analog Output Function Block Specific Parameters (Slot 1)

Parameter	Description
SP (Index 25)	The Setpoint defines the position of the final control element within the travel span (between OPEN and CLOSE position) in units of PV_SCALE in mode Auto.
PV_SCALE (Index 27)	Conversion of the Process Variable into percent using the high and low scale values. The engineering unit of PV_SCALE high and low scale values are related to the PV_UNIT of the configured transducer block. The PV_SCALE high and low scale values follow the changes of the PV_UNIT of the related transducer block automatically.
READBACK (Index 28)	The actual position of the final control element within the travel span (between OPEN and CLOSE position) in units of PV_SCALE.
RCAS_IN (Index 30)	Target setpoint in units of PV_SCALE and status provided by a supervisory host to the analog control or output block in mode RCas.
IN_CHANNEL (Index 37)	Reference to the active transducer block and its parameter which provides the actual position of the final control element.
OUT_CHANNEL (Index 38)	Reference to the active transducer block and its parameter which provides the position value for the final control element.
FSAVE_TIME (Index 39)	Time in seconds from detection of failure of the actual used setpoint (SP_D = bad or RCAS_IN <> Good) to the action of the block if the condition still exists.
FSAVE_TYPE (Index 40)	Defines reaction of the device if failure of actual used setpoint is still detected after FSAFE_TIME or if the status of actual used setpoint is Initiate Fail-Safe.
FSAVE_VALUE (Index 41)	Default value for the OUT parameter, if sensor or sensor electronic fault is detected. The unit of this parameter is the same as the OUT parameter.
RCAS_OUT (Index 43)	Function block setpoint in units of PV_SCALE and status. Provided to a supervisory host for monitoring/back calculation and to allow action to be taken under limited conditions or mode change.
POS_D (Index 47)	The current position of the valve (discrete). The coding of the POS_D is as follows: 0 = not initialized 1 = closed 2 = opened 3 = intermediate
SETP_DEVIATION (Index 48 – Not Used)	Difference between the setpoint signal and feedback position in percent of travel span (between OPEN and CLOSE position).
CHECK_BACK (Index 49)	Detailed information of the device, bitwise coded. More than one message possible at once.
CHECK_BACK_MASK (Index 50)	Definition of supported CHECK_BACK information bits 0 = not supported 1 = supported
SIMULATE (Index 51)	For commissioning and maintenance reasons, it is possible to simulate the input or output values by modifying the value and the status. That means that the transducer block and the function block will be disconnected.
INCREASE_CLOSE (Index 52)	Direction of positioner in mode RCas and Auto 0 = rising (increasing of setpoint-input results in valve OPENING) 1 = falling (increasing of setpoint-input results in valve CLOSING)
OUT (Index 53)	This parameter is the process variable of the analog output block in engineering units in Auto and RCas mode and is the valued specified by the operator/engineering in Man and LO mode.
OUT_SCALE (Index 54)	Conversion of the OUT of the function block in percent to OUT in engineering units as the output value of the function block. The parameter specifies the high and low scale values, engineering units code, and number of digits to the right of the decimal point.

Discrete Input Function Block Specific Parameters (Slots 2 through 5)

Parameter	Description
OUT_D (Index 26)	This parameter is the process variable of the discrete input block in Auto and RCas mode and is the value specified by the operator/engineer in Man and LO.
CHANNEL (Index 30)	Reference to the active transducer block which provides the measurement value to the function block.
INVERT (Index 31)	Indicates whether the SP_D should be logically inverted before writing to OUT_D in mode Auto or RCas. 0 = not inverted 1 = invert
FSAFE_TYPE (Index 36)	Defines reaction of the device, if failure of actual used setpoint is still detected after FSAFE_TIME or if the status of actual used setpoint is Initiate Fail-Safe.
FSAFE_VAL_D (Index 37)	The preset discrete OUT_D used if FSAFE_TYPE = 0 and FSAFE is activated.
SIMULATE (Index 40)	For commissioning and maintenance reasons, it is possible to simulate the input or output values by modifying the value and the status. That means that the transducer block and the function block will be disconnected

Discrete Output Function Block Specific Parameters (Slots 6 and 7)

Parameter	Description
SP_D (Index 25)	Setpoint of function block used in mode Auto.
OUT_D (Index 26)	This parameter is the process variable of the discrete output block in Auto and RCas mode and is the value specified by the operator/engineer in Man and LO.
READBACK_D (Index 28)	In the case of valve control, this object indicates the position of discrete valve and the sensor states.
RCAS_IN_D (Index 30)	Target setpoint and status provided by a supervisory host to the discrete output block used in mode RCas.
CHANNEL (Index 33)	Reference to the active transducer block which provides the measurement value to the function block.

Parameter	Description
INVERT (Index 34)	Indicates whether the SP_D should be logically inverted before writing to OUT_D in mode Auto or RCas. 0 = not inverted 1 = invert
FSAVE_TIME (Index 35)	Time in seconds from detection of failure of the actual used setpoint (SP_D = bad or RCAS_IN <> Good) to the action of the block if the condition still exists.
FSAVE_TYPE (Index 36)	Defines reaction of the device if failure of actual used setpoint is still detected after FSAFE_TIME or if the status of actual used setpoint is Initiate Fail-Safe.
FSAVE_VAL_D (Index 37)	The preset discrete OUT_D used if FSAFE_TYPE = 0 and FSAFE is activated.
RCAS_OUT_D (Index 38)	Function block setpoint and status provided to a supervisory host for monitoring/back calculation and to allow action to be taken under limited conditions or mode change.
SIMULATE (Index 40)	For commissioning and maintenance reasons, it is possible to simulate the input or output values by modifying the value and the status. That means that the transducer block and the function block will be disconnected.
CHECKBACK_D (Index 49)	Detailed information of the device, bitwise coded. More than one message possible at once.
CHECK_BACK_MASK (Index 50)	Definition of supported CHECK_BACK information bits. 0 = not supported 1 = supported

Analog Input Function Block Specific Parameters (Slot 8)

Parameter	Description
OUT (Index 26)	This parameter is the process variable of the analog output block in engineering units in Auto and RCas mode and is the valued specified by the operator/engineering in Man and LO mode.

Parameter	Description
PV_SCALE (Index 27)	Conversion of the process variable into percent using the high and low scale values. The engineering unit of PV_SCALE high and low scale values are related to the PV_ UNIT of the configured transducer block. The PV_SCALE high and low scale values follow the changes of the PV_UNIT of the related transducer block automatically.
OUT_SCALE (Index 28)	Conversion of the OUT of the function block in percent to OUT in engineering units as the output value of the function block. The parameter specifies the high and low scale values, engineering units code, and number of digits to the right of the decimal point.
LIN_TYPE (Index 29)	Determines if the values passed by the transducer block to the AI block may be used directly or if the value is in different units and must be converted linearly, with square root, or other conversion types.
CHANNEL (Index 30)	Reference to the active transducer block which provides the measurement value to the function block.
PV_FTIME (Index 32)	The function block parameter PV_FTIME contains the time constant for the rise time of the FB output up to a value of 63.21% resulted from a jump on the input. The engineering unit of the parameters is seconds.
FSAFE_TYPE (Index 33)	Defines reaction of the device, if failure of actual used setpoint is still detected after FSAFE_TIME or if the status of actual used setpoint is Initiate Fail-Safe.
FSAFE_VALUE (Index 34)	Default value for the OUT parameter, if sensor or sensor electronic fault is detected. The unit of this parameter is the same as the OUT parameter.
ALARM_HYS (Index 35)	Defines an adjustable hysteresis required before triggering an alarm. If a value of one process variable is just at the value of a limit and if the variable fluctuates around the limit it will generate many limit violations. It is therefore possible to trigger messages only after crossing this adjustable hysteresis.
HI_HI_LIM (Index 37)	Upper limit value for alarms with engineering unit of the OUT parameter. If the measured variable is equal or higher than the upper limit value the State Bits in the State Byte to OUT and the FB parameter ALARM_SUM change to 1. The unit of this parameter is the same as the OUT parameter.
HI_LIM (Index 39)	Upper limit value for warnings with engineering unit of the OUT parameter. If the measured variable is equal to or higher than the upper limit value, the State Bits in the State Byte of OUT and in the FB parameter ALARM_SUM have to change to 1.
LO_LIM (Index 41)	Lower limit value for warnings with engineering unit of the OUT parameter. If the measured variable is equal to or lower than the lower limit value, the State Bits in the State Byte of OUT and in the FB parameter ALARM_SUM changes to 1.
LO_LO_LIM (Index 43)	Lower limit value for alarms with engineering unit of the OUT parameter. If the measured variable is equal to or lower than the lower limit value, the State Bits in the State Byte of OUT and in the FG parameter ALARM_SUM is changed to 1.
HI_HI_ALM (Index 46)	This parameter contains the state of the upper limit of an alarm and the related time stamp.
HI_ALM (Index 47)	This parameter contains the state of the upper limit of a warning and the related time stamp.
LO_ALM (Index 48)	This parameter contains the state of the lower limit of a warning and the related time stamp. The time stamp expresses the time at which the measured variable has been equal to or higher than the lower limit of the warning.
LO_LO_ALM (Index 49)	This parameter contains the state of the lower limit of an alarm and the related time stamp. The time stamp expresses the time at which the measured variable has been equal to or higher than the lower limit of the alarm.
SIMULATE (Index 50)	For commissioning and maintenance reasons, it is possible to simulate the input or output values by modifying the value and the status. This means that the transducer block and the function block will be disconnected.
OUT_UNIT_TEXT (Index 51 – Not Used)	If a specific unit of OUT parameter is not in the code list, the user has the possibility to write the specific text in this parameter.

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.

Physical Block A software block that describes the necessary parameters and functions of the device hardware itself.

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.

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.

Segment Coupler A device that is used to attach PA devices to a PROFIBUS network.

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.

Transducer Block A software block that controls access to the I/O devices through a device-independent interface defined for use by function blocks.

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

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FCD LMENIM2336-03 Printed in USA.