XMPro-10 series Programmable Logic Controller

Data sheet applicable for:

- **XM14-DT:** PLC with 8 digital inputs and 6 digital outputs.
- **XM17-ADT**: PLC with 8 digital inputs, 6 digital outputs, 2 analog inputs and 1 analog output.
- **XM14-DT-HIO**: PLC with 8 digital inputs and 6 digital outputs. Of the 8 digital inputs, 6 can be high speed inputs [HSI]. Of the 6 digital outputs, 2 can be high speed outputs [HSO].

Introduction

XMPro-10 is a family of compact, cost-effective, and powerful Programmable Logic Controllers (PLCs).

Table of Contents

Features of XMPro-10 series PLCs

- Self-contained unit with in-built Inputs/Outputs (I/Os).
- Easy addition of digital or analog input/outputs using expansion modules.
- Flexible connectivity via Ethernet and RS485.
- Message Queuing Telemetry Transport (MQTT).
- Inbuilt Proportional-Integral-Derivative (PID) function with manual tuning.
- Programming by powerful yet intuitive XMPS - 2000 software.

Front view

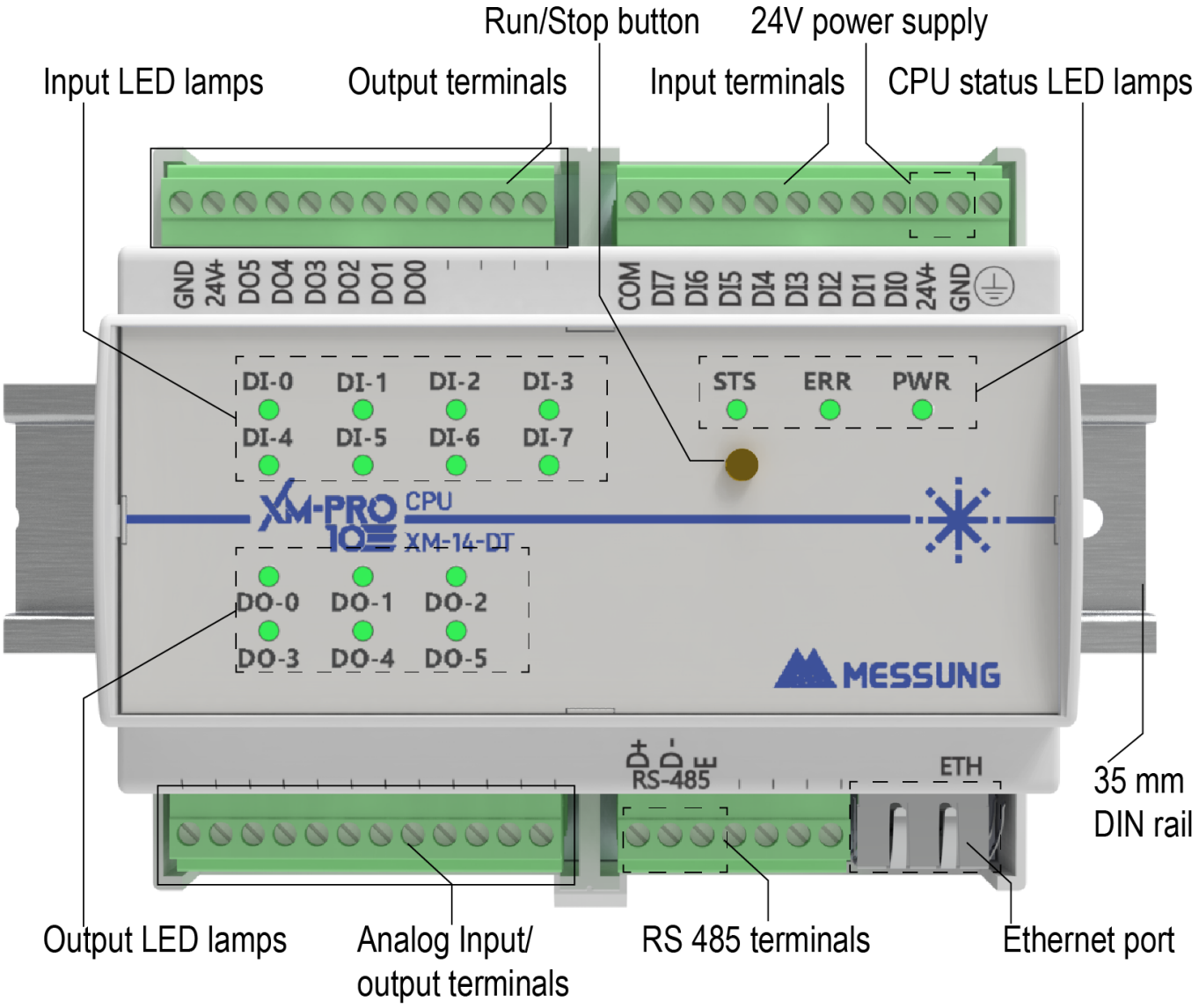

Figure 1. XM14-DT PLC

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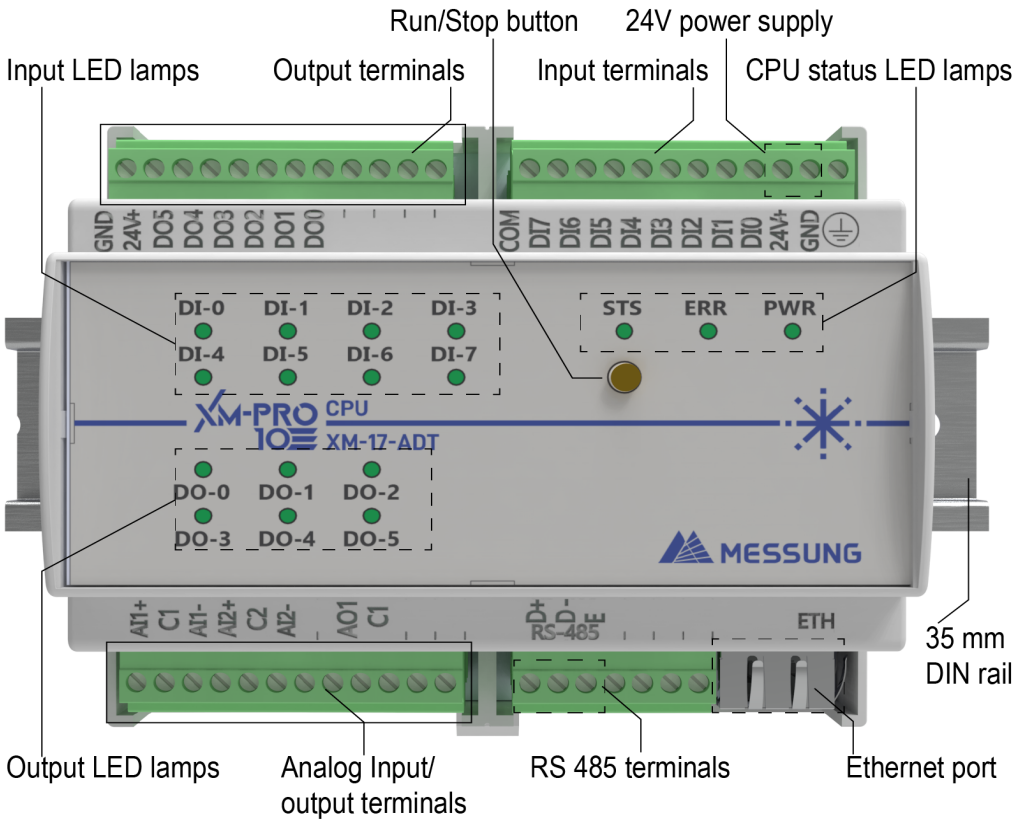

Figure 2. XM17-ADT PLC

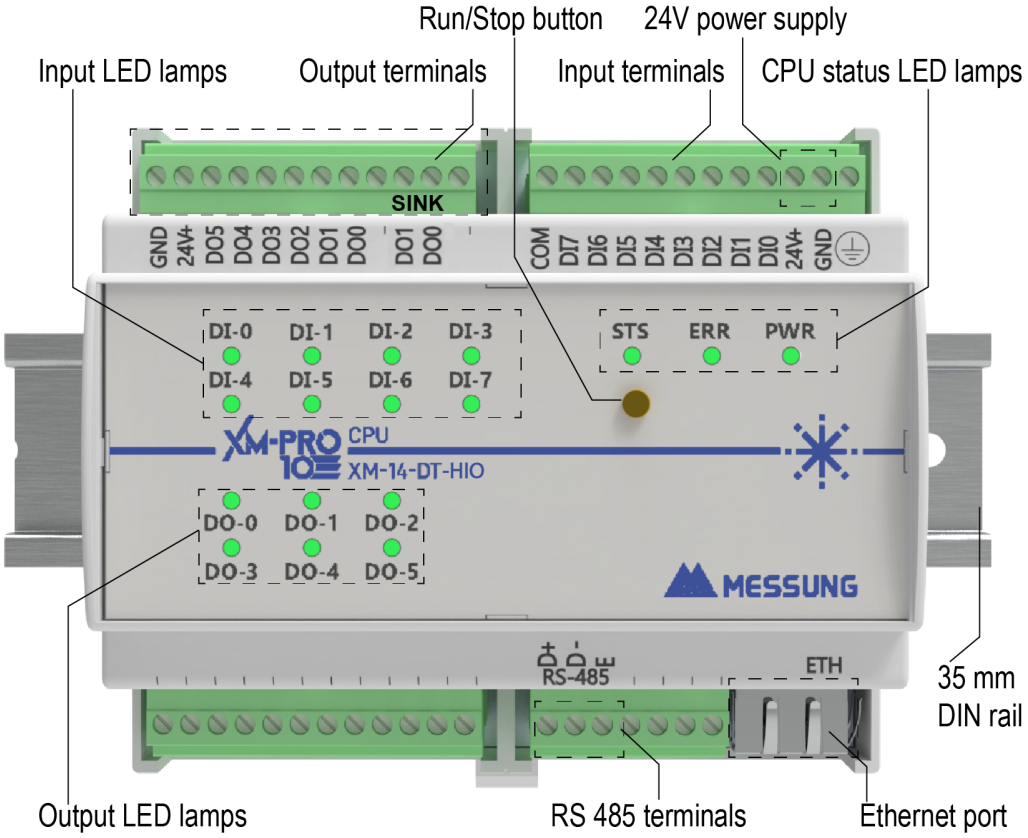

Figure 3. XM14-DT-HIO PLC

Local expansion for PLC unit

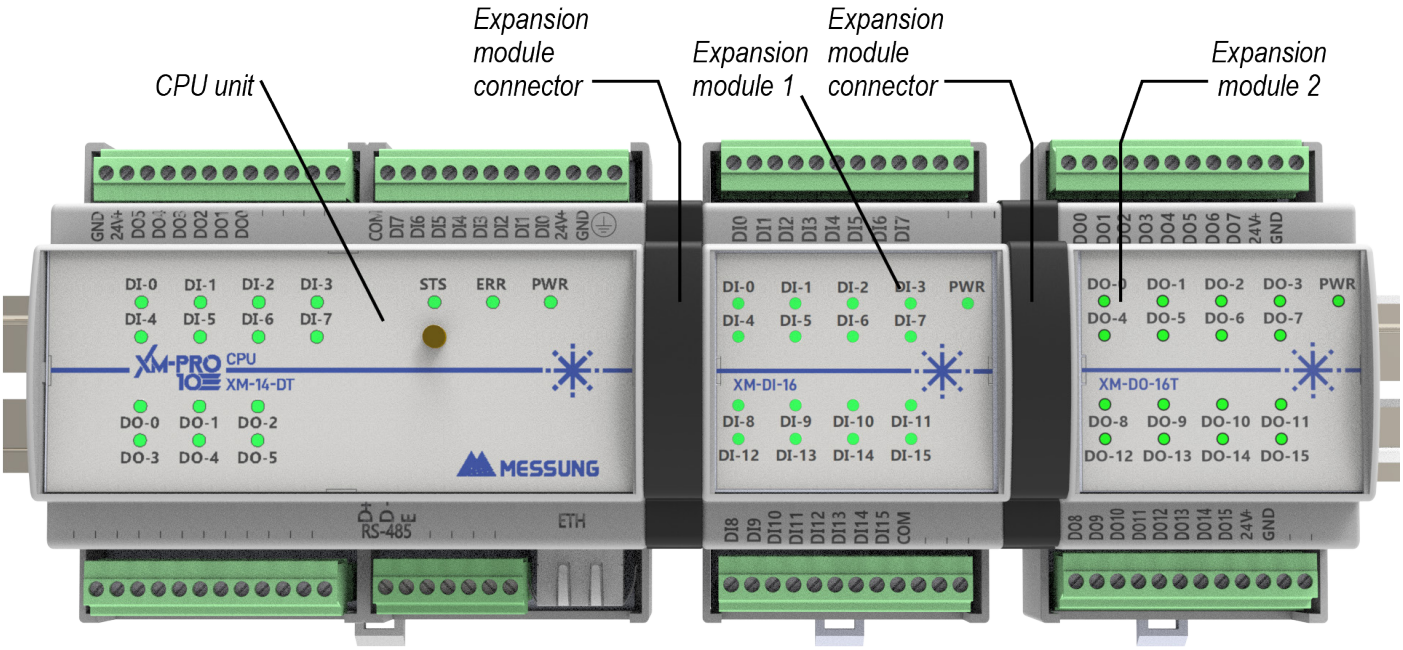

Figure 4. PLC with 2 expansion modules

Specification

General Features	XM14-DT	XM17-ADT	XM14-DT-HIO
PLC supply voltage	24V DC (18-30V DC)	24V DC (18-30V DC)	24V DC (18-30V DC)
Digital inputs	8	8	8, (6 can be HSI)
Digital outputs	6	6	6, (2 Can be HSO)
Analog inputs	-	2	-
Analog outputs	-	1	-
High speed inputs (HSI)	-	-	6
High speed outputs (HSO)	-	-	2
RS485 port	1	1	1
Ethernet port	1	1	1
MQTT*	Available	Available	Available
PID**	Available	Available	Available
Local expansion	▪ Maximum of 5 number of local expansion modules is possible. ▪ Maximum local I/O expansion points should be less than 66 for XM-14-DT and 63 for XM-17-ADT. ▪ Total number of points includes on-board I/Os and a maximum of 5 external modules.		
Remote expansion	▪ Maximum number of on-board + local + remote I/O points should be less than 80. ▪ Example: If 62 on-board + local expansion I/O points are already used, only 18 I/O points will be available for remote expansion.		
Maximum input power	6 W		
Maximum output power	3.6 W		

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General Features	XM14-DT	XM17-ADT	XM14-DT-HIO
RTC (Real Time Clock)	1 milliseconds resolution, retention time of 14 days, maximum variation of 3 seconds per day.		
CPU speed	240 Nano seconds for Bit Instructions 280 Nano seconds for Word Instructions		
Addressable variables memory (F/S/W/P/T/C)	4.224 KB		
Program memory	256 KB		
Retain/Persistent memory	3.2 KB		
Timers - On Delay , Off Delay, Pulse	256 each		
Timers resolution	0.01 seconds, 0.1 seconds, 1 seconds		
Counters	Up Counter, Down Counter		
Programming software	XMPS - 2000 software		
Programming language	Ladder diagram		
Status and diagnostics	STS, ERR, PWR LED lamps		
Multi-functional key	RUN/STOP modes		
IP level	IP 20		
Operating temperature	0 to 55°C		
Storage temperature	-5°C to +55°C		
Operating and Storage, relative humidity	5 to 95% RH (no condensation)		
Standards	CE, RoHS		
Isolation	Isolation between power supply and CPU		
	Isolation between digital I/Os and CPU		
Maximum wire size	0.5 mm^2 with lugs		
	1.5 mm^2 without lugs		
Dimensions	106 mm (width) X 91 mm (height) X 62 mm (depth)		
Weight	225 grams		

* For implementing the MQTT function:

1. Study the brief MQTT function section in this data sheet on page 13.
2. Study the detailed MQTT function section in the device manual: <link>

**For implementing the PID function:

1. Study the brief PID function section in this data sheet on page 15.
2. Study the detailed PID function section in the device manual: <link>

Digital inputs [XM14-DT, XM17-ADT and XM14-DT-HIO PLCs]

Parameter	Value
Input type	Source/Sink
Isolation	Optical
Supply voltage	24 VDC
Input voltage Range	18 VDC to 30 VDC for logical inputs
Connection Type	Pluggable terminal connector
0 Signal (low)	0 to 5 VDC
1 Signal (high)	18 VDC to 30 VDC
Maximum input current	6 mA at 24 VDC
Response time	0.1 milliseconds
Indication	Green LED lamps

Digital outputs [XM14-DT, XM17-ADT and XM14-DT-HIO PLCs]

Parameters	Value
Output type	Transistor Source Type
Isolation	Optical/Galvanic
Maximum output current	0.5A per channel
	2A per group
Protection	Protected against surge voltages
Indication	Green LED lamps

Analog inputs [XM17-ADT PLC]

Parameter	Value	
Input type	Voltage or current, individually configurable	
Input ranges	0-10 VDC, 0-20 mA, 4-20 mA	
Engineering scale	0 to 4095	
Resolution	12 bits	
Conversion time	17 ms	
Data rate	60 samples per second	
Analog to digital conversion resolution	Voltage	2.5 mV
	Current	5.12 µA
Input impedance	Voltage	> 1 MΩ
	Current	250 Ω
Maximum permissible input	Voltage	12 V
	Current	22 mA
Accuracy	± 0.1 % of full-scale rating @ 25°C	
Protection	Protected against reverse polarity	
Indication	Green LED lamps	

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Analog outputs [XM17-ADT PLC]

Parameter	Value	
Output type	Voltage or current, individually configurable	
Input ranges	0-10 VDC, 0-20 mA, 4-20 mA	
Engineering scale	0 to 4095	
Resolution	12 bits	
Settling time	5 milliseconds	
Digital to analog conversion resolution	Voltage	2.5 mV
	Current	5.12 µA
Load impedance	Voltage	> 1 KΩ
	Current	< 500 Ω
Maximum permissible input	Voltage	10.5 V
	Current	21 mA
Accuracy	± 0.1 % of full-scale rating @ 25°C	
Indication	Green LED lamps	

High speed inputs [XM14-DT-HIO]

Parameter	Value
Number of high-speed inputs	6, sink or source type
Maximum number of high-speed counters	4
Single Phase HSC (High-speed counting)	4, at DI0, DI1, DI2, and DI3 *
Quadrature Input	1x ,2x and 4x - 2 pairs at DI0-DI1 DI2-DI3 *
Maximum number of external interrupts	4 at DI0, DI3, DI4, DI6 *
Configuration mode	1. Up/Down mode 2. Encoder - Up and Down, 2x and 4x 3. External interrupt mode
Counting input detection edge	Rising edge
Data format	Signed DInt - 32 bits
Operation limit	From - 2147483648 to 2147483647
Maximum input frequency	100 Khz
* If the pin is already used for one mode, the same pin cannot used for another mode. For example, if the DI0 is used for an interrupt, then it cannot used for another function like single phase HSC.	

High speed outputs [XM14-DT-HIO]

Parameter	Value
Number of high-speed outputs	2, sink or source type
Output type - voltage	Transistor: Source (24VDC) (+ ve) Isolated: Sink (0VDC) (- ve) (Range: -18V to 30V)
Maximum output current	0.5A per output (30mA maximum for 100KHZ)

Parameter	Value
Configuration modes	1. Normal Digital Output 2. PTO
Data format	Unsigned DInt - 32 bits
Operation limit	From 0 to 4294967295
Maximum output frequency	100 Khz
Minimum Pulse Width @ 24 VDC	50 % duty cycle

Multi-functional (Run/Stop) button

Button operation	Action
Press the button for 5 seconds	Switch to Run/Stop mode

LED lamps

Conditions	LED lamp behavior
Green PWR LED lamp (Power)	Lit continuously whenever the PLC has DC power.
Green STS LED lamp (Status)	
PLC after power switches on	Blinks fast for 2-3 seconds.
Start mode	Lit continuously.
Stop mode	Off continuously.
Bootloader mode	Toggles continuously with delay of 200 milliseconds.
Green ERR LED lamp (Error)	
Expansion error	Blinks < 20 times.

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Wiring diagram for XM-14-DT PLC

- Digital Inputs and outputs
  - Digital input: Sink [NPN] or source [PNP]) type
  - Digital output: Source [PNP] type
- The following diagram shows the XM-14- DT PLC with digital inputs and digital outputs.

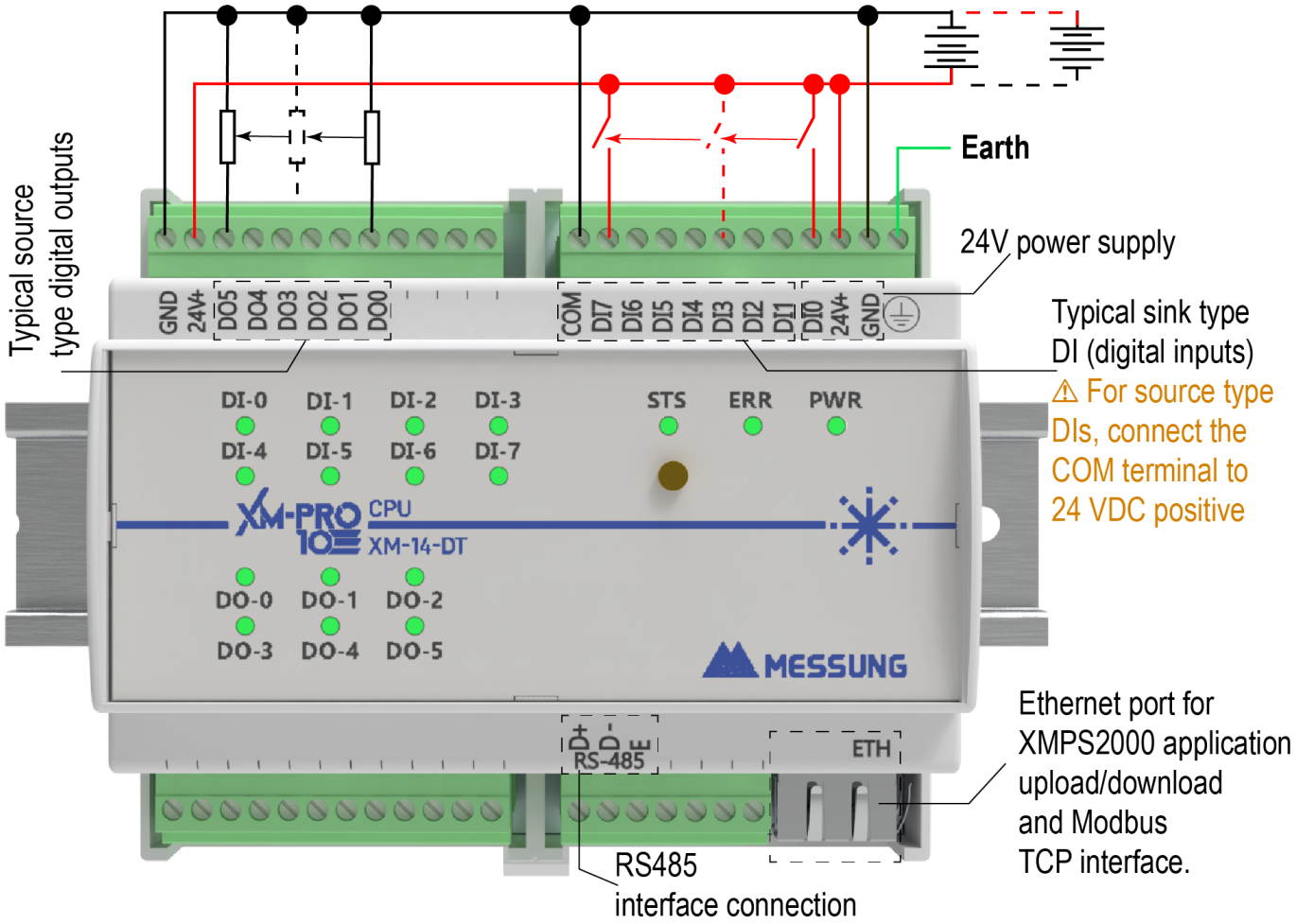

Figure 5. Typical wiring diagram of XM-14-DT PLC

Wiring diagram for XM-17- ADT PLC

- Digital Inputs and outputs
  - Digital input: Sink [NPN] or source [PNP]) type
  - Digital output: Source [PNP] type
  - Analog input: Voltage 0-10 VDC or 0-20 mA / 4-20 mA
  - Analog output: Voltage 0-10 VDC or 0-20 mA / 4-20 mA
- The following diagram shows the XM-17- ADT PLC with digital inputs,digital outputs, analog inputs and analog outputs.

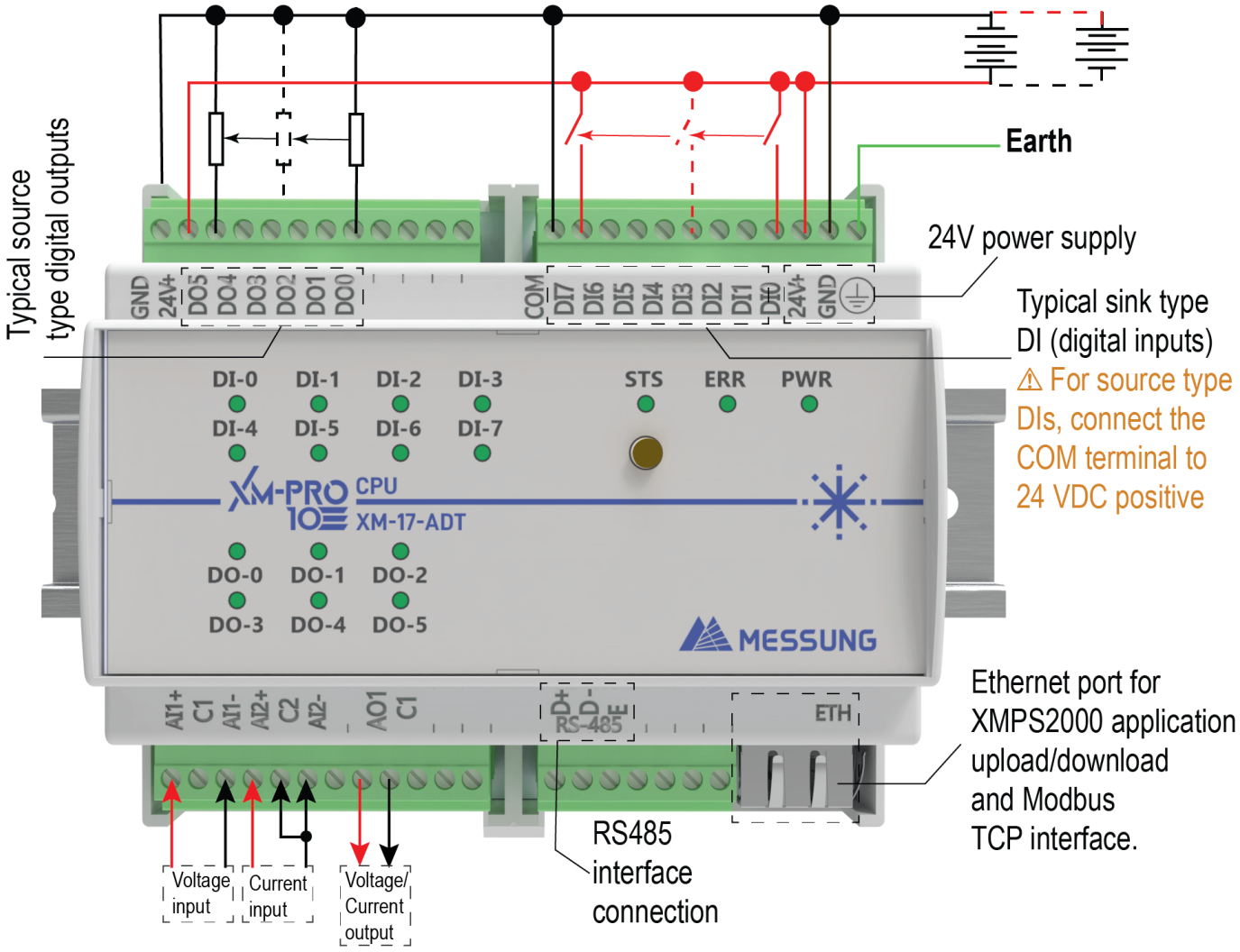

Figure 6. Typical wiring diagram of XM-17-ADT PLC

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Wiring diagram for XM-14- DT-HIO PLC with DI and DO

- Digital Inputs and outputs, high-speed input and output (HIO)
  - Digital input: Sink [NPN] or source [PNP]) type
  - Digital Output: Source [PNP] type
- The following diagram shows the XM-14- DT-HIO PLC with digital inputs and digital outputs.

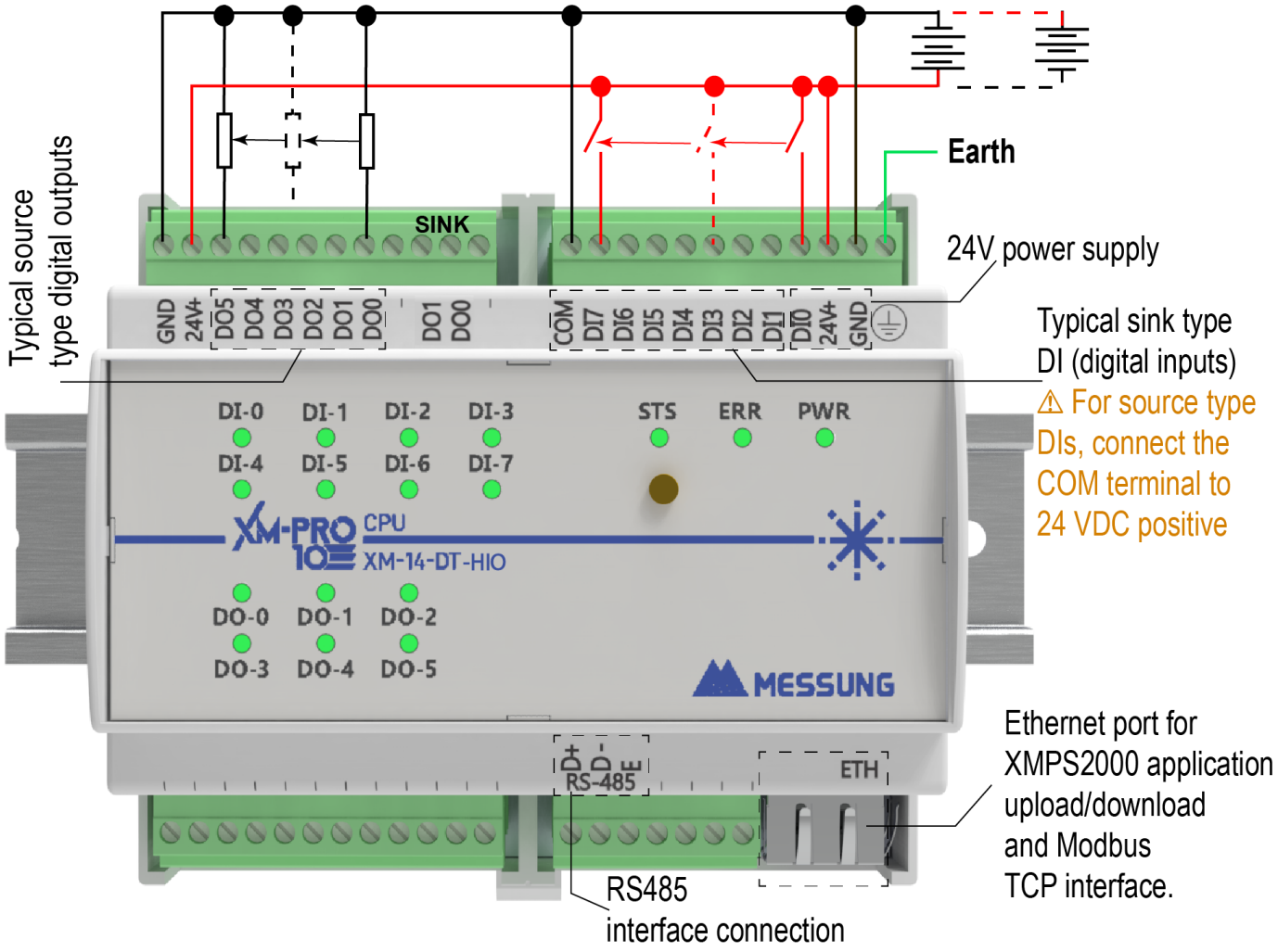

Figure 7. Typical wiring diagram of XM-14-DT-HIO PLC (image 1/3) with DI/DO

Wiring diagram for XM-14- DT-HIO PLC with HSI- single phase counter

- High-Speed input connection for **single phase counter**
  - Only Up count or
  - Only Down count
  - Sink [NPN] / Source [PNP]) type connections
- High-speed output connection for **Pulse Train Output (PTO)**
  - Sink [NPN] / Source [PNP]) type connections
- The following diagram shows the XM-14- DT-HIO PLC with single-phase counter inputs and PTO output.

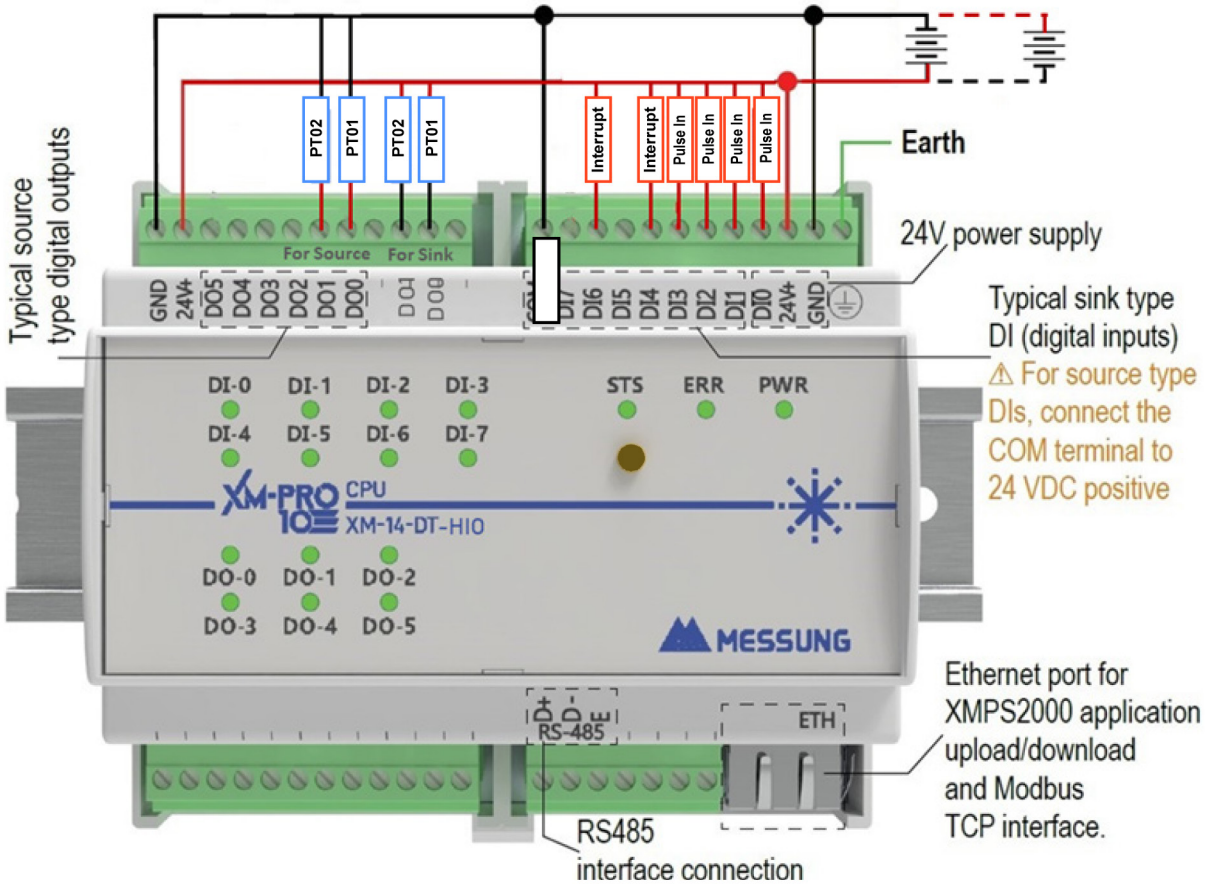

Figure 8. Typical wiring diagram of XM-14-DT-HIO PLC (image 2/3) with HSI- single phase counter

Wiring diagram for XM-14- DT-HIO PLC with quadrature inputs

- High-Speed connection for **quadrature inputs**
- Up/Down count mode or
  - 2 X Encoder mode
  - 4 X Encoder mode
  - Sink [NPN] / Source [PNP]) type connections
- High-speed output connection for **PTO**
  - Sink [NPN] / Source [PNP]) type connections
- The following diagram shows the XM-14- DT-HIO PLC with HSI- Quadrature inputs.

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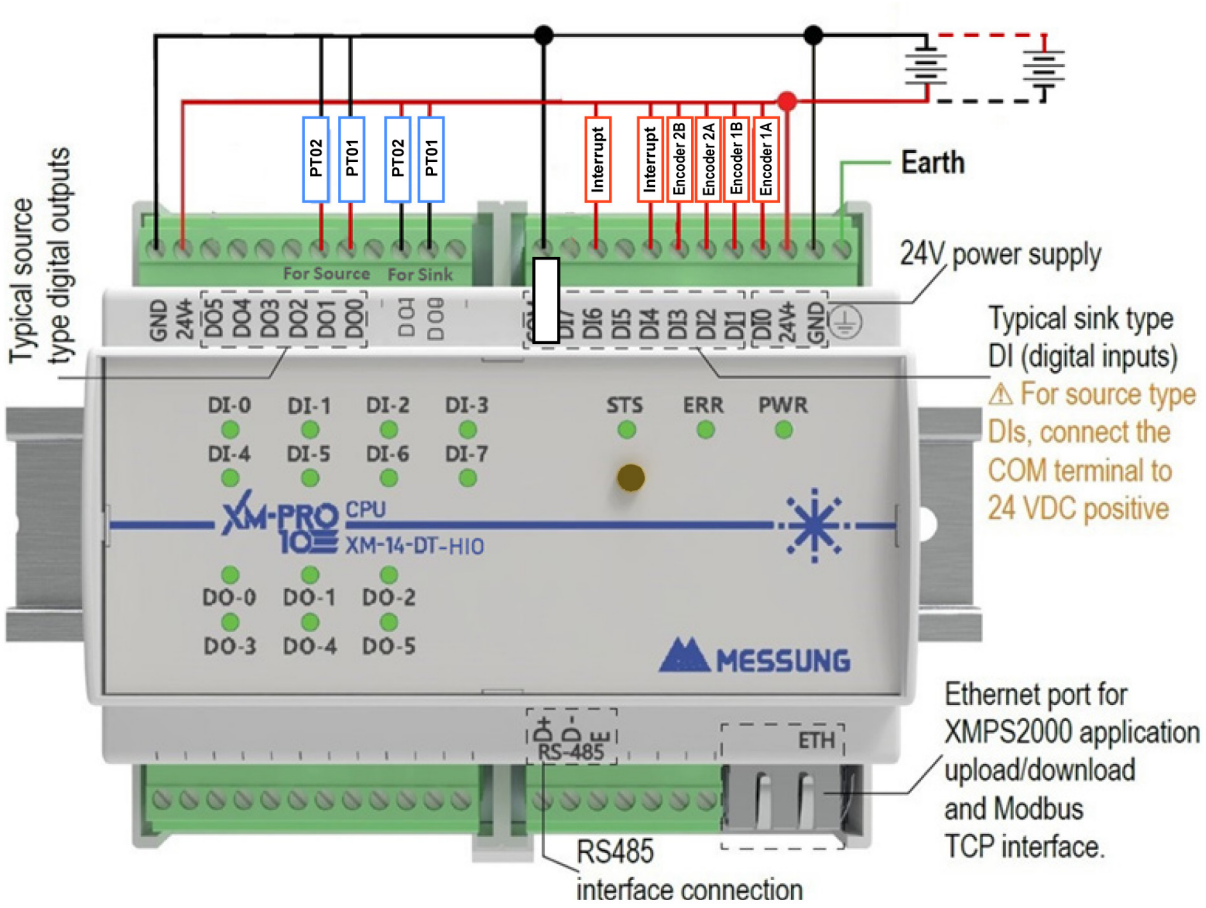
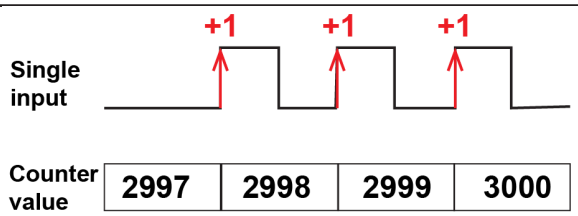
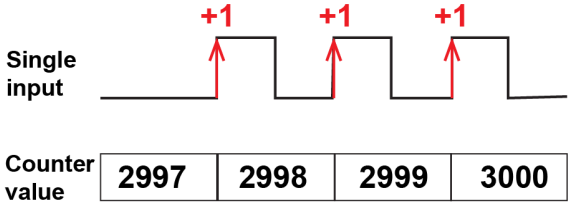
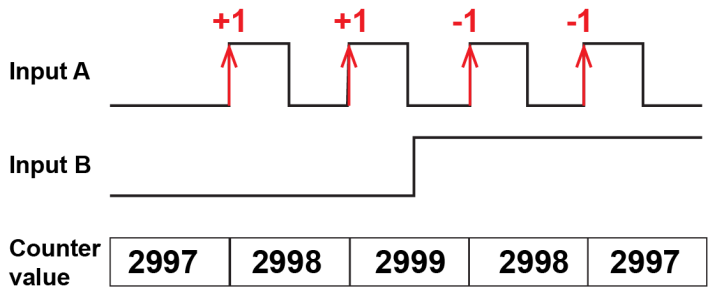
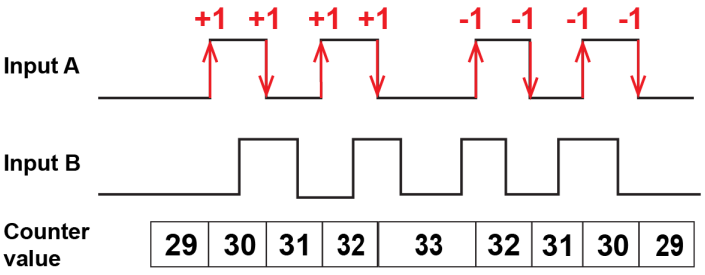
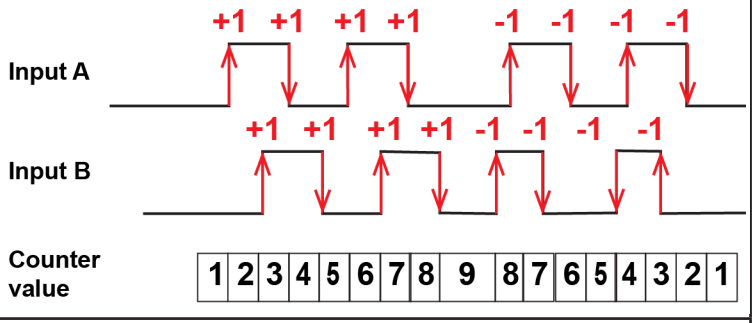


Figure 9. Typical wiring diagram of XM-14-DT-HIO PLC (image 3/3) with HSI quadrature inputs

High speed input (timing diagram)

Input mode	Number of inputs used for the mode	Timing diagram/notes
Up counter	Single input Up	
Down counter	Single input Down	

Input mode	Number of inputs used for the mode	Timing diagram/notes
Up/Down Directional Control	Two inputs	
Quadrature 2x encoder	Two inputs/ three inputs	
Quadrature 4x encoder	Two inputs/ three inputs	
Interrupt	Single input	The interrupt is a rising pulse of 50 µs.
Normal input	Single input	

High speed outputs properties

Output mode	Number of outputs used for the mode	Notes
PTO	Single output	Frequency up to 100 Khz with 50 % duty cycle.
Digital output	Single output	

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Message Queuing Telemetry Transport (MQTT) protocol

Introduction

- MQTT is a light weight TCP/IP protocol featuring publish-subscribe messaging for transporting messages between devices.
- The protocol is designed for the transport of telemetry data (sensor data) in low bandwidth environment.
- The protocol is suited for Machine to Machine (M2M) applications with better scalability for Internet of Things (IoT) and cloud applications.

Advantages

- Real-time data communication, Lightweight and efficient for low-bandwidth networks
- Remote monitoring and control

Comparison with traditional protocols like Modbus or OPC-UA

- Simpler to implement.
- Faster communication.
- Better scalability for IoT and cloud applications.

Integration of PLC with MQTT

- MQTT alllows easy implementation of real-time control, data logging, and monitoring.
- Available with TLS level 1.2 Security (Transport Layer Security).

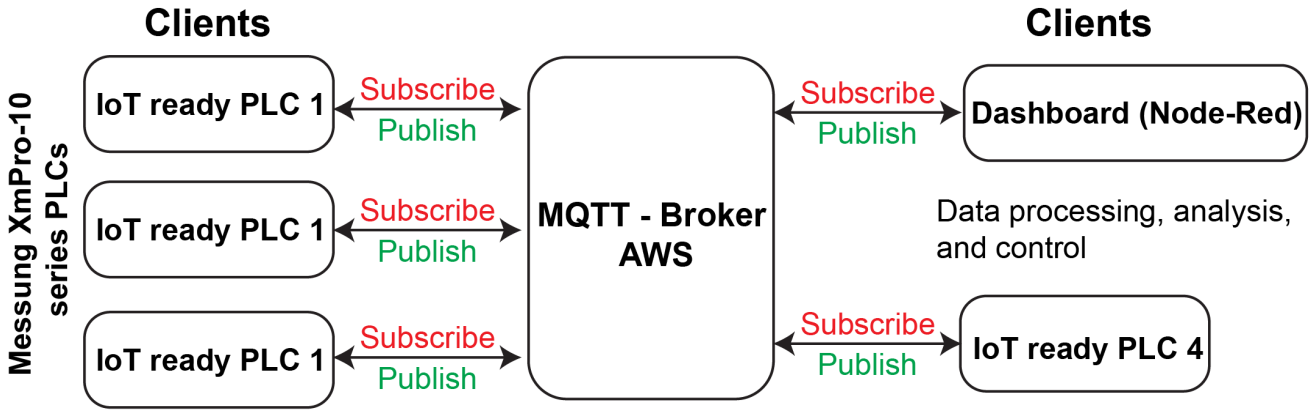

Figure 10. Components of MQTT

- To implement the MQTT function, study the section in the device manual: <link>

Proportional Integral Derivative (PID) function

- PID stands for Proportional Integral Derivative, and it is a type of controller that can be used in a PLC (Programmable Logic Controller) to maintain a process at a desired setpoint.
- PID controllers are used in a variety of applications, including temperature, pressure, flow rate, and speed control.
- PID controllers use a control loop to monitor the process variable (PV) and adjust the manipulation variable (MV) to match the set value (SV). The controller uses three parameters to adjust the output: proportional (P), integral (I), and derivative (D).
- Proportional (P) corrects the error proportionally to the current error.
- Integral (I) corrects the error based on the accumulation of past errors.
- Derivative (D): Corrects the error based on the rate of change of the error.
- The control output u(t) is given as:

$$u(t) = k_P \left(e(t) + \frac{1}{T_i} \int e(t)\, dt + T\, d \frac{de(t)}{dt} \right)$$

Where, e(t) = Error, kp = Proportional Gain, Ti = Integral Time, Td = Derivative Time

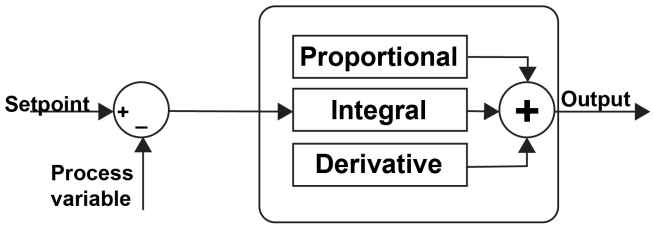

Figure 11. PID control architechture

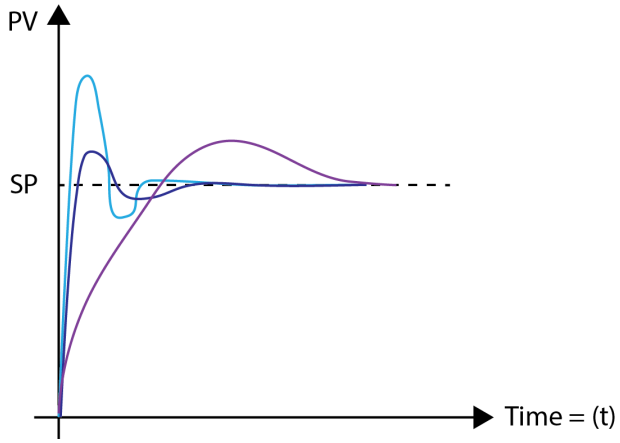

Figure 12. PID waveform

- PID controllers find use in application that need reduced overshoot and undershoot, improved stability, and handle sudden changes in the process.
- The PID controllers can be set up using input and output cards using the programming software.
- To implement the PID function, study the section in the device manual: <link>

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Connecting the modules

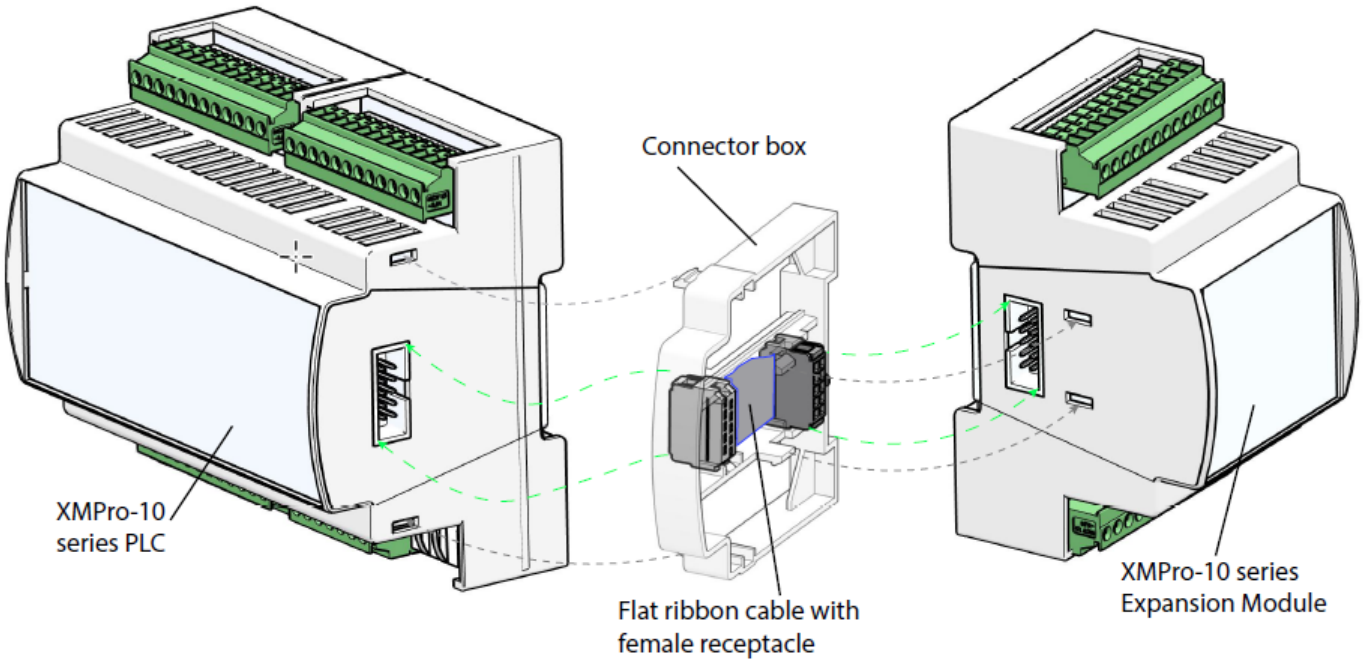

Figure 13. Connecting the modules 1/2

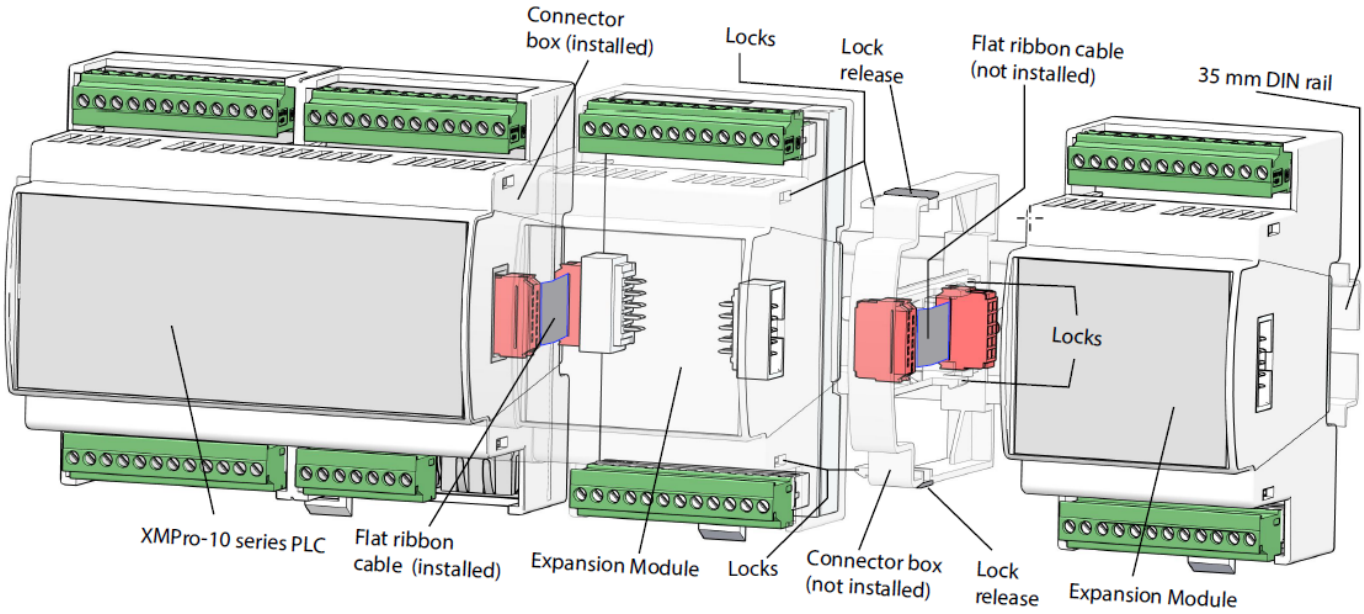

Figure 14. Connecting the modules 2/2

Steps to connecting the modules together

1. Fit the Expansion module on the 35 mm DIN rail to the right of the XMPro-10 PLC.

2. Install a Connector Box between the PLC and Expansion modules. This box encloses a Flat Ribbon Cable (FRC) for the electrical connections.
3. Insert the female receptacle on the FRC in the male header on the PLC module and the Expansion module after mating the slots in the two connectors.
4. Fit the Connector box on the DIN rail between the PLC or the Expansion module. Slide the locks on the Connector box into matching slots on the PLC or the Expansion module.
5. Add more Expansion modules to the right of 1st Expansion module. Follow steps 2 through 4.
6. When required, unlock the Connector box from the PLC or Expansion module by simultaneously pressing the Lock Release surfaces on top and bottom of the unit. Unplug the FRC cable to separate the connections between PLC and the Expansion module.

Fitting and removal

⚠ XmPro 10 series units fit on a 35 mm DIN rail channel.

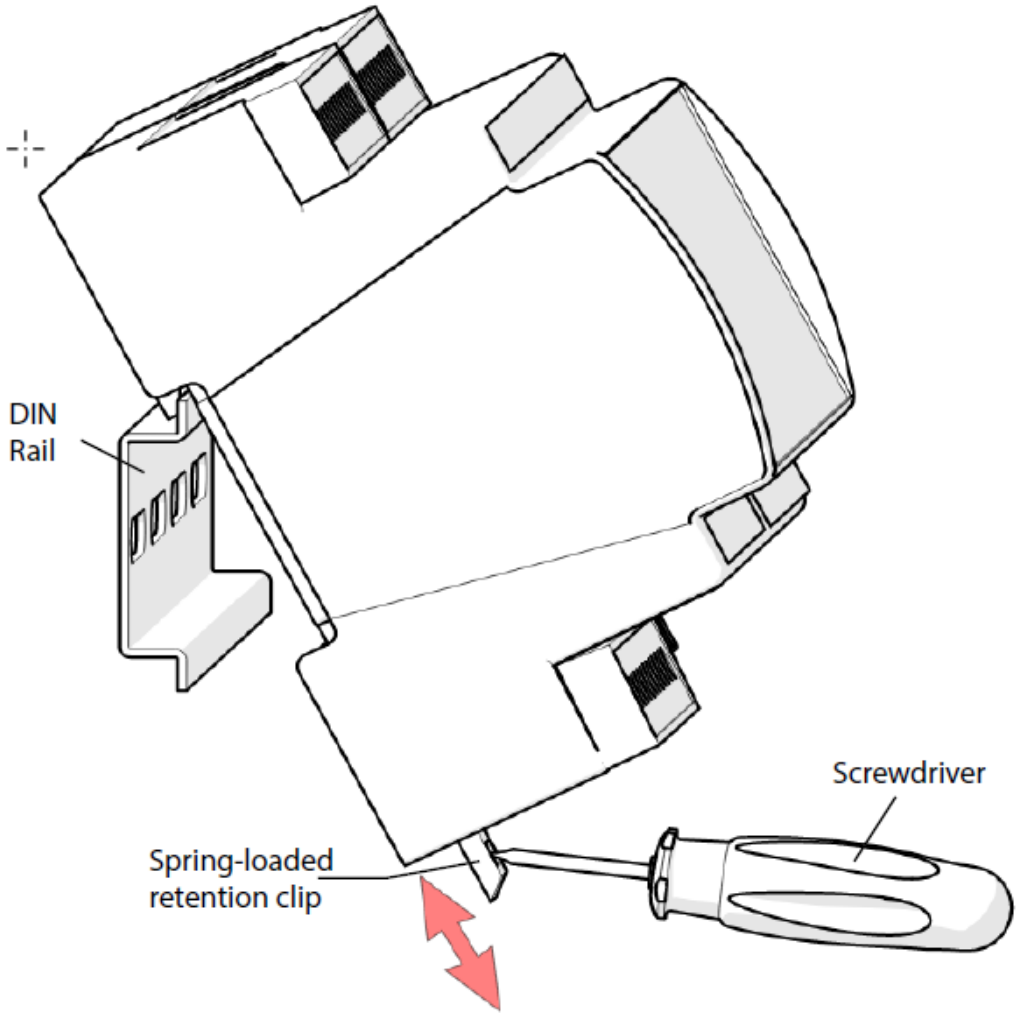

Figure 15. Pull the retention clip and locate housing on DIN rail

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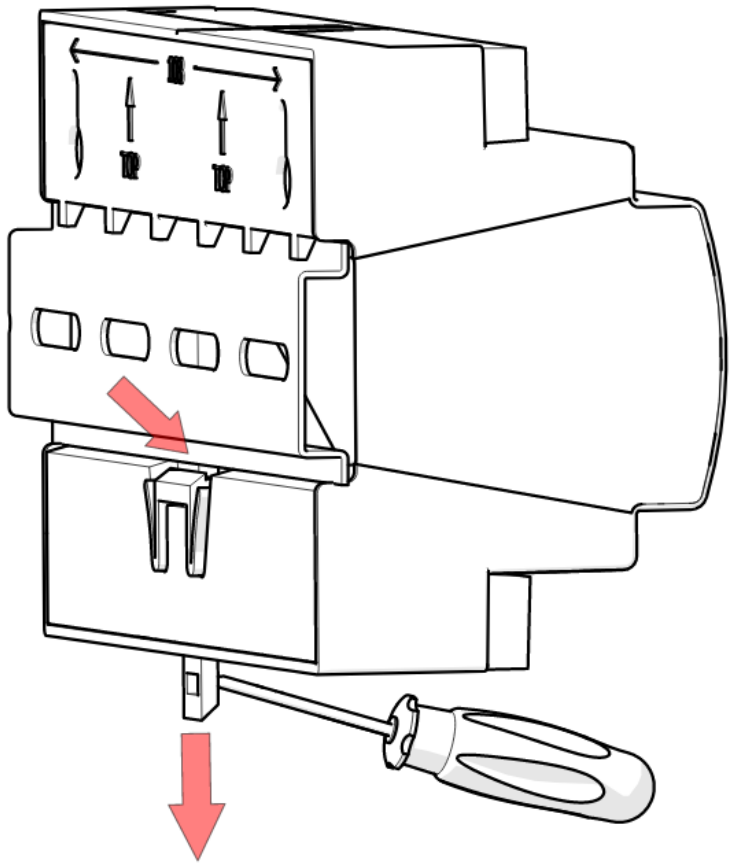

Figure 16. Keep the retention clip pulled, fit the housing on the DIN rail

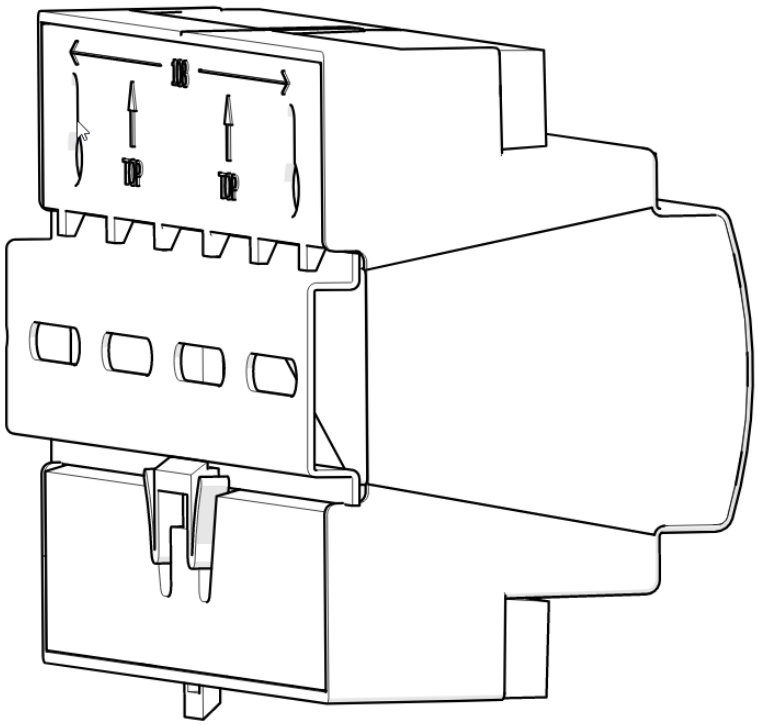

Figure 17. Release retention clip and the housing will lock onto the DIN rail

Steps for removal

1. Engage the slot at rear of XmPro 10 series unit with the upper edge of DIN rail.
2. Pull down the spring-loaded retention clip using a flat-blade screwdriver.
3. Push the unit onto the DIN rail.
4. Release the retention clip to lock the XmPro 10 series unit on the DIN rail.
5. Reverse the procedure for removing the XmPro 10 series unit from the DIN rail.

Safety instructions

⚠ Do install the unit only by qualified professionals, following all applicable laws and regulations.

⚠ Do not connect mains supply or any other external voltage to any terminal of the XmPro10 series unit.

⚠ Do ensure that the panel or box with the device is locked to prevent unauthorized access.

⚠ Do protect all electrical loads against overloads and short-circuits.

⚠ Do ensure adequate ventilation and protection from dripping water.

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