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Limitorque Actuation Systems

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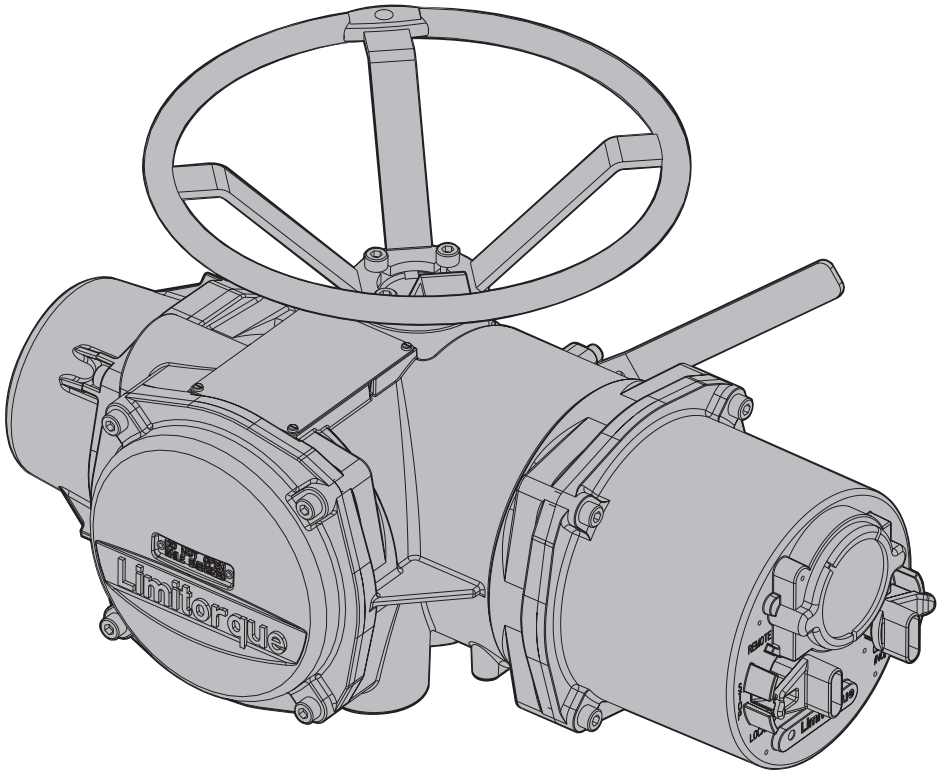

Limitorque®

Accutronix MX/DDC-100 Field Unit
Installation and Operation

Accutronix MX/DDC-100 Field Unit Installation and Operation Manual

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Table of Contents

Figures

Tables

1 Introduction

1.1 Purpose

This manual explains how to install and operate the Accutronix MX™/DDC-100 field unit and is to be used as an addendum to **Bulletin 130-11000**, **Accutronix MX Installation and Operation Manual**. Up to 250 actuators, each containing a DDC-100 field unit, may be connected by a single twisted-pair cable to form a DDC-100 network. This network permits the actuators to be operated by various control room devices such as a distributed control system (DCS), a programmable logic controller (PLC), or a personal computer (PC). The DDC-100 system communicates status and alarm data from each Accutronix MX (referred to as MX) and valve.

1.2 How to Use this Manual

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

Section 1 - Introduction
Details user safety and knowledge requirements, system capabilities, and features.

Section 2 - System Components
Focuses on the description of the DDC-100 system hardware and software components.

Section 3 - Installation and Configuration
Provides details for installing and configuring a field unit.

Section 4 - Associated Documents
Provides a list of documents on related subjects for additional MX and DDC-100 system information.

Section 5 - Troubleshooting

Section 6 - Index

Section 7 - How to Order Parts

Appendix A - Wiring Diagram
Details wiring connections.

Appendix B - MX/DDC Register Definitions
Descriptive terms.

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. **User must follow local and state safety regulations.**

Safety notices are presented in this manual in three forms:

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

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

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

1.4 User Knowledge

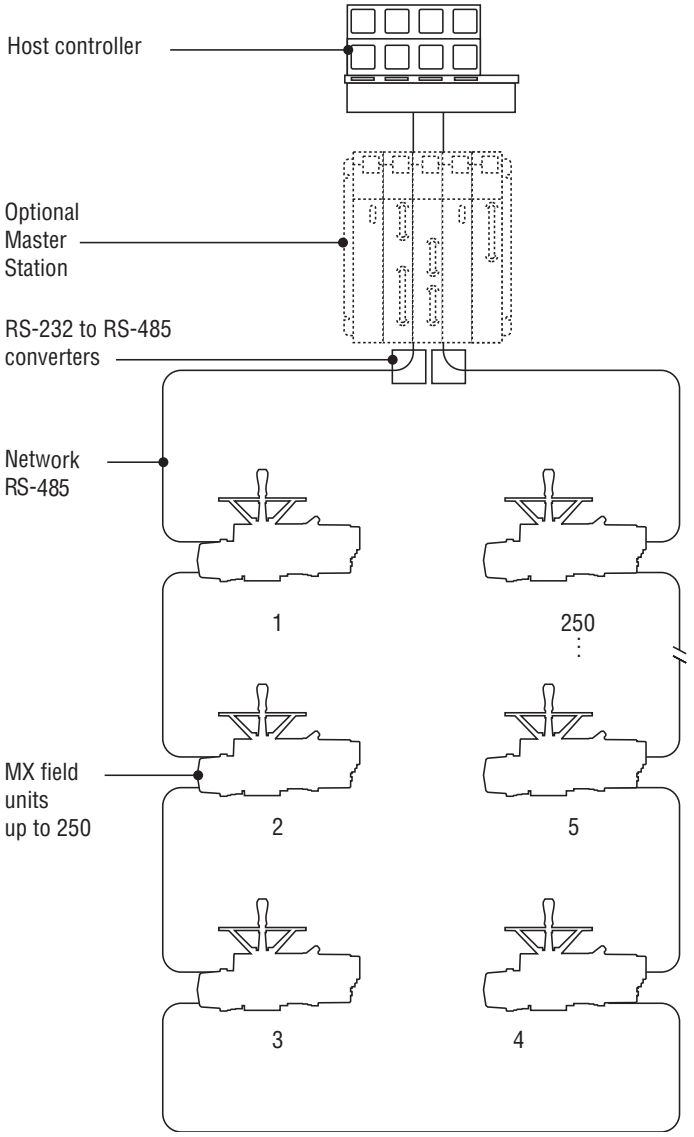
It is recommended that the user read this manual in its entirety before the DDC-100 equipped actuator is installed and operated.

The user needs to have a fundamental knowledge of electronics and microprocessor concepts. An understanding of valve actuators and digital control systems is beneficial to the field unit user.

1.5 DDC-100 System Capabilities and Features

Limitorque's distributed digital control (DDC) valve control network supports up to 250 actuators over a single twisted-pair cable using Modbus™ protocol. MX actuators and other devices can be accessed from a control room for integration with a distributed control system (DCS), programmable logic controller (PLC), or personal computer (PC) based network. The DDC-100 system consists of a host system, controller, network, and field units. A typical DDC-100 system is shown in **Figure 1.1**.

Figure 1.1 – Typical DDC-100 system with or without a Master Station



1.5.1 General Specifications

Direct-to-Host Specifications:

- Direct connection to host controller
- Communicates using the Modbus protocol and the RS-485 electrical standards
- Configurable bitmap
- High-level surge protection on network

Network Specifications:

- Redundant loop or single-ended loop topology
- Modbus protocol and the RS-485 electrical standards
- High speed—up to 19.2 kbaud communications

MX Field Unit Specifications:

- "**OPEN**," "**STOP**," and "**CLOSE**" commands
- "**ESD**" and "**MOVE–TO**" position commands
- Actuator status and alarm messages
- Six digital inputs and two analog inputs for user (see **Table 2.2, Register Definitions**)
- Two surge-protected and mutually isolated communication channels
- Accutronix control panel configuration
- Torque output (for reference only) and position feedback
- User's analog input feedback
- Nine digital inputs (six standard/three optional)
- Seven digital outputs (four standard/three optional)

Master Station (Optional) Specifications:

- Host interface—RS-232 or RS-485 (Modbus protocol)
- LED indicator for network status
- Configurable polling sequence priority
- Configurable bitmap to host
- Redundant RS-485 network ports
- High-level surge protection on network
- Logging port for maintenance PC

2 System Components

2.1 Introduction

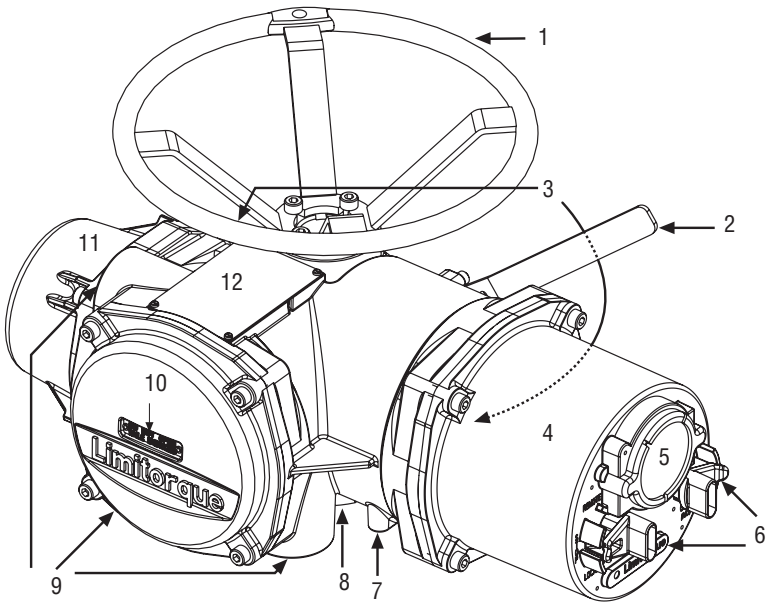
This section gives an overview of the components used in the DDC-100 system. The field unit is installed in each MX actuator. The network cable connects the field unit to the network via the actuator terminal block. The network cable is connected to a host controller or Master Station.

2.2 Hardware

NOTE: Recommended storage procedures are detailed in **Bulletin 130-12000**, **Accutronix MX Maintenance and Spare Parts Manual**. Failure to comply with recommended procedures will void the warranty. For longer-term storage, contact Limitorque for procedures and recommendations.

Figure 2.1 – MX-05 actuator

Piece	Description
1	Handwheel
2	Declutch Lever
3	Oil Fills (dotted arrow depicts fill on declutch side)
4	Controls Compartment (field unit location)
5	LCD Display
6	Control Knobs
7	Ground Lug
8	Thrust/Torque Base
9	Conduit Entries
10	Terminal Compartment
11	Motor
12	Nameplate



2.2.1 Accutronix MX

The MX is a multi-turn valve actuator designed for operation of ON-OFF and modulating valve applications. This actuator controls the opening and closing of valves. See **Figure 2.1**.

The MX features include:

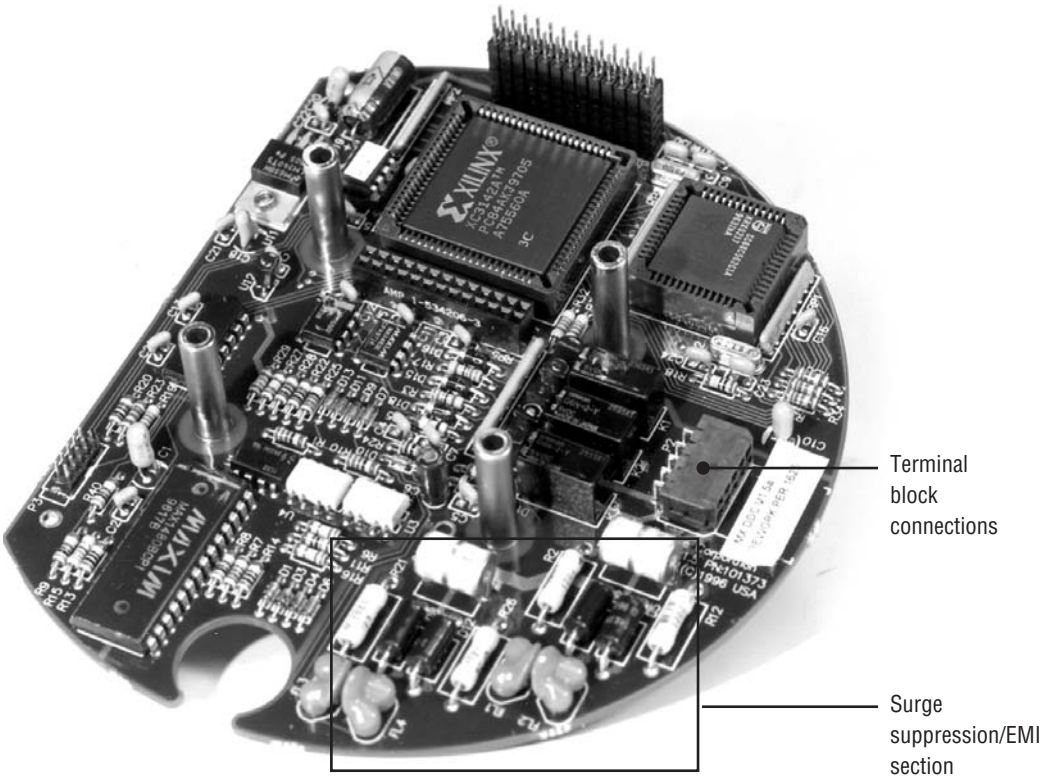
- Non-intrusive setup
- Separately sealed terminal chamber
- Patented absolute encoder for valve position sensing (no battery required)
- 32-character LCD for indication and calibration
- Sophisticated electronic control, monitoring, and diagnostic capabilities with patented LimiGard™ technology

2.2.2 DDC–100 Field Unit

The DDC-100 field unit is installed in the MX controls compartment. This unit permits the actuator to be controlled by a host controller or Master Station via the DDC-100 network. The field unit includes two high-level, surge-protected, and isolated network communication channels, configurable digital I/O, and configuration via LCD screen. The following commands and information may be transmitted over the DDC-100 network:

- "**OPEN**," "**STOP**," and "**CLOSE**" commands
- "**ESD**" and "**MOVE–TO**" position commands
- Actuator status and alarm messages
- Six digital inputs and two analog inputs for user (see **Table 2.2, Register Definitions**)
- Two surge-protected and mutually isolated communication channels
- Accutronix control panel configuration
- Torque output (for reference only) and position feedback
- User's analog input feedback
- Nine digital inputs (six standard/three optional)
- Seven digital outputs (four standard/three optional)

Figure 2.2 – DDC-100 field unit



2.2.3 Host Controller

In the DDC-100 system, the network can be connected directly to a host controller without an interposing Master Station.

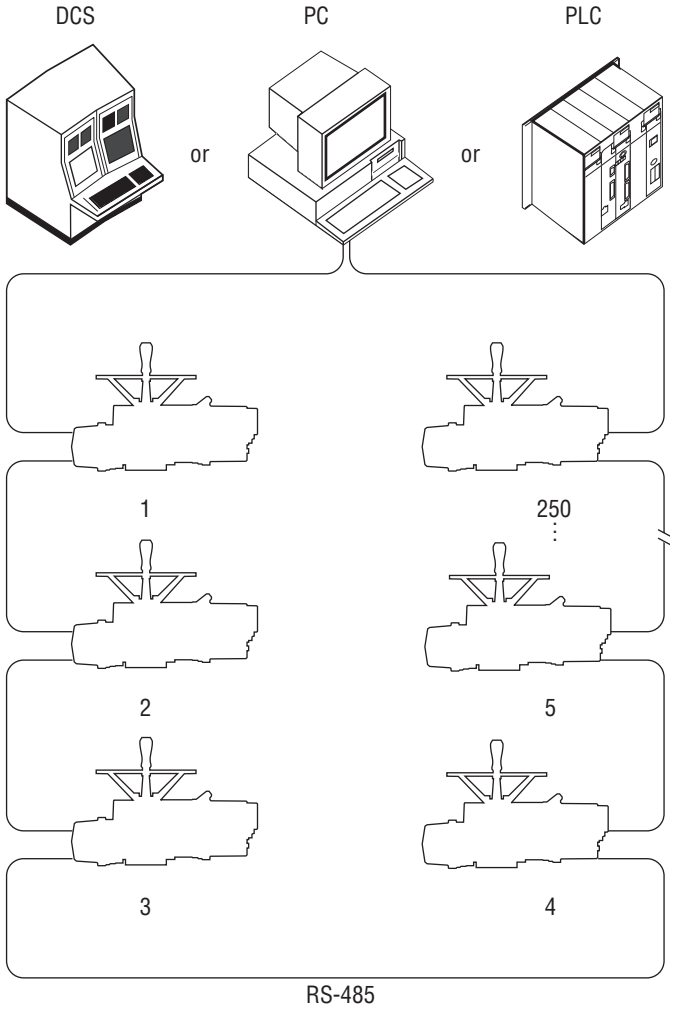
In this configuration, the host sends commands and messages to and gathers responses from the field units. The commands and messages are sent via RS-485 data signals. The gathered responses are stored in a data table in the host and are periodically updated by sequential polling of the field units. The host controls up to 250 field units. See **Section 3.1.2.3**, **Network Cable Connection to Host System or Master Station**.

When a host controller is used to directly communicate with the field units, i.e., direct-to-host communications, it communicates using the Modbus protocol and the RS-485 electrical standard. See **Bulletin 435-23009**, **DDC-100 Direct-to-Host Programming Guide** for details. This host controller can be one of the following:

- An external distributed control system (DCS)
- Programmable logic controller (PLC)
- Personal computer (PC)

A typical direct-to-host arrangement is shown in **Figure 2.3**.

Figure 2.3 – Typical direct-to-host arrangement



2.2.4 Master Station

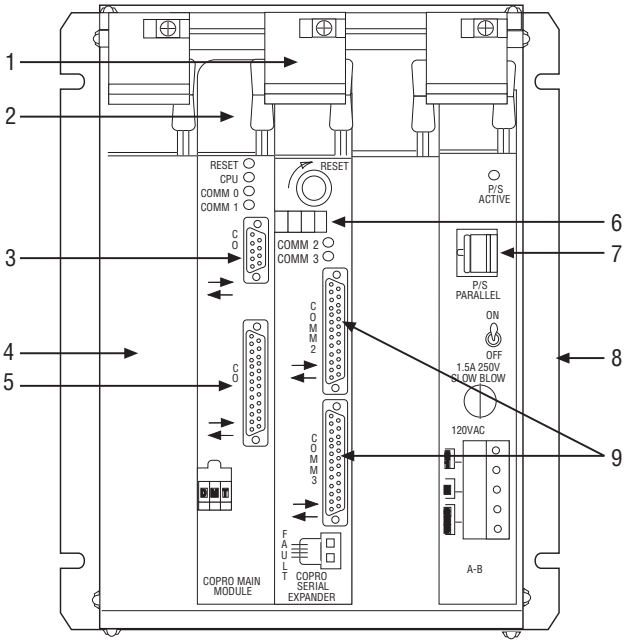
A Master Station may be used in the DDC-100 system. Master stations are normally located in the control room, and serve as the interface between the field units and the host controller. The following functions are provided:

- Continuous polling of actuator network
- Message routing to/from field units
- Data concentration
- Data logging

In this configuration, the Master Station receives commands from a host controller. The Master Station communicates with the host controller using the Modbus Protocol and the RS-232 or RS-485 electrical standard. See **Bulletin 435-21012**, **DDC-100 Master Station Installation and Operation Manual** for details.

The Master Station sends commands and messages to and gathers responses from the field units. The commands and messages are sent via RS-485 data signals. The gathered responses are stored in a poll table in the Master Station and are periodically updated by sequential polling of the field units. The Master Station controls up to 250 field units. See **Section 3.1.2.3**, **Network Cable Connection to Host System or Master Station**.

Figure 2.4 – Typical Master Station



Piece	Description
1	Serial Expander
2	Control Processor
3	Diagnostic Port
4	PLC (optional)
5	DCS Port
6	LED Display
7	Power Supply
8	Chassis
9	Network Ports

2.2.5 RS-232/RS-485 Converter

The Limitorque RS-232/RS-485 converter changes the RS-232 data signals for the host controller or Master Station to RS-485 data signals for the network. It also supplies surge suppression and electrical isolation. The converter is available as steered or self-steering, based on the host's ability to toggle the RTS line. See **Bulletin 435-30003**, **RS-232/RS-485 Self-Steering and Steered Signal Converter Product Bulletin** for further details.

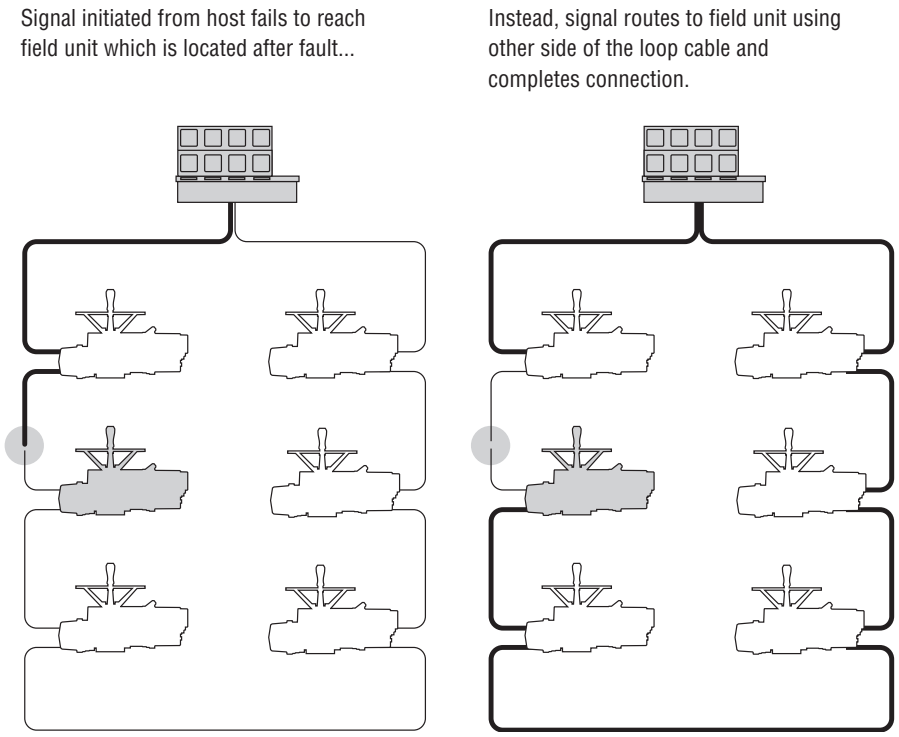
The converter may be used with a host controller for signal conversion and surge protection or for surge protection only. For additional information, see **Bulletin 435-23009**, **DDC-100 Direct-to-Host Programming Guide**.

The converter is required when using a Master Station supplied by Limitorque. For additional information, see **Bulletin 435-21012**, **DDC-100 Master Station Installation and Operation Manual**.

2.2.6 Network Cable

The network consists of a shielded, twisted-pair cable that connects all field units and the host/Master Station. The cable is normally connected in a loop fashion so that any single break or short will not disable communication.

Figure 2.5 – Redundant connection operation in redundant loop topology



The network cable connects the field units to the host controller or Master Station. Belden 3074F, 3105A, or 9841 shielded, twisted-pair cable should be used. The use of other cables may result in a reduction of internodal distances or increased error rate, and is the user's responsibility.

Belden 3074F Specifications

- Total cable length between repeaters or nodes with repeaters: up to 19.2 kbps: 5000' (1.52 km)

For loop mode, this is the total length between operating field units. If a field unit loses power, then the relays internal to the field unit connect the A1 Channel to the A2 Channel, which effectively doubles the length of the cable (assuming a single field unit fails). To ensure operation within specifications in the event of power failure to field units, this consideration must be added. **Example:** To ensure operation with specification when any two consecutive field units lose power, the maximum length of cable up to 19.2 bkps should not exceed 5000' (1.52 km) per every four field units. See **Section 3.1.2.3**, **Network Cable Connection to Host Controller or Master Station**.

Key Specifications

- Resistance/1000 ft = 18 AWG (7 x 26) 6.92 ohms each conductor (13.84 ohms for the pair)
- Capacitance/ft = 14 pF (conductor-to-conductor)
- Capacitance/ft = 14 pF (conductor-to-shield)

Belden 3105A Specifications

- Total cable length between repeaters or nodes with repeaters:
  up to 19.2 kbps: 4500' (1.37 km)

For loop mode, this is the total length between operating field units. If a field unit loses power, then the relays internal to the field unit connect the A1 Channel to the A2 Channel, which effectively doubles the length of the cable (assuming a single field unit fails). To ensure operation within specifications in the event of power failure to field units, this consideration must be added. **Example:** To ensure operation with specification when any two consecutive field units lose power, the maximum length of cable up to 19.2 bkps should not exceed 4500' (1.37 km) per every four field units. See **Section 3.1.2.3**, **Network Cable Connection to Host Controller or Master Station**.

Key Specifications

- Resistance/1000 ft = 22 AWG (7 x 30) 14.7 ohms each conductor (29.4 ohms for the pair)
- Capacitance/ft = 11.0 pF (conductor-to-conductor)
- Capacitance/ft = 20.0 pF (conductor-to-shield)

Belden 9841 Specifications

- Total cable length between repeaters or nodes with repeaters:
  up to 19.2 kbps: 3500' (1 km)

For loop mode, this is the total length between operating field units. If a field unit loses power, then the relays internal to the field unit connect the A1 Channel to the A2 Channel, which effectively doubles the length of the cable (assuming a single field unit fails). To ensure operation within specifications in the event of power failure to field units, this consideration must be added. **Example:** To ensure operation with specification when any two consecutive field units lose power, the maximum length of cable up to 19.2 bkps should not exceed 3500' (1 km) per every four field units. See **Section 3.1.2.3**, **Network Cable Connection to Host Controller or Master Station**.

Key Specifications

- Resistance/1000 ft = 24 AWG (7 x 32) 24 ohms each conductor (48 ohms for the pair)
- Capacitance/ft = 12.8 pF (conductor-to-conductor)
- Capacitance/ft = 23 pF (conductor-to-shield)

2.3 Software

2.3.1 Modbus Protocol

The Modbus protocol was developed by AEG Modicon® for communicating to various networked devices. The relationship between these devices and a central controller is called a master-slave relationship in which the master (host device) initiates all communication. The slave devices (DDC-100 field units in the actuators) respond to the queries from the master.

Modbus only permits one device to communicate at any given time (simultaneous communication is prohibited) to ensure process control integrity.

2.3.2 Modbus Function Codes

The controlling device (master) must conform to the Modbus protocol as defined in the **Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev. G** and support Modbus function codes 01 through 06 and 08. These function codes are a subset of the complete protocol and are defined in **Table 2.1**.

Table 2.1 – Modbus function codes supported

Function Code	Name	Bit/Register Addressing	Extended Addressing Range
01	Read Coil Status	Bit	0,000 - 9,999
03	Read Holding Register	Register	40,000 - 49,999
04	Read Input Register	Register	30,000 - 39,999
05	Force Single Coil	Bit	0,000 - 9,999
06	Preset Single Register	Register	40,000 - 49,999
08	Diagnostics	N/A	N/A
15	Force Multiple Coils	Bit	0,000 - 9,999
16	Preset Multiple Registers	Register	40,000 - 49,999

Modbus function codes 15 and 16 are supported in:
MX/DDC firmware 02/01.00 and greater.

See **Table 2.2** for a complete listing of MX/DDC holding registers.

Table 2.2 – Register definitions (see **Appendix B**)

Register #	Description	Meaning
1	Command	Registers 1 and 2 are write-only registers used for Modbus Function Code 06
2	Argument	Registers 1 and 2 are write-only registers used for Modbus Function Code 06
3	Analog Output	APT Scaled Output Value (Default 0-100)[1]
4	Analog Output	ATT Scaled Output Value (Default 0-100)[1]
5	Analog Input	Future Implementation
6	Analog Input	Analog Input 1 (Default 0-100)[1] User 4-20 mA Input (Heavy Smoothing)
7	Analog Input	Analog Input 2 (Default 0-100)[1] User 4-20 mA Input
8	Position	Valve Position, Scaled Value (Default 0-100)[1]
9	Status Register	16 Bits of field unit status: Bit 0 Opened Bit 1 Closed Bit 2 Stopped Bit 3 Opening Bit 4 Closing Bit 5 Valve jammed Bit 6 Actuator switched to local mode[2] Bit 7 Combined fault[3] Bit 8 Over temperature fault Bit 9 Future Implementation Bit 10 Network Channel A fault[4] (Terminals 15 and 16) Bit 11 Network Channel B fault[4] (Terminals 29 and 41) Bit 12 Open torque switch fault Bit 13 Close torque switch fault Bit 14 Valve-operated manually fault Bit 15 Phase error

Note 1: Default value is scaled 0-100 of span. Changes made to "Analog Scale" affect analog registers (3, 4, 6, 7, 8) and "move-to" commands. (0-100, 0-255, 0-4095)

Note 2: MX/DDC actuators shipped prior to 2nd QTR, 1999, have the following definition for Register 9 Bit 6. When this bit has a value of 1 or true, the actuator selector switch is in LOCAL mode. This bit does not indicate STOP or REMOTE. The actuator selector switch in REMOTE (available for network control) is indicated by Register 12 Bit 0 having a value of 1 or true. Register 9 Bit 6 value 0 (zero) or false AND Register 12 Bit 0 value 0 (zero) or false indicates selector switch is in the STOP position.

MX/DDC actuators shipped after 2nd QTR, 1999, have the following definition of Register 9 Bit 6. When this bit has a value of 1 or true, the actuator is in LOCAL or STOP (unavailable for network control). The actuator selector switch in REMOTE (available for network control) is indicated by Register 12 Bit 0 having a value of 1 or true.

IMPORTANT: Verify host program when installing an MX/DDC actuator shipped after 2nd QTR, 1999, on a network commissioned before 2nd QTR, 1999, for proper indication of selector switch values. Failure to verify proper selector switch indication at the host may cause unsafe conditions at the facility.

Note 3: Combined Fault bit is high when Bit 5 or 8 or 9 or 15 or (Bits 10 and 11) is high.

Note 4: Channel A is physical connection A1. Channel B is physical connection A2. (See **Appendix A**.)

Table 2.2 – Register definitions (continued) (see **Appendix B**)

Register #	Description	Meaning
10	Fault Register	16 Bits of field status Bit 0 Not Used Bit 1 Not Used Bit 2 Not Used Bit 3 Not Used Bit 4 One or more phases are missing Bit 5 Reverse phase sequence is occurring Bit 6 Not Used Bit 7 Not Used Bit 8 Not Used Bit 9 Not Used Bit 10 Network emergency shutdown is active Bit 11 Local PB emergency shutdown is active Bit 12 SBC microprocessor has reset since the last poll Bit 13 Future Implementation Bit 14 Opening in local mode Bit 15 Closing in local mode
11	Digital Outputs	Value of 16 Digital Outputs Bit 0 Close contactor (Interlocked) Bit 1 Open contactor (Interlocked) Bit 2 AS-1 Bit 3 AS-2 Bit 4 AS-3 Bit 5 AS-4 Bit 6 AR-1 (Opt) Bit 7 AR-2 (Opt) Bit 8 AR-3 (Opt) Bit 9 Network Relay Bits 10-15 Not Used
12	Digital Inputs 1	Value of 16 Digital Inputs Bit 0 Remote Switch Bit 1 Thermal Overload Bit 2 Open Torque Switch Bit 3 Open Limit Switch Bit 4 Close Torque Switch Bit 5 Close Limit Switch Bit 6 Not Used Bit 7 Not Used Bit 8 User Input 0, Terminal 21 Bit 9 User Input 1, Terminal 10 Bit 10 User Input 2, Terminal 9 Bit 11 User Input 3, Terminal 6 Bit 12 User Input 4, Terminal 7 Bit 13 User Input 5, Terminal 5 Bit 14 Opt User Input 6, Terminal 23 Bit 15 Opt User Input 7, Terminal 24

Table 2.2 – Register definitions (continued) (see **Appendix B**)

Register #	Description	Meaning
13	Digital Inputs 2	Value of 16 Digital Inputs Bits 0-1 Not Used Bit 2 Analog Input 1 lost Bit 3 Analog Input 2 lost Bit 4 Network Channels A/B timed out Bit 5 Not Used Bit 6 DDC board present Bit 7 I/O option board present Bits 8-11 Not Used Bit 12 Phase lost Bit 13 Phase reverse Bit 14 Opt User Input 8, Terminal 25 Bit 15 Not Used
14	Timers and Analog Channels	Bits 0-15 Not Used
15	User Faults	Bits 0-15 Not Used
16	Current State	Bits 0-15 Not Used
17	Field Unit Holding Register	Special Applications Only
18	Field Unit Holding Register	Special Applications Only
19	Field Unit Holding Register	Special Applications Only
20	Field Unit Holding Register	Special Applications Only
21	Field Unit Holding Register	Special Applications Only
22	Field Unit Holding Register	Special Applications Only
23	Field Unit Holding Register	Special Applications Only
24-44	Reserved	Special Applications Only
45-47	Not Named	Special Applications Only
48	TP_START_POSITION	Special Applications Only
49	TP_STOP_POSITION	Special Applications Only
50	TP_SAMPLE	Special Applications Only
51	TP_MID_T_HIGH	Special Applications Only
52	TP_MID_T_POS	Special Applications Only
53	TP_MID_T_AV_VAL	Special Applications Only
54	TP_STOP_VAL	Special Applications Only
55	TP_BEFORE_ MID_T_HIGH	Special Applications Only
56	TP_AFTER_ MID_T_HIGH	Special Applications Only

Table 2.3 – DDC-100 coil assignments, Modbus 05 command usage for digital outputs

Coil Number	Bit Number	Function
1	00	Close/Stop
2	01	Open/Stop
3	02	AS-1 Latched
4	03	AS-2 Latched
5	04	AS-3 Latched
6	05	AS-4 Latched
7	06	AR-1 (Opt) Unlatched - N/O
8	07	AR-2 (Opt) Unlatched - N/O
9	08	AR-3 (Opt) Unlatched - N/C

Table 2.4– Modbus 06 command and field unit holding register 40001

Host Commands to Field Unit Register 1	Value (Decimal)	Function
Null Command	0	No action
Open	256	Open actuator
Stop	512	Stop actuator
Close	768	Close actuator
Reset Field Unit	1024	Reset processor
Start Network ESD	1280	ESD initiate
Stop Network ESD	1536	ESD terminate
Engage Relay #1	2304	AS-1
Engage Relay #2	2560	AS-2
Engage Relay #3	2816	AS-3
Engage Relay #4	3072	AS-4
Engage Relay #5	3328	AR-1
Engage Relay #6	3584	AR-2
Engage Relay #7	3840	AR-3
Disengage Relay #1	4352	AS-1
Disengage Relay #2	4608	AS-2
Disengage Relay #3	4864	AS-3
Disengage Relay #4	5120	AS-4
Disengage Relay #5	5376	AR-1
Disengage Relay #6	5632	AR-2
Disengage Relay #7	5888	AR-3
Move-To (Enable)[1]	6656	Initiates “move-to”

Note 1: This is a two-step command. A valid value must be written to Register 2 before issuing this command. (See **Note 1** of **Table 2.2**.)

NOTE: Null Command – The field unit takes no action when this command is received. This command is typically used by a host output register when required.

NOTE: Modbus command 06 allows writing to Modbus registers. The only registers that should be written to in the field unit are Registers 1 and 2.

CAUTION: Do not write to any other registers other than those instructed by this manual. Failure to adhere to this warning may result in equipment damage. Table 2.4 defines the write holding register commands.

For MX-DDC field units containing firmware 02/01.00 or greater, the “move-to” command may be executed with a one-step command.

Example of Single Register Write “Move-To” Command
This command allows a Host to issue the “move-to” command with a single write utilizing the Modbus function code 06. Register 1 will be used to complete this command.

Rules for Utilizing Command
Field unit scaling must be configured for 0-100.

To use the hexadecimal method of determining a single write “move-to” command, 0x4B is always placed into the Hi Byte of Register 1. The desired position value is always placed into the Lo Byte of Register 1.

To move the actuator to a position of 50%, place the value 0x4B in the high byte and the value 0x32 (50 decimal) into the low byte.

To use the decimal method of determining a single write “move-to” command, add the desired position value to 19200.

2.3.2.1 Modbus Function Code 15 (Force Multiple Coils)

This function code allows the user to force multiple coils with a single command and uses the same coil assignments as the Function Code 05.

It should be noted that the coils are operated from the lowest coil number to the highest. Forcing coil 1 or 2 OFF (0) is considered a stop command, sending a 15 command to force two coils starting with coil 1, with coil 1 ON and coil 2 OFF, would result in the unit stopping, since coil 2 is forced OFF after coil 1 is forced ON.

To prevent inadvertent Stop commands from being issued, it is recommended to force one coil at a time.

Available digital outputs for DDC-100 Field Units are listed in **Table 2.3**. Force multiple coil commands should be issued only once for the desired field unit control. Repeated issuance of an acknowledged command will degrade network performance.

NOTE: This function code is implemented in MX-DDC Firmware 02/01.00 and greater.

2.3.2.2 Modbus Function Code 16 (Preset Multiple Registers)

This function code is used to preset single or multiple registers in the field unit and uses the same predetermined register values as the function code 06. This function code is typically used to command the DDC-100 Field Unit by writing values to the 40001 and/or 40002 registers.

Modbus function code 16 command values for controlling the DDC-100 Field Unit are given in **Table 2.4**. Each command should be issued only one time for the desired field until control. Repeated issuance of an acknowledged command will degrade network performance.

The normal response returns the slave address, function code, starting address, and quantity of registers preset.

NOTE: This function code is implemented in MX-DDC Firmware 02/01.00 and greater.

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3 Installation and Configuration

3.1 Site and Network Cable Preparation

3.1.1 Site Preparation

Prepare the site and associated equipment for operation of the DDC-100 controlled MX actuators as follows:

1. Prepare a detailed site plan consisting of the following:
   - Actuator locations, tag numbers, DDC addresses
   - Junction boxes, terminal strip locations, and tag numbers
2. Provide free access to the MX control panel and terminal block for setup, configuration, and troubleshooting.
3. Prepare cable and label all wires. See **Section 3.1.2**, **Network Cable Preparation**.
4. Install power and control wires in separate conduits. Shielding is not sufficient to prevent induction of stray voltages onto signal leads from the power lines.
5. Install and verify earth grounds.

NOTE: Limitorque defines an effective local earth ground as a low impedance (less than 5 ohms) path to:

- A ground electrode placed in close vicinity of the actuator that is free of ground loop currents. **OR**
- A safety ground that is 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 that 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 should be provided.

3.1.2 Network Cable Preparation

3.1.2.1 Network Cable Connection to Limitorque RS-232/RS-485 Converters

For the RS-485 connection, the network cable is connected to the converter via a three-pin or five-pin removable connector (depending on the converter model). This connector is located on the rear of the converter. Prepare the cable as detailed in **Section 3.1.2.2**, **Network Cable Connection to the Field Unit**.

Self-Steering Converter – P/N 61-825-1032-4

Table 3.1 details the connections and wire color.

Table 3.1 – Self-steering converter connections

Pin	Function	Wire Color
1	DATA	White
2	DATA*[1]	Blue
3	Earth ground[2]	Shield

Note 1: Indicates negative side of signal.
Note 2: Must be connected to earth ground to assure surge protection.

Steered Converter – P/N 61-825-0966-4

Table 3.2 details the connections and wire color.

Table 3.2 – Steered converter connections

Pin	Function	Wire Color
1	DATA	White
2	DATA*[1]	Blue
3	Earth ground[2]	Shield
4	Not Used	Not Used
5	Not Used	Not Used

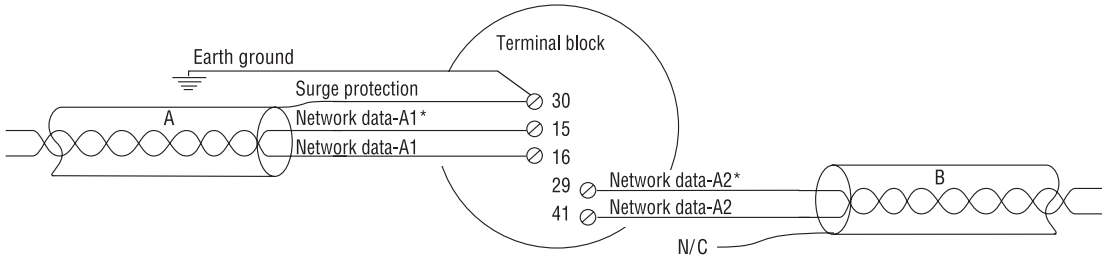
Note 1: Indicates negative side of signal.
Note 2: Must be connected to earth ground to assure surge protection.

For more information see **Bulletin 435-30003**, **RS-232/RS-485 Self-Steering and Steered Signal Converter Product**, or **Bulletin 435-23009**, **Direct-to-Host Programming Guide**.

3.1.2.2 Network Cable Connection to the Field Unit

The DDC-100 field unit is connected to the network via the MX terminal block. The network cable is connected to the terminal block as shown in **Figure 3.1**.

Figure 3.1 – Network connections for loop topology



NOTE:
1. Shielded, twisted-pair cables should be used.
2. Shields are connected to earth ground at one end only to avoid ground loops.
3. Clean earth-ground connection (less than 5 ohms) enhances noise rejection and provides a clear/safe path for surge currents.

Prepare the network cable for connection to the MX terminal block as follows.

CAUTION: Strip stranded conductors carefully; do not damage the strands. This will weaken the conductor. Do not nick conductors or conductor insulation when stripping away the insulation. Nicking stresses the conductor and can cause the conductor to break. This type of damage may not be apparent and failure can occur later without warning.

NOTE: Multi-pair cables should provide shielding for each conductor pair.

NOTE: Excess cable should be cut, not coiled or looped, to prevent noise induction into the network and to reduce signal loss through unnecessarily long cable runs.

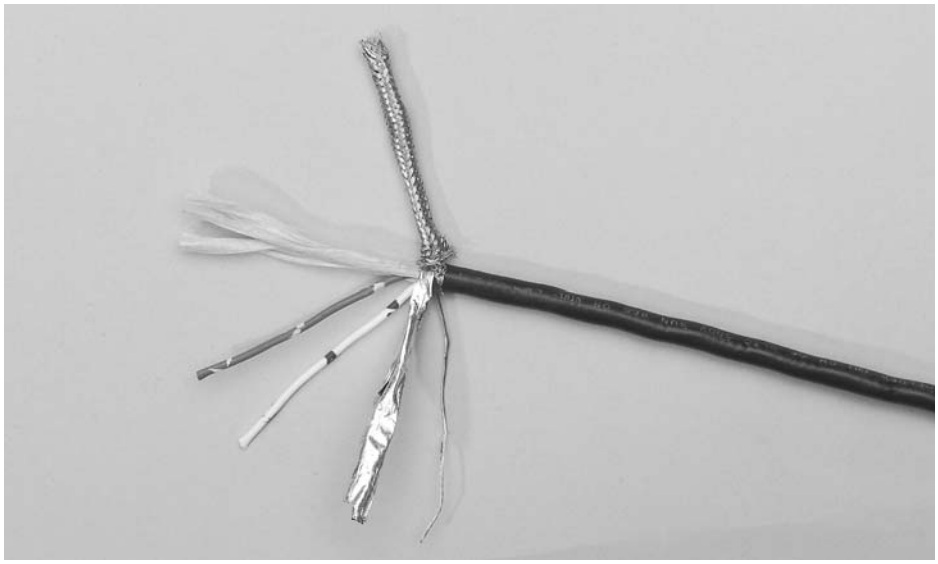
Cable Preparation

1. Remove two to three inches (5 to 8 cm) of the outer plastic jacket as shown in **Figure 3.2**.

Figure 3.2 – Removing outer plastic jacket

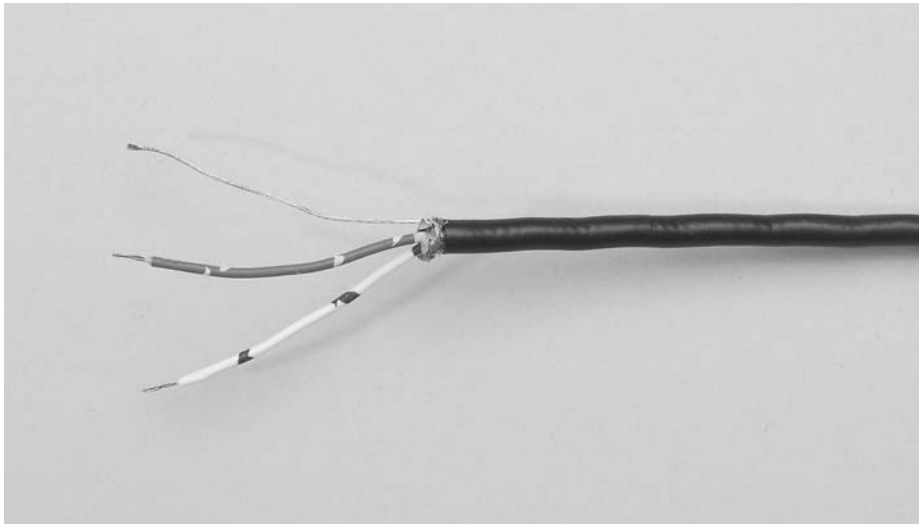
2. Separate the cable parts. Unbraid the shield and peel back the foil shield to the same point where the outer jacket was removed as shown in **Figure 3.3**.

Figure 3.3 – Separating cable parts



3. Cut away the braided shield and the foil shield. Strip the insulation from the conductors approximately 0.4 inch (1 cm) as shown in **Figure 3.4**.

Figure 3.4 – Stripping conductors



4. Apply heat shrink tubing to insulate the drain wire and to provide stress relief to the cable as shown in **Figure 3.5**.

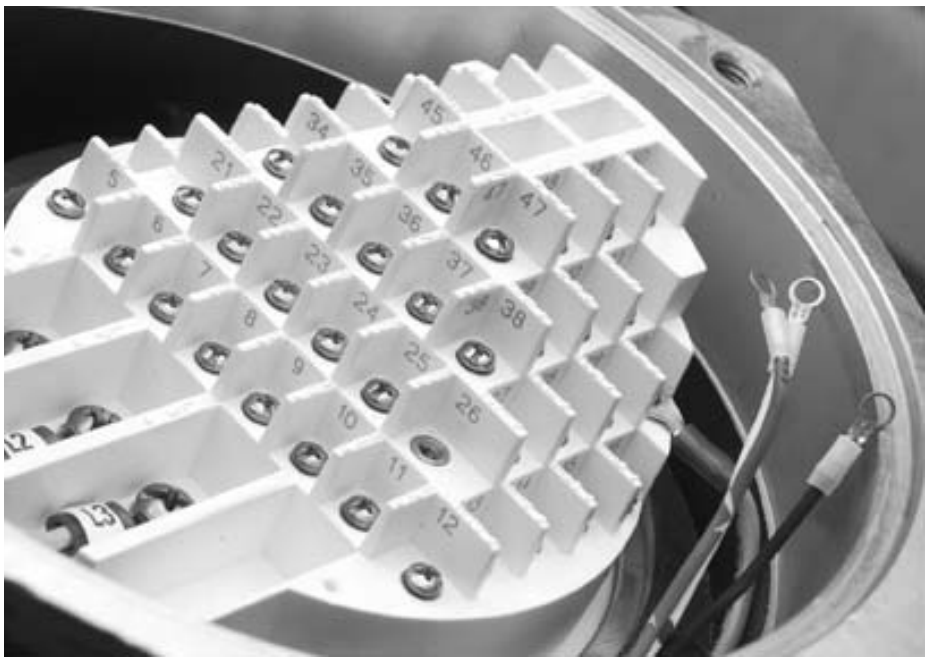
Figure 3.5 – Applying heat shrink tubing

CAUTION: Do not melt the insulation.

NOTE: Ungrounded drain wires should be cut even with the cable sheath. The brand foil and drain wire should have heat shrink tubing applied.

5. Install ring tongue connectors as shown in **Figure 3.6**.
   Flowserve recommends the use of Thomas & Betts #RZ22-6 for optimum results.

Figure 3.6 – Ring tongue connectors



6. Connect the network cables to the MX terminal block as shown in **Figure 3.6**. **Table 3.3** details a connection for the loop topology.

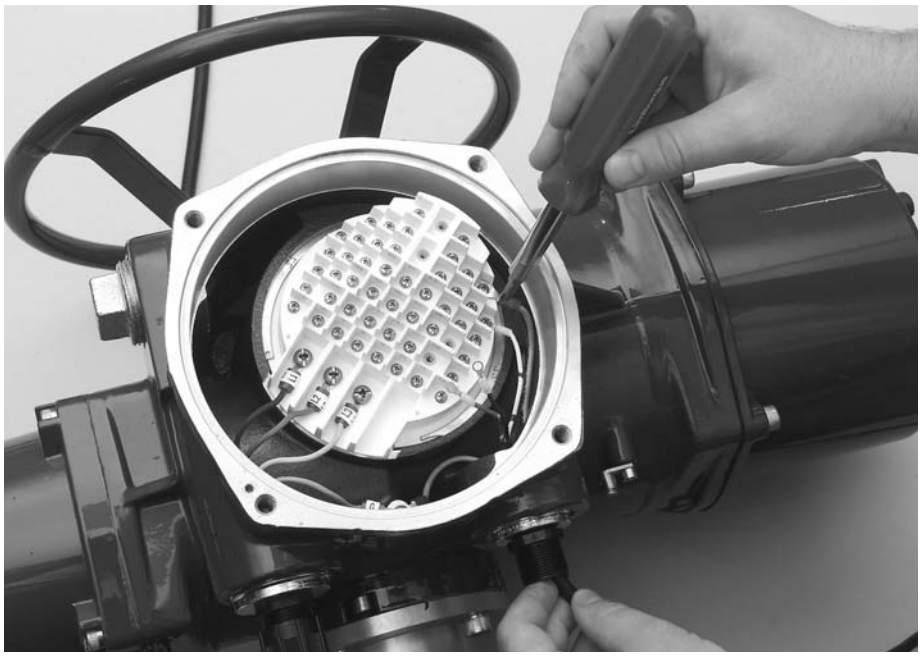
Table 3.3 – Loop topology connection

Terminal Block Number	Function
15	DATA-A1*
16	DATA-A1
29	DATA-A2*
41	DATA-A2
30	Earth ground for surge protection circuit

NOTE: Ground each segment of the cabling at only one point to prevent ground loops, which can affect system performance. Verify the actuator is properly grounded.

7. Install jumper cable from terminal block pin 30 to earth ground or ground lug.

Figure 3.7 – Connecting network cable to MX terminal block



3.1.2.3 Network Cable Connection to Host Controller or Master Station

Two network topologies are commonly used and supported for the MX:

- Redundant loop (recommended)
- Single-ended loop

Redundant Loop

The redundant loop topology requires two serial communication ports on the host device.

- Each field unit can be accessed by two host/master ports.
- The connections from the serial ports to the field units and connections between field units are made with shielded, twisted-pair cable in a loop configuration.
- A single line break or short can occur while maintaining communication to all field units. **Figure 3.8** shows the redundant loop network topology for a direct-to-host connection.

The redundant loop topology is wired as follows: see **Figure 3.8**.

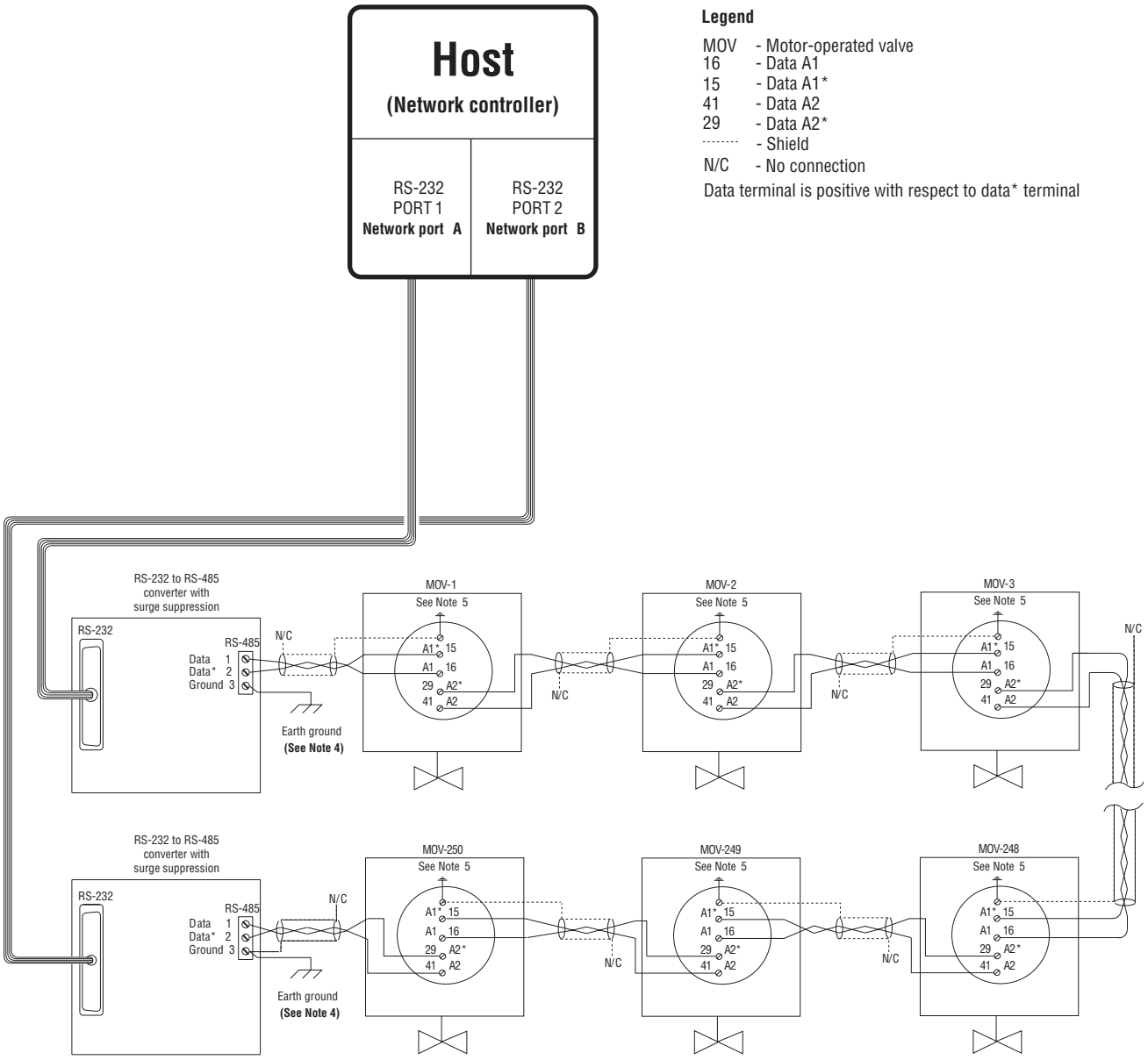
1. Connect the host device port 1 through an RS-232 to RS-485 (if required) converter to the first field unit port A1 @ MX terminal block numbers 15 and 16.
2. Connect the port A2 @ MX terminal block numbers 29 and 41 to the next field unit's port A1.
3. Each subsequent field unit is connected in the same manner – receiving data through its port A1, then passing the data out through its port A2 to the next field unit.
4. The last field unit's port A2 is connected to the host device's port 2. The host device should be configured to ignore messages that it sends out when it returns to its other port.

The direction of data flow can be reversed because of the bi-directional capability of the serial ports.

a. Communications can be initiated by connecting host port 2 to first field unit port A2.
b. Port A1 of the first field unit is then connected to port A2 of the next field unit.
c. Port A1 of the last field unit is then connected to host port 1.

In either direction, the signal is regenerated in each field unit to permit long-distance communication with reduced noise sensitivity and improved reliability.

Figure 3.8 – Redundant loop topology – direct-to-host connection



Notes:

1. Belden 3074F, 3105A, or 9841 shielded cable is recommended.
2. Correct polarity for field unit and network controller connection is necessary for proper operation.
3. Connections shown are typical. The number of MOVs shown may not indicate true system size.
4. ⏚ Earth ground: ground rod
5. ⏚ Earth ground: ground rod or lug in actuator if actuator is grounded.

Diagnostic note:

Polarity and level of the network's data connection can be checked by measuring voltage between data and data* terminals. This voltage should be greater than +200 mV DC with network controller (host) network ports disconnected. Data terminal is positive with respect to data* terminal.

Earth ground note:

If low impedance earth ground is not available at each actuator, contact engineering for alternative earth ground surge protection strategies.

Single-Ended Loop

The single-ended loop topology is identical to the redundant loop topology with the following exception: only one end of the network is connected to the host device.

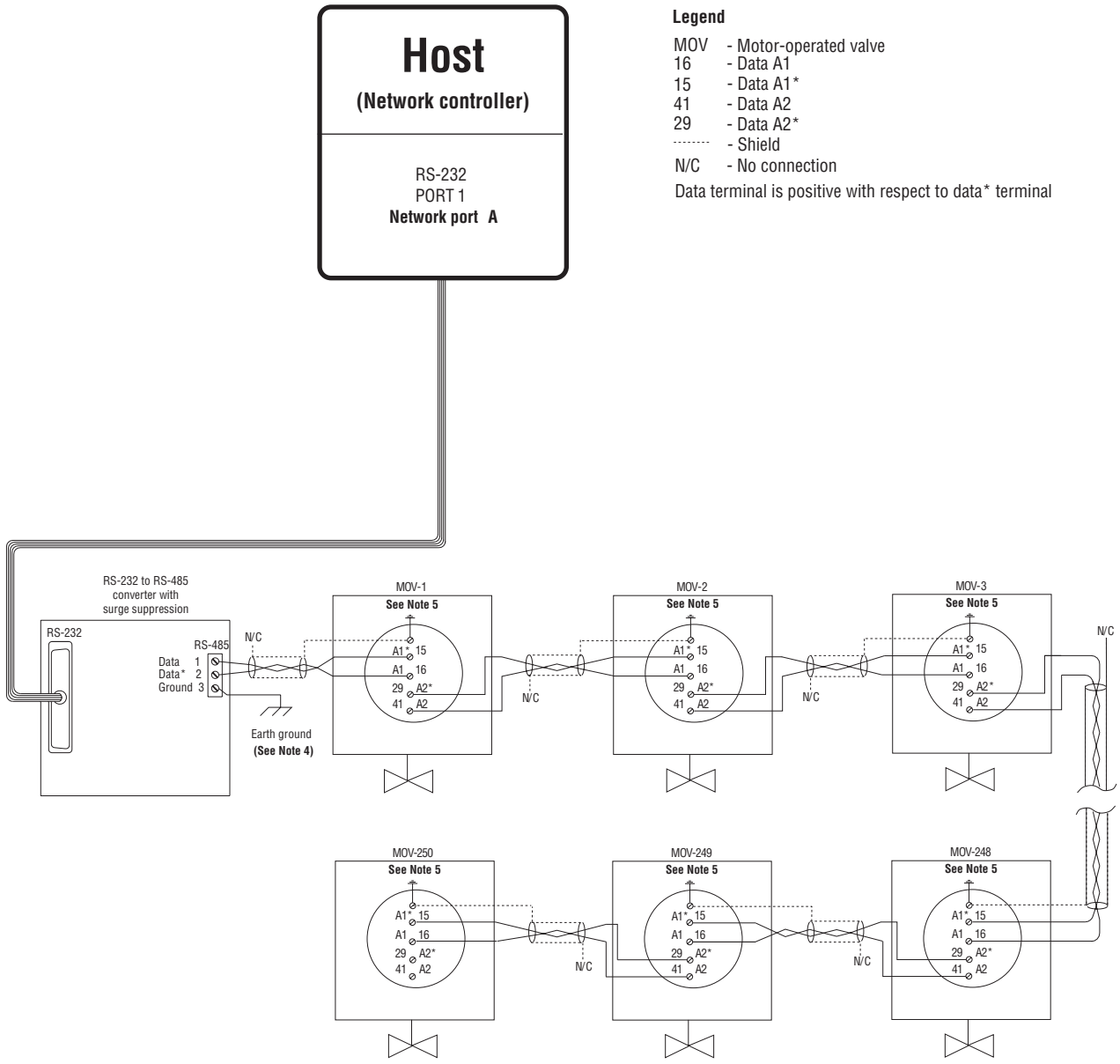
The single-ended topology is wired as follows:

1. Connect the host port 1 to the first field unit port A1 @ MX terminal block numbers 15 and 16.
2. Connect port A2 of this field unit @ MX terminal block numbers 29 and 41 to port A1 of the next field unit.
3. Continue steps 1 and 2 until the last field unit is connected.

NOTE: If a stub cable is run from port A2 of the last field unit (MX terminal block numbers 29 and 41) to a planned field unit location, or the last field unit is disconnected, the open end of the cable must be terminated with a 120 ohm resistor to prevent unacceptable signal reflections. Termination impedance is supplied when the actuator field unit is the last unit.

The single-ended loop topology supports the same number of field units and distances as the redundant loop topology. The single-ended loop topology is less reliable than the redundant loop topology because the host can only reach the field units from one direction. If a data cable break occurs, communication will be lost to all nodes on the far side of the break.

Figure 3.9 – Single-ended loop topology



Notes:

1. Belden 3074F, 3105A, or 9841 shielded cable is recommended.
2. Correct polarity for field unit and network controller connection is necessary for proper operation.
3. Connections shown are typical. The number of MOVs shown may not indicate true system size.
4. ⏚ Earth ground: ground rod
5. ⏚ Earth ground: ground rod or lug in actuator if actuator is grounded.

Diagnostic note:

Polarity and level of the network's data connection can be checked by measuring voltage between data and data* terminals. This voltage should be greater than +200 mV DC with network controller (host) network ports disconnected. Data terminal is positive with respect to data* terminal.

Earth ground note:

If low impedance earth ground is not available at each actuator, contact engineering for alternative earth ground surge protection strategies.

3.2 Installation Verification

3.2.1 Network Cabling Installation Verification

After installation is complete and prior to operation, inspect the network cable and its connection to each field unit for the following:

NOTE: Units should be disconnected from power. Network should be disconnected from host.

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1. There should be:
   - No nicks in the insulation—this can cause a short between conductors or to the grounded shield.
   - No cut strands in a stranded conductor—this can cause a poor connection and eventually an open circuit.
2. Verify that there is data wiring on each actuator per wiring diagram.
3. Cable armor should not be shorted to the cable shield/drain wire. Cable armor may not be at ground potential and could be subject to lightning surges.
4. The shield/drain wire should only be grounded at one end of each cable segment (the section between adjacent actuators on the loop or between the host system/Master Station and an actuator) to avoid ground loop problems.
5. The ground/earth connection should be at true ground potential and effective at all times. See No. 5 in **Section 3.1.1**, **Site Preparation**.

For the redundant loop, use a voltmeter in the control room. Determine the following by measuring resistance of individual wires in the network cables:

NOTE: Power must be OFF on all field devices, and A1/A2 cables must be disconnected from the RS-232/RS-485 converters and network host.

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1. Data wire A1 to data wire A2 should be equal to the resistance value of network cable length/cable resistance per 1000 ft.
2. Data* wire A1 to data* wire A2 should be equal to the resistance value of network cable length/cable resistance per 1000 ft.
3. Confirm open circuit between data and data* cables.
4. Confirm open circuit between data, data*, and shield.
5. Confirm open circuit between shield and shield.

3.2.2 Field Unit Installation Verification

NOTE: Connect to either 24 V DC power or mains and activate power.

Verify the field unit is installed as follows:

1. Enter the "**SETUP**" mode as detailed in **Bulletin 130-11000**, **MX Installation and Operation Manual**.
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 STATUS?**"
4. Select "**YES**" to scroll through the menu selections. The LCD will read "**DDC (OK) – NEXT?**" if installed.

NOTE: If the "**DDC (OK) – NEXT?**" does not appear, contact Flowserve for assistance.

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5. To return to the normal display, use the red knob to select either "**LOCAL**" or "**REMOTE**."

3.3 Field Unit Configuration

The actuator has been configured with all customer-specified parameters and no further calibration should be necessary. Only the address needs to be configured. If full valve data was not provided when ordering, or if changes are needed for parameters other than the DDC option, refer to **Bulletin 130-11000**, **MX Installation and Operation Manual**. If any changes to the DDC configuration are required, see **Section 3.3.1**, **Configuring Field Unit Parameters**.

3.3.1 Configuring Field Unit Parameters

The following instructions assume that all MX and DDC parameters are set, except the address.

1. Enter the "**SETUP**" mode as detailed in **Bulletin 130-11000**, **MX Installation and Operation Manual**.
2. When LCD reads "**CHANGE SETTINGS?**", use the black knob to select "**YES**."
3. Enter password. (100=Default)
4. The LCD will display the "**CHANGE SETTINGS**" mode menu items. Select "**NO**" until screen displays "**CHANGE DDC?**" Select "**YES**." LCD will display DDC menu items.
5. Select "**YES**" to each menu item until "**DDC ADDRESS OK?**" appears. Select "**NO**" if address displayed is not correct.
6. Enter an address from 1 to 250 by toggling "**NO**" until the correct address is displayed.
7. Return red selector switch to "**REMOTE**" or "**LOCAL**" to save address.

CAUTION: The network address must be entered in accordance with the user address assignment sheet. This assignment sheet should correspond to the contract specifications. The same address must not be used anywhere else in the same network.

All DDC parameters have been factory-set in accordance with customer specifications or defaults. These parameters may be viewed or changed as described in **Bulletin 130-11000**, **MX Installation and Operation Manual**.

3.3.1.1 Viewing DDC Parameters

Enter the "**VIEW SETTINGS**" mode and "**VIEW DDC?**" as detailed in **Bulletin 130-11000**, **MX Installation and Operation Manual**. The display will show the state or value of the following menu items:

- Status (ON or OFF)
- DDC Address
- Protocol (Baud Rate)
- Analog Scale

NOTE: "**VIEW DDC?**" will not appear if the DDC-100 Network Board is not installed. If the "**VIEW DDC?**" does not appear, contact Limitorque.

3.3.1.2 Changing DDC Parameters

Enter the "**CHANGE SETTINGS**" mode and "**CHANGE DDC?**" as detailed in **Bulletin 130-11000**, **MX Installation and Operation Manual**. The following parameters may be changed:

- Status (ON or OFF)
- Protocol (Baud Rate)
- DDC Address
- Analog Scale

Each parameter is discussed below:

Status (ON or OFF)

This parameter activates or deactivates the field unit.

NOTE: When the field unit is installed at the factory, the default status is ON. If DDC status is OFF, the LCD screen will display "**XXX% OPEN**, **DDC OFF**."

Use the black control knob to select "**NO**," which toggles the field unit OFF and ON.

If DDC option is ON, the Modutronic option must be OFF. Use the Modutronic option to configure the proportional band and deadband for "move-to" control.

Protocol (Baud Rate)

The protocol and baud rate selected depend on the system design. All field units and the host system/Master Station must have the same protocol and baud rate.

1. Using the black control knob, actuate "**NO**" to change the protocol/baud rate.
   Possible selections are:
   - MODBUS RTU 19.2k BAUD
   - MODBUS RTU 9600 BAUD (Default)
   - MODBUS ASCII 19.2k BAUD
   - MODBUS ASCII 9600 BAUD

NOTE: All field units must have same configuration–either RTU or ASCII.

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2. Select "**YES**" to choose the proper protocol/baud rate.

DDC Address

The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network. Select "**NO**" for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 250.

⚠ WARNING: Each actuator must have a unique address.

Analog Scale

The digital values of external analog data received over the DDC network may be scaled as shown below to suit the users preference.

Using the black control knob, select "**NO**" until the required scale is displayed. The scale options are as follows:

- 0-100 of span
- 0-255 of span
- 0-4095 of span

The changing of the analog scale will affect all the digital values in registers 3, 4, 6, 7, 8 and "move-to" commands. Scaling conventions must be consistent between the field unit and host device.

Standard Digital Inputs (Register 12, Bits 08–13)

The field unit contains six digital inputs for monitoring the status of external contacts. The inputs may be powered one of two ways:

- From the MX (24 VDC or 110 VAC)
- From the customer's source (24 VDC or 120 VAC)

NOTE: These digital inputs are meaningful only when DDC option is used.

The six standard digital inputs may be configured in a number of ways for monitor and/or control. (See **Table 3.4** and **Table 3.5**.) In any selected configuration, the inputs may be monitored via the DDC-100 network by reading the field unit holding registers 40012 and 40013.

The presence of voltage on a terminal will indicate a "TRUE" condition. The absence of voltage will indicate a "FALSE" condition.

Depending on configuration, the host may read the digital input to monitor field-installed devices connected to the MX/DDC input OR may monitor the digital input to verify an actuator function in relation to a preselected condition (ESD, Hardwire Remote Control, Inhibits).

Optional Digital Inputs (Register 12, Bits 14-15, and Register 13, Bit 14)

When supplied with I/O option board, the field unit contains three additional digital inputs on the I/O option board for monitoring the status of external contacts. The inputs may be powered one of two ways:

- From the MX (24 VDC or 110 VAC)
- From the customer's source (24 VDC or 120 VAC)

(See **Table 3.4** and **3.5**.)

NOTE: These digital inputs are meaningful only when both DDC and I/O options are used.

3.3.1.3 Configuring for Position Control or "Move-To" Operation (Option)

The MX/DDC contains a default proportional band value of 15% and a deadband value of 2%. The MX/DDC may be sent to an intermediate position by utilizing the Modbus function code 06. First issue the desired position, then issue the "move-to" enable (see **Table 2.4**).

To alter the default proportional band and deadband values, the modulating position control (MPC) feature must be enabled.

MX/DDC field units are shipped without MPC enabled, but this feature may be enabled in the field. Please contact the Limitorque Service Department to order the MPC feature which allows adjustments of the proportional band and deadband values.

NOTE: If DDC option is ON, the Modutronic option must be OFF.

To alter proportional band and deadband values: (Refer to **Bulletin 130-11000, Section Modutronic Option**)

1. "**CHANGE MODUTRONIC?**"
2. Select "**YES**."
3. "**STATUS (ON) – OK?**"
4. Select "**YES**."
5. "**PROP'L BAND (15%) – OK?**"
6. Select "**NO**" until desired position is viewed. Then select "**YES**."
7. "**FAIL POSITION (CLOSE) – OK?**"
8. Select "**NO**" until desired position is viewed. Then select "**YES**." (This setting will have no meaning with DDC.)
9. "**DEADBAND (2%) – OK?**"
10. Select "**NO**" until desired value is viewed. Then select "**YES**."
11. "**POLARITY 20mA=OPEN – OK?**"
12. Select "**YES**."
13. "**DELAY AFTER STOP 0 SECONDS – OK?**"
14. Select "**YES**."
15. "**4-20mA SIGNAL RANGE?**"
16. Select "**NO**."
17. "**CHANGE MODUTRONIC?**"
18. Select "**YES**."
19. "**STATUS (ON) – OK?**"
20. Select "**NO**."
21. "**STATUS (OFF) – OK?**"
22. Select "**YES**."
23. Exit **SETUP**.

NOTE: Modutronic STATUS must be OFF, once the proportional band and deadband values are changed.

Table 3.4 – MX/DDC digital input configurations (only one selection per row is permitted)

Standard Digital Input Options	Alternate Digital Input Options
ESD	User Input 0
Open Inhibit	User Input 1
Close Inhibit	User Input 2
3-Wire Maintain	User Input 3, 4, 5
3-Wire Inching (default)	
4-Wire	
User Input 6, 7, 8 (opt)	

Table 3.5 – MX/DDC digital inputs (cross-reference of various inputs)

Terminal #	Basic Function	Digital Input	True Value[1]	False Value	Register . Bit
21	ESD Input	User Input 0	1	0	12 . 08
10	Open Inhibit	User Input 1	1	0	12 . 09
9	Close Inhibit	User Input 2	1	0	12 . 10
6	Stop PB Input	User Input 3	0	1	12 . 11
7	Open PB Input	User Input 4	1	0	12 . 12
5	Close PB Input	User Input 5	1	0	12 . 13
23	User Input 6 (Opt)	User Input 6 (Opt)	1	0	12 . 14
24	User Input 7 (Opt)	User Input 7 (Opt)	1	0	12 . 15
25	User Input 8 (Opt)	User Input 8 (Opt)	1	0	13 . 14

Note 1: True value indicates voltage present at terminal point.

Table 3.6 – Digital input voltages

Terminal #	Min "ON"	Max "OFF"	Max Load	Min Signal Duration
5	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
6	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
7	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
9	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
10	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
21	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
23	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
24	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	
25	19.2 VAC/DC	5.0 VAC/DC	10 mA / 110 VAC	250–350 ms
			2 mA / 24 VDC	

Conversion from Basic Function to Standard Digital Inputs

To convert LOCAL ESD INPUT to DIGITAL INPUT 0: (Refer to **Bulletin 130-11000**, **MX Installation and Operation Manual**).

1. "**CHANGE ESD?**"
2. Select "**YES**."
3. "**STATUS (ON) – OK?**"
4. Select "**NO**."
5. Exit **SETUP**.

NOTE: The ESD function is now disabled.

To convert OPEN/CLOSE INHIBIT INPUTS to Digital Input 1 & 2: (Reference **Bulletin 130-11000**, **MX Installation and Operation Manual**).

1. "**CHANGE INHIBITS?**"
2. Select "**YES**."
3. "**CHANGE OPEN INHIBITS?**"
4. Select "**YES**."
5. "**STATUS (ON) – OK?**"
6. Select "**NO**."
7. "**CHANGE OPEN INHIBITS?**"
8. Select "**NO**."
9. "**CHANGE CLOSE INHIBITS?**"
10. Select "**YES**."
11. "**STATUS (ON)–OK?**"
12. Select "**NO**."
13. Exit **SETUP**.

NOTE: The OPEN/CLOSE INHIBIT function is now disabled.

To convert Remote Control OPEN/CLOSE/STOP/CLOSE Inputs to Digital Input 3, 4, 5: (Refer to **Bulletin 130-11000**, **MX Installation and Operation Manual)**.

1. "**CHANGE REMOTE CONTROL?**"
2. Select "**YES**."
3. "**MODE 4-WIRE–OK?**"
4. Select "**NO**."
5. "**MODE 3-WIRE MAINT–OK?**"
6. Select "**NO**."
7. "**MODE 3-WIRE INCH–OK?**"
8. Select "**NO**."
9. "**MODE USER INPUT–OK?**"
10. Select "**YES**."
11. "**CHANGE REMOTE CONTROL?**"
12. Select "**NO**."
13. Exit **SETUP**.

NOTE: The REMOTE CONTROL OPEN/CLOSE/STOP/CLOSE function is now disabled.

Digital Outputs (Register 11, Bits 02-05 [AS]; Register 11, Bits 06-08 [AR])

Four latching digital outputs are provided to control external equipment; AS-1, AS-2, AS-3, and AS-4 as standard. These are normally configured to trip when the valve reaches the OPEN and CLOSED positions. However, the configuration may be changed to "**DDC CONTROLLED**," in which case these contacts may be opened and closed over the network. See **Bulletin 130-11000**, **MX Installation and Operation Manual**. Register 11 is used only for status (read-only).

When the I/O option board is supplied and AR relays are enabled, three additional non-latching relays may also be monitored or controlled. (See **Table 3.7**.)

NOTE: Digital outputs must have corresponding digital feedback (digital input) to verify digital output position.

Table 3.7 – MX/DDC digital outputs AS 1-4 and AR 1-3

Digital Output	Terminals	Action on Engaging Relay Output	Feedback	Register Bit
AS-1	1, 2	Latched Relay. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.02
AS-2	3, 4	Latched Relay. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.03
AS-3	31, 32	Latched Relay. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.04
AS-4	42, 43	Latched Relay. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.05
AR-1	35, 36	Non-Latching. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.06
AR-2	44, 34	Non-Latching. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.07
AR-3	33, 20	Non-Latching. May be configured as: Open Contact, Close Contact, Blinking Contact	Controlled device MUST provide digital input feedback	11.08

3.4 Configuration Confirmation

Field unit operation cannot be verified until the complete DDC-100 system is operational. However, routine checks can be performed to verify many functions.

3.4.1 Checking Connections

Verify that all connections, including data wires, shield ground, digital inputs (optional), digital outputs (optional), and analog inputs (optional) are in accordance with MX wiring diagrams and field unit diagrams in **Section 3.1.2**, **Network Cable Preparation**.

3.4.2 View Settings

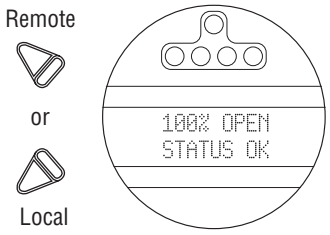
Refer to **Bulletin 130-11000**, **MX Installation and Operation Manual** to access the "**VIEW SETTINGS**" menu. Verify the settings as follows:

1. Confirm the DDC status is ON.
2. Confirm the address for each field unit is correct and unique.
3. Confirm the baud rate and the protocol are correct.
4. If the MX-AS contacts are to be used to control external equipment, verify that each of the digital outputs, AS-1 through AS-4, is set for "**DDC CONTROLLED**" in the "**VIEW STATUS AND ALARM CONTACTS**" menu. (Refer to **Table 3.7**.)

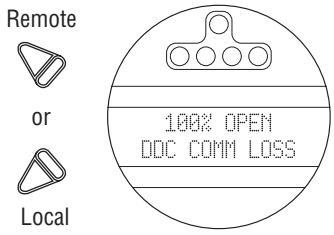
3.4.3 Checking the Normal Display

Place the selector switch in "**LOCAL**" or "**REMOTE**" position. The valve position will be indicated at the top of the LCD. "**STATUS OK**" or "**DDC COMM LOSS**" should be indicated at the bottom of the LCD display.

- If "**STATUS OK**" is displayed, the field unit is communicating with the host/Master Station.
- If "**DDC COMM LOSS**" is displayed, no communication is occurring. This could be due to a number of factors, including problems with the host system (Master Station) and/or network. Check all local connections and configurations. Confirm that the host is connected, configured for baud rate, protocol to match DDC, and operational. See also **Section 5**, **Troubleshooting**.



Field unit is communicating with host/master station



No communications

3.4.4 Modsim™ Software

Modsim is Limitorque's **MOD**bus **SIM**ulator software program. Modsim provides an interface between the user and the Modbus commands. Modsim can be used for:

- Diagnostics
- Troubleshooting
- Network commissioning/verification

Contact Limitorque Sales at (804) 528-4400 for information regarding purchase and use of Modsim.

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4 Associated Documents

Accutronix MX Actuator	
Quick Start-Up Instructions (Accutronix MX Actuators)	Limitorque Bulletin 130-11005
MX Installation and Operation Manual	Limitorque Bulletin 130-11000
Protection, Control and Monitoring Features of MX Electric Actuators	Limitorque Bulletin 130-00500
MX Maintenance and Spare Parts Manual	Limitorque Bulletin 130-12000

Direct-to-Host	
DDC-100 Direct-to-Host Programming Guide	Limitorque Bulletin 435-23009
RS-232/RS-435 Self-Steering and Steered Signal Converter Product Bulletin	Limitorque Bulletin 435-30003

Master Station	
DDC-100 Master Station Installation and Operation Manual	Limitorque Bulletin 435-21012
RS-232/RS-435 Self-Steering and Steered Signal Converter Product Bulletin	Limitorque Bulletin 435-30003

Modsim	
Modsim Operation Manual	Limitorque Bulletin 435-23001

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5 Troubleshooting

1. Refer to **Appendix A, Wiring Diagram.**
2. With power off and network disconnected, verify continuity between A1, A2 and A1*, A2*.
3. With power applied and network disconnected, verify 0.2 to 0.45 VDC between A1, A1* and A2, A2*.
4. Confirm that a jumper cable is installed between the grounding lug and terminal 30.
5. Verify proper setup for MX/DDC.
   - MPC (modulating position control) must be OFF.
   - ESD must be configured for desired function and properly wired.
   - OPEN INHIBIT must be configured for desired function and properly wired.
   - CLOSE INHIBIT must be configured for desired function and properly wired.
   - Remote four-wire control is not selected if not in use. Properly wired if selected.
6. Confirm there are no duplicate DDC addresses.
7. Confirm that ground is at one end only per network cable segment.
8. Confirm protocol, baud rate
   example: Field Unit 1 - 9600, Modbus, RTU, 8,1,N
   Field Unit 2 - 9600, Modbus, ASCII, 8,1,N
   Confirm error and correct
   Field Unit N - 9600, Modbus, RTU, 8,1,N
9. Confirm that host controller allows sufficient timeout periods (at least 200 ms).
   Confirm that host controller allows at least one message retry before declaring loss of communication.
10. Main power supply must be within +/- 10% of nominal unit power rating at all times. Refer to nameplate for voltage.
11. UPS of 24 V DC must be within +/- 10% at all times.
12. Workmanship:
    - The Accutronix MX is non-intrusive which facilitates ease of configuration without removal of the controls cover. Removal of the controls cover without permission from Flowserve can void the warranty.
    - Practice all plant and safety codes and standards. Failure to follow instructions can result in personal injury and/or property damage.
    - Do NOT remove covers of Division 1 units with power applied to prevent the possible ignition of hazardous atmospheres.
    - All servicing should be performed by qualified technicians. Dangerous voltages may be present on the circuit boards and terminations.
    - Use extreme caution when working around power input cables. These cables have potentially lethal voltages on them.
    - Replace fuses only with specified parts for continued safe operation.
    - Have qualified personnel verify all wiring and connections against vendor drawings prior to energizing the equipment. Incorrect wiring and/or connections can result in equipment damage.

NOTE: Removal of control cover and replacement of control boards must be performed by authorized Limitorque service personnel only. Consult a Limitorque service coordinator at (804) 528-4400.

CAUTION: There is potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

- The circuit boards in the MX/DDC-100 contain components that are subject to damage from electrostatic discharge (static electricity). The following precautions and procedures are recommended when handling circuit boards and components. Failure to observe these practices when handling and shipping circuit board products may void your warranty.
    - Keep plastics and other materials prone to the buildup of electrostatic charges (static electricity) away from boards, components, and work area.
    - Avoid synthetic or wool clothing; wear cotton or cotton blend materials. Keep components and circuit boards away from clothing and hair.
    - Discharge static electricity on your body by touching and momentarily holding a grounded metal object before handling electronic components. This is especially important after walking across carpeted areas.
    - Handle components in the field as little as necessary.
    - Handle components only by the edges, and avoid contact with leads, circuits, or connectors.
    - Do not touch the surface of the printed circuit board, the connectors, or the components with conductive devices or with your hands.
    - Always place the component or board into an anti-static protective bag for transportation or storage.
    - Transport all static-sensitive components only in static-shielding carriers or packages. Place static awareness labels on all components to prevent removal from static-shielding container during transit.
    - Handle all static-sensitive components at a static-safe work area including floor mat, wrist strap, air ionizer, ground cord, and conductive table mat.
    - Do not subject components to sliding movements over any surface, at any time.

6 How to Order Parts

To order parts or obtain further information about your Limitorque DDC-100 field unit, contact your local Limitorque distributor sales office, or:

Flowserve Corporation
Flow Control Division
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 http://www.limitorque.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

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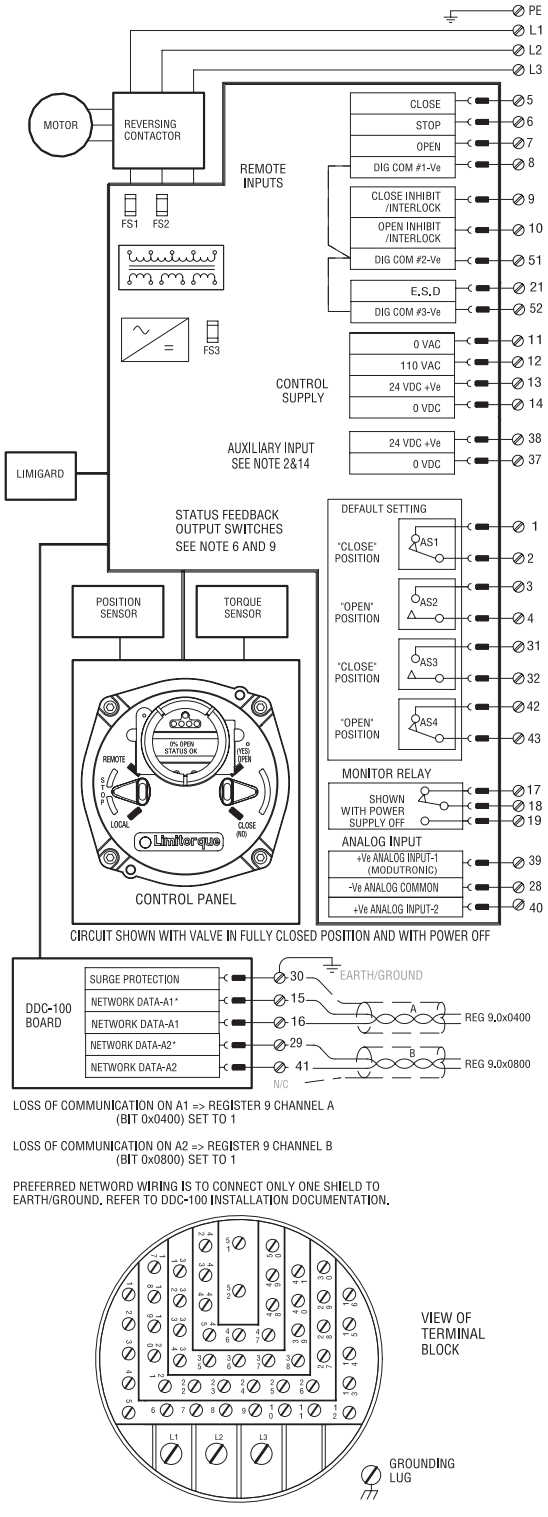
A Appendix – Wiring Diagram

Figure A.1 (1 of 2) – Typical Accutronix MX/DDC-100 wiring diagram



TRANSFORMER TAPPING OPTIONS

TYPE	TAPPING	TYPE	TAPPING
A	220 V	B	115 V
	380 V		220 V
	415 V		525 V
	460 V		575 V

NOTES

1. FUSES

FS1 (PRIMARY), FS2 (PRIMARY): 600 VAC, 1 A, 200 kA Int RATING, FAST ACTING 10.3 x 38.1 mm TUBE.

FS3 (SECONDARY) - 0.1 A, 250 V, TIME DELAY, 5 x 20 mm, GLASS TUBE

2. AUXILIARY INPUT

BACK-UP 24 VDC UPS POWER MAY BE CONNECTED TO TERMINAL'S 37 AND 38. MAXIMUM CURRENT DRAW IS 1 AMP. THIS POWERS ALL CONTROLS FOR LOCAL INDICATION AND CONFIGURATION. DDC-100 BOARD WILL BE POWERED IF SUPPLIED. ANALOG OUTPUT AND ALARM RELAYS SUPPLIED WILL BE POWERED FOR UNITS MANUFACTURED SUBSEQUENT TO Q1/2003. REVERSING CONTACTOR WILL NOT BE POWERED. CUSTOMER SHOULD SUPPLY EXTERNAL FUSE AS REQUIRED BY LOCAL ELECTRICAL CODES.

3. MAXIMUM EXTERNAL LOAD

TERMINALS 13 AND 14 (24 VDC) - 10 W MAX. EXT. LOAD
TERMINALS 11 AND 12 (110 VAC) - 0 V MAX EXT. LOAD
SUITABLE FOR DIGITAL INPUTS ONLY, PROTECTED BY FS3.

4. REMOTE INPUTS SIGNAL THRESHOLD

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

5. CONTROL SIGNAL DURATION

REQUIRED CONTROL SIGNAL DURATION = 250 - 350 ms.

6. STATUS FEEDBACK OUTPUT SWITCHES

THE ACTUATOR STATUS CONTACTS (AS) AND ALARM RELAYS (AR) MAY BE INDIVIDUALLY CONFIGURED AS NORMALLY OPEN OR NORMALLY CLOSED LATCHED CONTACTS OR AS BLINKER CONTACTS TO INDICATE ONE OF THE FUNCTIONS LISTED BELOW:

CLOSE
CLOSING
MID-TRAVEL
OPENING
OPEN
STOPPED
VALVE MOVING
LOCAL SELECTED
LOCAL STOP/OFF
MANUAL OVERRIDE
REMOTE SELECTED
VALVE JAMMED
MOTOR OVERTEMP
OVERTORQUE
OPEN TORQUE SW
CLOSE TORQUE SW
CLOSE INHIBIT
OPEN INHIBIT
ESD SIGNAL
NO ANALOG SIGNAL
LOST PHASE
LIMIGARD ACTIVE
HARDWARE FAILURE

7. CONTACT RATINGS

AS 1, 2, 3 AND 4 - 5.0 AMPS AT 125 VAC, 30 VDC (250 VAC-CENELEC)
MONITOR RELAY - 5.0 AMPS AT 250 VAC, 30 VDC

8. EXACT END POSITION INDICATION

ON TORQUE-SEATED VALVES THE LCD AND "AS" CONTACTS, CONFIGURED AS END OF TRAVEL LIMITS, AUTOMATICALLY PROVIDE EXACT END OF POSITION INDICATION.

9. DEFAULT SETTING

ACTUATORS ARE NORMALLY SHIPPED WITH DEFAULT SETTINGS AS SHOWN ON THIS DIAGRAM. THE "AS" CONTACTS ARE SHOWN WITH VALVE IN FULLY CLOSED POSITION. SEE CONTACT DEVELOPMENT BELOW.

OUTPUT SWITCH CONTACT DEVELOPMENT

OUTPUT SWITCH	VALVE POSITION FULL CLOSE	VALVE POSITION FULL OPEN	FUNCTION
AS1	●	—	CLOSE LIMIT
AS2	—	●	OPEN LIMIT
AS3	●	●	CLOSE LIMIT
AS4	●	—	OPEN LIMIT

10. ANALOG INPUT

STANDARD SIGNAL 4-20 mA
INPUT IMPEDANCE = 250 ohms
INPUT CAPACITACNE = 0.1µF±30%
99% ACCURACY
CONFIGURABLE SCALING

Figure A.1 (2 of 2) – Typical Accutronix MX/DDC-100 wiring diagram

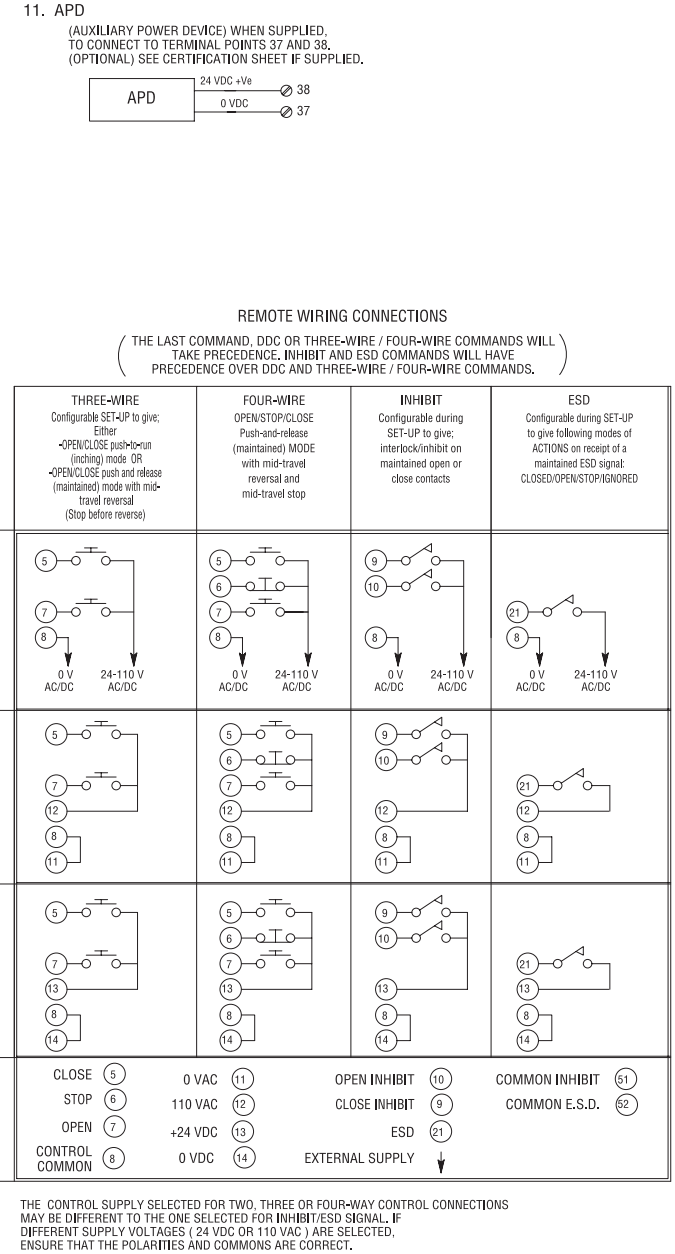
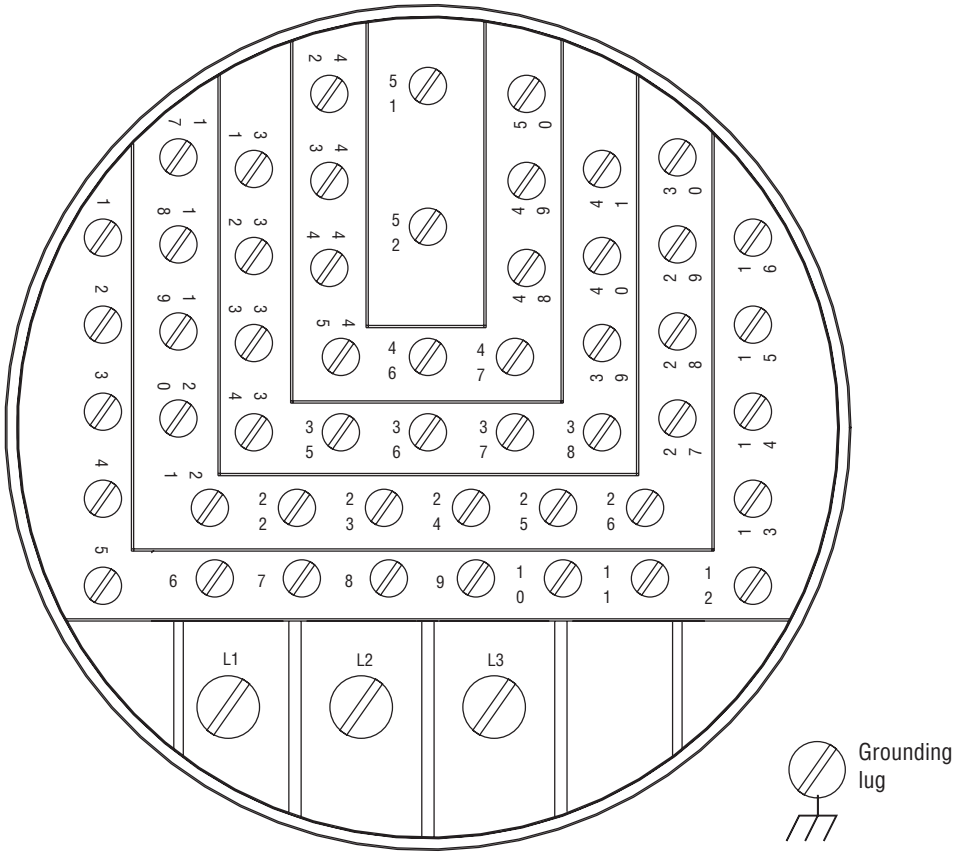


Figure A.3 - Terminal block



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B Appendix – MX/DDC Register Definitions

Register 1

Command register. Write-only. 16-bit unsigned value. Control register for input of predetermined actuator control values. Typical values equate to Open, Stop, Close, "Move-To" Enable, etc.

Register 2

Argument register. Write-only. 16-bit unsigned value. Control register for input of variable data used for predefined actuator control scenarios. Typical usage is for input of desired valve position when used with the "move-to" command.

Register 3

APT output value. Read-only. 16-bit unsigned value. APT option MUST be enabled for a value to be displayed in this register. Reports the APT 4-20 mA output signal value as configured in 0-100 increments of span. May be adjusted to different scaling of 0-255 or 0-4095. Referenced as terminal points 46 and 45 (common).

Scaling chosen through local control station (LCS) **"CHANGE DDC?"** subroutine **"ANALOG SCALE 0-100-OK?"** provides information for diagnostic purposes, and will alter values displayed in registers 3, 4, 6, 7, 8.

Register 4

ATT output value. Read-only. 16-bit unsigned value. ATT option MUST be enabled for a value to be displayed in this register. Reports the ATT 4-20 mA output signal value as configured in 0-100 increments of span. May be adjusted to different scalings of 0-255 or 0-4095. Referenced as terminal points 50 and 49 (common).

Scaling chosen through local control station (LCS) **"CHANGE DDC?"** subroutine **"ANALOG SCALE 0-100-OK?"** provides information for diagnostic purposes, and will alter values displayed in registers 3, 4, 6, 7, 8.

Register 5

Indicates measured voltage of three-phase power. 16-bit unsigned value. Provides information for diagnostic purposes.

Register 6

Analog Input 1. Typically used for analog input. Read-only. 16-bit unsigned value. May be configured to record a 4-20 mA signal. Default scale is 0-100 increments of span. May be adjusted to different scaling of 0-255 or 0-4095. (Typically used for MPC input which cannot be used with DDC enabled.) Referenced as terminals 39 and 28 (common).

Scaling chosen through LCS **"CHANGE DDC?"** subroutine **"ANALOG SCALE 0-100-OK?"** provides information for diagnostic purposes, and will alter values displayed in registers 3, 4, 6, 7, 8.

Register 7

Analog Input 2. Typically used for analog input. Read-only. 16-bit unsigned value. May be configured to record a 0-5 VDC or 4-20 mA signal. Default scale is 0-100 increments of span. May be adjusted to different scaling of 0-255 or 0-4095. Referenced as terminals 40 and 28 (common).

Scaling chosen through LCS **"CHANGE DDC?"** subroutine **"ANALOG SCALE 0-100-OK?"** provides information for diagnostic purposes, and will alter values displayed in registers 3, 4, 6, 7, 8.

Register 8

Continuous position feedback. Read-only. 16-bit unsigned value. Default scale is 0-100 increments of open. May be adjusted to different scaling of 0-255 or 0-4095.

Scaling chosen through LCS "**CHANGE DDC?**" subroutine "**ANALOG SCALE 0-100-OK?**" will alter values displayed in registers 3, 4, 6, 7, 8.

Register 9

Status register. Read-only. 16-bit unsigned value. Contains most desired indications of field unit status. This register is a MUST in controlling a field unit.

Bit 00 Open – Valve is fully opened. This bit is ORd with bits 01, 02, 03, 04. Value of 1=True, Value of 0=False.

Bit 01 Close – Valve is fully closed. This bit is ORd with bits 00, 02, 03, 04. Value of 1=True, Value of 0=False.

Bit 02 Stopped in Mid-Travel - Valve stopped in mid-travel. This bit indicates neither the Open or Close Limit Switch is engaged. This bit is ORd with bits 00, 01, 03, 04. Value of 1=True, Value of 0=False.

Bit 03 Opening – Valve traveling in the Open direction. This bit is ORd with bits 00, 01, 02, 04. Value of 1=True, Value of 0=False.

Bit 04 Closing – Valve traveling in the Close direction. This bit is ORd with bits 00, 01, 02, 03. Value of 1=True, Value of 0=False.

Bit 05 Valve Jammed – Valve is jammed. This bit indicates the valve was traveling or attempting to travel in either the Open or Close direction and has tripped the torque switch. This bit is ONLY active should the actuator be commanded to move via the pushbutton station or remote control and an over-torque condition occurs. Value of 1=True, Value of 0=False.

Bit 06 NOT in Remote – Monitors the actuator LCS. Indicates the LCS has been switched to the Local or Stop position. The host will not be able to control the actuator. Value of 1=True, Value of 0=False.

Bit 07 Combined Fault – The combined fault bit indicates there is a severe problem with the field unit. When this bit is TRUE, the actuator must be considered "OFFLINE." This bit indicates a fault when both bits (10 and 11) are TRUE or bit 5 or bit 8, or bit 9, or bit 15 is TRUE. Value of 1=True, Value of 0=False.

Bit 08 Thermal Overload Fault – Indicates the motor has overheated and the thermistor has opened. This unit is unable to operate and time is required for the motor to cool and reset the thermistor. Value of 1=True, Value of 0=False.

Bit 09 Future Implementation

Bit 10 Channel A Fail – Indicated field unit has stopped communicating on network Channel A (A1). Monitors communication on terminal points 15 and 16. Value of 1=True, Value of 0=False.

Bit 11 Channel B Fail – Indicated field unit has stopped communicating on network Channel B (A2). Monitors communication on terminal points 29 and 41. Value of 1=True, Value of 0=False.

Bit 12 Open Torque Switch Fault – Indicates an over-torque condition while traveling in the open direction. The actuator will not move in the open direction unless the actuator is first moved toward the close position. Value of 1=True, Value of 0=False.

Bit 13 Close Torque Switch Fault – Indicates an over-torque condition while traveling in the close direction. The actuator will not move in the close direction unless the actuator is first moved toward the open position. Value of 1=True, Value of 0=False.

Bit 14 Valve Manually Moved – Indicates the valve position has been changed by stroking the valve with the actuator handwheel. (Actuator drive sleeve has rotated without motorized operation.) Value of 1=True, Value of 0=False.

Bit 15 Phase Error – Indicates loss of phase. Value of 1=True, Value of 0=False.

Register 10

Fault register. Read-only. 16-bit unsigned value. Contains additional field unit status. This register is optional for controlling a field unit.

Bit 00 Not Used
Bit 01 Not Used
Bit 02 Not Used
Bit 03 Not Used
Bit 04 Phase(s) Missing Fault – Indicates one or more phase(s) is absent for the three-phase power. Value of 1=True, Value of 0=False.
Bit 05 Phase Reversed Fault – Indicates field unit has noticed incorrect phase rotation of the incoming power. Value of 1=True, Value of 0=False.
Bit 06 Not Used
Bit 07 Not Used
Bit 08 Not Used
Bit 09 Not Used
Bit 10 Network ESD is ON – Indicates field unit has been issued a network ESD command. The field unit will command the actuator to operate to the preconfigured position (Open, Close, Stop, Ignore). The network ESD command must be terminated to reset this bit. Value of 1=True, Value of 0=False.
Bit 11 Local ESD is ON – Indicates field unit has been issued a local ESD command. The field unit will command the actuator to operate to the preconfigured position (Open, Close, Stop, Ignore). The local ESD command must be terminated to reset this bit. Value of 1=True, Value of 0=False.
Bit 12 Unit Reset Since Last Poll – Indicates field unit has reset since the last network poll. This bit is latched until read by the host controller. Value of 1=True, Value of 0=False.
Bit 13 Future Implementation
Bit 14 Opening in Local Mode – Monitors the actuator LCS Open switch. Indicates the actuator LCS has been switched to the Local position AND the actuator is being opened via the LCS. The host does not have control of the actuator. Value of 1=True, Value of 0=False.
Bit 15 Closing in Local Mode – Monitors the actuator LCS Close switch. Indicates the actuator LCS has been switched to the Local position AND the actuator is being closed via the LCS. The host does not have control of the actuator. Value of 1=True, Value of 0=False.

Register 11

Digital Outputs register. Read-only. 16-bit unsigned value. Contains additional field unit status. This register is optional for controlling a field unit.

Bit 00 Close – Indicates field unit close contactor is engaged and the valve is moving in the close direction. This bit is ORd with Register 11, bit 01. Value of 1=True, Value of 0=False.
Bit 01 Open – Indicates field unit open contactor is engaged and the valve is moving in the open direction. This bit is ORd with Register 11, bit 00. Value of 1=True, Value of 0=False.
Bit 02 User Output AS-1 – Indicates field unit AS-1 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a latched digital output, referenced as terminal points 1 and 2.
Bit 03 User Output AS-2 – Indicates field unit AS-2 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a latched digital output, referenced as terminal points 3 and 4.
Bit 04 User Output AS-3 – Indicates field unit AS-3 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a latched digital output, referenced as terminal points 31 and 32.
Bit 05 User Output AS-4 – Indicates field unit AS-4 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a latched digital output, referenced as terminal points 42 and 43.
Bit 06 User Output AR-1 – Optional I/O option board required. Indicates the optional field unit AR-1 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a non-latching digital output. Referenced as terminal points 35 and 36.

Bit 07 User Output AR-2 – Optional I/O option board required. Indicates the optional field unit AR-2 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a non-latching digital output. Referenced as terminal points 44 and 34.
Bit 08 User Output AR-3 – Optional I/O option board required. Indicates the optional field unit AR-3 Relay has been energized. This relay is configurable to operate under many conditions including DDC control. Verify current configuration via the MX LCS. This is a non-latching digital output. Referenced as terminal points 33 and 20.
Bit 09 Network Bypass Relay – Indicates the network bypass relay is energized. Should this relay be de-energized, the actuator will fail to communicate with the host. Value of 1=True, Value of 0=False.
Bit 10 Not Used
Bit 11 Not Used
Bit 12 Not Used
Bit 13 Not Used
Bit 14 Not Used
Bit 15 Not Used

Register 12

Digital Inputs 1 register. Read-only. 16-bit unsigned value. Contains field unit status and digital input status.

Bit 00 Remote Selected – Monitors the actuator LCS. Indicates the LCS has been switched to the Remote position. The host is in control of the actuator. Value of 1=True, Value of 0=False.
Bit 01 Thermal Overload Fault – Indicates the motor has overheated and the thermistor has opened. This unit is unable to operate and time is required for the motor to cool and reset the thermistor. Value of 1=True, Value of 0=False.
Bit 02 Open Torque Switch – Indicates an overtorque condition while traveling in the open direction. This condition will also be true if the actuator is 100% open and torque-seated. Value of 1=True, Value of 0=False.
Bit 03 Open Limit Switch – Open limit switch is engaged. Valve is fully opened. Value of 1=True, Value of 0=False.
Bit 04 Close Torque Switch – Indicates an overtorque condition while traveling in the close direction. This condition will also be true if the actuator is 0% open and torque-seated. Value of 1=True, Value of 0=False.
Bit 05 Close Limit Switch – Close limit switch is engaged. Valve is fully closed. Value of 1=True, Value of 0=False.
Bit 06 Not Used
Bit 07 Not Used
Bit 08 User Input 0/ESD Input – User Input 0. Referenced as Terminal 21. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF. Emergency shutdown input. ESD must be configured for OFF to use as a basic user input.
Bit 09 User Input 1/Open Inhibit Input – User Input 1. Referenced as Terminal 10. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF. Open inhibit input. Open Inhibit must be configured for OFF to use as a basic user input.
Bit 10 User Input 2/Close Inhibit Input – User Input 2. Referenced as Terminal 9. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF. Close inhibit input. Close Inhibit must be configured for OFF to use as a basic user input.
Bit 11 User Input 3/Remote Stop Input – User Input 3. Referenced as Terminal 6. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=False/OFF, Value of 0=True/ON. Remote open input. Remote Control must be configured for OFF to use as a basic user input.
Bit 12 User Input 4/Remote Open Input – User Input 4. Referenced as Terminal 7. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF. Remote open input. Remote Control must be configured for OFF to use as a basic user input.
Bit 13 User Input 5/Remote Close Input – User Input 5. Referenced as Terminal 5. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF. Remote close input. Remote Control must be configured for OFF to use as a basic user input.
Bit 14 User Input 6 – Optional I/O option board required. User Input 6. Referenced as Terminal 23. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF.

Bit 15 User Input 7 - Optional I/O option board required. User Input 7. Referenced as Terminal 24. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF.

Register 13

Digital Inputs 2 register. Read-only. 16-bit unsigned value. Contains field unit status and digital input status.

Bit 00 Not Used

Bit 01 Not Used

Bit 02 Analog Input 1 Lost - Indicates analog Input 1 is not receiving a 4-20 mA signal. Referenced as Terminals 39 and 28 (common). Value of 1=True, Value of 0=False.

Bit 03 Analog Input 2 Lost - Indicates analog Input 2 is not receiving a 4-20 mA signal. Referenced as Terminals 40 and 28 (common). Value of 1=True, Value of 0=False.

Bit 04 Network Channel A/B Lost - Indicates field unit has stopped communicating on network Channel A (Register 9 bit 10) AND has stopped communicating on network Channel B (Register 9 Bit 11). The bit is ONLY available via the local serial port. Value of 1=True, Value of 0=False.

Bit 05 Not Used

Bit 06 DDC Board Present - Indicates presence of optional DDC-100 board. This board allows the actuator to be configured for use on the DDC-100 network. Value of 1=True, Value of 0=False.

Bit 07 I/O Optional Board Present - Indicates presence of optional I/O option board. This board provides AR-1 to AR-3 Relays and User Inputs 6-8. This board also contains the 4-20 mA outputs for analog position transmitter (APT) and analog torque transmitter (ATT). Value of 1=True, Value of 0=False.

Bit 08 Not Used

Bit 09 Not Used

Bit 10 Not Used

Bit 11 Not Used

Bit 12 Phase Lost - Indicates field unit has noticed a phase(s) is absent for the three-phase power. Value of 1=True, Value of 0=False.

Bit 13 Phase Reverse - Indicates field unit has noticed a three-phase rotation is incorrect. The field unit will operate the actuator in the proper direction to prevent damage to the valve. Value of 1=True, Value of 0=False.

Bit 14 User Input 8 - Optional I/O option board. User Input 8. Referenced as Terminal 25. Connect with 120 VAC or 24 VDC. Minimum ON voltage 19.2 V AC/DC; maximum OFF voltage 5.0 V AC/DC. Value of 1=True/ON, Value of 0=False/OFF.

Bit 15 Not Used

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