M238 Logic Controller

Hardware Guide

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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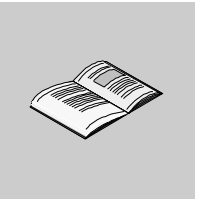
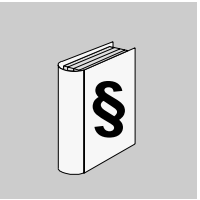
Table of Contents



Safety Information **5**
About the Book **7**
Chapter 1 About the Modicon M238 Logic Controller **11**
Modicon M238 Logic Controller Devices Overview 12
Communication Features 14
Fast Input/Output Functions and Availability 16
Programming Software 18
Physical Description 19
Additional Modules and Maximum Hardware Configuration 21
Accessories 23
Chapter 2 Installation **29**
Installation and Maintenance Requirements 30
First Startup 32
Internal and External Backup Batteries 34
Dimensions 37
Mounting Positions 38
Minimum Clearances 41
The DIN Rail 43
Mounting on a DIN Rail 44
Mounting on a Metallic Panel 47
Environmental Specifications 49
Chapter 3 Wiring and Electrical Specifications **51**
3.1 AC/DC Power Supply Wiring and Specifications 52
Wiring Requirements 53
DC Power Supply Wiring and Specifications 57
AC Power Supply Wiring and Specifications 60
Grounding Shielded Cables 63
3.2 Input Wiring Specifications for AC/DC Controllers 65
Regular Input Wiring Specifications 66
Fast Input Wiring Specifications 69
3.3 Output Wiring Specifications for DC Controllers 72
Regular Output Wiring Specifications for DC Controllers 73
Fast Output Wiring and Specifications for DC Controller 77

3.4 Output Wiring Specifications for AC Controllers 82
Relay Output Wiring Specifications for AC Controllers 83
Transistor Output Wiring Specifications for AC Controllers 87
Chapter 4 Connecting the Modicon M238 Logic Controller to a PC 91
Connecting the Controller to a PC 91
Chapter 5 Serial Line Connection 97
Serial Line Connection. 97
Chapter 6 CANopen Connection 101
CANopen Connection 101
Chapter 7 Controller Diagnostic and I/O Management 105
System Diagnostic Using LED Display 106
Input Management. 109
Output Management for DC Controllers 113
Output Management for AC Controllers. 118
Chapter 8 Fast Inputs/Outputs 123
8.1 HSC (High Speed Counter) 124
HSC Overview 125
Modes 127
HSC I/O Mapping. 129
8.2 PTO (Pulse Train Output) 132
PTO Overview 133
PTO I/O Mapping. 137
8.3 PWM (Pulse Width Modulation). 138
PWM Overview 139
PWM I/O Mapping 140
8.4 FG (Frequency Generator) 141
Frequency Generator. 142
FG I/O Mapping 143
Chapter 9 Wiring Diagram Examples. 145
Wiring Diagram Examples for 1 Encoder on Fast Inputs. 146
Wiring Diagram Examples for 2 Encoders on Fast Inputs 148
Wiring Diagram Examples on Regular Inputs 150
Wiring Diagram Examples for PTO/PWM Actuator on Fast Outputs. . . . 151
Wiring the Modicon M238 Logic Controller to the LEXIUM 05 via the Universal Signal Interface Converter (USIC) 152
Glossary 157
Index 163

Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION
CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

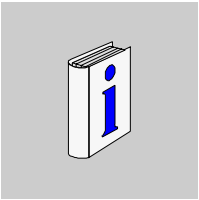
CAUTION
CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

About the Book



At a Glance

Document Scope

Use this document to:

- Install and operate your Modicon M238 Logic Controller.
- Connect the Modicon M238 Logic Controller to a programming device equipped with SoMachine software.
- Interface the Modicon M238 Logic Controller with I/O modules, HMI and other devices.
- Familiarize yourself with the Modicon M238 Logic Controller features.

NOTE: Read and understand this document and all related documents *(see page 8)* before installing, operating, or maintaining your Modicon M238 Logic Controller.

The new Modicon M238 Logic Controller users should read through the entire document to understand all features.

Validity Note

This document has been updated with the release of SoMachine V2.0.

The technical characteristics of the device(s) described in this manual also appear online. To access this information online:

Step	Action
1	Go to *www.schneider-electric.com*
2	In the **Search** box on the home page, type a model number. Do not type any blank spaces in the model number. To get information on a grouping similar modules, you can use the characters ****; do not use dots or *xx*'s.
3	Under **All**, click **Products** →**Product Datasheets** and select the model number that interests you.
4	To save or print a data sheet as a .pdf file, click **Export to PDF**.

The characteristics presented in this manual should be the same as those that appear online. In line with our policy of constant improvement we may revise content over time to improve clarity and accuracy. In the event that you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of Documentation	Reference Number
M238 Logic Controller Programming Guide	EIO0000000384 (ENG); EIO0000000385 (FRE); EIO0000000386 (GER); EIO0000000387 (ITA); EIO0000000388 (SPA); EIO0000000389 (CHS)
Modicon TM2 Digital I/O Modules Hardware Guide	EIO0000000028 (ENG); EIO0000000029 (FRE); EIO0000000030 (GER); EIO0000000031 (SPA); EIO0000000032 (ITA); EIO0000000033 (CHS)
Modicon TM2 Analog I/O Modules Hardware Guide	EIO0000000034 (ENG); EIO0000000035 (FRE); EIO0000000036 (GER); EIO0000000037 (ITA); EIO0000000038 (SPA); EIO0000000039 (CHS)
Modicon TM2 High Speed Counter Modules Hardware Guide	EIO0000000022 (ENG); EIO0000000023 (FRE); EIO0000000024 (GER); EIO0000000025 (SPA); EIO0000000026 (ITA); EIO0000000027 (CHS)
Modicon TWDNOI10M3 AS-Interface Master Module Hardware Guide	EIO0000000608 (ENG); EIO0000000609 (FRE); EIO0000000610 (GER); EIO0000000611 (SPA); EIO0000000612 (ITA); EIO0000000613 (CHS)

499TWD01100 Gateway for M238 Hardware Guide	EIO0000000414 (ENG); EIO0000000415 (FRE); EIO0000000416 (GER); EIO0000000417 (SPA); EIO0000000418 (ITA); EIO0000000419 (CHS)
XBTZGCCAN, XBTZGCCANS0 Modules-Hardware Guide	AAV87521
XBTZGCANM, XBTZGCANMS0 Modules-Hardware Guide	BBV4422600

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Product Related Information

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

EXPLOSION HAZARD

This equipment is suitable for use in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

About the Modicon M238 Logic Controller

1

Introduction

This chapter provides an overview of the Modicon M238 Logic Controller.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
Modicon M238 Logic Controller Devices Overview	12
Communication Features	14
Fast Input/Output Functions and Availability	16
Programming Software	18
Physical Description	19
Additional Modules and Maximum Hardware Configuration	21
Accessories	23

Modicon M238 Logic Controller Devices Overview

Overview

The Schneider Electric Modicon M238 Logic Controller has a variety of powerful features. This controller can service a wide range of applications.

Key Features

The Modicon M238 Logic Controller is supported and programmed with the SoMachine Programming Software, which provides the following IEC61131-3 programming languages:

- IL: Instruction List
- ST: Structured Text
- FBD: Function Block Diagram
- SFC: Sequential Function Chart
- LD: Ladder Diagram
- CFC: Continuous Function Chart

The Modicon M238 Logic Controller can manage up to 7 tasks (1 MAST task and up to 6 other tasks).

The power supply of Modicon M238 Logic Controller is either:

- 24 Vdc
- 100...240 Vac

The Modicon M238 Logic Controller with DC power supply includes the following features:

- 14 digital inputs, including 8 fast inputs
- 10 digital outputs, including 4 fast outputs

The Modicon M238 Logic Controller with AC power supply includes the following features:

- 14 digital inputs, including 8 fast inputs
- 10 digital outputs, including 6 relay outputs

Modicon M238 Logic Controller Range

The following table describes the M238 range *(see page)* and features:

Reference	Power Supply	Serial Ports	CANopen Master	Digital Inputs	Digital Outputs	Memory size
M238 DC Range						
TM238LFDC24DT••••	24 Vdc	SL1: RS232/RS485 SL2: RS485	Yes	8 fast inputs(1) + 6 regular inputs	4 transistor fast outputs(2) + 6 transistor regular outputs	2 MB
TM238LDD24DT	24 Vdc	SL1: RS232/RS485	No			1 MB
M238 AC Range						
TM238LFAC24DR••••	100...240 Vac	SL1: RS232/RS485 SL2: RS485	Yes	8 fast inputs(1) + 6 regular inputs	4 transistor outputs + 6 relay outputs	2 MB
TM238LDA24DR	100...240 Vac	SL1: RS232/RS485	No			1 MB

(1) The fast inputs can be used either as regular inputs or as fast inputs for counting or event functions.

(2) The fast outputs can be used either as regular outputs or as fast outputs for PTO (Pulse Train Output), HSC (High Speed Counter), PWM (Pulse Width Modulation), or FG (Frequency Generator) functions.

Communication Features

Port SL1

On TM238LFDC24DT•• and TM238LFAC24DR••, the first serial line connector supports RS232- and RS485-based communications:

- supports the ASCII protocol for communication with devices such as modems, printers, and barcode readers.
- supports the SoMachine protocol.
- can act as either master or slave on a Modbus network.
- does not support the Ethernet/Modbus gateway 499TWD01100.

On TM238LDD24DT and TM238LDA24DR, the serial line connector supports RS232- and RS485-based communications:

- supports the ASCII protocol for communication with devices such as modems, printers, and barcode readers.
- supports the SoMachine protocol.
- provides 5 Vdc power supply on the serial line, for HMI connection.
- can act as either master or slave on a Modbus network.
- supports the Ethernet/Modbus gateway 499TWD01100.

For more information, refer to serial line connection. *(see page 97)*

Port SL2

On TM238LFDC24DT•• and TM238LFAC24DR••, the second serial line connector supports RS485-based communications:

- supports the ASCII protocol for communication with devices such as modems, printers, and barcode readers.
- supports the SoMachine protocol.
- can act as either master or slave on a Modbus network.
- provides 5 Vdc power on the serial line, which makes it the preferred port for HMI connections.
- supports the Ethernet/Modbus gateway 499TWD01100.

For more information, refer to serial line connection. *(see page 97)*

Port CANopen

On TM238LFDC24DT•• and TM238LFAC24DR••, the CANopen Master can manage:

- digital and analog input/output modules (DS401)
- motor drives (DS402)
- control devices (DSP403)
- encoders (DS406)
- closed loop controllers (DSP404)
- controllers (DS405)
- Radio Frequency Identification Devices (RFID)
- third-party devices such as standard slaves

For more information, refer to CANopen connection. *(see page 101)*

Fast Input/Output Functions and Availability

Fast Input/Output Functions

In accordance with the availability table (below), the Modicon M238 Logic Controller can provide the following high-speed input and pulse output features that motion control applications require:

- *HSC (High Speed Counter)* allows rapid sampling of sensors, encoders, switches, etc.
- *PTO (Pulse Train Output)* facilitates the generation of pulses that are sent to stepper motor and servo drives. This function implements digital technology for precise positioning tasks.
- *PWM (Pulse Width Modulation)* allows your controller to output a wave signal with a programmable frequency and a variable duty cycle resulting in the variation of the average value of the waveform.
- *FG (Frequency Generator)* allows your controller to output a square wave signal with a programmable frequency and a duty cycle equal to 50%.

Availability Table

This table shows the available fast I/O functions:

Reference	Power Supply	HSC	PTO	PWM	FG
DC Reference					
TM238LFDC24DT••	24 Vdc	Yes	Yes	Yes	Yes
TM238LDD24DT	24 Vdc	Yes	Yes	Yes	Yes
DC Reference					
TM238LFAC24DR••	100...240 Vac	Yes	No	No	No
TM238LDA24DR	100...240 Vac	Yes	No	No	No

The fallback settings that may be configured (fallback to 0, fallback to 1, or fallback to the current state) do not apply to outputs Q0, Q1, Q2 or Q3 if these outputs are configured for PTO, PWM, FG, or HSC operation. If a detected error results in the controller entering fallback mode, these outputs will fallback to a value of 0 irrespective of the configured fallback setting.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Design and program your system so that controlled equipment assumes a safe state when the controller enters fallback mode if you use outputs Q0, Q1, Q2, or Q3 for PTO, PWM, FG, or HSC operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE:

- Fallback configuration for outputs does not apply when outputs Q0,Q1, Q2, and Q3 are used for PTO, PWM, FG or HSC operation. In these cases fallback value is always 0.
- In case of fallback for PTO operation, any ongoing move is aborted and ramp-down to 0 (controlled stop feature).

Programming Software

SoMachine

Use the *SoMachine* software to program the Controller.

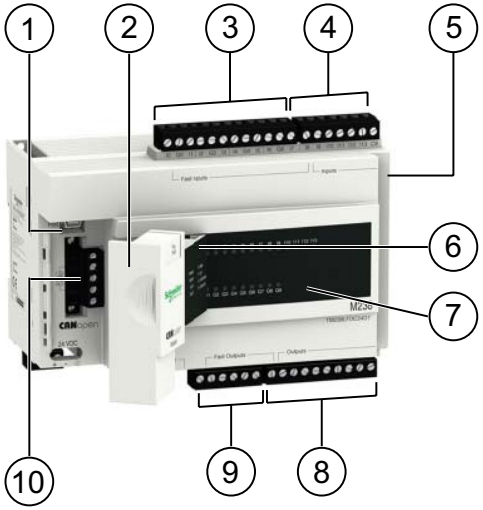
SoMachine is a professional, efficient and open OEM software solution that helps you to develop, configure and commission the entire machine in a single environment (including logic, motor control, HMI and related network automation functions).

SoMachine allows you to program and commission the entire range of elements in Schneider Electric's Flexible Machine Control that helps you to achieve the most optimized control solution for each machine's requirements.

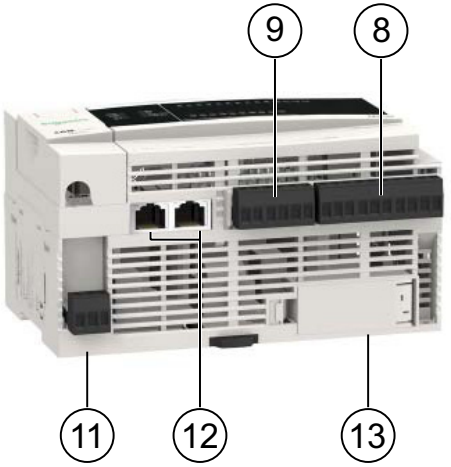
All information about SoMachine is included in the global online help.

Physical Description

Physical Description



1 USB Mini-B port, marked Prg. Port, for connecting the programming terminal
2 Hinged access cover with 2 cable guides (1 removable for Prg. Port and 1 for the CANopen cable)
3 Removable screw terminal block (12 terminals) for connecting the sensors (24 Vdc fast inputs)
4 Removable screw terminal block (7 terminals) for connecting the sensors (24 Vdc inputs)
5 Connector for digital I/O TM2 D••, analog I/O TM2 A••, counter TM200 HSC206D•, and AS-Interface TWDNOI10M3 expansion modules (7 modules max.)
6 Display showing the controller status
7 Display showing the I/O states (I0...I13 and Q0...Q9)
8 Removable screw terminal block (10 terminals) for connecting the 6 pre-actuators
9 Removable screw terminal block (6 terminals) for connecting the 4 pre-actuators
10 Removable screw terminal block (5 terminals marked CANopen) for connecting the CANopen bus, with model TM238LFDC24DT•• or TM238LFAC24DR••



8 Removable screw terminal block (10 terminals) for connecting the 6 pre-actuators

9 Removable screw terminal block (6 terminals) for connecting the 4 pre-actuators

11 Removable screw terminal block (3 terminals):
On TM238LFDC24DT•• and TM238LDD24DT: +, -, marked 24 VDC for connecting the 24 Vdc power supply
On TM238LFAC24DR•• and TM238LDA24DR: L, N, marked 100-240 VAC for connecting the 100...240 Vac power supply

12 1 RJ 45 connector marked SL1 (with model TM238LDD24DT or TM238LDA24DR) or 2 RJ 45 connectors (with model TM238LFDC24DT•• or TM238LFAC24DR••) marked SL1 and SL2 for connecting serial links.

13 Hinged cover for accessing the optional backup battery for the RAM memory and the real-time clock inside the controller.

Additional Modules and Maximum Hardware Configuration

Expansion Modules

The following table shows the expansion modules available for the Modicon M238 Logic Controller:

Module Number	Description	Characteristics	Hardware Guide
TM2D ••	Digital I/O Modules	Digital I/O module features, with corresponding channel type, voltage/current and terminal type are provided in the M238 catalog.	TM2 Digital I/O Modules Hardware Guide, reference EIO0000000028 *(see Modicon TM2, Digital I/O Modules, Hardware Guide)*
TM2A ••	Analog I/O Modules	Analog I/O module features, with corresponding channel type, voltage/current and terminal type are provided in the M238 catalog.	TM2 Analog I/O Modules Hardware Guide, reference EIO0000000034 *(see Modicon TM2, Analog I/O Modules, Hardware Guide)*
TM200 HSC206D•	Expert I/O Modules	Expert I/O module features, with corresponding performance and terminal type are provided in the M238 catalog.	TM2 High-speed counter modules Hardware Guide, reference EIO0000000022 *(see Modicon TM2, High Speed Counter Modules, Hardware Guide)*

Communication Modules

The following table shows the communication modules available for the Modicon M238 Logic Controller:

Module Number	Protocol
Modbus Communication Gateways	
499 TWD 01100	Ethernet/Modbus
LUF P7	Profibus DP/Modbus
LUF P9	DeviceNet/Modbus
AS-Interface bus interface module	
TWDNOI10M3	AS-Interface V2 bus interface master module. TWD AS-Interface Module *(see Modicon TWDNOI10M3, AS-Interface Master Module, Hardware Guide)*

Maximum Hardware Configuration

The Modicon M238 Logic Controller can support up to 7 expansion I/O modules. However, no more than 3 Expert I/O Modules TM200HSC206D•, and no more than 2 AS-Interface modules TWDNOI10M3 may be included in any given configuration.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

- Verify that the Modicon M238 Logic Controller and its expansion modules are securely locked together and to the DIN rail before adding or removing an expansion module.
- Positively confirm that all expansion modules are fully connected before placing your device into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Accessories

Overview

This section describes accessories for the Modicon M238 Logic Controller and their characteristics followed by details for solutions based on Modicon M238 Logic Controller with RS 485 and CANopen communications.

Accessories Supplied with the Modicon M238 Logic Controller

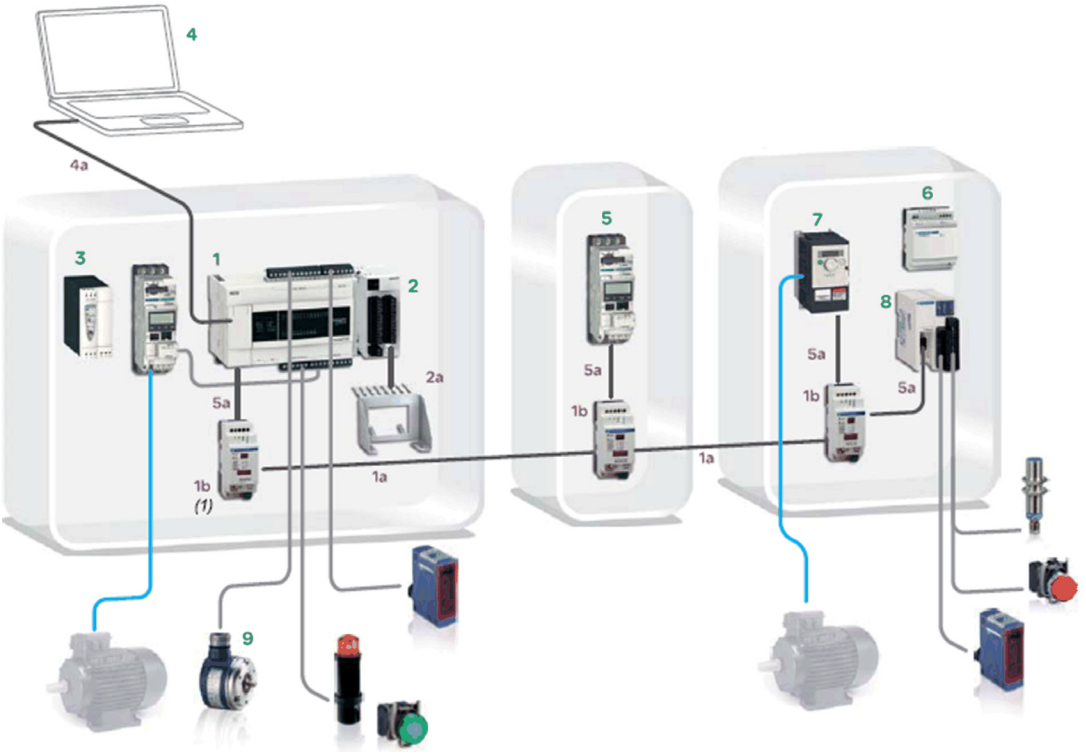
Description	Use	Quantity	Reference
Removable screw connectors	set of 5 removable screw connectors for digital I/O	1	TM238 RSSCT
	5-way connector with a line terminator for a CANopen link	1	TM238 CNTLSCT

Accessories

Description	Use		Quantity	Reference
Terminal port/USB port cordset	from the USB mini-B port on the Modicon M238 Logic Controller to the type A USB port on the PC terminal		3 m (10 ft)	TCS XCNA MUM3P
RS 232 serial link cordset for DTE/DCE terminal device	1 RJ 45 connector and 1 SUB-D 9 connector	for DTE terminal (printer)	3 m (10 ft)	TCS MCN 3M4F3C2
		for DCE terminal (modem, converter)	3 m (10 ft)	TCS MCN 3M4M3S2
Removable spring connectors for digital I/O	set of 5 removable spring connectors. Replaces the 5 screw connectors supplied with Modicon M238 Logic Controller.		1	TM238 RSSPT
USB/RS 485 converter	facilitates the updating the controller's firmware through RS 485 for product version < PV0.9.		1	TSX CUSB 485
Modbus communication gateways	Ethernet/Modbus		1	499 TWD 01100
	Profibus DP/Modbus		1	LUF P7
	DeviceNet/Modbus		1	LUF P9
Modbus cordset	2 RJ 45 connector	for Ethernet gateway 499 TWD 01100	2.5 m (8.3 ft)	XBTZ9980
		for Profibus DP LUF P7, DeviceNet LUF P9 gateway and transceiver USB/RS485 TSX CUSB 485	1 m (3.3 ft)	VW3 A8 306 R10
			3 m (10 ft)	VW3 A8 306 R30
			0.3 m (1 ft)	VW3 A8 306 R03

Description	Use	Quantity	Reference
Offset cordset for USB port	allows the offset of USB port from Modicon M238 Logic Controller or XBTG terminals to panel or closet door.	1 m (3.3 ft)	HMI ZSUSBB
Removable backup batteries	Lithium Thionyl Chloride type for Modicon M238 Logic Controller	Single	TSX PLP 01
		10 pack	TSX PLP 101
End brackets	blocking Modicon M238 Logic Controller and I/O modules on a DIN Rail.	1	AB1AB8P35
Grounding Bar	connection of the cable shield and the module's functional ground	1	TM2 XMTGB
Shielding take-up clip	Mounting and connecting the ground to the cable shielding.	25 pack	TM200 RSRCEMC

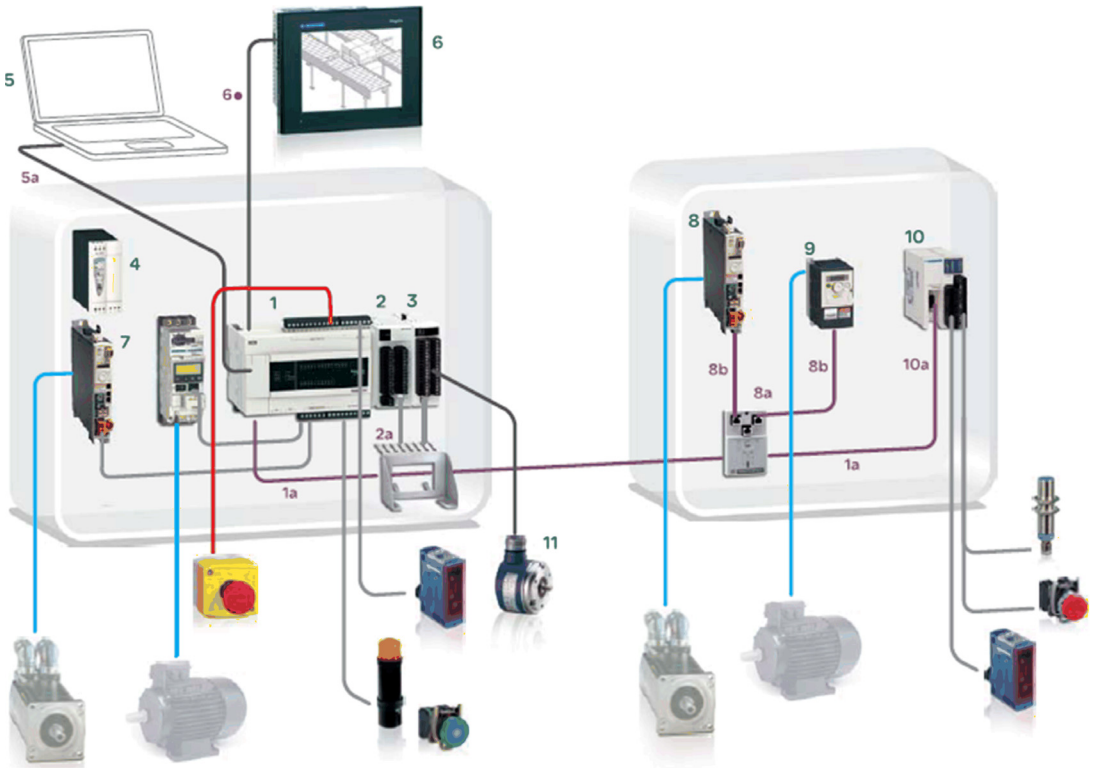
Modicon M238 Logic Controller Based Solution with RS 485 Serial Link



(1) Recommended device for connecting the Modbus trunk cable on screw terminal block and for distances >30m

N°	Products	Reference	Description
1	Logic controller	TM238LDD24DT, TM238LDA24DR	Controller with 24 I/O (including 2 Inputs use as fast inputs) and SL1 port (Modbus protocol)
2	Module with 8 analog inputs	TM2 ARI 8LT	Module with 8 temperature probe input (2 or 3 wires), connected on 2 screw terminal blocks
3	Phaseo 24Vdc power supply	ABL 8REM24•••	Optimum power supply, •••: **030** for I=3A, **050** for I=5A
4	Programming PC	MSD CHNSFUV20	SoMachine Software, 1-station license
5	TeSysU starter-controller	LUB 320	32A power based with multifunction controller unit LUCM 32BL and Modbus communication module LUL C032
6	Power supply 24Vdc Phaseo	ABL 7RM24025	Modular power supply 2.5A
7	Altivar 312 variable speed drive	ATV 312••••••	Drive for asynchronous motor (integrated Modbus and CANopen)
8	Advantys OTB distributed I/O	OTB 1S0 DM9LP	Modbus bus interface module, 12 x 24 Vdc inputs, 2 x 24 Vdc outputs and 6 relay outputs
9	Osicodeur incremental encoder	XCC 14•K/15•Y/19•KN	Rotary 40/58/90mm of diameter with Push-pull outputs with extension cable XCC PM23121L•
1a	Modbus trunk cable	TSX SCA 100/200/500	RS 485 double shielded twisted pair cable, length 100/200/500m (300/600/1,500 ft)
1b	Modbus junction box	TWD XCA ISO	Screw terminal block for trunk cable, 2 RJ45 connectors for tap junction, line isolation and end line termination, 24 Vdc power supply
2a	Grounding plate	TM2 XMTGB	Connection of cable shielding and functional ground on the module 2
4a	Terminal port/PC USB port cordset	TCS XCN AMUM3P	Cordset from USB port on the controller to PC terminal USB port
5a	Modbus drop cables	VW3 A8 306 R03/10/30	Cordset with 2 RJ 45 connector, length 0.3/1/3 m (1/3.3/10 ft)

Modicon M238 Logic Controller Based Solution with CANopen Serial Link



N°	Products	Reference	Description
1	Logic controller	TM238LFDC24DT••	Controller with 24 I/O (including 2 outputs use as PTO signals) and integrated CANopen port
		TM238LFAC24DR••	Controller with 24 I/O (without PTO and PWM functionality)
2	Module with 8 analog inputs	TM2 ARI 8LT	Module with 8 temperature probe input (2 or 3 wires), connected on 2 screw terminal blocks
3	High-speed counter module	TM200 HSC 206 DF	Module with 2 60kHz high-speed counting channels, connected on 2 spring terminal blocks
4	Phaseo 24Vdc power supply	ABL 8REM24•••	Optimum power supply, •••: **030** for I=3A, **050** for I=5A
		ABL 8RPS24•••	Universal power supply, •••: **050** for I=5A, **100** for I=10A
5	Programming PC	MSD CHNSFUV20	SoMachine Software, 1-station license

N°	Products	Reference	Description
6	Magelis HMI Terminals (Modbus protocol)	XBT N200/R400 + 6a XBT RT500/RT511 + 6a	Small Panel with keypad for displaying text messages of 2...10 lines Connection to controller serial port SL2, 5 Vdc power supply via controller (1)
		XBT N401/R410 + 6b XBT R5410/R411 + 6b	Small Panel with keypad for displaying text messages and control/configuration of data, 5.7” screen, external 24 Vdc power supply Connection to controller serial port SL1 or SL2
		XBT GT11••/GT1335 + 6a	Advanced Touch Panel with graphic display, 3.8” screen, external 24 Vdc power supply Connection on COM1 port to controller serial port SL1 or SL2
	Magelis HMI Terminals (SoMachine-Network protocol)	XBT GT2••0...7340 + 6c XBT GK•••0 + 6c	Advanced Touch Panel with graphic display, 5.7”...15” screen, external 24 Vdc power supply Connection on COM1 port to controller serial port SL1 or SL2
7	Lexium 32 servo drive	LXM 32••••	Servo drive on CANopen bus, to be used with BRH/BSH motor
8	Lexium 32 servo drive	LXM 32••••	Servo drive on CANopen bus, to be used with BRH/BSH motor
9	Altivar 312 variable speed drive	ATV 312••••••	Drive for asynchronous motor (integrated Modbus and CANopen)
10	Advantys OTB distributed I/O	OTB 1S0 DM9LP	Modbus bus interface module, 12 x 24 Vdc inputs, 2 x 24 Vdc outputs and 6 relay outputs
11	Osicodeur incremental encoder	XCC 14•K/15•Y/19•KN	Rotary 40/58/90mm of diameter with Push-pull outputs with extension cable XCC PM23121L•
1a	CANopen cable	TSX CAN CA 50/100/300	Cable for standard environment, length 50/100/300 m (150/300/900 ft)
2a	Grounding plate	TM2 XMTGB	Connection of cable shielding and functional ground on modules 2 and 3
5a	Terminal port/PC USB port cordset	TCS XCN AMUM3P	Cordset from USB port on the controller to PC terminal USB port, length 3 m (10 ft)
6•	Magelis HMI Cordsets	6a: XBT Z9980	2 RJ 45 connector, RS 485 Modbus, length 2.5m (7.5 ft)
		6b: XBT Z938	1 SUB-D25 and1 RJ 45 connector, RS 485 Modbus, length 2.5m (7.5 ft)
		6c: XBT Z9008	1 SUB-D9 and1 RJ 45 connector, RS 485 Modbus, length 2.5m (7.5 ft)
8a	IP20 junction box	VW3 CAN TAP2	IP20 junction box with 2 CANopen RJ45 connectors and 1 diagnostic terminal RJ45 connector

N°	Products	Reference	Description
8b	CANopen preassembled cordset	VW3 CAN CARR03/1	Cordset with 2 RJ 45 connectors, length 0.3/1m (1/3.3 ft)
10a	IP20 SUB-D9 Connector	TSX CAN KCDF 90T TSX CAN KCDF 180T	Connector with line terminator, straight/right-angled
(1) Except for XBT RT511, connection to controller serial port SL1 or SL2, external 24 Vdc power supply			

Installation

2

Introduction

This chapter provides installation safety guidelines, device dimensions, mounting instructions, and environmental specifications.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
Installation and Maintenance Requirements	30
First Startup	32
Internal and External Backup Batteries	34
Dimensions	37
Mounting Positions	38
Minimum Clearances	41
The DIN Rail	43
Mounting on a DIN Rail	44
Mounting on a Metallic Panel	47
Environmental Specifications	49

Installation and Maintenance Requirements

Before Starting

Read and understand this manual before beginning the installation of your Modicon M238 Logic Controller.

Disconnecting Power

All options and modules should be assembled and installed before installing the control system on a mounting rail, onto a mounting plate or in a panel. Remove the control system from its mounting rail, mounting plate or panel before disassembling the equipment.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

Programming Considerations

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Operating Environment

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

EXPLOSION HAZARD

This equipment is suitable for use in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use appropriate safety interlocks where personnel and/or equipment hazards exist.
- Install and operate this equipment in an enclosure appropriately rated for its intended environment.
- Use the sensor and actuator power supplies only for supplying power to the sensors or actuators connected to the module.
- Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment.
- Do not use this equipment in safety critical machine functions.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to unused connections, or to connections designated as Not Connected (N.C.).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Install and operate this equipment according to the environmental conditions described in the operating limits.
- Use the sensor and actuator power supplies only for supplying power to the sensors or actuators connected to the module.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

First Startup

Introduction

This procedure will help you through the first installation and start up of your Modicon M238 Logic Controller.

Startup Procedure

Step	Action	Comment
1	Unpack your Modicon M238 Logic Controller and check the contents of the package.	Package contents *(see page 23)*
2	Install the external backup battery (optional).	Backup Battery type: Lithium Thionyl Chloride Backup Battery reference: TSX PLP 01
3	Plug your controller on DIN rail.	Refer to Mounting on a DIN rail *(see page 44)*
4	Connect your devices to the Inputs.	Refer to the Input Wiring Chapter *(see page 65)*.
5	Connect your devices to the Outputs.	Refer to the Output Wiring Chapter *(see page 72)*.
6	Connect your Modicon M238 Logic Controller to the power supply.	Refer to the DC/AC Power Supply Wiring and Specifications *(see page 52)*.
7	Connect your Modicon M238 Logic Controller to your PC.	SoMachine must be installed on your PC. Refer to the Connecting to a PC *(see page 91)*.
8	Turn on power.	Refer to the Controller State Diagram *(see Modicon M238 Logic Controller, Programming Guide)*.
9	Login to your Modicon M238 Logic Controller.	Refer to the M238 Programming Guide *(see Modicon M238 Logic Controller, Programming Guide)*.
10	Create an application.	Refer to the M238 Programming Guide *(see Modicon M238 Logic Controller, Programming Guide)*.
11	Load your application to the Modicon M238 Logic Controller.	Refer to the M238 Programming Guide *(see Modicon M238 Logic Controller, Programming Guide)*.

Step	Action	Comment
12	Create your boot application.	Refer to the M238 Programming Guide *(see Modicon M238 Logic Controller, Programming Guide)*.
13	Run the application.	Refer to the M238 Programming Guide *(see Modicon M238 Logic Controller, Programming Guide)*.

Internal and External Backup Batteries

Introduction

The Modicon M238 Logic Controller has 2 backup batteries:
- 1 embedded internal backup battery (rechargeable)
- 1 external backup battery (not rechargeable)

In the event of a power outage, both backup batteries will retain the internal clock, system data and the values of variables associated with your SoMachine application.

Internal Backup Battery

Use: In the event of a transient power outage or while replacing the external backup battery, the internal backup battery will retain data.

Backup Time: 3 days

Battery Monitoring Features: None

Rechargeable: 22 hours to reach full charge

Replaceable: No

NOTE: For most applications, the internal backup battery is sufficient. For specific applications that require long-term backup of data, the external backup battery *(see page 34)* option provides extended backup duration.

External Backup Battery

Backup Battery Type: Lithium Thionyl Chloride

Reference: TSX PLP 01 for a single backup battery or TSX PLP 101 for a 10 pack.

Use: The external backup battery can store data longer than the internal backup battery can.

Backup Time: Up to 1 years with the recommended backup battery.

Backup Battery Monitoring Features:

You can check the charge level of the external backup battery
- directly on the face of the controller using the LED *(see page 106)*,
- by programming the GetBatteryLevel function *(see Modicon M238 Logic Controller, System Functions and Variables, M238 PLCSystem Library Guide)* in your application, or
- by reading the system variable PLC_R.i_wBatteryStatus *(see Modicon M238 Logic Controller, System Functions and Variables, M238 PLCSystem Library Guide)*.

Rechargeable: No

Replaceable: Yes

While lithium batteries are preferred due to their slow discharge and long life, they can present hazards to personnel, equipment and the environment, and must be handled properly.

⚠ DANGER

EXPLOSION, FIRE, OR CHEMICAL HAZARD

Follow these instructions for the lithium batteries:
- Replace with identical type.
- Follow all battery manufacturer's instructions.
- Remove all replaceable batteries before discarding unit.
- Recycle or properly dispose of used batteries.
- Protect battery from any potential short circuit.
- Do not recharge, disassemble, heat above 100 °C (212 °F), or incinerate.
- Use your hands or insulated tools to remove or replace the battery.
- Maintain proper polarity when inserting and connecting a new battery.

Failure to follow these instructions will result in death or serious injury.

Installing and Replacing the External backup battery

Before installing or replacing the external backup battery, follow these steps so that the data stored in RAM memory is not lost when the external backup battery is removed from its compartment.

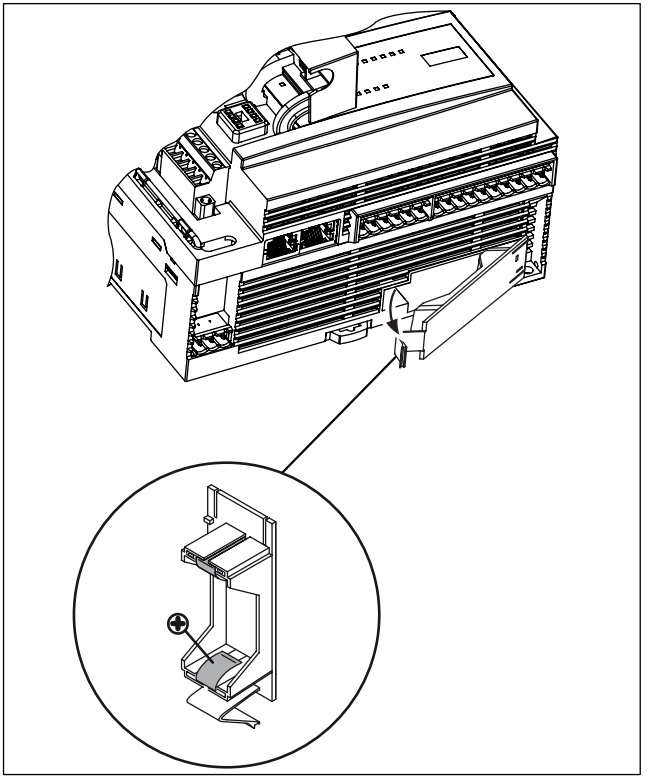
CAUTION

LOSS OF DATA

Before you replace the external backup battery, make sure that the controller has been powered for at least 24 hours so that the internal backup battery is charged.

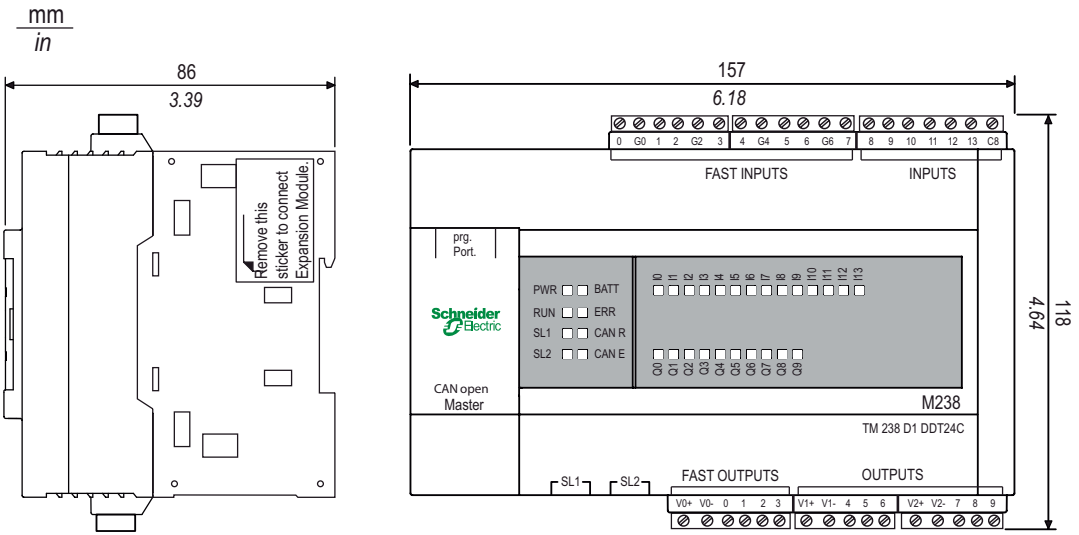
Failure to follow these instructions can result in equipment damage.

To install or replace the external backup battery, follow these steps:

Step	Action
1	Power off your controller.
2	Open the cover to access the backup battery compartment as shown below. 
3	Remove the used battery from the compartment.
4	Insert the new battery in the compartment in accordance with the polarity markings in the compartment and on the battery.
5	Close the cover and verify that the latch clicks into place.
6	Power up your Modicon M238 Logic Controller. **Note:** If you do not power up your Modicon M238 Logic Controller immediately, the external backup battery life might be significantly reduced.

Dimensions

Dimensions



Mounting Positions

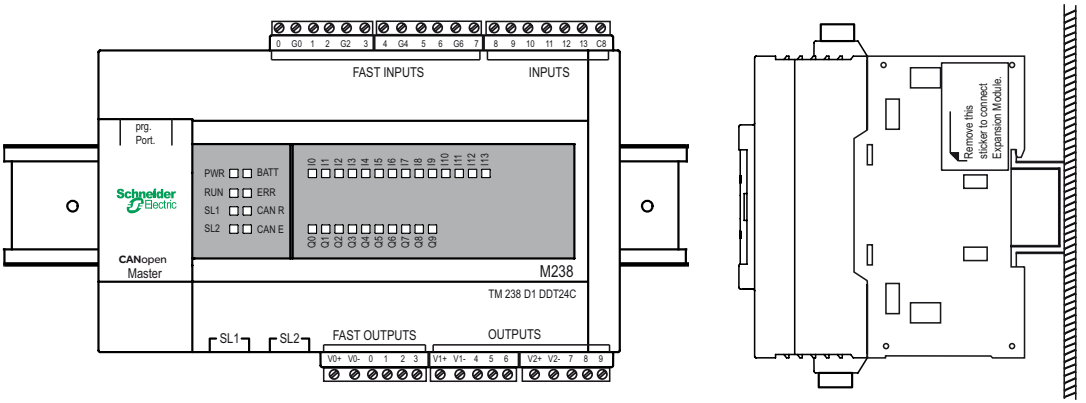
Introduction

This section describes the correct mounting positions for the Modicon M238 Logic Controller.

NOTE: Keep adequate spacing for proper ventilation and to maintain an ambient temperature between -10° C (14° F) and 55° C (131° F).

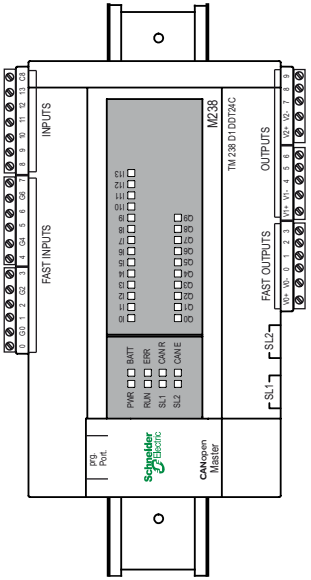
Correct Mounting Position

Whenever possible, the Modicon M238 Logic Controller should be mounted horizontally on a vertical plane as shown in the figure below:



Acceptable Mounting Positions

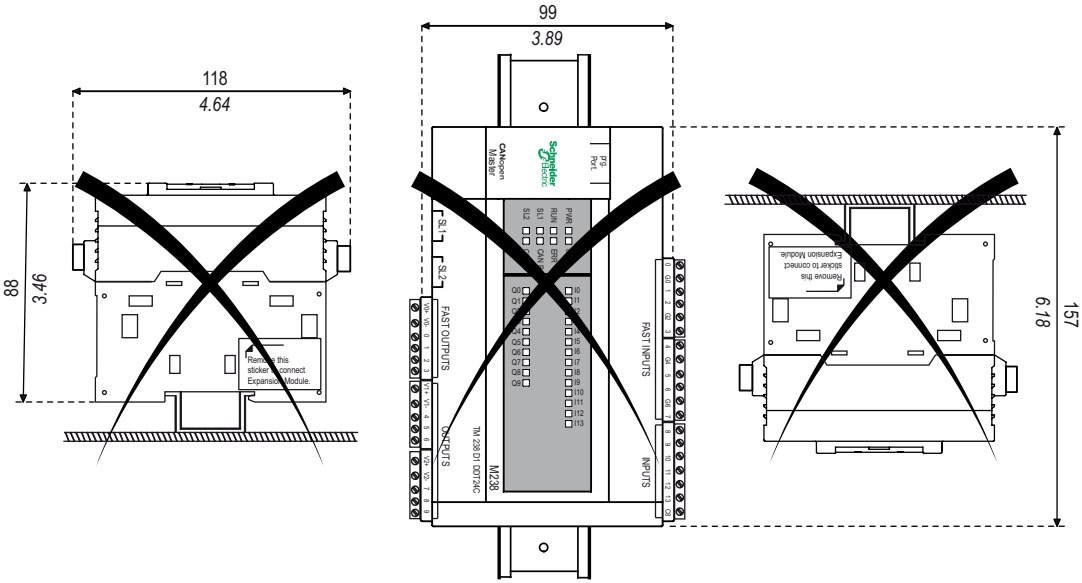
The Modicon M238 Logic Controller can also be mounted sideways on a vertical plane as shown below.



NOTE: Expansion modules must be on top.

Incorrect Mounting Position

The Modicon M238 Logic Controller should only be positioned as shown in Correct Mounting Position *(see page 38)* figure. The figures below show the incorrect mounting positions.



Minimum Clearances

Minimum Clearances

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Place devices dissipating the most heat at the top of the cabinet and ensure adequate ventilation.
- Avoid placing this equipment next to or above devices that might cause overheating.
- Install the equipment in a location providing the minimum clearances from all adjacent structures and equipment as directed in this document.
- Install all equipment according to the drawings specified in the related documentation.

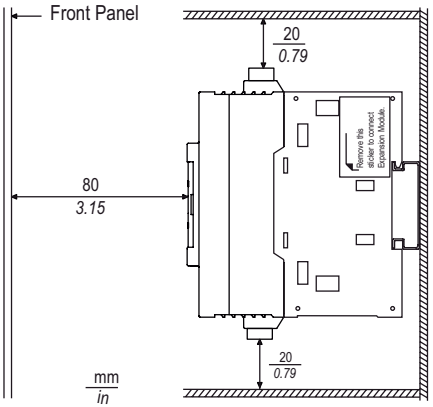
Failure to follow these instructions can result in death, serious injury, or equipment damage.

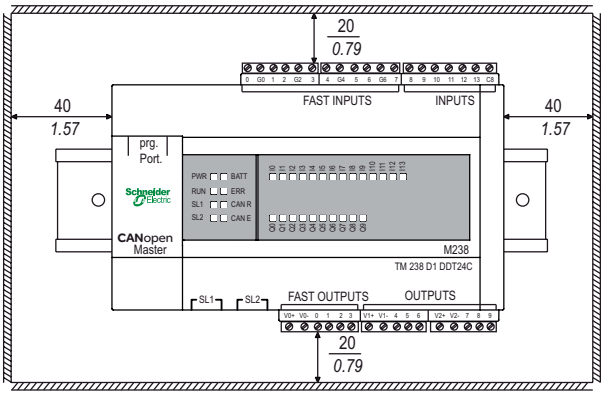
NOTE: Keep adequate spacing for proper ventilation and to maintain an ambient temperature between -10° C (14° F) and 55° C (131° F).

The Modicon M238 Logic Controller has been designed as an IP20 product and must be installed in an enclosure. Clearances must be respected when installing the product.

There are 3 types of clearances between:

- The Modicon M238 Logic Controller and all sides of the cabinet (including the panel door). This type of clearance allows proper circulation of air around the controller, and therefore keeps the sides of cabinet at the ambient temperature.
- The Modicon M238 Logic Controller terminal blocks and the wiring ducts. This distance avoids electromagnetic impulse between the controller and the wiring ducts.
- The Modicon M238 Logic Controller and other heat generating devices installed in the same cabinet.





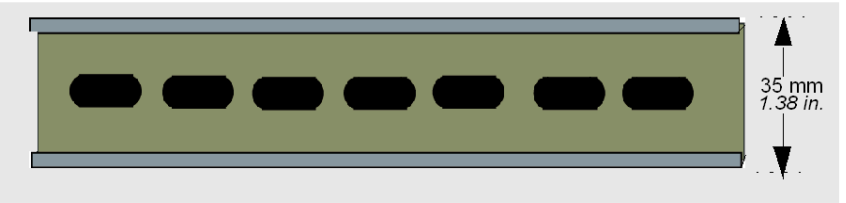
The DIN Rail

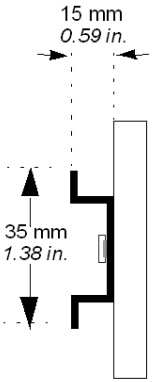
Introduction

You can mount the M238 and its expansions on a DIN rail. A DIN rail can be attached to a smooth mounting surface or suspended from a EIA rack or in a NEMA cabinet.

Dimensions of the DIN Rail

The DIN rail measures 35 mm (*1.38 in.*) high and 15 mm (*0.59 in.*) deep, as shown below.





Recommended Equipment

You can order the suitable DIN rail from Schneider Electric:

Rail depth	Catalogue part number
15 mm (*0.59 in.*)	AM1DE200

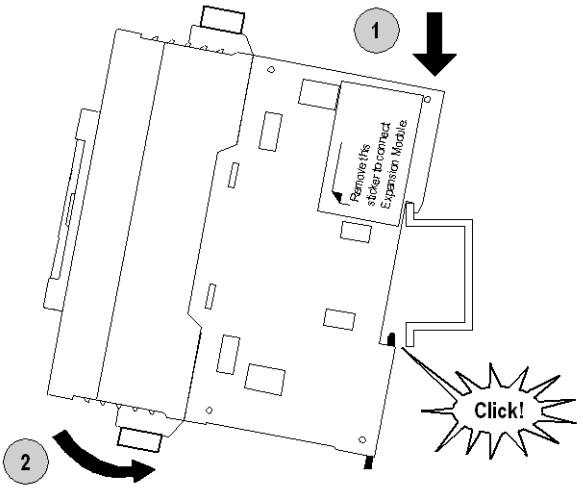
Mounting on a DIN Rail

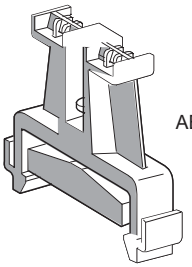
Introduction

This section describes mounting and removing of the Modicon M238 Logic Controller and its expansions on a DIN rail.

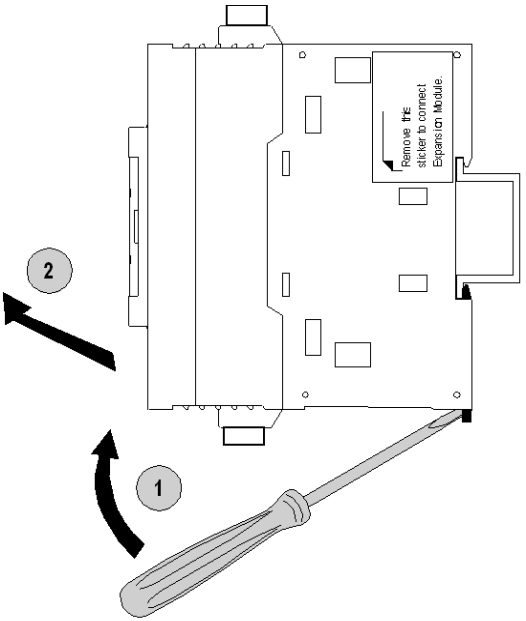
NOTE: Your Modicon M238 Logic Controller may differ from the illustrations in this section but the basic procedures are still applicable.

Installing the Modicon M238 Logic Controller on a DIN Rail

Step	Action
1	Secure the DIN rail to a panel by tightening screws.
2	Place the top groove of the Modicon M238 Logic Controller on the DIN rail and press the controller against the DIN rail until you hear the retaining clamp click into place. 

Step	Action
3	Place end brackets on each side of the controller and its associated I/O.  AB1AB8P35 **Note**: Use end brackets to help prevent the Modicon M238 Logic Controller and its I/O expansion modules assembly from moving sideways. It also provides better resistance to shock and vibration.

Removing the Modicon M238 Logic Controller from a DIN Rail

Step	Action
1	Using a screwdriver, pull down the retaining clamp located on the bottom of the Modicon M238 Logic Controller. 
2	Pull the Modicon M238 Logic Controller off the DIN rail from the bottom.

NOTE: Before re-installing the Modicon M238 Logic Controller on the DIN rail, push up the retaining clamp.

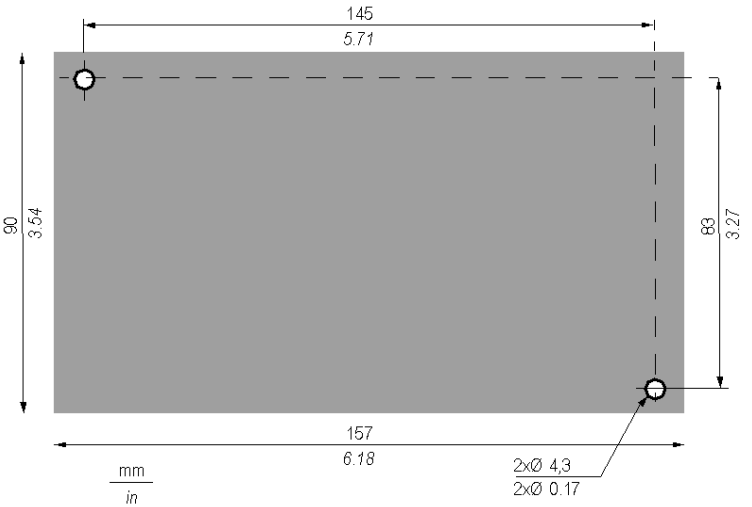
Mounting on a Metallic Panel

Introduction

This section provides information on how to mount the Modicon M238 Logic Controller on a metallic panel.

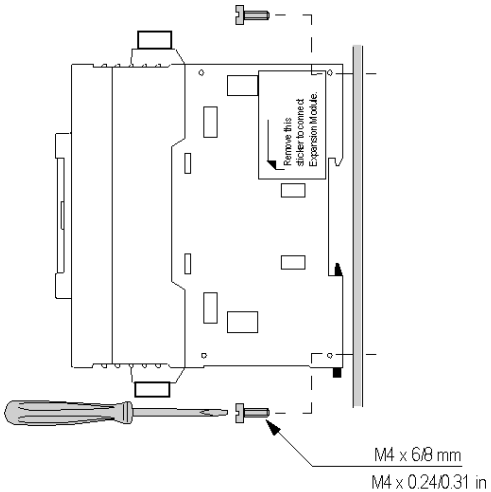
Mounting Holes

The following diagram shows the mounting holes for the Modicon M238 Logic Controller:



Mounting the Modicon M238 Logic Controller on a Metallic Panel

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**



Environmental Specifications

Environmental Specifications

Temperature	Operation	-10 to 55 °C (14 to 131 °F)
	Storage	-40 to 70 °C (-40 to 158 °F)
Relative humidity		95% maximum, non condensing
Degree of pollution		2
Degree of protection		IP 20
Altitude	Operation	0...2000 m (0 to 6560 ft)
	Storage	0...3000 m (0 to 9842 ft)
Vibration resistance	Mounted on a DIN rail	3.5 mm fixed amplitude from 5...8.4 Hz 9.8 m/s^2 (1 g_n) fixed acceleration from 8.4...150 Hz
	Plate or panel mounted	1.6 mm fixed amplitude from 2...25 Hz 39.2 m/s^2 (4 g_n) fixed acceleration from 25...100 Hz
Shock resistance		147 m/s^2 (15 g_n) for a duration of 11 ms
Weight		590 g (1.3 lb)

NOTE: Please see catalog for more specific information on the environmental specifications.

Wiring and Electrical Specifications

3

Overview

This chapter provides power supply and input/output wiring rules and diagrams.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
3.1	AC/DC Power Supply Wiring and Specifications	52
3.2	Input Wiring Specifications for AC/DC Controllers	65
3.3	Output Wiring Specifications for DC Controllers	72
3.4	Output Wiring Specifications for AC Controllers	82

3.1 AC/DC Power Supply Wiring and Specifications

Overview

This section describes the wiring and electrical specifications of AC/DC power supply on controllers.

What's in this Section?

This section contains the following topics:

Topic	Page
Wiring Requirements	53
DC Power Supply Wiring and Specifications	57
AC Power Supply Wiring and Specifications	60
Grounding Shielded Cables	63

Wiring Requirements

Overview

There are several rules that must be followed when wiring a Modicon M238 Logic Controller.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

Rules

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

The following rules must be applied when wiring the M238:

- I/O and communication wiring must be kept separate from the power wiring. Route these 2 types of wiring in separate cable ducting.
- Verify that the operating conditions and environment are within the specification values.
- Use proper wire sizes to meet voltage and current requirements.
- Use copper conductors only.
- Use twisted-pair, shielded cables for analog, expert and/or fast I/O.
- Use twisted-pair, shielded cables for networks and field bus (CANopen, serial, Ethernet).

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for all input, output and communication types specified above.
- Properly ground the cable shields as indicated in the related documentation.
- Route communications and I/O cables separately from power cables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more details, refer to Grounding Shielded Cables *(see page 63)*.

Rules for Removable Screw Terminal Block

The following table shows the cable types and wire sizes for a removable screw terminal block (I/Os and Power Supply):

6 / 0.23 mm / in						
mm^2	0,2…1,5	0,25…1,5	0,2…1	0,2…1,5	0,25…1	0,5...1,5
AWG	*24…14*	*24…14*	*26…16*	*24…14*	*24…16*	*20...14*

Ø 3,5 mm (*0.1 in*)	C	N.m	0,6
		lb-in	*5.3*

Use copper conductors only.

Rules for Removable Spring Terminal Block

The following table shows the cable types and wire sizes for a removable spring terminal block (I/Os and Power Supply):

6 / 0.23 mm / in.				
mm^2	0,2…1,5	0,25…1,5	0,25…1	0,5...1,5
AWG	*24…14*	*24…14*	*24…16*	*20...14*

Use copper conductors only.

The spring clamp connectors of the terminal block are designed for only one wire or one cable end. Two wires to the same connector must be installed with a double wire cable end to help prevent loosening.

⚠ DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Do not insert more than one wire per connector of the terminal block without a double wire cable end.

Failure to follow these instructions will result in death or serious injury.

DC Power Supply Wiring and Specifications

Overview

This section provides the wiring diagrams and the specifications of the DC power supply.

The information below refers to the following model numbers:
- TM238LFDC24DT••
- TM238LDD24DT

Power Supply Voltage Range

If the specified voltage range is not maintained, outputs may not switch as expected. Use appropriate safety interlocks and voltage monitoring circuits.

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

DC Power Supply Specifications

Model Number		**TM238LFDC24DT••**	**TM238LDD24DT**
Voltage	rated voltage (Un)	24 Vdc	
	limit (including ripple)	19.2...28.8 Vdc	20.4...28.8 Vdc
Sensor power supply		Use an external 24 Vdc Phaseo power supply from the Optimum range.	
Maximum inrush current at Un		35 A	
Duration of short transient power interruption [1]		10 ms	
Maximum consumption with expansion modules		17.2 W	

Model Number		TM238LFDC24DT••	TM238LDD24DT
Dielectric Strength	between power supply terminals and ground terminals	500 Vdc for 1 min.	Not isolated, Internal Gnd is connected to the controller frame
	between I/O terminals and ground terminals	500 Vdc for 1 min.	
Isolation Resistance	between power supply terminals and ground terminals	> 10 MΩ (below 500 Vdc)	-
	between I/O terminals and ground terminals	> 10 MΩ (below 500 Vdc)	
(1) The Modicon M238 Logic Controller has been designed to continue operation during short transient power interruptions.			

The duration of the interruptions where the Modicon M238 Logic Controller continues normal operation is variable depending upon the load on the power supply of the Modicon M238 Logic Controller, but generally a minimum of 10 ms is maintained as specified by IEC standards.

If there is a minimum load on the Modicon M238 Logic Controller power supply, the duration can be as great as 400 ms.

When planning the management of the power supplied to the controller, you must consider this duration due to the fast cycle time.

There could potentially be many scans of the logic and consequential updates to the I/O image table during the power interruption, while there is no external power supplied to the inputs, the outputs or both depending on the power system architecture and power interruption circumstances.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Individually monitor each source of power used in the Modicon M238 Logic Controller system including input power supplies, output power supplies and the power supply to the controller to allow appropriate system shutdown during power system interruptions
- The inputs monitoring each of the power supply sources must be unfiltered inputs.

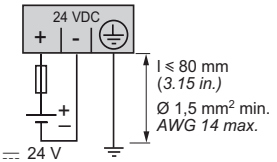
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Power Supply Wiring Diagram

The power supply of this equipment does not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits and the internal backup battery or otherwise result in unintended operation of the equipment.

CAUTION
INOPERABLE EQUIPMENT Verify the wiring conforms to the polarity markings on the connections of this equipment and as described in the related documentation. **Failure to follow these instructions can result in equipment damage.**

The following figure shows the power supply wiring diagram:



Use an external fast-blow fuse 2 A type F (UL recognized and CSA approved).

Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

AC Power Supply Wiring and Specifications

Overview

This section provides the wiring diagrams and the specifications of the AC power supply.

The information below refers to the following model numbers:
- TM238LFAC24DR••
- TM238LDA24DR

Power Supply Voltage Range

If the specified voltage range is not maintained, outputs may not switch as expected. Use appropriate safety interlocks and voltage monitoring circuits.

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

AC Power Supply Specifications

Model Number		**TM238LFDC24DT••, TM238LDD24DT**
Voltage	rated voltage (Un)	100...240 Vac
	limit (including ripple)	85...264 Vac
Sensor power supply		Use an external 24 Vdc Phaseo power supply from the Optimum range.
Maximum inrush current at Un		35 A
Duration of short transient power interruption [1]		10 ms
Maximum consumption with expansion modules		25 W at 100 Vac 42 W at 264 Vac

Model Number		TM238LFDC24DT••, TM238LDD24DT
Dielectric Strength	between power supply terminals and ground terminals	1000 Vdc for 1 min.
	between I/O terminals and ground terminals	1000 Vdc for 1 min.
Isolation Resistance	between power supply terminals and ground terminals	> 10 MΩ (below 500 Vdc)
	between I/O terminals and ground terminals	> 10 MΩ (below 500 Vdc)
(1) The Modicon M238 Logic Controller has been designed to continue operation during short transient power interruptions.		

The duration of the interruptions where the Modicon M238 Logic Controller continues normal operation is variable depending upon the load on the power supply of the Modicon M238 Logic Controller, but generally a minimum of 10 ms is maintained as specified by IEC standards.

If there is a minimum load on the Modicon M238 Logic Controller power supply, the duration can be as great as 400 ms.

When planning the management of the power supplied to the controller, you must consider this duration due to the fast cycle time.

There could potentially be many scans of the logic and consequential updates to the I/O image table during the power interruption, while there is no external power supplied to the inputs, the outputs or both depending on the power system architecture and power interruption circumstances.

⚠ WARNING

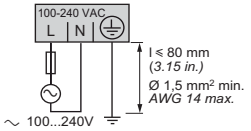
UNINTENDED EQUIPMENT OPERATION

- Individually monitor each source of power used in the Modicon M238 Logic Controller system including input power supplies, output power supplies and the power supply to the controller to allow appropriate system shutdown during power system interruptions
- The inputs monitoring each of the power supply sources must be unfiltered inputs.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Power Supply Wiring Diagram

The following figure shows the power supply wiring diagram:



Use an external fuse 2 A type T (UL recognized and CSA approved).

Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

Grounding Shielded Cables

Modicon M238 Logic Controller Grounding Shielded Cables

To help minimize the effects of electromagnetic interference, cables carrying the fast I/O, analog I/O and field bus communication signals must be shielded.

⚠ WARNING

IMPROPER GROUNDING CAN CAUSE UNINTENDED EQUIPMENT OPERATION

- Use cables with insulated shielded jackets for analog I/O, fast I/O and communication signals.
- Ground shielded cables for analog I/O, fast I/O and communication signals at a single point [1]
- Always comply with local wiring requirements regarding grounding of cable a shields.

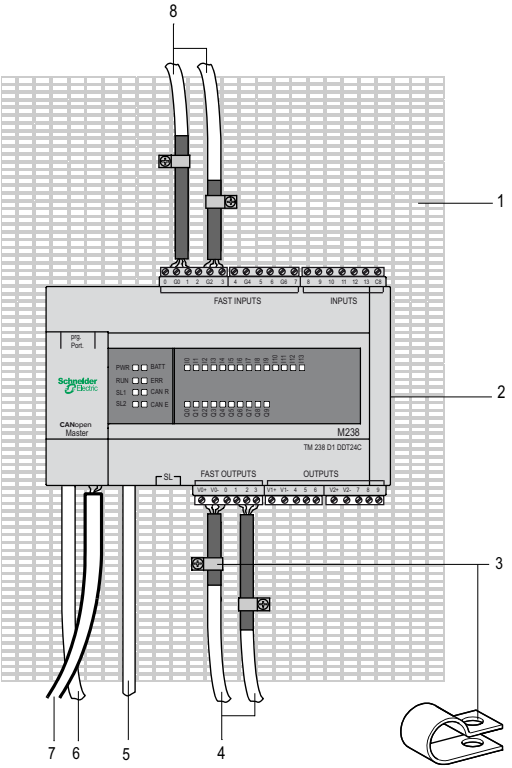
Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: [1]Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short circuit currents.

The use of shielded cables requires compliance with the following wiring rules:

- For protective ground connections (PE), metal conduit or ducting can be used for part of the shielding length, provided there is no break in the continuity of the ground connections. For functional ground (FE), the shielding is intended to attenuate electromagnetic interference and the shielding must be continuous for the length of the cable. If the purpose is both functional and protective, as is often the case for communication cables, the cable should have continuous shielding.
- Wherever possible, keep cables carrying one type of signal separate from the cables carrying other types of signals or power.

The following figure shows the proper method for wiring an Modicon M238 Logic Controller's shielded cables to ground:



1 Metal plate or metal panel (ground casing) connected to the Frame Ground terminal.
2 Modicon M238 Logic Controller.
3 Shielding take-up clip TM200 RSRCEMC: attach the shielding for the cables (4) and (8) as close as possible to the controller base and after stripping the cable insulation from the shielding. Then attach the cable to the metal support (1) by attaching the clamp to the exposed shielding. The shielding must be clamped tightly enough to the metal support to permit good contact.
4 Shielded cables for connecting the outputs to the actuators with PTO/PWM/FG signals.
5 Shielded cordset for connecting the serial links SL1 and/or SL2 for TM238LFDC24DT•• and TM238LFAC24DR••. TCS MCN 3M4•••2 serial communication cords include the grounding lug.
6 Shielded cable for connecting the CANopen bus.
7 Unshielded power supply wires or cable (2 conductors + ground)
8 Shielded cable for connecting the encoder and sensor signals used on the fast outputs in counter mode.

NOTE: The shielding of the shielded cables for connecting sensors/actuators to the analog I/O modules should be secured and grounded as shown in (3) (identical to cables 4 and 8) using TM2 XMTGB ground connection plate.

3.2 Input Wiring Specifications for AC/DC Controllers

Overview

This section describes the wiring and electrical specifications of inputs for AC/DC Controllers.

What's in this Section?

This section contains the following topics:

Topic	Page
Regular Input Wiring Specifications	66
Fast Input Wiring Specifications	69

Regular Input Wiring Specifications

Overview

This section provides the wiring diagrams, specifications, and internal input circuit of the regular inputs.

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Regular Input Specifications

The following table provides information about the main characteristics of the regular inputs:

Model Number		**TM238LFDC24DT••,** **TM238LDD24DT** **TM238LFAC24DR••,** **TM238LDA24DR**
Number of Input Channels		6
Rated Input Voltage		24 Vdc sink/source input signal
Common		1
Input Voltage Range		19.2...30 Vdc
Rated Input Current		10.4 mA
Input Impedance		2.3 kΩ
Input Limit Values	at state 1 (voltage / current)	≥ 15 Vdc / ≥ 2 mA
	at state 0 (voltage / current)	≤5 Vdc / ≤1.5 mA
Anti-bounce filtering (configurable)		0 - 1.5 - 4 or 12 ms

Model Number		**TM238LFDC24DT••, TM238LDD24DT** **TM238LFAC24DR••, TM238LDA24DR**
Turn on Time		< 1 ms
Turn off Time		< 1 ms
Isolation	between channels	None
	between channels and internal logic	500 Vdc
Input Type		Type 1 (IEC 61131-2)
Input Signal Type		sink/source
Maximum Cable Length		30 m (98.4 ft)

Source Input Principle

Current flows from the controller input terminal block to the switch if an input signal turns on.

NOTE: Inputs from I8 to I13 are Sink or Source inputs.

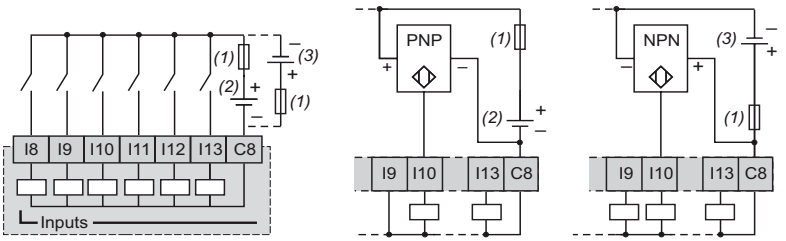
Sink Input Principle

Current flows from the switch to the controller input terminal block if an input signal turns on.

NOTE: Inputs from I0 to I7 are Sink inputs.

Regular Input Wiring Diagram

The following figure shows the regular input wiring diagram:



(1) Fast-blow fuse 0.5 A
(2) Sink input (positive logic)
(3) Source input (negative logic)

Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

Fast Input Wiring Specifications

Overview

This section provides the wiring diagrams, specifications, and internal input circuit of the fast inputs. You must use shielded cable on the fast inputs.

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Fast Input Specifications

The following table provides information about the main characteristics of the fast inputs:

Model Number		**TM238LFDC24DT••, TM238LDD24DT** **TM238LFAC24DR••, TM238LDA24DR**
Number of Input Channels		8
Rated Input Voltage		24 Vdc
Common		4
Input Voltage Range		19.2...30 Vdc
Rated Input Current		8 mA
Input Impedance		3 kΩ
Input Limit Values	at state 1 (voltage / current)	≥ 15 V / ≥ 2 mA
	at state 0 (voltage / current)	≤5 V / ≤1.5 mA
Bounce filtering (configurable)		0.004 - 0.4 - 1.2 or 4 ms

Model Number		**TM238LFDC24DT••,** **TM238LDD24DT** **TM238LFAC24DR••,** **TM238LDA24DR**
Anti-bounce filtering (configurable)		0 - 1.5 - 4 or 12 ms
Turn on Time		300 ns
Turn off Time		300 ns
Isolation	between channels	500 Vdc
	between channels and internal logic	500 Vdc
Input Type		Type 1 (IEC 61131-2)
Input Signal Type		sink
Maximum Cable Length		10 m (32.8 ft)

Shielded Cable Connection

To improve Electromagnetic Compatibility (EMC), use shielded cables for fast inputs. The shielding must be securely connected to ground. The fast input shields may be connected either to the functional ground (FE) of your system via the TM2 XMTGB grounding bar or to the protective ground (PE).

⚠ WARNING

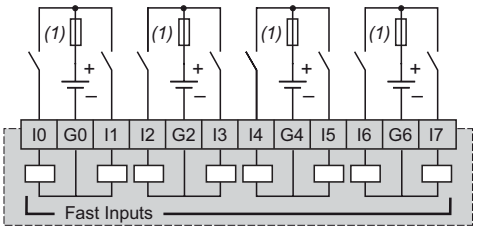
UNINTENDED EQUIPMENT OPERATION

Properly ground the cable shields as indicated in the related documentation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Fast Input Wiring Diagram

The following figure shows the fast inputs wiring diagram:



(1) Fast-blow fuse 0.5 A

Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53).*

3.3 Output Wiring Specifications for DC Controllers

Overview

This section describes the wiring and electrical specifications of outputs for DC controllers.

What's in this Section?

This section contains the following topics:

Topic	Page
Regular Output Wiring Specifications for DC Controllers	73
Fast Output Wiring and Specifications for DC Controller	77

Regular Output Wiring Specifications for DC Controllers

Overview

This section provides the wiring diagrams, the specifications, and the internal output circuit of the regular outputs.

The information below refers to the following model numbers:

- TM238LFDC24DT••
- TM238LDD24DT

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Regular Output Specifications

The following table provides information about the main characteristics of the regular outputs:

Model Number		**TM238LFDC24DT••, TM238LDD24DT**
Number of Output Channels		6
Output Power Supply	rated voltage	24 Vdc
	limit	19.2...30 Vdc (including ripple)
Maximum Output Current		500 mA
Commons		2
Response Time		< 1 ms
Protection	against reverse polarity	No
	against short-circuits and overloads	Yes
Length of Connection Cables		30 m (98.4 ft) max.
Isolation	between channels	500 Vdc
	between channels and internal logic	500 Vdc

Regular Output Wiring Diagram

The outputs of this equipment do not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits or otherwise result in unintended operation of the equipment.

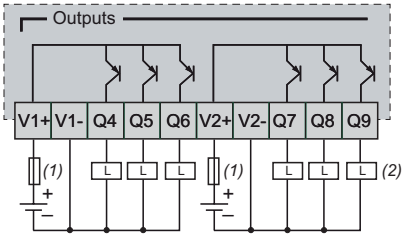
CAUTION

DAMAGED OUTPUT CIRCUITS

Verify the wiring conforms to the polarity markings on the output connections of this equipment and as described in the related documentation.

Failure to follow these instructions can result in equipment damage.

The following figure shows the regular outputs wiring diagram:



(1) Fast-blow fuse 2 A
(2) Protection for inductive load

In the case of a short-circuit or current overload, the common group of outputs automatically enter into thermal protection mode (all outputs set to 0), and are then periodically rearmed (each second) to test the connection state. However, you must be aware of the effect of this rearming on the machine or process being controlled.

⚠ WARNING

UNINTENDED MACHINE STARTUP

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The automatic rearming feature can be inhibited. For this controller, use the `GetShortcutStatus` function to force the group of regular outputs to remain at 0 (OFF).

Depending on the load, a protection circuit may be needed for the outputs on the controllers and certain modules. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

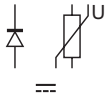
⚠ CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

Failure to follow these instructions can result in injury or equipment damage.

Choose a protection circuit from the following diagrams according to the power supply used. Connect the protection circuit to the outside of the controller or relay output module.



For more information about protecting outputs from inductive load damage see the TM2 Digital I/O Module Hardware Guide *(see Modicon TM2, Digital I/O Modules, Hardware Guide)*.

Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

Fast Output Wiring and Specifications for DC Controller

Overview

This section provides the wiring diagrams, specifications, and internal output circuit of the fast outputs.

The information below refers to the following model numbers:
- TM238LFDC24DT••
- TM238LDD24DT

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Fast Output Specifications

The following table provides information about the main characteristics of the fast outputs:

Model Number		**TM238LFDC24DT••, TM238LDD24DT**
Number of Output Channels		4
Output Power Supply	rated voltage	24 Vdc
	limit	19.2...30 Vdc (including ripple)
Maximum Output Current	regular mode	500 mA
	PWM/FG/PTO modes	100 mA
Commons		1
Response Time	regular mode	< 1 ms
	HSC reflex mode	< 0.25 ms
Leakage Current		0.3 mA

Model Number		TM238LFDC24DT••, TM238LDD24DT
Protection	against reverse polarity	No
	against short-circuits to 0 V and overloads	Yes
	against short-circuits to +24 V	No
Maximum Cable Length	regular mode	30 m (98.4 ft)
	PWM/FG/PTO modes	10 m (32.8 ft) with shielded cable
Isolation	between channels	500 Vdc
	between channels and internal logic	500 Vdc

Selecting Cables

To select the correct cables for your application, proceed as follows:

If...	Then...
you use the PTO/PWM/FG function	use shielded cables. *(see page 63)*
you don't use the PTO/PWM/FG function	use standard cables.

Shielded Cable Connection

To improve Electromagnetic Compatibility (EMC), use shielded cables for fast outputs. The shielding must be securely connected to ground. The fast output shield may be connected either to the functional ground (FE) of your system via the TM2 XMTGB grounding bar or to the protected ground (PE).

⚠ WARNING

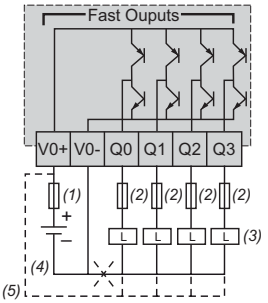
UNINTENDED EQUIPMENT OPERATION

Properly ground the cable shields as indicated in the related documentation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Fast Output Wiring Diagram

The following figure shows the fast outputs source wiring diagram:



(1) 2 A fast-blow fuse
(2) Fast-blow fuse:
0.5 A in standard use
0.1 A in PTO use
(3) Protection for inductive load
(4) Positive logic output wiring
(5) Negative logic output wiring

The outputs of this equipment do not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits or otherwise result in unintended operation of the equipment.

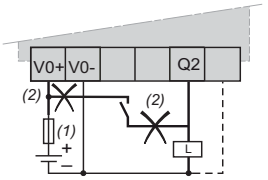
CAUTION

DAMAGE TO FAST OUTPUTS

- Ensure adequate protection against short-circuits on the power supply to the fast outputs.
- Do not connect positive voltage to any of the DC fast outputs terminals (Q0, Q1, Q2, Q3).
- Comply with the wiring diagrams in this documentation.

Failure to follow these instructions can result in equipment damage.

Example of an incorrect wiring on Q2:



(1) 2 A fast-blow fuse
(2) Incorrect wiring

In the case of a short-circuit or current overload, the common group of outputs automatically enter into thermal protection mode (all outputs set to 0), and are then periodically rearmed (each second) to test the connection state. However, you must be aware of the effect of this rearming on the machine or process being controlled.

⚠ WARNING

UNINTENDED MACHINE STARTUP

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The automatic rearming feature can be inhibited. For this controller, use the `GetShortcutStatus` function to force the group of fast outputs to remain at 0 (OFF).

Depending on the load, a protection circuit may be needed for the outputs on the controllers and certain modules. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

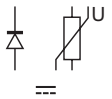
⚠ CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

Failure to follow these instructions can result in injury or equipment damage.

Choose a protection circuit from the following diagrams according to the power supply used. Connect the protection circuit to the outside of the controller or relay output module.



For more information about protecting outputs from inductive load damage see the TM2 Digital I/O Module Hardware Guide *(see Modicon TM2, Digital I/O Modules, Hardware Guide)*.

Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

3.4 Output Wiring Specifications for AC Controllers

Overview

This section describes the wiring and electrical specifications of outputs for AC Controllers.

What's in this Section?

This section contains the following topics:

Topic	Page
Relay Output Wiring Specifications for AC Controllers	83
Transistor Output Wiring Specifications for AC Controllers	87

Relay Output Wiring Specifications for AC Controllers

Overview

This section provides the wiring diagrams, specifications, and internal output circuit of the relay outputs.

The information below refers to the following model numbers:

- TM238LFAC24DR••
- TM238LDA24DR

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Relay Output Specifications

The following table provides information about the main characteristics of the relay outputs:

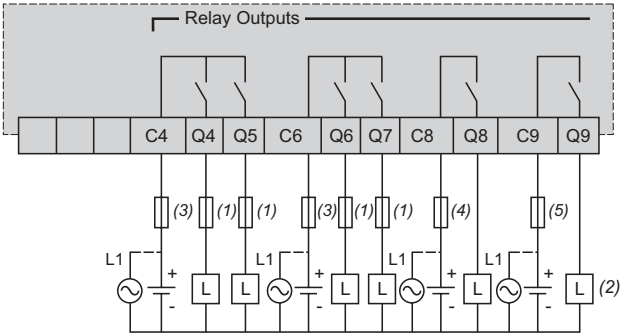
Model Number		**TM238LFAC24DR••, TM238LDA24DR**
Number of Output Channels		6
Output Power Supply	rated voltage	24 Vdc / 240 Vac
	limit	30 Vdc / 250 Vac
Output Current	rated current	C4, C6: 4 A per common and 2 A per channel (Q4, Q5, Q6, Q7) C8: 2 A C9: 5 A
	limit	-

Model Number		**TM238LFAC24DR••, TM238LDA24DR**
Commons		C4: 2 N/O contacts C6: 2 N/O contacts C8: 1 N/O contact C9: 1 N/O contact
Minimum Switching Load		10 mA per 5 Vdc (reference value)
Contact Resistance when new		50mΩ
Loads on Relay Output Q4...Q8	resistive	2 A at 240 Vac or 2 A at 30 Vdc (with 600 operations per hour max.
	minimum electrical service life	$1x10^5$ operations
	minimum mechanical service life	$20x10^6$ operations
	inductive without protection device / Capacitive	See note [1].
Loads on relay output Q9	resistive	5 A at 240 Vac or 5 A at 30 Vdc (with 1800 operations per hour max).
	minimum electrical service life	$5x10^4$ operations
	minimum mechanical service life	$20x10^6$ operations
	inductive without protection device / Capacitive	See note [1].
Isolation	between channels	500 Vrms for 1min
	between channels and internal logic	500 Vrms for 1min

[1] Carefully read the information concerning inductive and capacitive loads in the *Relay Output Wiring Diagram* below.

Relay Output Wiring Diagram

The following figure shows the relay outputs wiring diagram:



(1) 2 A fast-blow fuse
(2) Load protected against inductive charge
(3) 4 A slow-blow fuse
(4) 2 A slow-blow fuse
(5) 5 A slow-blow fuse
L1 All relays use the same phase across relay groups for alternate current connections

Depending on the load, a protection circuit may be needed for the relay outputs. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

⚠ CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

Failure to follow these instructions can result in injury or equipment damage.

Relay outputs can support up to 240 Vac. Inductive damage to these types of outputs can result in welded contacts and loss of control. Each inductive load must be equipped with a protection device such as a peak limiter, RC circuit or flyback diode. Capacitive loads are not supported by these relays.

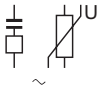
⚠ WARNING

RELAY OUTPUTS WELDED CLOSED

- Always protect relay outputs from inductive alternating current load damage using an appropriate external protective circuit or device.
- Do not connect relay outputs to capacitive loads.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Choose a protection circuit from the following diagrams according to the power supply used. Connect the protection circuit to the outside of the controller or relay output module.



For more information about protecting outputs from inductive load damage see the TM2 Digital I/O Module Hardware Guide *(see Modicon TM2, Digital I/O Modules, Hardware Guide)*.

Terminal Tightening Torque

CAUTION

INOPERABLE EQUIPMENT

Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.).

Failure to follow these instructions can result in equipment damage.

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

Transistor Output Wiring Specifications for AC Controllers

Overview

This section provides the wiring diagrams, specifications, and internal output circuit of the transistor outputs.

The information below refers to the following model numbers:
- TM238LFAC24DR••
- TM238LDA24DR

⚠ DANGER

FIRE HAZARD

Use only the recommended wire sizes for I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the following tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Transistor Output Specifications

The following table provides information about the main characteristics of the transistor outputs:

Model Number		**TM238LFAC24DR••, TM238LDA24DR**
Number of Output Channels		4
Output Power Supply	rated voltage	24 Vdc
	limit	19.2...30 Vdc (including ripple)
Maximum Output Current		500 mA
Commons		1
Response Time		< 0.25 ms

Model Number		TM238LFAC24DR••, TM238LDA24DR
Protection	against reverse polarity	No
	against short-circuits to 0 V and overloads	Yes
	against short-circuits to +24 V	No
Length of Connection Cables		30 m (98.4 ft) max.
Isolation	between channels	500 Vdc
	between channels and internal logic	500 Vdc

Transistor Output Wiring Diagram

The outputs of this equipment do not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits or otherwise result in unintended operation of the equipment.

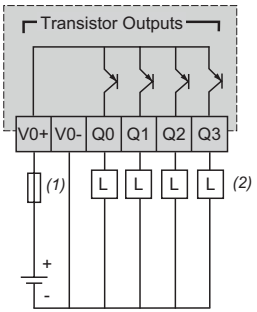
CAUTION

DAMAGED OUTPUT CIRCUITS

Verify the wiring conforms to the polarity markings on the output connections of this equipment and as described in the related documentation.

Failure to follow these instructions can result in equipment damage.

The following figure shows the transistor outputs wiring diagram:



(1) 2 A fast-blow fuse
(2) Protection for inductive load

In the case of a short-circuit or current overload, the common group of outputs automatically enter into thermal protection mode (all outputs set to 0), and are then periodically rearmed (each second) to test the connection state. However, you must be aware of the effect of this rearming on the machine or process being controlled.

⚠ WARNING

UNINTENDED MACHINE STARTUP

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The automatic rearming feature can be inhibited. For this controller, use the `GetShortcutStatus` function to force the group of transistor outputs to remain at 0 (OFF).

Depending on the load, a protection circuit may be needed for the outputs on the controllers and certain modules. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

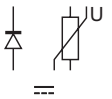
⚠ CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

Failure to follow these instructions can result in injury or equipment damage.

Choose a protection circuit from the following diagrams according to the power supply used. Connect the protection circuit to the outside of the controller or relay output module.



Terminal Tightening Torque

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Wire Stripping and Cable Size

For the cable types and wire sizes, refer to Wiring Requirements *(see page 53)*.

Connecting the Modicon M238 Logic Controller to a PC

4

Connecting the Controller to a PC

Overview

To transfer, run and monitor the applications, connect the controller to a computer, that has SoMachine installed. Use one of the following USB cables:

TCS XCNA MUM3P : This USB cable is suitable for short duration connection like quick updates or retrieving data values.

BMX XCA USBH045 : Grounded and shielded, this USB cable is suitable for long duration connection.

NOTE: You can only connect 1 controller to the PC at the same time.

The USB Mini-B Port is the programming port you can use to connect a PC with a USB host port using SoMachine software. Using a typical USB cable, this connection is suitable for quick updates of the program or short duration connections to perform maintenance and inspect data values. It is not suitable for long term connections such as commissioning or monitoring without the use of specially adapted cables to help minimize electromagnetic interference.

⚠ WARNING

INOPERABLE EQUIPMENT OR UNINTENDED EQUIPMENT OPERATION

- You must use a shielded USB cable such as a BMX XCAUSBH0•• secured to the functional ground (FE) of the system for any long term connection.
- Do not connect more than one controller at a time using USB connections.

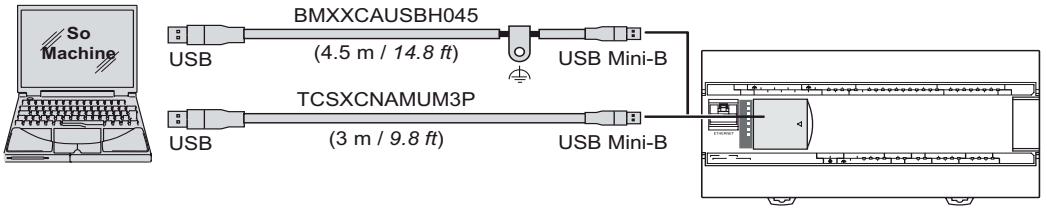
Failure to follow these instructions can result in death, serious injury, or equipment damage.

The communication cable should be connected to the PC first to minimize the possibility of electrostatic discharge affecting the controller.

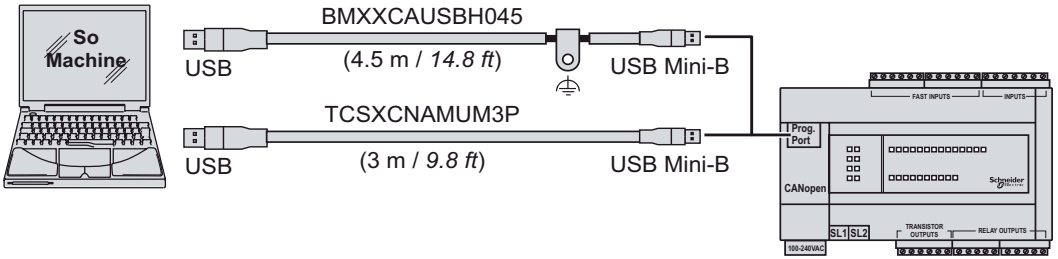
CAUTION
INOPERABLE EQUIPMENT Always connect the communication cable to the PC before connecting it to the controller. **Failure to follow these instructions can result in equipment damage.**

USB Mini-B Port Connection

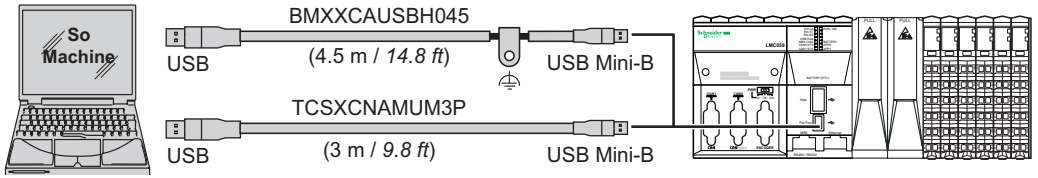
The following figure shows the USB connection to a PC:



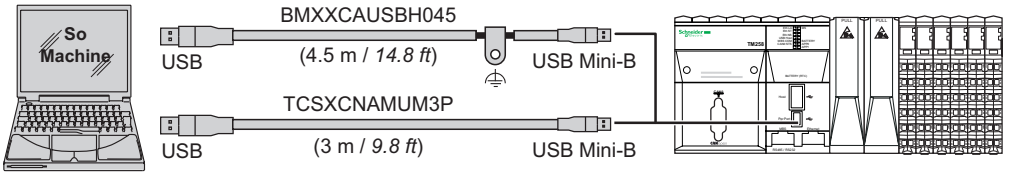
The following figure shows the USB connection to a PC:



The following figure shows the USB connection to a PC:



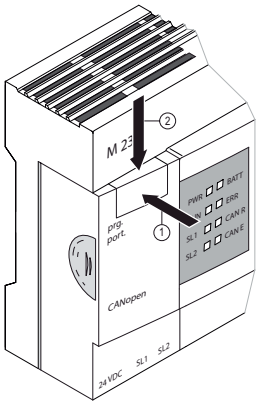
The following figure shows the USB connection to a PC:



To connect the USB cable to your controller, do the following:

Step	Action
1	**1a** If making a long term connection using the cable BMX XCA USBH045, or other cable with a ground shield connection, be sure to securely connect the shield connector to the functional ground (FE) or protective ground (PE) of your system before connecting the cable to your controller and your PC. **1b** If making a short term connection using the cable TCS XCNA MUM3P or other non-grounded USB cable, proceed to step 2.
2	Connect the USB cable connector to the PC.
3	Connect the Mini connector of your USB cable to the controller USB connector.

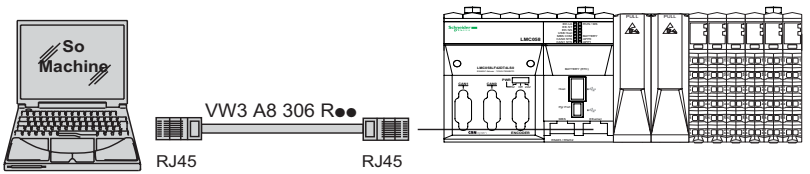
Step	Action
1	**1a** If making a long term connection using the cable BMX XCA USBH045, or other cable with a ground shield connection, be sure to securely connect the shield connector to the functional ground (FE) or protective ground (PE) of your system before connecting the cable to your controller and your PC. **1b** If making a short term connection using the cable TCS XCNA MUM3P or other non-grounded USB cable, proceed to step 2.
2	Connect your USB cable to the computer.
3	Open the hinged access cover.
4	Connect the Mini connector of your USB cable to the controller USB connector.

Step	Action
1	**1a** If making a long term connection using the cable BMX XCA USBH045, or other cable with a ground shield connection, be sure to securely connect the shield connector to the functional ground (FE) or protective ground (PE) of your system before connecting the cable to your controller and your PC. **1b** If making a short term connection using the cable TCS XCNA MUM3P or other non-grounded USB cable, proceed to step 2.
2	Open the USB cover to have access to the Programming Port:  **1** Push horizontally on the USB cover and hold down. **2** Slide the USB cover downward.
3	Connect the USB cable connector to the PC.
4	Connect the Mini connector of your USB cable to the M238 USB connector.

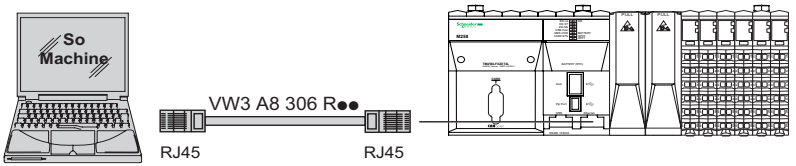
Ethernet Port Connection

You can also connect the controller to a PC using an Ethernet cable.

The following figure shows the Ethernet connection to a PC:



The following figure shows the Ethernet connection to a PC:



To connect the controller to the PC, do the following:

Step	Action
1	Connect your Ethernet cable to the PC.
2	Connect your Ethernet cable to the Ethernet port on the controller.

Serial Line Connection

5

Serial Line Connection

Serial Link Capabilities

To enable communications through serial links, the standard Modicon M238 Logic Controller includes an RS 232/485 serial link and an RS 485 serial link with 5 Vdc power supply (SL1 or SL2 depending on the model).

This isolated serial port allows Modicon M238 Logic Controller to communicate according to 3 protocols:

SoMachine for link with SoMachine compliant device (routing or variable access)

Modbus in order to meet the needs of master/slave architectures with Schneider Electric or third party devices

ASCII in character mode for links with serial devices (printer, modem, or barcode reader)

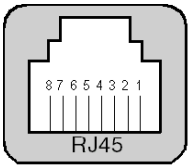
NOTE: Under most circumstances, you should avoid connecting multiple instances of SoMachine to the same controller via the serial line, Ethernet and/or the USB port simultaneously. While it is possible, there could arise conflicts in actions taken by the various instances of SoMachine such as program, configuration or data edits, or control commands to the controller or its application. For more information, see the programming guide for your particular controller.

Serial Lines Connectors Pinout

The Modicon M238 Logic Controller has two 8-pin RJ45 connectors that provide serial link connection:

- 1 marked SL1 (Serial Line 1) for the RS 232/485 serial line
- 1 marked SL2 (Serial Line 2) for the RS 485 serial line

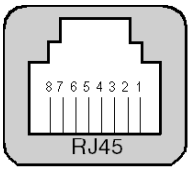
SL1



Pin	RS232	RS485	Description
1	RXD	N.C.	received data
2	TXD	N.C.	transmitted data
3	RTS	N.C.	request to send
4	–	D1 (A+)	differential pair
5	–	D0 (B-)	
6	CTS	N.C.	clear to send
7	+ 5 Vdc / 200 mA (1)		HMI power supply (1)
8	0 V		Signal Common

NOTE: (1) Pin 7 is dedicated to supply power to HMI devices such as XBT Nx00/R400/RT500 or small equipment such as Ethernet Gateway through the serial link cable. Only for TM238LDD24DT and TM238LDA24DR controllers.

SL2



Pin	RS485	Description
1	N.C.	N.C.
2	N.C.	N.C.
3	N.C.	N.C.
4	D1 (A+)	differential pair
5	D0 (B-)	
6	N.C.	N.C.

Pin	RS485	Description
7	+ 5 Vdc / 200 mA (1)	HMI power supply (1)
8	0 V	Signal Common

NOTE: (1) Pin 7 is dedicated to supply power to HMI devices such as XBT Nx00/R400/RT500 or small equipment such as Ethernet Gateway, through serial link cable.

Serial Line Specifications

Characteristics	**Serial Line 1 *(1)***		**Serial Line 2 *(1)***
Model Number	**TM238LDD24DT, TM238LDA24DR**	**TM238LFDC24DT••, TM238LFAC24DR••**	**TM238LFDC24DT••, TM238LFAC24DR••**
Type	Master/slave type isolated serial link		
Standards	RS485/RS232		RS485
Protocol selection	User programmable in SoMachine		
Number of wires	RS485: 4 RS232: 5		4
Connector	RJ45 female		
Supply output	5 Vdc/200 mA	-	5 Vdc/200 mA
Short circuit protection	Yes		
Overload protection	Yes		
Reverse polarity protection	No		
Data rate	1.2...115.2 Kbps (115.2 Kbps by default)	1.2...38.4 Kbps (19.2 Kbps by default) (115.2 Kbps with SoMachine Protocol)	1.2...115.2 Kbps (115.2 Kbps by default)
Line Polarization	User programmable in SoMachine		-
Shield ground	Yes		
Shield ground to signal lines rigidity	500 Vdc		

(1) Serial link 1 and serial link 2 are not isolated from one another.

Modbus and ASCII Network Characteristics

Protocol		**Modbus**		**Character Mode**	
		Physical Interface			
		RS232	**RS485, 2-wire**	**RS232**	**RS485, 2-wire**
Structure	Type	Isolated serial link			
	Access method	Master/slave type			
Transmission	Mode	Asynchronous in basic band			
	Frame	RTU/ASCII, Half duplex		Full duplex	Half duplex
	Data rate	refer to Serial Line Specifications *(see page 99)*			
	Format	7 or 8 data bits, 1 or 2 stop bits			
	Parity	Without, even or odd			
	Medium	Shielded twisted pair		Single or double shielded twisted pair	Shielded twisted pair
Configuration	Number of devices	2 (point to point	32 max per segment	2 (point to point)	32 max per segment
Services	Frame	250 bytes of data per request	–	–	–
	Security, check parameter	One CRC on each frame (RTU) One LRC on each frame (ASCII)		One LRC on each frame (ASCII)	
	Monitoring	Diagnostic counters, event counters		–	

CANopen Connection

6

CANopen Connection

CANopen Capabilities

The Modicon M238 Logic Controller CANopen master has the following features:

Maximum number of slaves on the bus	16 CANopen slave devices
Maximum length of CANopen fieldbus cables	According to the CAN specification (see Cable Length and Transmission Speed).
Maximum number of PDOs managed by the master	32 TPDOs + 32 RPDOs

For each additional CANopen slave,

- the application size increases by an average of 10 kbytes that can result a memory size overload.
- the configuration initialization time at the startup increases that can lead to watchdog condition.

Although SoMachine does not restrict you from doing so, we recommend that you not exceed more than 16 CANopen slave modules (and/or 32 TPDOs and 32 RPDOs) in order to have a sufficient performance tolerance and to avoid any performance degradation.

⚠ WARNING

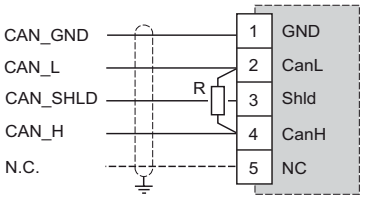
UNINTENDED EQUIPMENT OPERATION

Do not connect more than 16 CANopen slave devices to the controller to avoid system overload watchdog condition.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

CAUTION
DEGRADATION OF PERFORMANCE Do not exceed more than 32 TPDOs and 32 RPDOs for the Modicon M238 Logic Controller. **Failure to follow these instructions can result in equipment damage.**

CANopen Wiring Diagram



R Line termination resistor (120 Ω)

Pin	Signal	Description	Marking	Color of Cable
1	CAN_GND	CAN Ground	GND	black
2	CAN_L	CAN_L bus line (dominant low)	CanL	blue
3	CAN_SHLD	Optional CAN shield	Shld	-
4	CAN_H	CAN_H bus line (dominant high)	CanH	white
5	Not used	Reserved	N.C.	red

CAUTION
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Cable Length

Transmission speed is limited by the bus length and the type of cable used.

The following table describes the relationship between the maximum transmission speed and the bus length (on a single CAN segment without a repeater).

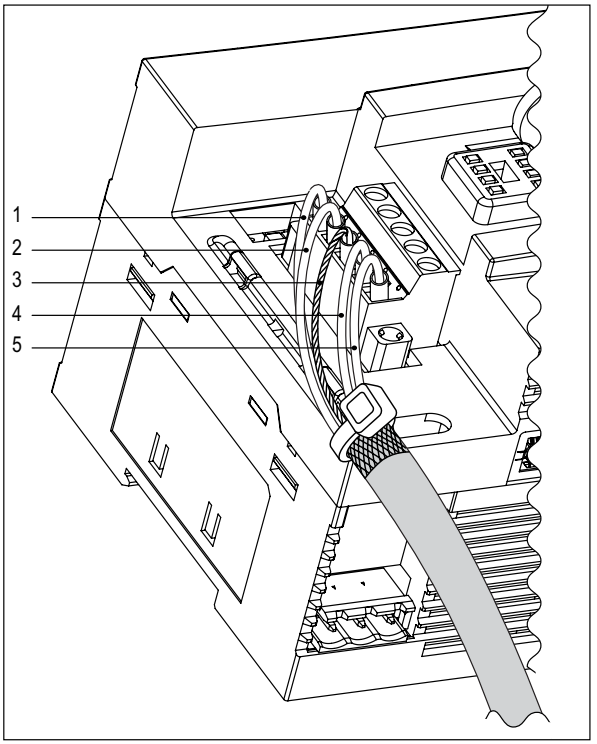
Maximum transmission baud rate	Bus length
1000 Kbps	20 m (65 ft)
800 Kbps	40 m (131 ft)
500 Kbps	100 m (328 ft)
250 Kbps	250 m (820 ft)
125 Kbps	500 m (1,640 ft)
50 Kbps	1000 m (3280 ft)
20 Kbps	2500 m (16,400 ft)

CANopen Wiring

The CANopen network cable is a shielded twisted double-pair cable that complies with the CANopen standard CiA DR-303-1.

The CANopen network cable must be properly grounded to the Modicon M238 Logic Controller Shield Ground (Shld), or CANopen communications may be interrupted or operate improperly.

The following figure shows the wiring of the cable CANopen to the Modicon M238 Logic Controller



1 CAN_GND
2 CAN_L
3 CAN_SHLD
4 CAN_H
5 N.C.

Controller Diagnostic and I/O Management

7

Introduction

This chapter provides information about controller diagnostic and I/O management.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
System Diagnostic Using LED Display	106
Input Management	109
Output Management for DC Controllers	113
Output Management for AC Controllers	118

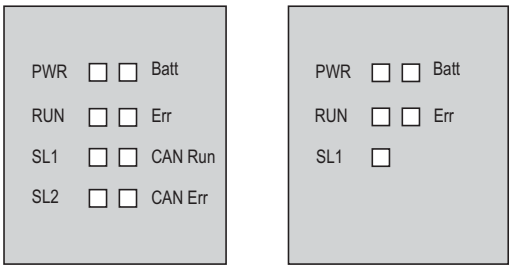
System Diagnostic Using LED Display

Introduction

This section provides information about the controller operating status and troubleshooting using LEDs on the front of the Modicon M238 Logic Controller.

This controller has either 5 or 8 LED, depending on the Controller model, that report different states of the system. In addition, there are 24 LEDs that report the input and output logic states.

System LED Display



Display 1: LEDs on the TM238LFDC24DT•• and TM238LFAC24DR•• Controllers
Display 2: LEDs on the TM238LDD24DT and TM238LDA24DR Controllers

The table below shows system LED description:

LED	Color	Description
PWR	green	• ON: power on • OFF: power off
Batt	red	• ON: The external backup battery is depleted or absent and needs to be replaced as soon as possible. The remaining charge may not be sufficient to maintain data in persistent memory. • Regular flashes: The backup battery needs to be replaced but still maintains data. • OFF: The backup battery charge is ok. • This LED can be deactivated using the `InhibitBatLowLed` *(see Modicon M238 Logic Controller, System Functions and Variables, M238 PLCSystem Library Guide)* function.
RUN	green	• ON: The controller is in RUN state. • OFF: No program in the controller. • Regular flashes: The controller is in STOP state. • Slow flashes (25% ON, 75% OFF): The controller is stopped on a breakpoint.

LED	Color	Description
Err	red	• ON, with RUN LED flashing: EXCEPTION state due to application watchdog or system overload. • Fast flashes: Internal error detected. • 3 flashes, with RUN LED in OFF state: no application in the controller. • Slow flashes (25% ON, 75 % OFF), Non-blocking detected error: Current application has not been saved as a boot project or detected error on expansion bus. • Regular flashes, with RUN LED in OFF state: Corrupted or missing firmware.
SL1	yellow	Shows the activity of the serial line 1.
SL2(1)	yellow	Shows the activity of the serial line 2.
CAN Run(1)	green	Indicates the status of the CANopen network. See table below.
CAN Err.(1)	red	Indicates errors detected by the CANopen Master or the CANopen physical layer. See table below.

(1) Only for TM238LFDC24DT•• and TM238LFAC24DR••.

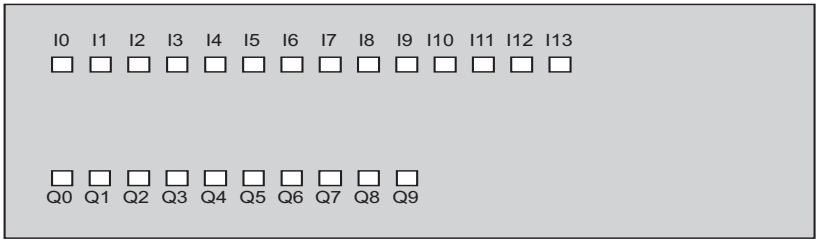
CANopen LEDs Description (only for TM238LFDC24DT•• and TM238LFAC24DR••)

The CAN Run LED indicates the status of the CANopen network. the CAN Err. LED indicates the status of the CANopen physical layer and the presence or absence of regularly recurring CAN messages (sync, guard or heartbeat).

The following table describes the status of CANopen LEDs:

LED		Status	Meaning
CAN Run	green	off	No CANopen master configured
		flashing	The CANopen bus is in initialization phase
		1 flash per second	The CANopen bus is stopped
		on	The CANopen bus is operational
CAN Err.	red	off	No CANopen fault detected
		flashing	CANopen configuration not valid
		1 flash per second	Alarm threshold exceeded (too many errors detected)
		2 flashes per second	A “Node Guarding” or “Heartbeat” event has occurred
		on	The CANopen bus is stopped (BUS OFF)

I/O LED Display



The LEDs indicate the logic state of each input and output:

- ON: Input or output state is active.
- OFF: Input or output state is inactive.

Input Management

Introduction

The Modicon M238 Logic Controller includes 14 digital inputs, including 8 fast inputs.

The following functions are configurable on regular and/or fast inputs:

- Filters (depends on the function associated with the input).
- 8 fast inputs can be either latched or used for events (rising edge, falling edge, or both) and thus be linked to an external task (up to 4).
- Any input can be used for the RUN/STOP function.
- Some of the inputs can be used by HSC, PTO, PWM, and FG functions.

NOTE: All inputs by default can be used as regular inputs.

Input Management Functions Availability

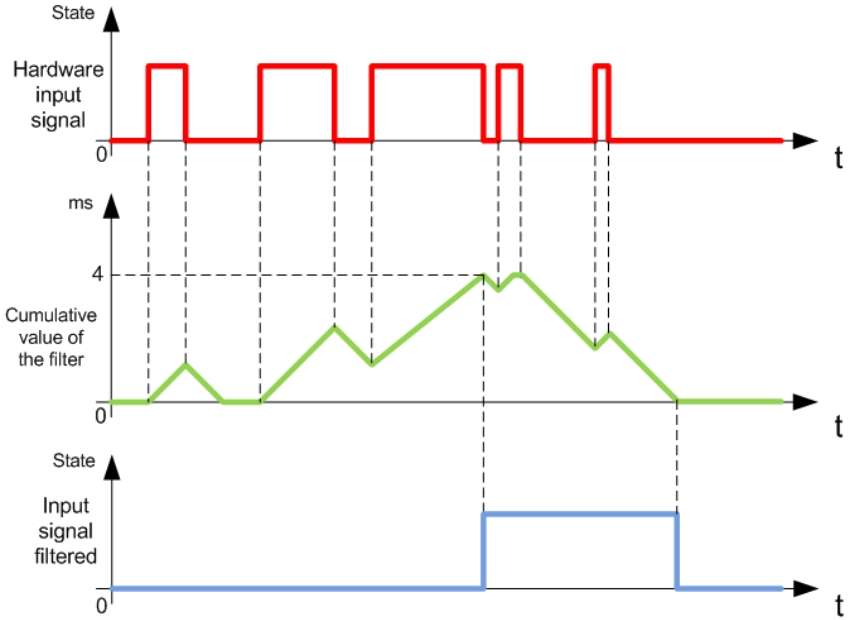
An input is either not configured, or used for RUN/STOP, or used for events, or used by HSC, PTO, PWM, and FG functions. See the table below:

Model Number		**TM238LFDC24DT••, TM238LDD24DT TM238LFAC24DR••, TM238LDA24DR**				**TM238LFDC24DT•• , TM238LDD24DT**	**TM238LFAC24DR•• , TM238LDA24DR**
Function		**Input function**				**HSC/PTO/PWM/FG**	
		None	**RUN/STOP**	**Latch**	**Event**		
Filter type		**Integrator**	**Integrator**	**Bounce**	**Bounce**		
Fast Input	I0	X	X	X	X	HSC	
	I1	X	X	X	X	HSC	
	I2	X	X	X	X	HSC	
	I3	X	X	X	X	HSC	
	I4	X	X	X	X	HSC	
	I5	X	X	X	X	HSC	
	I6	X	X	X	X	HSC	
	I7	X	X	X	X	HSC	
Regular Input	I8	X	X	–	–	PWM/FG	–
	I9	X	X	–	–	PWM/FG/PTO	–
	I10	X	X	–	–	–	–
	I11	X	X	–	–	PWM/FG	–
	I12	X	X	–	–	PWM/FG/PTO	–
	I13	X	X	–	–	–	–

Integrator Filter Principle

The integrator filter is designed to reduce the effect of noise. Setting a filter value allows the controller to ignore some sudden changes of input levels caused by noise.

The following timing diagram illustrates the integrator filter effects for a value of 4 ms:

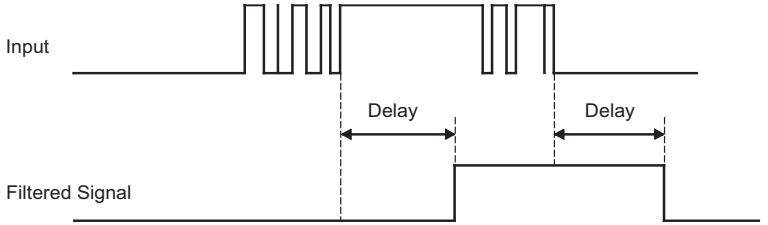


NOTE: The value selected for the filter's time parameter specifies the cumulative time in ms that must elapse before the input can be 1.

Bounce Filter Principle

The bounce filter is designed to reduce the bouncing effect at the inputs. Setting a bounce filter value allows the controller to ignore some sudden changes of input levels caused by noise. The bounce filter is only available on the fast inputs.

The following timing diagram illustrates the anti-bounce filter effects:



Bounce Filter Availability

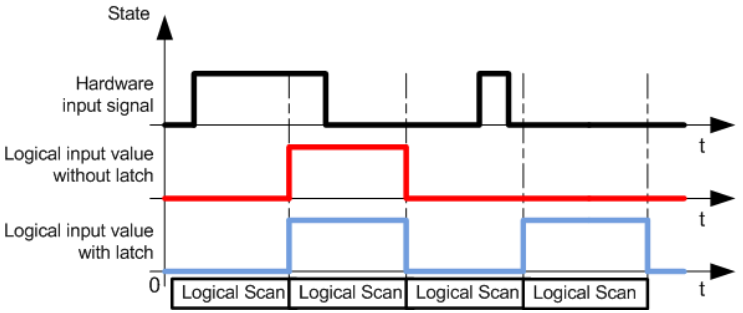
The bounce filter can be used on a fast input when:

- Latch is used, or Event is used, and
- No HSC is enabled

Latching

Latching is a function that can be assigned to the Modicon M238 Logic Controller fast inputs. This function is used to memorize (or latch) any pulse with a duration that is less than the Modicon M238 Logic Controller scan time. When a pulse is shorter than one scan, the controller latches the pulse, which is then updated in the next scan. This latching mechanism only recognizes rising edges. Falling edges cannot be latched. Assigning inputs to be latched is done with the I/O configuration screen in SoMachine.

The following timing diagram illustrates the latching effects:



Event

An input configured for Event can be associated with an External Task *(see Modicon M238 Logic Controller, Programming Guide)*.

RUN/STOP

The RUN/STOP function is used to start or stop a program using an input:

- When the configured RUN/STOP input is at logic 0, the controller is put into a STOP state and any other outside command to enter the RUN state is ignored.
- A rising edge (passing from 0 to 1) of the RUN/STOP input provokes automatically a start-up of the application as the controller enters a RUN state.
- When the configured RUN/STOP input is at logic 1, then the controller program is running unless otherwise commanded by SoMachine (RUN/STOP commands from SoMachine are allowed).

⚠ WARNING

UNINTENDED MACHINE OR PROCESS START UP

- Be sure of the state of security of your machine or process environment before applying power to the Run/Stop input.
- Use the Run/Stop input to help prevent the unintentional start up from a remote location.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information, refer to Embedded I/O configuration *(see Modicon M238 Logic Controller, Programming Guide)*.

Output Management for DC Controllers

Introduction

The information below refers to the following model numbers:
- TM238LFDC24DT••
- TM238LDD24DT

The Modicon M238 Logic Controller with DC power supply includes 10 digital outputs, including 4 fast outputs.

The following output functions are configurable on regular and/or fast outputs:
- HSC (reflex features on HSC threshold)
- PTO
- PWM
- FG

NOTE: All outputs by default can be used as regular outputs.

Output Management Functions Availability

Function		**HSC**				**PTO**		**PWM FG**	
Type		**Main**	**Simple(1)**	**Main**	**Simple(2)**				
Channel Number		**0**	**0...3**	**4**	**4...7**	**PTO0**	**PTO1**	**PWM0 FG0**	**PWM1 FG1**
Fast Output	Q0	–	–	–	–	PTO0 Output0	–	PWM0/FG0 Output	–
	Q1	–	–	–	–	PTO0 Output1	–	–	–
	Q2	–	–	–	–	–	PTO1 Output0	–	PWM1/FG1 Output
	Q3	–	–	–	–	–	PTO1 Output1	–	–

Function		HSC				PTO		PWM FG	
Type		Main	Simple(1)	Main	Simple(2)				
Channel Number		0	0...3	4	4...7	PTO0	PTO1	PWM0 FG0	PWM1 FG1
Regular Output	Q4	HSC0 reflex Output0(3)	–	–	–	–	–	–	–
	Q5	HSC0 reflex Output1(3)	–	–	–	–	–	–	–
	Q6	–	–	–	–	–	–	–	–
	Q7	–	–	HSC4 reflex Output0(3)	–	–	–	–	–
	Q8	–	–	HSC4 reflex Output1(3)	–	–	–	–	–
	Q9	–	–	–	–	–	–	–	–

(1) Channels HSC0 to HSC3 are usable as a Simple HSC only if HSC0 is not used as a Main HSC *(see page 125)*.

(2) Channels HSC4 to HSC7 are usable as a Simple HSC only if HSC4 is not used as a Main HSC *(see page 125)*.

(3) Reflex output used or not according to configuration. If not configured, the output is a regular output by default.

Fallback Modes (Behaviour for outputs in Stop)

When the controller enters the STOP or EXCEPTION state for any reason, the Local (Embedded and Expansion) outputs are set to fallback values. Two modes are available:

Set all outputs to default Each output is set to the configured default value, either 0 or 1 (initially set to 0 in the configuration).

Keep current values Each output remains in its current state

The fallback settings that may be configured (fallback to 0, fallback to 1, or fallback to the current state) do not apply to outputs Q0, Q1, Q2 or Q3 if these outputs are configured for PTO, PWM, FG, or HSC operation. If a detected error results in the controller entering fallback mode, these outputs will fallback to a value of 0 irrespective of the configured fallback setting.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Design and program your system so that controlled equipment assumes a safe state when the controller enters fallback mode if you use outputs Q0, Q1, Q2, or Q3 for PTO, PWM, FG, or HSC operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE:

- Fallback configuration for outputs does not apply when outputs Q0,Q1, Q2, and Q3 are used for PTO, PWM, FG or HSC operation. In these cases fallback value is always 0.
- In case of fallback for PTO operation, any ongoing move is aborted and ramp-down to 0 (controlled stop feature).

Short-circuit or Over-current on Outputs

In the case of short-circuit or over-current on outputs, there are different considerations for the 3 groups of outputs:

- Group 1 (Q0 to Q3): 4 fast outputs
- Group 2 (Q4 to Q6): 3 regular outputs
- Group 3 (Q7 to Q9): 3 regular outputs

The following table describes the detection:

If...	then...
you have a short-circuit at 0V on group 1	the group 1 automatically go into thermal protection mode (all fast, PWM or FG outputs set to 0 and PTO outputs runs a quick stop deceleration) and are then periodically rearmed every 10 seconds to test the connection state (see warning below). For more information, refer to fast output wiring diagram *(see page 79)*.
you have short-circuit at 24V on group 1	nothing is detected and can result in equipment damage (see caution below).

If...	then...
you have a short-circuit at 0V on group 2 or 3	the impacted group automatically go into thermal protection mode (all regular or HSC outputs set to 0) and are then periodically rearmed every 10 seconds to test the connection state (see warning below). For more information, refer to regular output wiring diagram *(see page 73)*.
you have short-circuit at 24V on group 2 or 3	nothing is detected and no heating.
the current crossing the group 1, 2, or 3 is too high	a thermal disjunction occurs shutting down the outputs.The outputs are forced to 0, and cannot be set to 1 until the temperature decreases.

NOTE: The short-circuit diagnostic for each group is provided by the function GetshortcutStatus *(see Modicon M238 Logic Controller, System Functions and Variables, M238 PLCSystem Library Guide)*.

⚠ WARNING

UNINTENDED MACHINE STARTUP

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The automatic rearming feature can be inhibited. For this controller, use the `GetshortcutStatus` function to force the group of outputs to remain at 0 (OFF).

The outputs of this equipment do not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits or otherwise result in unintended operation of the equipment.

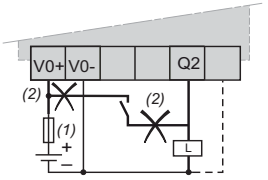
CAUTION

DAMAGE TO FAST OUTPUTS

- Ensure the use of adequate protection against short-circuits on the power supply to the fast outputs.
- Do not connect positive voltage to any of the DC fast outputs terminals (Q0, Q1, Q2, Q3).
- Comply with the wiring diagrams immediately after this message.

Failure to follow these instructions can result in equipment damage.

Example of an incorrect wiring on Q2:



(1) 2 A fast-blow fuse
(2) Incorrect wiring

Output Management for AC Controllers

Introduction

The information below refers to the following model numbers:
- TM238LFAC24DR••
- TM238LDA24DR

The Modicon M238 Logic Controller with AC power supply includes 10 digital outputs, including 6 relay outputs.

The following output function are configurable on transistor outputs:
- HSC (reflex features on HSC threshold)

NOTE: All outputs by default can be used as regular outputs.

Output Management Functions Availability

Function		**HSC**			
Type		**Main**	**Simple(1)**	**Main**	**Simple(2)**
Channel Number		**0**	**0...3**	**4**	**4...7**
Transistor Output	Q0	HSC0 reflex Output0(3)	–	–	–
	Q1	HSC0 reflex Output1(3)	–	–	–
	Q2	–	–	HSC4 reflex Output0(3)	–
	Q3	–	–	HSC4 reflex Output1(3)	–

(1) Channels HSC0 to HSC3 are usable as a Simple HSC only if HSC0 is not used as a Main HSC *(see page 125)*.

(2) Channels HSC4 to HSC7 are usable as a Simple HSC only if HSC4 is not used as a Main HSC *(see page 125)*.

(3) Reflex output used or not according to configuration. If not configured, the output is a regular output by default.

Fallback modes (Behaviour for outputs in Stop)

When the controller enters the STOP or EXCEPTION state for any reason, the Local (Embedded and Expansion) outputs are set to fallback values. Two modes are available:

Set all outputs to default Each output is set to the configured default value, either 0 or 1 (initially set to 0 in the configuration).

Keep current values Each output remains in its current state

The fallback settings that may be configured (fallback to 0, fallback to 1, or fallback to the current state) do not apply to outputs Q0, Q1, Q2 or Q3 if these outputs are configured for PTO, PWM, FG, or HSC operation. If a detected error results in the controller entering fallback mode, these outputs will fallback to a value of 0 irrespective of the configured fallback setting.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Design and program your system so that controlled equipment assumes a safe state when the controller enters fallback mode if you use outputs Q0, Q1, Q2, or Q3 for PTO, PWM, FG, or HSC operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE:

- Fallback configuration for outputs does not apply when outputs Q0,Q1, Q2, and Q3 are used for PTO, PWM, FG or HSC operation. In these cases fallback value is always 0.
- In case of fallback for PTO operation, any ongoing move is aborted and ramp-down to 0 (controlled stop feature).

Short-circuit or Over-current on Outputs

In the case of short-circuit or over-current on outputs, there are different considerations for the 2 groups of outputs:

- Group 1 (Q0 to Q3): Transistor outputs
- Group 2 (Q4 to Q9): Relay outputs

The following table describes the detection:

If...	then...
you have short-circuit at 0V on group 1	the group 1 automatically go into thermal protection mode (all regular or HSC outputs set to 0) and are then periodically rearmed (each 10 second) to test the connection state (see warning below). For more information, refer to transistor output wiring diagram *(see page 88)*.
you have short-circuit at 24V on group 1	nothing is detected and no heating.
you have short-circuit at 0V or 24V on group 2	nothing is detected.
the current crossing the group 1 is too high	a thermal disjunction occurs shutting down the group 1.The outputs of group 1 are forced to 0, and cannot be set to 1 until the temperature decreases.

NOTE: The short-circuit diagnostic for each group is provided by the function GetshortcutStatus *(see Modicon M238 Logic Controller, System Functions and Variables, M238 PLCSystem Library Guide)*.

⚠ WARNING

UNINTENDED MACHINE STARTUP

Inhibit the automatic rearming of outputs if this feature is an undesirable behavior for your machine or process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The automatic rearming feature can be inhibited. For this controller, use the `GetshortcutStatus` function to force the group of outputs to remain at 0 (OFF).

Relay outputs are electromechanical switches capable of carrying significant levels of current and voltage. All electromechanical devices have a limited operational life and must be installed so as to minimize the potential for unintended consequences. The relay outputs of this device can remain ON or OFF regardless of logical control.

⚠ WARNING

MALFUNCTION OF OUTPUTS

Use appropriate, external safety interlocks on outputs where personnel and/or equipment hazards exist.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Fast Inputs/Outputs

8

Introduction

This chapter provides information about the *Fast I/Os (Input/Outputs)* and their associated functions.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
8.1	HSC (High Speed Counter)	124
8.2	PTO (Pulse Train Output)	132
8.3	PWM (Pulse Width Modulation)	138
8.4	FG (Frequency Generator)	141

8.1 HSC (High Speed Counter)

Overview

This section will help you use the HSCfunctions *(see Modicon LMC058 Motion Controller, High Speed Counting, LMC058 Expert I/O Library Guide)* and the mapping of I/O.

Fast Input/Outputs that are not configured by the HSC functions can be used as regular Input/Outputs *(see Modicon M238 Logic Controller, Programming Guide)*.

What's in this Section?

This section contains the following topics:

Topic	Page
HSC Overview	125
Modes	127
HSC I/O Mapping	129

HSC Overview

Introduction

All Modicon M238 Logic Controller include embedded HSC inputs which can be activated and setup using the HSC counting modes.

Concept

The HSC function is used for counting pulses and depending on the configuration update outputs, regardless of the scan time of the application. The maximum frequency is 100 kHz.

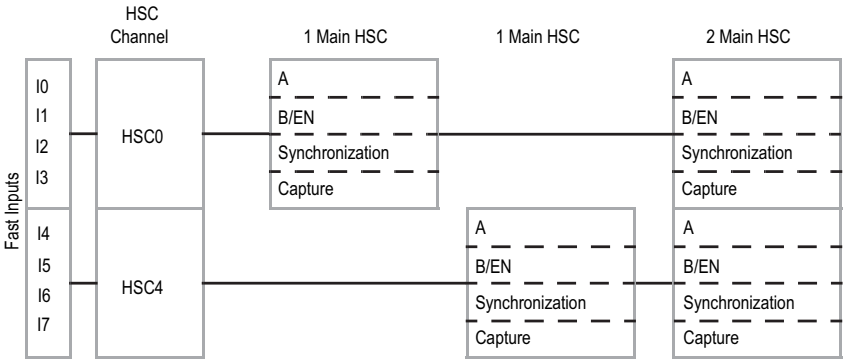
The Simple HSC only uses 1 counting input and no output. Two counting modes allow to program an action in the context of an application task (no event management) when a predefined count is reached.

The Main HSC can use up to 4 inputs and 2 outputs, depending on the input mode and configured functions: 5 counting modes are supported, with optional capture, thresholds and event management.

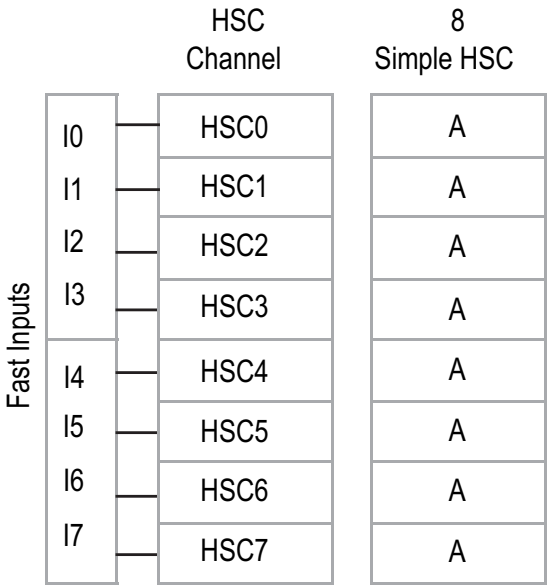
NOTE: The fallback settings that may be configured (fallback to 0, fallback to 1, or fallback to the current state) will not have the expected effect on outputs Q0, Q1, Q2 or Q3 if these outputs are configured for HSC operation. If a detected error results in the controller entering fallback mode, these outputs will fallback to a value of 0 irrespective of the configured fallback setting.

Input Mapping for 2 Main HSC

The following illustration shows the differences in configuration between the 2 Main HSCs.



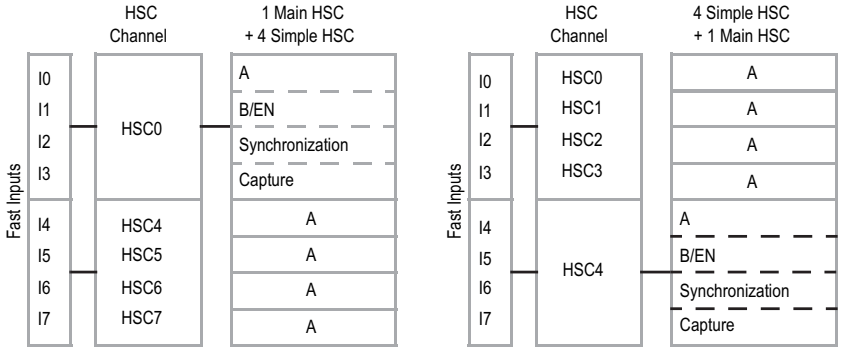
Input Mapping for 8 Simple HSC



NOTE: An HSC channel can be assigned any fast input address. There is no preferred addressing order.

Input Mapping for 1 Main HSC + 4 Simple HSC

The following illustration shows the different configurations of 1 Main + 4 Simple HSC.



Modes

Introduction

This section provides informations about the following HSC modes:

- One Shot
- Modulo Loop
- Free Large
- Event Counting
- Frequency Meter

One Shot

The One Shot counter mode allows you to count a predefined number of pulses and stop.

Principle: The counter decreases from a preset value and stops when its current value reaches 0. At this point, the done bit is set and the current counter value is not modified by any new pulses from the input. The counter waits for the next synchronization to restart.

Example: The preset value may be a number of pieces to be packaged.

Modulo Loop

The Modulo Loop counter mode is used for applications for which actions are repetitive.

Principle: In this mode the counter repeatedly counts from 0 to a user-defined maximum value then returns to 0 and moves on, in a direct way. In reverse, the counter counts down from the maximum value to 0 then presets to the maximum value and continues to decrease. This mode can be used with a single Encoder.

Free Large

The Free Large counter mode is for axis monitoring or labeling when the incoming position of each part has to be known.

Principle: In the Free Large Counter mode, the module behaves like a high-range Up/Down counter. This mode can be used with a single Encoder.

Event Counting

The Event Counting mode is used to count a sequence of events over a given period of time.

Principle: The counter assesses the number of pulses applied on the input for a predefined period of time. The counting register is updated at the end of each period with the number of events received.

Frequency Meter

The Frequency Meter mode allows the measurement of an event's frequency, speed, rate, or flow.

Principle: The measured frequency is a mean frequency: number of events in the time interval converted to number of events per second (Hz).

Implementation in SoMachine

To configure HSC parameters, refer to the HSC Library *(see Modicon M238 Logic Controller, Programming Guide)* Online Help.

HSC I/O Mapping

HSC I/O Mapping for DC Controllers

The table below shows the availability of the HSC functions according to the inputs and outputs:

Function		**HSC**									
Type		**Main**	**Simple(1)**				**Main**	**Simple(2)**			
Channel		**0**	**0**	**1**	**2**	**3**	**4**	**4**	**5**	**6**	**7**
Fast Input	I0	A	A	–	–	–	–	–	–	–	–
	I1	B(3)(4)	–	A	–	–	–	–	–	–	–
	I2	Sync(4)	–	–	A	–	–	–	–	–	–
	I3	Cap(4)	–	–	–	A	–	–	–	–	–
	I4	–	–	–	–	–	A	A	–	–	–
	I5	–	–	–	–	–	B(3)(4)	–	A	–	–
	I6	–	–	–	–	–	Sync(4)	–	–	A	–
	I7	–	–	–	–	–	Cap(4)	–	–	–	A
Regular Output	Q4	HSC0 reflex Output0(4)	–	–	–	–	–	–	–	–	–
	Q5	HSC0 reflex Output1(4)	–	–	–	–	–	–	–	–	–
	Q6	–	–	–	–	–	–	–	–	–	–
	Q7	–	–	–	–	–	HSC4 reflex Output0(4)	–	–	–	–
	Q8	–	–	–	–	–	HSC4 reflex Output1(4)	–	–	–	–
	Q9	–	–	–	–	–	–	–	–	–	–

A Input counting signal
B Input counting signal or enable depending configuration of HSC block
Sync Reset and start counting
Cap Capture current position signal

(1) Channels HSC0 to HSC3 are usable as a Simple HSC only if HSC0 is not used as a Main HSC *(see page 125)*.

(2) Channels HSC4 to HSC7 are usable as a Simple HSC only if HSC4 is not used as a Main HSC *(see page 125)*.

(3) A and B functions depend on the configuration of Main HSC mode *(see page 127)*.

*(4)*Used or not according to the configuration of Main HSC mode.

HSC I/O Mapping for AC Controllers

The table below shows the availability of the HSC functions according to the inputs and outputs:

Function		**HSC**									
Type		**Main**	**Simple(1)**				**Main**	**Simple(2)**			
Channel		**0**	**0**	**1**	**2**	**3**	**4**	**4**	**5**	**6**	**7**
Fast Input	I0	A(3)	A	–	–	–	–	–	–	–	–
	I1	B(3)(4)	–	A	–	–	–	–	–	–	–
	I2	Sync(4)	–	–	A	–	–	–	–	–	–
	I3	Cap(4)	–	–	–	A	–	–	–	–	–
	I4	–	–	–	–	–	A(3)	A	–	–	–
	I5	–	–	–	–	–	B(3)(4)	–	A	–	–
	I6	–	–	–	–	–	Sync(4)	–	–	A	–
	I7	–	–	–	–	–	Cap(4)	–	–	–	A

A Input counting signal
B Input counting signal or enable depending configuration of HSC block
Sync Reset and start counting
Cap Capture current position

Function		**HSC**									
Type		**Main**	**Simple(1)**				**Main**	**Simple(2)**			
Channel		**0**	**0**	**1**	**2**	**3**	**4**	**4**	**5**	**6**	**7**
Transistor Output	Q0	HSC0 reflex Output0(4)	–	–	–	–	–	–	–	–	–
	Q1	HSC0 reflex Output1(4)	–	–	–	–	–	–	–	–	–
	Q2	–	–	–	–	–	HSC4 reflex Output0(4)	–	–	–	–
	Q3	–	–	–	–	–	HSC4 reflex Output1(4)	–	–	–	–

A Input counting signal
B Input counting signal or enable depending configuration of HSC block
Sync Reset and start counting
Cap Capture current position

(1) Channels HSC0 to HSC3 are usable as a Simple HSC only if HSC0 is not used as a Main HSC *(see page 125)*.

(2) Channels HSC4 to HSC7 are usable as a Simple HSC only if HSC4 is not used as a Main HSC *(see page 125)*.

(3) A and B functions depend on the configuration of Main HSC mode *(see page 127)*.

(4) Optional: used or not according to the configuration of Main HSC mode.

8.2 PTO (Pulse Train Output)

Overview

This section will help you use the PTO functions *(see Modicon M238 Logic Controller, Programming Guide)* and the mapping of I/O.

Fast Input/Outputs that are not configured by the PTO functions can be used as regular Input/Outputs *(see Modicon M238 Logic Controller, Programming Guide)*.

What's in this Section?

This section contains the following topics:

Topic	Page
PTO Overview	133
PTO I/O Mapping	137

PTO Overview

Introduction

The information below refers to the following model numbers:

- TM238LFDC24DT••
- TM238LDD24DT

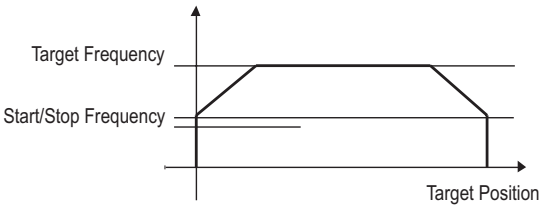
The *PTO (Pulse Train Output)* function implements digital technology for precise positioning tasks.

Concept

Pulse Train Output (PTO) function is used to control a stepper or servo motor. It provides a square wave output for a specified number of pulses and frequency, with controlled acceleration and deceleration.

A set of function blocks are provided with the PTO library to command a move: PTOMoveVelocity, PTOMoveRelative, PTOHome, PTOStop (see M238 PTO Library) *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*.

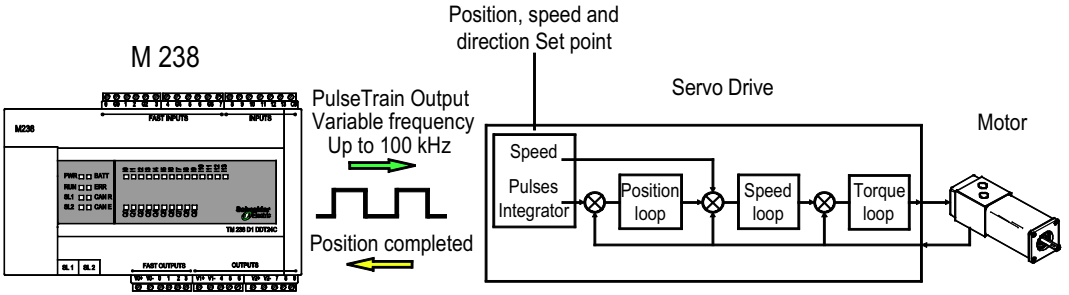
The following diagram gives an example of a move:



Trapezoidal Profile

PTO Function Use

The PTO function is used to control Lexium 05 - SD3 motion controllers or third-party servo-drives with an open collector input and an integrated position loop.



A pulse profile can be used to control a stepper motor through a basic ramp up, run, and ramp down sequence or more complicated sequences. The control positioning is relative without feedback. The position loop may be integrated in the servo-drive.

The Hardware

2 PTO channels are available on the controller. Each PTO channel is associated to 2 fast outputs and 1 regular auxiliary input *(see page 137)*.

Modes

4 PTO modes are available to drive a motor:
- Pulse/Direction
- Direction/Pulse
- ClockWise/CounterClockWise
- CounterClockWise/ClockWise

Optional input can be configured as:
- Drive ready input, to control correct operation of the drive.
- Origin input, to be used as reference point detection signal in combination with PTOHome function.

NOTE: You must configure the Origin input to use PTOHome function.

Pulse/Direction and Direction/Pulse modes generate 2 signals:
- output Pulse signal provides the motor operating speed.
- the Direction signal provides the motor rotation direction.

ClockWise/CounterClockWise and CounterClockWise/ClockWise modes generate 1 signal that defines the motor operating speed. This signal is implemented either on the PTO output 0 or on the PTO output 1 depending on the motor rotation direction.

The following table determines the signal applied on each PTO output:

PTO mode	PTO Output0	PTO Output1
Pulse/Direction	Pulse	-
	-	Direction
Direction/Pulse	-	Pulse
	Direction	-
ClockWise/CounterClockWise	ClockWise	-
	-	CounterClockWise
CounterClockWise/ClockWise	-	ClockWise
	CounterClockWise	-

Motion Functions

4 motion functions are available:
- Move Velocity: moving at a programmed speed
- Move Relative: moving of a programmed distance
- Homing: moving to the reference position
- Stop: stop moving

Performance

The maximum generated frequency is 100 kHz.

The 2 PTO channels can be used simultaneously but can only control independent axes. Therefore the embedded PTO function can be used for:
- single axis point-to-point motion
- 2-axis simultaneous point-to-point motion (each axis is managed independently)

But you should not use it for:
- 2-axis synchronized point-to-point motion
- 2-axis interpolation motion

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

Do not use the PTO channels to perform 2-axis synchronized point-to-point motion control or 2-axis motion interpolation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Implementation in SoMachine

To configure PTO parameters, refer to the PTO/PWM Library *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*.

PTO I/O Mapping

PTO I/O Mapping

The table below shows the availability of the PTO functions according to the inputs and outputs:

Function		**PTO**	
Channel		**PTO0**	**PTO1**
Regular Input	I8	–	–
	I9	Auxiliary input PTO0	–
	I10	–	–
	I11	–	–
	I12	–	Auxiliary input PTO1
	I13	–	–
Fast Output	Q0	PTO0 Output0	–
	Q1	PTO0 Output1	–
	Q2	–	PTO1 Output0
	Q3	–	PTO1 Output1

8.3 PWM (Pulse Width Modulation)

Overview

This section will help you use the PWM functions *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*and the mapping of I/O.

Fast Input/Outputs that are not configured by the PWM functions can be used as regular Input/Outputs *(see Modicon M238 Logic Controller, Programming Guide)*.

What's in this Section?

This section contains the following topics:

Topic	Page
PWM Overview	139
PWM I/O Mapping	140

PWM Overview

Introduction

The information below refers to the following model numbers:
- TM238LFDC24DT••
- TM238LDD24DT

The Pulse Width Modulation (PWM) function generates a square wave signal with programmable frequency and variable width (duty cycle). The module uses one internal clock generator and provides an output signal on a dedicated output channel. This output signal can directly to command a variable motion of the axis. The target frequency is always positive.

For more information on the PWM functionality. *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*

Main Characteristics

The signal form depends on the following output parameters:
- **Frequency** configurable from 0.1 Hz to 20 kHz with a 0.1 Hz step
- **Duty Cycle** of the output signal from 0% to 100%

The Hardware

2 PWM channels are available on the controller. Each PWM channel is associated to 1 fast output and 2 regular auxiliary inputs *(see page 140)*.

Implementation in SoMachine

To configure PWM parameters, refer to the PTO/PWM Library *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*.

PWM I/O Mapping

PWM I/O Mapping

The table below shows the availability of the PWM functions according to the inputs and outputs:

Function		**PWM**	
Channel		**PWM0**	**PWM1**
Regular Input	I8	Auxiliary input (Enable) PWM0	–
	I9	Auxiliary input (Sync) PWM0	–
	I10	–	–
	I11	–	Auxiliary input (Enable) PWM1
	I12	–	Auxiliary input (Sync) PWM1
	I13	–	–
Fast Output	Q0	PWM0 Output	–
	Q1	–	–
	Q2	–	PWM1 Output
	Q3	–	–

8.4 FG (Frequency Generator)

Overview

This section will help you use the FG functions *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)* and the mapping of I/O.

Fast Input/Outputs that are not configured by the FG functions can be used as regular Input/Outputs *(see Modicon M238 Logic Controller, Programming Guide)*.

What's in this Section?

This section contains the following topics:

Topic	Page
Frequency Generator	142
FG I/O Mapping	143

Frequency Generator

Introduction

The information below refers to the following model numbers:
- TM238LFDC24DT••
- TM238LDD24DT

The Frequency Generator (FG) function generates a square wave signal with programmable frequency and duty cycle equal to 50%. The controller uses an internal clock generator and provides an output signal on dedicated output channel. This output signal can directly to command a constant motion of the axis. The target frequency is always positive.

For more information on the FG functionality. *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*

Main characteristics

The signal form depends on the following input parameter:
- **Frequency** configurable from 1 Hz to 100 kHz with a 1 Hz step

The Hardware

2 FG channels are available on the controller. Each FG channel is associated to 1 fast output and 2 regular auxiliary inputs *(see page 143)*.

Implementation in SoMachine

To configure FG parameters, refer to the PTO/PWM Library *(see Modicon M238 Logic Controller, Pulse Train Output, Pulse Width Modulation, M238 PTOPWM Library Guide)*.

FG I/O Mapping

FG I/O Mapping

The table below shows the availability of the FG functions according to the inputs and outputs:

Function		**FG**	
Channel		**FG0**	**FG1**
Regular Input	I8	Auxiliary input (Enable) FG0	–
	I9	Auxiliary input (Sync) FG0	–
	I10	–	–
	I11	–	Auxiliary input (Enable) FG1
	I12	–	Auxiliary input (Sync) FG1
	I13	–	–
Fast Output	Q0	FG0 Output	–
	Q1	–	–
	Q2	–	FG1 Output
	Q3	–	–

Wiring Diagram Examples

9

Introduction

This chapter provides wiring diagram examples.

What's in this Chapter?

This chapter contains the following topics:

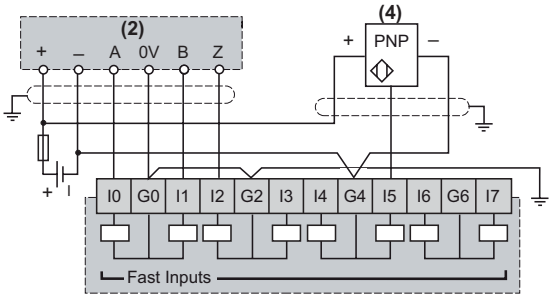
Topic	Page
Wiring Diagram Examples for 1 Encoder on Fast Inputs	146
Wiring Diagram Examples for 2 Encoders on Fast Inputs	148
Wiring Diagram Examples on Regular Inputs	150
Wiring Diagram Examples for PTO/PWM Actuator on Fast Outputs	151
Wiring the Modicon M238 Logic Controller to the LEXIUM 05 via the Universal Signal Interface Converter (USIC)	152

Wiring Diagram Examples for 1 Encoder on Fast Inputs

Introduction

This section provides wiring diagram examples for 1 encoder on fast inputs.

Incremental Encoder with Phase-Shifted Signals with TDC and 3-Wire PNP Detector

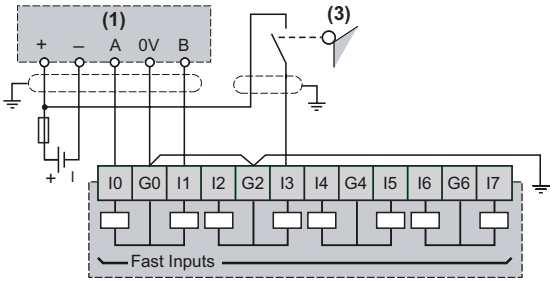


(2) Dual-phase encoder with index
(4) PNP sensor

NOTE:

- Use a specific auxiliary power supply for the encoders and sensors connected to the fast inputs and used in fast counter mode.
- Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.
- Use a 0.5 A fast-blow fuse.

Incremental Encoder with Phase-Shifted Signals without TDC and Electromechanical Sensor



(1) Dual-phase encoder without index
(3) Limit switch

NOTE:

- Use a specific auxiliary power supply for the encoders and sensors connected to the fast inputs and used in fast counter mode.
- Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.
- Use a 0.5 A fast-blow fuse.

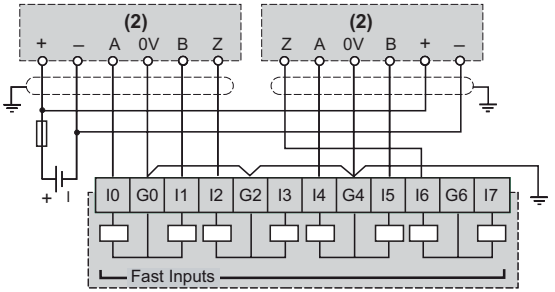
Wiring Diagram Examples for 2 Encoders on Fast Inputs

Introduction

This section provides wiring diagram examples for 2 encoders on fast inputs.

NOTE: The hardware limitation is 2 incremental encoders with phase-shifted signals.

Incremental Encoders with Phase-Shifted Signals with TDC

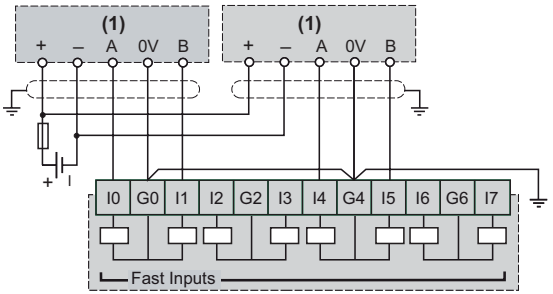


(2) Dual-phase encoder with index

NOTE:

- Use a specific auxiliary power supply for the encoders and sensors connected to the fast inputs and used in the fast counter mode.
- Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.
- Use a 0.5 A fast-blow fuse.

Incremental Encoders with Phase-Shifted Signals without TDC



(1) Dual-phase encoder without index

NOTE:

- Use a specific auxiliary power supply for the encoders and sensors connected to the fast inputs and used in the fast counter mode.
- Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.
- Use a 0.5 A fast-blow fuse.

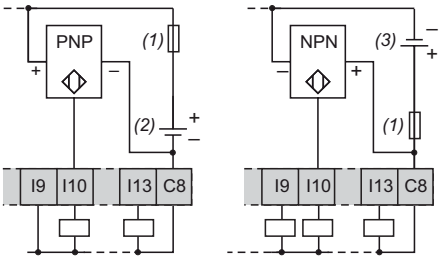
Wiring Diagram Examples on Regular Inputs

Introduction

This section provides a wiring diagram example for Inputs.

3-wire PNP and 3-wire NPN Sensors Wiring Diagram

The following figure shows an example of connection of 3-wire PNP and 3-wire NPN sensors on regular inputs:



(1) 0.5 A fast-blow fuse
(2) Sink input (positive logic)
(3) Source input (negative logic)

NOTE:

- For improved electromagnetic compatibility (EMC), use the same power supply for the inputs as the Modicon M238 Logic Controller.

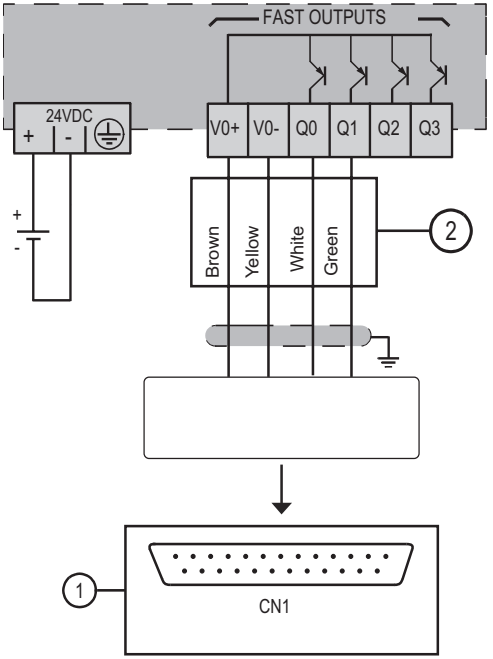
Wiring Diagram Examples for PTO/PWM Actuator on Fast Outputs

Introduction

This section provides wiring diagram examples for a PTO/PWM actuator on fast outputs.

The information below refers to the following model numbers:
- TM238LFDC24DT••
- TM238LDD24DT

PTO/PWM Actuator SD 326 Type



1 Actuator SD 326 with PTO/PWM signals delivering a 24 Vdc power supply
2 VW3S8202R30 cable

NOTE: Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.

PTO/PWM Actuator Universal Signal Interface Converter (USIC)

Refer to the Modicon M238 Logic Controller wiring example to the Lexium via USIC *(see page 152)*.

Wiring the Modicon M238 Logic Controller to the LEXIUM 05 via the Universal Signal Interface Converter (USIC)

Introduction

This section provides an example of an implementation with the PTO function.

The information below refers to the following model numbers:

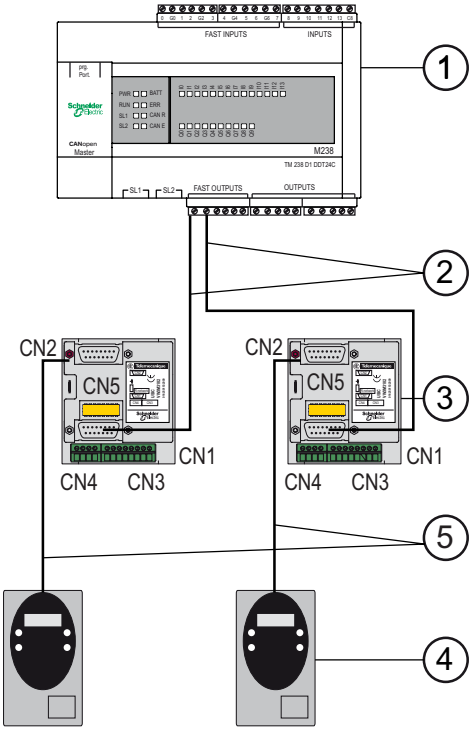
- TM238LFDC24DT••
- TM238LDD24DT

Principle

The pulse/direction input of a drive receives pulses and converts them to make the motor move.

Hardware Configuration

The following illustration shows the connections between the different parts of the hardware configuration.



CN5 Resistor network

Label	Description	Reference	Quantity
1	Modicon M238 Logic Controller	TM238LFDC24DT•• or TM238LDD24DT	1
2	Modicon M238 Logic Controller/USIC cable cable length = 3 m (9.8 ft)	VW3M8210R30	2
3	USIC	VW3M3102	2
4	Lexium 05	–	2
5	USIC/Lexium05 cable cable length = 3 m (9.8 ft)	VW3M8209R30	2

NOTE: At the USIC, the CN5 resistor connected at the CN1 inputs is designed for a maximum of 5 Vdc. Excessive voltage can damage the product either immediately or over time.

⚠ CAUTION

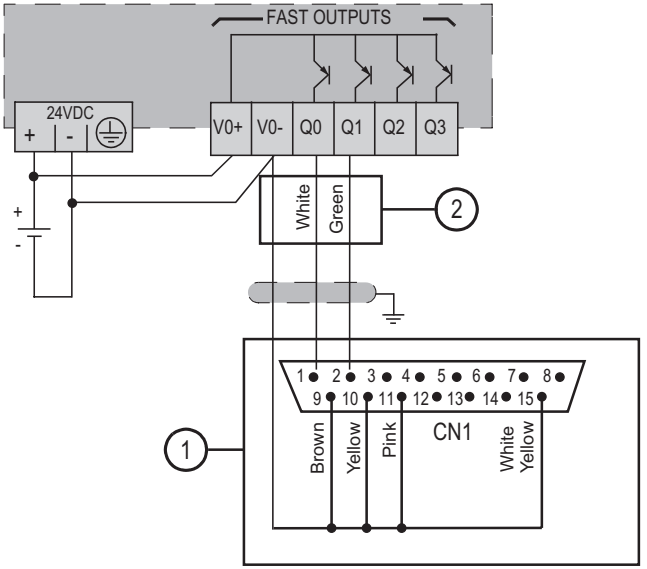
UNEXPECTED EQUIPMENT OPERATION OR INOPERABLE EQUIPMENT

Remove the CN5 Resistor Network from the USIC.

Failure to follow these instructions can result in injury or equipment damage.

Wiring Modicon M238 Logic Controller to USIC

The VW3M8210R30 cable is required for this wiring.

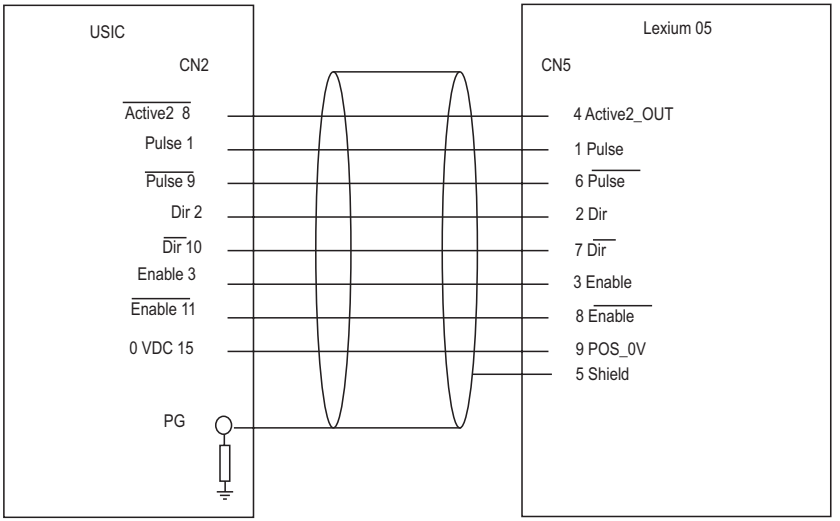


1 Actuator with USIC type PTO/PWM signals
2 VW3M8210R30 cable

NOTE: Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.

Wiring USIC to Lexium 05

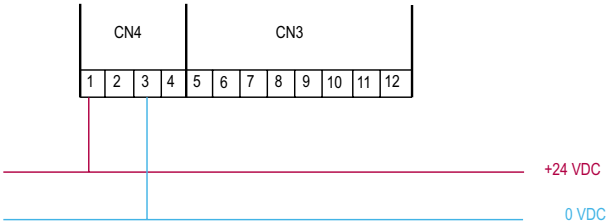
This wiring can be done by using the prefabricated cable reference: VW3M8209R30



NOTE: Use cordsets with mandatory shielding to connect to the metal support for mounting the Modicon M238 Logic Controller. 10 m (32.8 ft) max.

Wiring USIC

The CN4 and CN3 USIC pins need to be wired as shown:



USIC Implementation

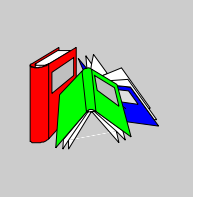
PTO signals generated by the Modicon M238 Logic Controller are in 24 Vdc. The *USIC (Universal Signal Interface Converter)* converts 24 Vdc signal into 5 Vdc signal.

For more information, refer to the documentation of the USIC.

Lexium Implementation

Refer to the documentation of the Lexium 05.

Glossary



A

ASCII

The *american standard code for information interchange* is a communication protocol for representing alphanumeric characters (letters, numbers, and certain graphic and control characters).

C

CANopen

CANopen is an open industry-standard communication protocol and device profile specification.

CFC

The *continuous function chart* (an extension of the IEC61131-3 standard) is a graphical programming language that works like a flowchart. By adding simple logicals blocks (AND, OR, etc.), each function or function block in the program is represented in this graphical format. For each block, the inputs are on the left and the outputs on the right. Block outputs can be linked to inputs of other blocks in order to create complex expressions.

controller

A *controller* (or “programmable logic controller,” or “programmable controller”) is used to automate industrial processes.

E

EEPROM

Electrically erasable programmable read-only memory is a type of non-volatile memory used to store data that must be saved when power is removed.

EIA rack

An *electronic industries alliance rack* is a standardized (EIA 310-D, IEC 60297 and DIN 41494 SC48D) system for mounting various electronic modules in a stack or rack that is 19 inches (482.6 mm) wide.

expansion bus

The *expansion bus* is an electronic communication bus between expansion modules and a CPU.

expansion I/O modules

An *expansion input or output module* is either a digital or analog module that adds additional I/O to the base controller.

F

FAST task

The *FAST task* is a periodic, high-priority task of a short duration that is run on a processor through its programming software. The task's fast speed keeps it from interfering with the execution of lower priority master (MAST) tasks. A FAST task is useful when fast periodic changes in discrete inputs need to be monitored.

FB

A *function block* performs a specific automation function, such as speed control, interval control, or counting. A function block comprises configuration data and a set of operating parameters.

FBD

A *function block diagram* is a graphically oriented programming language, compliant with IEC 61131-3. It works with a list of networks whereby each network contains a graphical structure of boxes and connection lines which represents either a logical or arithmetic expression, the call of a function block, a jump, or a return instruction.

firmware

The *firmware* represents the operating system on a controller.

H

HSC

high-speed counter

I

IEC 61131-3

The IEC 61131-3 is an *international electrotechnical commission* standard for industrial automation equipment (like controllers). IEC 61131-3 deals with controller programming languages and defines 2 graphical and 2 textual programming language standards:

- **graphical:** ladder diagram, function block diagram
- **textual:** structured text, instruction list

IL

A program written in the *instruction list* language is composed of a series of instructions executed sequentially by the controller. Each instruction includes a line number, an instruction code, and an operand. (IL is IEC 61131-3 compliant.)

IP 20

Ingress protection rating according to IEC 60529. IP20 modules are protected against ingress and contact of objects larger than 12.5 mm. The module is not protected against harmful ingress of water.

L

latching input

A *latching input* module interfaces with devices that transmit messages in short pulses. Incoming pulses are captured and recorded for later examination by the application.

LD

A program in the *ladder diagram* language includes a graphical representation of instructions of a controller program with symbols for contacts, coils, and blocks in a series of rungs executed sequentially by a controller. IEC 61131-3 compliant.

M

master/slave

The single direction of control in a network that implements the master/slave model is always from a master device or process to one or more slave devices.

Modbus

The Modbus communication protocol allows communications between many devices connected to the same network.

N

NEMA

The *national electrical manufacturers association* publishes standards for the performance of various classes of electrical enclosures. The NEMA standards cover corrosion resistance, ability to protect from rain and submersion, etc. For IEC member countries, the IEC 60529 standard classifies the ingress protection rating for enclosures.

network

A network includes interconnected devices that share a common data path and protocol for communications.

node

A *node* is an addressable device on a communication network.

P

protocol

A *protocol* is a convention or standard that controls or enables the connection, communication, and data transfer between two computing endpoints.

PTO

Pulse train outputs are used to control for instance stepper motors in open loop.

PWM

Pulse width modulation is used for regulation processes (e.g. actuators for temperature control) where a pulse signal is modulated in its length. For these kind of signals, transistor outputs are used.

R

real-time clock (RTC)

See RTC

reflex output

In a counting mode, the high speed counter's current value is measured against its configured thresholds to determine the state of these dedicated outputs.

RFID

Radio-frequency identification is an automatic identification method that relies on the storage and remote retrieval of data using RFID tags or transponders.

RPDO

A *receive PDO* sends data to a device in a CAN-based network.

RTC

The *real-time clock* option keeps the time for a limited amount of time even when the controller is not powered.

S

scan

A controller's scanning program performs 3 basic functions: [1] It reads inputs and places these values in memory; [2] it executes the application program 1 instruction at a time and stores results in memory; [3] It uses the results to update outputs.

SFC

A program written in the *sequential function chart* language can be used for processes that can be split into steps. SFC is composed of steps with associated actions, transitions with associated logic condition, and directed links between steps and transitions. (The SFC standard is defined in IEC 848. It is IEC 61131-3 compliant.)

Structured Text

A program written in the *structured text* (ST) language includes complex statements and nested instructions (such as iteration loops, conditional executions, or functions). ST is compliant with IEC 61131-3.

T

task

A group of sections and subroutines, executed cyclically or periodically for the MAST task, or periodically for the FAST task.

A task possesses a level of priority and is linked to inputs and outputs of the controller. These I/O are refreshed in consequence.

A controller can have sereval tasks.

threshold output

Threshold outputs are controlled directly by the HSC according to the settings established during configuration.

TPDO

A *transmit PDO* reads data from a device in a CAN-based system.

Index

A

AC power supply
    wiring, *60*
accessories, *23*
allocation, I/Os, *129*, *130*, *137*, *140*, *143*

B

battery, backup
    external, *34*
    internal, *34*

C

CANopen communication, *14*, *101*, *107*
clearance, minimum, *41*, *41*
communication
    CAN LEDs, *107*
    CANopen, *14*, *101*
    serial line, *14*, *97*
communication modules, *21*
connect a AC power supply, *60*
connect a DC power supply, *57*
connect fast input, *69*
connect fast output, *77*
connect regular input, *66*
connect regular output, *73*
connect relay output, *83*
connect transistor output, *87*
connections
    to CANopen slaves, *101*
    to external devices, *97*
cooling, *41*

D

DC Physical Description, *19*
DC power supply
    wiring, *57*
digital I/O assignment
    FG, *143*
    HSC, *129*, *130*
    PTO, *137*
    PWM, *140*
dimensions, *37*
DIN rail, *43*

E

electrical specification
    fast input, *69*
    fast output, *77*
    regular inputs, *66*
    regular output, *74*
    relay output, *83*
    transistor output, *87*
end bracket, *44*
environmental specifications, *49*
Example
    Wiring the controller and the Lexium, *152*
expansion modules, *21*
external backup battery, *34*

F

fast input
specifications, *69*
fast inputs
wiring diagram, *71*
fast output
specifications, *77*
wiring diagram, *79*
features
communication, *14*
fast I/Os, *16*
key features, *12*
filtering, input, *110*

G

Grounding Shielded Cables, *63*

H

high speed counter, *125*
HSC, *125*
features, *125*
modes, *127*

I

I/O allocation
FG, *143*
HSC, *129*, *130*
PTO, *137*
PWM, *140*
input specifications
fast, *69*
regular, *66*
inputs wiring diagram
fast, *71*
regular, *67*
Installation and Maintenance Requirements
installation, *30*
installation preparation, *32*
installing
on a DIN rail, *44*
on a metallic panel, *47*

L

latching input, *111*
LEDs
status, *106*

M

M238 based solution
CANopen serial link, *26*
RS 485 serial link, *24*
main features, *12*
maximum hardware configuration, *21*
modules, communication, *21*
modules, expansion, *21*
mounting holes layout, *47*
mounting positions, *38*
mounting procedure
on a DIN rail, *44*
on a metallic panel, *47*

O

Output Management
AC controller, *118*
DC controller, *113*
output specification
fast, *77*
regular, *74*
relay, *83*
transistor, *87*
output wiring diagram
fast, *79*
regular, *75*
relay, *85*
transistor, *88*
overview, *12*

P

programming
software, *18*
programming languages
IL, ST, FBD, SFC, LD, CFC, *12*
PTO, *133*, *133*

pulse train output, *133*
pulse width modulation, *139*
PWM, *139*, *139*

R

regular inputs
    specifications, *66*
    wiring diagram, *67*
regular output
    specifications, *74*
    wiring diagram, *75*
relay output
    specifications, *83*
    wiring diagram, *85*
RUN/STOP input, *112*

S

safety guidelines
    external battery disposal, *34*
    wiring, *53*
serial line
    specifications, *99*
serial line communication, *97*
software, programming, *18*
SoMachine, *18*
special functions
    Frequency Generator, *142*
    HSC, *125*
    latching input, *111*
    PTO, *133*
    PWM, *139*
    RUN/STOP input, *112*
special I/Os, *123*
specifications
    environmental, *49*
    fast input, *69*
    fast output, *77*
    regular inputs, *66*
    regular output, *74*
    relay output, *83*
    serial line, *99*
    transistor output, *87*
starting, *32*
status, LEDs, *106*
system diagnostic, using LEDs, *106*

T

tightening torque
    inputs terminals, *68*, *71*
    outputs terminals, *76*, *81*, *86*, *90*
transistor output
    specifications, *87*
    wiring diagram, *88*

U

USIC, *152*, *156*

W

wiring diagrams
    AC power supply, *60*
    DC power supply, *57*
    fast inputs, *71*
    fast output, *79*
    regular inputs, *67*
    regular output, *75*
    relay output, *85*
    transistor output, *88*
wiring rules, *53*