

EcoStruxure Machine Expert Industrial Ethernet Overview User 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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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, service, 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 a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

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

CAUTION

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

NOTICE

NOTICE is used to address practices not related to physical injury.

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 its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book



At a Glance

Document Scope

This document describes the Industrial Ethernet network of the Modicon devices.

Use this document to know the:

- Principles of the Industrial Ethernet network.
- Performances of the controllers.
- Supported devices.

NOTE: Read and understand this document and all related documents before installing, operating, or maintaining your controller.

Validity Note

This document has been updated for the release of EcoStruxure™ Machine Expert V1.1.

Related Documents

Title of Documentation	Reference Number
EcoStruxure Machine Expert EtherNet/IP - User Guide	<i>EIO0000003818 (ENG)</i> <i>EIO0000003819 (FRE)</i> <i>EIO0000003820 (GER)</i> <i>EIO0000003821 (SPA)</i> <i>EIO0000003822 (ITA)</i> <i>EIO0000003823 (CHS)</i> <i>EIO0000003824 (POR)</i> <i>EIO0000003825 (TUR)</i>
EcoStruxure Machine Expert Modbus TCP - User Guide	<i>EIO0000003826 (ENG)</i> <i>EIO0000003827 (FRE)</i> <i>EIO0000003828 (GER)</i> <i>EIO0000003829 (SPA)</i> <i>EIO0000003830 (ITA)</i> <i>EIO0000003831 (CHS)</i> <i>EIO0000003832 (POR)</i> <i>EIO0000003833 (TUR)</i>

Title of Documentation	Reference Number
Modicon M241 Logic Controller - Programming Guide	EIO0000003059 (ENG) EIO0000003060 (FRE) EIO0000003061 (GER) EIO0000003062 (SPA) EIO0000003063 (ITA) EIO0000003064 (CHS)
Modicon M251 Logic Controller - Programming Guide	EIO0000003089 (ENG) EIO0000003090 (FRE) EIO0000003091 (GER) EIO0000003092 (SPA) EIO0000003093 (ITA) EIO0000003094 (CHS)
Modicon TM4 Expansion Modules - Programming Guide	EIO0000003149 (ENG) EIO0000003150 (FRE) EIO0000003151 (GER) EIO0000003152 (SPA) EIO0000003153 (ITA) EIO0000003154 (CHS)
Modicon M262 Logic/Motion Controller - Programming Guide	EIO0000003651 (ENG) EIO0000003652 (FRE) EIO0000003653 (GER) EIO0000003654 (SPA) EIO0000003655 (ITA) EIO0000003656 (CHS) EIO0000003657 (POR) EIO0000003658 (TUR)
Modicon TM3 Bus Coupler - Programming Guide	EIO0000003643 (ENG) EIO0000003644 (FRE) EIO0000003645 (GER) EIO0000003646 (SPA) EIO0000003647 (ITA) EIO0000003648 (CHS) EIO0000003649 (POR) EIO0000003650 (TUR)
Modicon TMS Expansion Modules - Programming Guide	EIO0000003691 (ENG) EIO0000003692 (FRE) EIO0000003693 (GER) EIO0000003694 (SPA) EIO0000003695 (ITA) EIO0000003696 (CHS) EIO0000003697 (POR) EIO0000003698 (TUR)

Title of Documentation	Reference Number
EcoStruxure Machine Expert - Programming Guide	EIO0000002854 (ENG) EIO0000002855 (FRE) EIO0000002856 (GER) EIO0000002858 (SPA) EIO0000002857 (ITA) EIO0000002859 (CHS)
Motion Control Library Guide	EIO0000002221 (ENG) EIO0000002222 (GER) EIO0000002223 (CHS)
TcpUdpCommunication Library Guide	EIO0000002803 (ENG) EIO0000002804 (FRE) EIO0000002805 (GER) EIO0000002807 (SPA) EIO0000002806 (ITA) EIO0000002808 (CHS)
Distributed Modbus TCP Logic Controller M251 - System User Guide	EIO0000002902 (ENG)
Compact EtherNet/IP Logic Controller M251 - System User Guide	EIO0000002903 (ENG)

You can download these technical publications and other technical information from our website at <https://www.schneider-electric.com/en/download>

Product Related Information

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.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2015	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2015	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2016	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive (2006/42/EC)* and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Chapter 1

Overview

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Overview	14
Architecture	15
Principles	16
Controllers	18
Supported Devices	22

Overview

Overview

Industrial Ethernet is the term used to represent the industrial protocols that use the standard Ethernet physical layer.

On an Industrial Ethernet network, you can connect:

- Industrial devices (industrial protocols)
- Non-industrial devices (other Ethernet protocols)

In this document, Industrial Ethernet covers:

- EtherNet/IP
- Modbus TCP
- TCP/UDP
- Sercos

This document focuses on Industrial Ethernet devices connected on the device network of a controller.

Industrial Ethernet Features

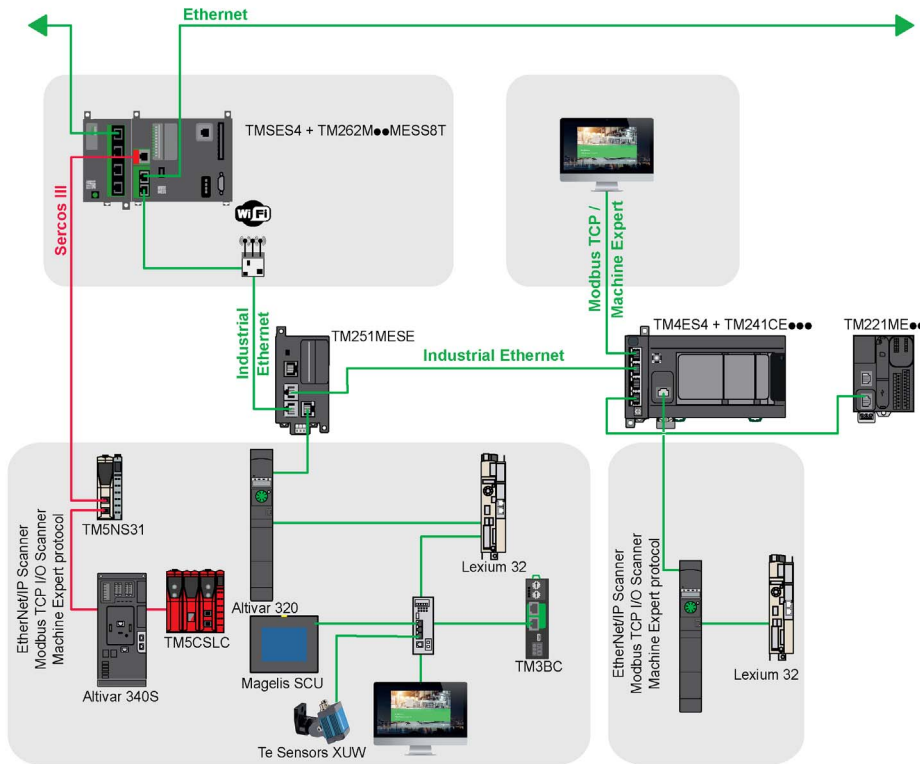
This table gives an overview of the Industrial Ethernet implementation features:

Feature	Industrial Ethernet capability
Number of devices and network flexibility	Star configuration. Infrastructure virtually unlimited. Superior total network distance. Advanced network management.
Data rate, wiring and distance	Capable of mixing fiber optic and copper cables within a system. 10/100 Mbit/s, up to 100 m (328 ft) for copper cable runs and up to 2000 m (6561 ft) for fiber optic cables. Noise immunity.
Protocols	Variety of protocols based on Ethernet.

Architecture

Industrial Ethernet Architecture

This figure presents a typical Industrial Ethernet architecture:



This architecture is configurable with EcoStruxure Machine Expert.

Principles

Overview

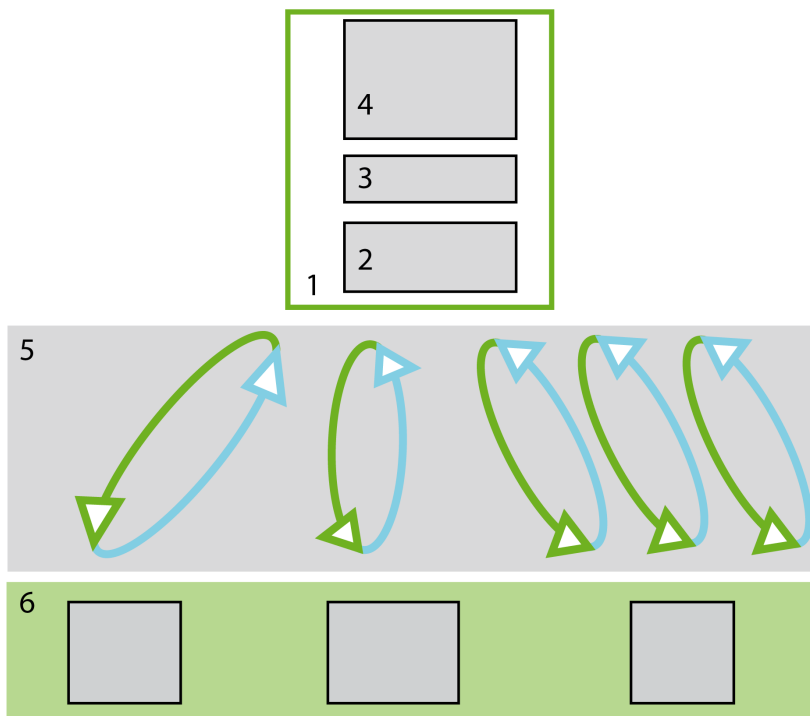
The controller controls Industrial Ethernet operating mode management. This management is performed using stable and cyclic data exchanges (scanner service).

Scanner services are available for the following protocols:

- EtherNet/IP (*see EcoStruxure Machine Expert EtherNet/IP, User Guide*)
- Modbus TCP (*see EcoStruxure Machine Expert Modbus TCP, User Guide*)

Scanner Principle

Industrial Ethernet scanner principle:



- 1 Controller (*see page 18*)
- 2 I/O images
- 3 Application interface
- 4 Application
- 5 Data exchanges in Modbus channels or EtherNet/IP connections
- 6 Slave devices (*see page 22*)

Data Exchanges

Controller manages (for each supported protocol):

- Cyclic data exchanges
- Non-cyclic data exchanges

Cyclic data exchange (example: implicit messages in EtherNet/IP) is used when data must be exchanged at a constant rate such as:

- Scanning various I/O modules
- Updating a variable speed drive
- Reading input data on sensors

Non-cyclic data exchange (example: implicit messages in EtherNet/IP) is typically used to obtain on-demand information from the target devices, such as:

- Configuration
- Diagnostics
- Data collection

Controllers

M241/M251 Controllers

This table presents the controllers that support Industrial Ethernet:

Parameter		TM251MESE, TM241CE24•, TM241CE40•, TM241CEC24•
Industrial Ethernet	Topology	Daisy chain and Star via switches
	Bandwidth	10/100 Mbit/s
EtherNet/IP Scanner	Performance	Up to 16 EtherNet/IP target devices managed by the controller, monitored within a timeslot of 10 ms.
	Number of connections	0...16
	Number of input words	0...1024
	Number of output words	0...1024
	I/O communications	EtherNet/IP Scanner service Function block for configuration and data transfer Originator/Target
Modbus TCP IO Scanner	Performance	Up to 64 Modbus TCP slave devices managed by the controller, monitored within a timeslot of 35 ms.
	Number of channels	0...64
	Number of input words	0...2048
	Number of output words	0...2048
	I/O communications	Modbus TCP IOScanner service Function block for data transfer Master/slave
Other services		FDT/DTM/EDS management
		FDR (Fast Device Replacement)
		DHCP server
		Security management (refer to Security Parameters of your controller programming guide.
		Modbus TCP server
		Modbus TCP client
		EtherNet/IP Adapter (controller as a target on EtherNet/IP)
		EtherNet/IP Originator
		Modbus TCP server (controller as a slave on Modbus TCP)
		Web server
		FTP server (FTP and TFTP protocols)
		SNMP
		IEC VAR ACCESS

Parameter	TM251MESE, TM241CE24•, TM241CE40•, TM241CEC24•
Additional features	<p>Possible to mix up to 16 EtherNet/IP and Modbus TCP devices. Devices can be directly accessed for configuration, monitoring, and management purposes.</p> <p>Network transparency between control network and device network (controller can be used as a gateway).</p> <p>NOTE: Using the controller as a gateway can impact the performance of the controller.</p>

NOTE: The input/output word limitations of the scanner have an impact on the number of devices on the device network. For example, with a TM251MESE, you can only connect up to 4 OsiSense XUW devices. Refer to protocol manager Load Verification for EtherNet/IP (*see EcoStruxure Machine Expert EtherNet/IP, User Guide*) or Modbus TCP (*see EcoStruxure Machine Expert Modbus TCP, User Guide*).

M262 Controllers

Parameter	TM262L•/TM262M•	
Industrial Ethernet	Topology	Daisy chain and Star via switches
	Bandwidth	10/100 Mbit/s for Ethernet 1 port 10/100/1000 Mbit/s for Ethernet 2 port
EtherNet/IP Scanner	Performance	Up to 64 EtherNet/IP target devices managed by the controller, monitored within a timeslot of 20 ms.
	Number of connections	TM262L10, TM262M15: 0...64, 96 slaves max. TM262L20, TM262M25, TM262M35: 0...64.
	Number of input words	0...15360
	Number of output words	0...15360
	I/O communications	EtherNet/IP Scanner service Function block for configuration and data transfer Originator/Target
Sercos Master	Performance	TM262M15: 0...4 axes with 12 Sercos III devices TM262M25: 0...8 axes with 16 Sercos III devices TM262M35: 0...16 axes with 24 Sercos III devices The Sercos III devices are monitored within a timeslot of 4 ms.

Parameter		TM262L•/TM262M•
Modbus TCP IO Scanner	Performance	Up to 64 Modbus TCP slave devices managed by the controller, monitored within a timeslot of 10 ms.
	Number of connections	TM262L10, TM262M15: 0...64, 96 slaves max. TM262L20, TM262M25, TM262M35: 0...64.
	Number of input words	0...8000
	Number of output words	0...8000
	I/O communications	Modbus TCP IOScanner service Function block for data transfer Master/slave
Other services	FDT/DTM management	
	FDR (Fast Device Replacement)	
	DHCP server	
	Security management (refer to Security Parameters and Firewall Configuration)	
	Modbus TCP server	
	Modbus TCP client	
	EtherNet/IP Adapter (controller as a target on EtherNet/IP)	
	EtherNet/IP Originator	
	Modbus TCP server (controller as a slave on Modbus TCP)	
	Web server	
	FTP server (FTP and TFTP protocols)	
	SNMP	
Additional features	IEC VAR ACCESS	
	Ring Topology	
Additional features		<p>Possible to mix EtherNet/IP and ModbusTCP devices:</p> <ul style="list-style-type: none"> ● TM262L10, TM262M15: 96 devices ● TM262L20, TM262M25, TM262M35: 128 devices. <p>Devices can be directly accessed for configuration, monitoring, and management purposes.</p> <p>Network transparency between control network and device network (controller can be used as a gateway <i>(see Modicon M262 Logic/Motion Controller, Programming Guide)</i>).</p> <p>NOTE: Using the controller as a gateway can impact the performance of the controller.</p>

Industrial Ethernet Port

To configure the Industrial Ethernet port:

1. Double-click the following node in the **Devices tree**:
 - TM241CE24•/TM241CE40•: **MyController** → **Ethernet_1**
 - M251 Logic Controller: **MyController** → **Ethernet_2**
 - TM262L•: **MyController** → **Ethernet_1** or **Ethernet_2**
 - TM262M•: **MyController** → **Ethernet_1** or **Ethernet_2**
2. Configure the network settings.

Protocol Manager

The controller uses a protocol manager to manage the device network:

Controllers/Protocol Managers	Industrial Ethernet Manager	Ethernet/IP Scanner	Modbus TCP IO Scanner	Sercos Master
M241	✓	–	–	–
M251	✓	–	–	–
M262	–	✓	✓	✓ ⁽¹⁾
(1) On Ethernet_1 on TM262M•				

Supported Devices

Supported Devices

This table presents the supported Industrial Ethernet devices:

Device name		Supported protocols				TVDA	Key features
		TCP/UDP	Modbus TCP	EtherNet/IP	Sercos III		
Predefined devices	Altivar 320	-	✓	✓	-	✓	FDR, DTM, libraries, predefined connections, predefined data exchanges
	Altivar 340	-	✓	✓	✓	✓	FDR, DTM, libraries, predefined connections, predefined data exchanges
	Altivar 6**	-	✓	✓	-	✓	FDR, DTM, libraries, predefined connections, predefined data exchanges
	Altivar 9**	-	✓	✓	-	✓	FDR, DTM, libraries, predefined connections, predefined data exchanges
	Lexium 32 M	-	✓	✓	-	✓	FDR, DTM, libraries, predefined connections, predefined data exchanges
<p>(1) The device can be declared as a Modbus TCP slave device if you add it in EcoStruxure Machine Expert as a generic slave device.</p> <p>(2) An EDS file provides, among other things, predefined connections to facilitate device network integration.</p> <p>(3) A generic slave device is used in EcoStruxure Machine Expert to add devices such as speed drives, sensors, or other controllers that are Modbus TCP, EtherNet/IP, or TCP/UDP devices.</p>							

Device name		Supported protocols				TVDA	Key features
		TCP/UDP	Modbus TCP	EtherNet/IP	Sercos III		
Predefined devices	Lexium ILA	-	✓	✓	-	✓	FDR, libraries, predefined connections, predefined data exchanges
	Lexium ILE	-	✓	✓	-	✓	FDR, libraries, predefined connections, predefined data exchanges
	Lexium ILS	-	✓	✓	-	✓	FDR, libraries, predefined connections, predefined data exchanges
	OsiSense XG	-	✓	✓	-	✓	Predefined connections, predefined data exchanges
	OsiSense XUW	-	-	✓	-	✓	Predefined connections, predefined data exchanges
	OTB1EODM9LP	-	✓	-	-	✓	Libraries, predefined connections, predefined data exchanges
	XPSMCM	-	(1)	✓	-	✓	Predefined connections, predefined data exchanges
	Harmony XB4R/5R	-	✓	-	-	-	DTM, libraries, predefined connections, predefined data exchanges
Bus Coupler	TM3BCEIP	-	✓	✓	-	✓	-
Other devices	Device provided with EDS file ⁽²⁾	-	-	✓	-	-	User parameters, predefined connections
	Generic slave device ⁽³⁾	✓	✓	✓	✓	-	User parameters (only for EtherNet/IP), libraries
<p>(1) The device can be declared as a Modbus TCP slave device if you add it in EcoStruxure Machine Expert as a generic slave device.</p> <p>(2) An EDS file provides, among other things, predefined connections to facilitate device network integration.</p> <p>(3) A generic slave device is used in EcoStruxure Machine Expert to add devices such as speed drives, sensors, or other controllers that are Modbus TCP, EtherNet/IP, or TCP/UDP devices.</p>							

Key Features

This table presents the key features:

Key features	Description
FDR	Fast Device Replacement: The device configuration is stored in the controller. When a device is replaced, the configuration is automatically loaded into the new device.
DTM	For devices supported by a DTM: FDT/DTM technology allows network devices to be configured in EcoStruxure Machine Expert. Refer to the Device Type Manager User Guide.
Libraries	Functions / function blocks (dedicated to the device) available for use by the application.
Predefined connections	Used to set up cyclic data exchanges. Select one of the proposed connections containing the relevant information. For more information, refer to Cyclic Data Exchanges (<i>see EcoStruxure Machine Expert Industrial Ethernet, User Guide</i>).
Predefined data exchanges	The cyclic data exchanges are set automatically: one predefined connection is automatically selected when you add the device to the project.
User parameters	Parameters that are sent automatically to the device at power-up. These parameters are used when replacing devices that do not support FDR.

TVDA

The following TVDA (Tested Validated Documented Architecture) System User Guides are related to Industrial Ethernet:

- Distributed Modbus TCP Logic Controller M251
- Compact EtherNet/IP Logic Controller M251

Some supported Industrial Ethernet devices (*see page 22*) are provided with application code templates (referred to as Device Modules) that provide a way to integrate devices such as variable speed drives or servo drives in the EcoStruxure Machine Expert project. The Device Modules are realized on function templates, a mechanism within EcoStruxure Machine Expert to recall predefined application program contents.

Each Device Module embeds the EcoStruxure Machine Expert application content to control the field device, monitor its status, and handle detected errors. It includes a separate global variable definition that provides the interface to access the device functionalities across the EcoStruxure Machine Expert automation project.

For more details, refer to TVDA Device Module Library, Function Template Library Guide.



D

device network

A network that contains devices connected to a specific communication port of a logic controller. This controller is seen as a master from the devices point of view.

DTM

(*device type manager*) Classified into 2 categories:

- Device DTMs connect to the field device configuration components.
- CommDTMs connect to the software communication components.

The DTM provides a unified structure for accessing device parameters and configuring, operating, and diagnosing the devices. DTMs can range from a simple graphical user interface for setting device parameters to a highly sophisticated application capable of performing complex real-time calculations for diagnosis and maintenance purposes.

O

Originator

In EtherNet/IP, the device that initiates a CIP connection for implicit or explicit messaging communications or that initiates a message request for un-connected explicit messaging.

See also *target*

T

Target

In EtherNet/IP, a device is considered to be the target when it is the recipient of a connection request for implicit or explicit messaging communications.

See also *Originator*

TVDA

(*tested validated documented architectures*) Control system proposals based on Schneider Electric components. TVDAs cover a wide range of machine types and consider machine performance requirements, installation constraints, and target costs. To optimize the implementation effort, each TVDA comes with a detailed component list, wiring diagrams, and commissioning guide, as well as controller and HMI applications to control components of the system.

