TeSys™ T LTMR

Motor Management Controller

Ethernet Communication Guide

DOCA0129EN-03
07/2023

www.se.com

Legal Information

The Schneider Electric brand and any trademarks of Schneider Electric SE and its subsidiaries referred to in this guide are the property of Schneider Electric SE or its subsidiaries. All other brands may be trademarks of their respective owners.

This guide and its content are protected under applicable copyright laws and furnished for informational use only. No part of this guide may be reproduced or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), for any purpose, without the prior written permission of Schneider Electric.

Schneider Electric does not grant any right or license for commercial use of the guide or its content, except for a non-exclusive and personal license to consult it on an "as is" basis. Schneider Electric products and equipment should be installed, operated, serviced, and maintained only by qualified personnel.

As standards, specifications, and designs change from time to time, information contained in this guide may be subject to change without notice.

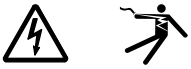
To the extent permitted by applicable law, no responsibility or liability is assumed by Schneider Electric and its subsidiaries for any errors or omissions in the informational content of this material or consequences arising out of or resulting from the use of the information contained herein.

Schneider Electric and TeSys are trademarks and the property of Schneider Electric SE, its subsidiaries, and affiliated companies. All other trademarks are the property of their respective owners.

Table of Contents

Safety Information

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 user guide or on the equipment to warn of hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either 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 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.

NOTE: Provides additional information to clarify or simplify a procedure.

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, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Electrical equipment should be transported, stored, installed, and operated only in the environment for which it is designed.

Product Related Information

Read and understand these instructions before performing any procedure with this device.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage. Do not touch. Use only electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors of the motor cable.
- Before performing work on the system, disconnect all power including external control power that may be present; place a **Do Not Turn On** label on all power switches; and lock all power switches in the open position.
- Install and close all covers before applying voltage.

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

Controllers may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data, or other user errors.

Damaged products or accessories may cause electric shock or unanticipated equipment operation.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Do not use damaged products or accessories.

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

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

⚠WARNING

UNANTICIPATED EQUIPMENT OPERATION

- Carefully install the wiring in accordance with the EMC requirements.
- Do not operate the product with unknown or unsuitable settings or data.
- Perform a comprehensive commissioning test.

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

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for 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, 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 an LTMR controller 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.

WARNING: This product can expose you to chemicals including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

1. For additional information, refer to NEMA ICS 1.1 (latest edition), “Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control.”

About the Book

Document Scope

The purpose of this guide is to:

- Show you how to connect the Ethernet/IP and Modbus TCP networks on your TeSys T LTMR controller.
- Show you how to set up the LTMR controller to use Ethernet/IP and Modbus TCP for display, monitoring, and control.
- Provide examples of setup using the commissioning software.

NOTE: Read and understand this document (see below) before installing, operating, or maintaining your device.

Validity Note

This guide is valid for LTMR Ethernet controllers. Some functions are available depending on the software version of the controller.

Related Documents

Title of Documentation	Description	Reference Number
TeSys T LTMR - Motor Management Controller - User Guide	This is the main user guide that introduces the complete TeSys T range and describes the main functions of the TeSys T LTMR motor management controller and LTME expansion module.	DOCA0127EN
TeSys T LTMR - Motor Management Controller - Installation Guide	This guide describes the installation, commissioning, and maintenance of the TeSys T LTMR motor management controller.	DOCA0128EN
TeSys T LTMR - Motor Management Controller - Modbus Communication Guide	This guide describes the Modbus network protocol version of the TeSys T LTMR motor management controller.	DOCA0130EN
TeSys T LTMR - Motor Management Controller - PROFIBUS DP Communication Guide	This guide describes the PROFIBUS-DP network protocol version of the TeSys T LTMR motor management controller.	DOCA0131EN
TeSys T LTMR - Motor Management Controller - CANopen Communication Guide	This guide describes the CANopen network protocol version of the TeSys T LTMR motor management controller.	DOCA0132EN
TeSys T LTMR - Motor Management Controller - DeviceNet Communication Guide	This guide describes the DeviceNet network protocol version of the TeSys T LTMR motor management controller.	DOCA0133EN
TeSys® T LTM CU - Control Operator Unit - User Manual	This manual describes how to install, configure, and use the TeSys T LTMCU Control Operator Unit.	1639581EN
Compact Display Units - Magelis XBT N/XBT R - User Manual	This manual describes the characteristics and presentation of the XBT N/XBT R display units.	1681029EN
TeSys T LTMR Ethernet/IP with a Third-Party PLC - Quick Start Guide	This guide provides a single reference for configuring and connecting the TeSys T and the Allen-Bradley programmable logic controller (PLC).	DOCA0119EN

Title of Documentation	Description	Reference Number
TeSys T LTM R Modbus - Motor Management Controller - Quick Start Guide	This guide uses an application example to describe the different steps to quickly install, configure, and use TeSys T for Modbus network.	1639572EN
TeSys T LTM R Profibus-DP - Motor Management Controller - Quick Start Guide	This guide uses an application example to describe the different steps to quickly install, configure, and use TeSys T for PROFIBUS-DP network.	1639573EN
TeSys T LTM R CANopen - Motor Management Controller - Quick Start Guide	This guide uses an application example to describe the different steps to quickly install, configure, and use TeSys T for CANopen network.	1639574EN
TeSys T LTM R DeviceNet - Motor Management Controller - Quick Start Guide	This guide uses an application example to describe the different steps to quickly install, configure, and use TeSys T for DeviceNet network.	1639575EN
Electromagnetic Compatibility - Practical Installation Guidelines	This guide provides an insight to the electromagnetic compatibility.	DEG999EN
TeSys T LTM R•• - Instruction Sheet	This document describes the mounting and connection of the TeSys T LTMR motor management controller.	AAV7709901
TeSys T LTM E•• - Instruction Sheet	This document describes the mounting and connection of the TeSys T LTME expansion module.	AAV7950501
Magelis Compact Terminals XBT N/R/RT - Instruction Sheet	This document describes the mounting and connection of the Magelis XBT-N display units.	1681014
TeSys T LTM CU• - Instruction Sheet	This document describes the mounting and connection of the TeSys T LTMCU control unit	AAV6665701
TeSys T DTM for FDT Container - Online Help	This online help describes the TeSys T DTM and the custom logic editor embedded in the for TeSys T DTM which allows customization of the control functions of the TeSys T motor management system.	1672614EN
Modicon M340 BMX NOC 0401 Ethernet Communication Module - User Manual	This manual describes the use of the Modicon M340 BMX NOC 0401 Ethernet communication module and describes the creation of a complete configuration.	S1A34009
TCSMCNAM3M002P USB to RS485 Converter - Quick Reference Guide	This instruction guide describes the configuration cable between computer and TeSys T: USB to RS485	BBV28000
Electrical Installation Guide (Wiki version)	The aim of the Electrical Installation Guide (and now Wiki) is to help electrical designers and contractors to design electrical installations according to standards such as the IEC60364 or other relevant standards.	www.electrical-installation.org
National Electric Code - NFPA70E	The NEC is the primary governing set of rules for installation and operation of low voltage electrical equipment in the United States.	www.nfpa.org
Canadian Electrical Code	The CEC is the primary governing set of rules for installation and operation of low voltage electrical equipment in Canada.	www.csagroup.org
Modbus Official Site	This site describes about Modbus and its various products.	www.modbus.org

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

Terminology

The technical terms, terminology, and the corresponding descriptions in this manual normally use the terms or definitions in the relevant standards.

Among others, these standards include:

- IEC 61158 series: Industrial communication networks - Fieldbus specifications
- IEC 61784 series: Industrial communication networks - Profiles
- IEC 60204-1: Safety of machinery - Electrical equipment of machines – Part 1: General requirements
- IEC 61915-2: Low-voltage switchgear and controlgear – Device profiles for networked industrial devices – Part 2: Root device profiles for starters and similar equipment

In addition, the term **zone of operation** is used in conjunction with the description of specific hazards, and is defined as it is for a **hazard zone** or **danger zone** in the EC Machinery Directive (2006/42/EC) and in ISO 12100-1.

Also see the glossary at the end of this manual.

Introducing the TeSys T Motor Management System

Overview

This chapter introduces the TeSys T motor management system and its companion devices.

Presentation of the TeSys T Motor Management System

Aim of the Product

The TeSys T motor management system offers protection, control, and monitoring capabilities for single-phase and three-phase AC induction motors.

The system is flexible, modular, and can be configured to meet the requirements of applications in industry. The system is designed to meet the needs for integrated protection systems with open communications and a global architecture.

Highly accurate sensors and solid-state full motor protection provide better utilization of the motor. Complete monitoring functions enable analysis of motor operating conditions and faster responses to minimize system downtime.

The system offers diagnostic and statistics functions and configurable indications and detected conditions, allowing better prediction of component maintenance, and provides data to continuously improve the entire system.

For more details on the product, refer to the TeSys T LTMR Motor Management Controller User Guide.

Firmware Update Policy

Firmware update is recommended to benefit from the latest features and potential bug fixes. Update the firmware to the latest version when the latest features and bug fixes are required for your application. Use the firmware release notes to confirm if an update to the latest version of the firmware is relevant for your application. The latest firmware and release notes can be found together by searching for "TeSys T Firmware" at www.se.com.

Firmware Update with TeSys Programmer

Use the latest version of TeSys Programmer software to update the TeSys T range of devices with the latest firmware version available. The latest version of TeSys Programmer software is available at www.se.com. For more information on the use of TeSys Programmer software, refer to TeSys Programmer Help document that is provided with the software.

Cyber Security

Introduction

Cyber Security is a branch of network administration that addresses attacks on or by computer systems and through computer networks that can result in accidental or intentional disruptions.

The objective of Cyber Security is to help provide increased levels of protection for information and physical assets from theft, corruption, misuse, or accidents while maintaining access for their intended users.

No single Cyber Security approach is adequate. Schneider Electric recommends a defense-in-depth approach. Conceived by the **National Security Agency** (NSA), this approach layers the network with security features, appliances, and processes.

The basic components of Schneider Electric's defense-in-depth approach are:

1. Risk assessment. A systematic security analysis of the deployment environment and related systems.
2. A security plan built on the results of the risk assessment.
3. A multi-phase training campaign.
4. Network separation and segmentation. Physical separation of the control network from other networks using a demilitarized zone (DMZ), and the division of the control network itself into segments and security zones.
5. System Access Control. Controlling logical and physical access to the system with firewalls, authentication, authorization, VPN, and antivirus software. This effort also includes traditional physical security measures such as video surveillance, fences, locked doors and gates, and locked equipment cabinets.
6. Device hardening, the process of configuring a device against communication-based threats. Device hardening measures include disabling unused network ports, password management, access control, and the disabling of all unnecessary protocols and services.
7. Network monitoring and maintenance. An effective defense-in-depth campaign requires continual monitoring and system maintenance to meet the challenge of new threats as they develop.

This chapter defines the elements that help you configure a system that is less susceptible to cyber attacks.

For detailed information on the defense-in-depth approach, refer to the TVDA: How Can I Reduce Vulnerability to Cyber Attacks on the Schneider Electric website.

To submit a Cyber Security question, report security issues, or get the latest news from Schneider Electric, visit the Schneider Electric website.

Backing-up and Restoring the Software Configuration

To protect your data, Schneider Electric recommends backing-up the device configuration and keeping your backup file in a secure place. The backup is available in the device DTM, using "load from device" and "store to device" functions.

Remote Access to the Device

When remote access is used between a device and the motor management controller, ensure your network is secure (VPN, firewall…).

Machines, controllers, and related equipment are usually integrated into networks. Unauthorized persons and malware may gain access to the machine as well as to

other devices on the network/fieldbus of the machine and connected networks via insufficiently secure access to software and networks.

⚠WARNING

UNAUTHORIZED ACCESS TO THE MACHINE VIA SOFTWARE AND NETWORKS

- In your hazard and risk analysis, consider all hazards that result from access to and operation on the network/fieldbus and develop an appropriate cyber security concept.
- Verify that the hardware infrastructure and the software infrastructure into which the machine is integrated as well as all organizational measures and rules covering access to this infrastructure consider the results of the hazard and risk analysis and are implemented according to best practices and standards covering IT security and cyber security (such as: ISO/IEC 27000 series, Common Criteria for Information Technology Security Evaluation, ISO/ IEC 15408, IEC 62351, ISA/IEC 62443, NIST Cybersecurity Framework, Information Security Forum - Standard of Good Practice for Information Security).
- Verify the effectiveness of your IT security and cyber security systems using appropriate, proven methods.

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

Data Flow Restriction

To control the access to the device and limit the data flow, the use of a firewall is required (for example, a ConneXium Tofino Firewall).

The ConneXium TCSEFEA Tofino firewall is a security appliance that provides levels of protection against cyber threats for industrial networks, automation systems, SCADA systems, and process control systems.

This firewall is designed to permit or deny communications between devices connected to the external network connection of the firewall and the devices connected to the internal network connection.

The firewall can restrict network traffic based on user defined rules that would permit only authorized devices, communication types and services.

The firewall includes built-in security modules and an off-line configuration tool for creating zones within an industrial automation environment.

Wiring of the Ethernet Network

Overview

This chapter describes how to connect an LTMR controller to an Ethernet network using an RJ45 connector.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical 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.
- 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 anticipated transmission delays or failures of the link. (1)
- Each implementation of an LTMR controller 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*.

Ethernet Network Characteristics

Overview

The LTMR Ethernet TCP/IP controller complies with the specifications of the EtherNet/IP and Modbus/TCP protocols.

Characteristics for Connection to the Ethernet Network

Characteristics	Value
Maximum number of LTMR controllers per subnet	A network with a DHCP server is limited to 160 LTMR controllers.
Maximum number of LTMR controllers per segment	Limit the number of LTMR controllers on a daisy chain network to 16 to avoid a decrease in performance.
Type of cable	Straight or crossed category 5 shielded twisted pair
Maximum cable length (daisy chain)	100 m (328 ft)
Transmission speed	10 MB/100 MB

Ethernet Network Port Wiring Terminal Characteristics

General

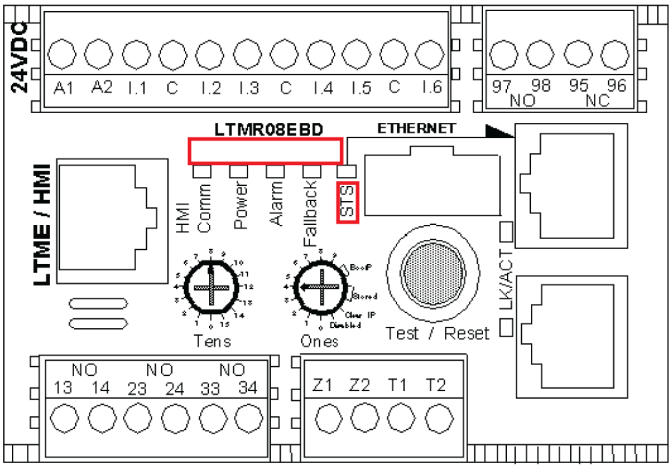
The main physical characteristics of Ethernet ports are:

Physical interface	Ethernet 10/100BASE-T
Connector	RJ45

Hardware Generations

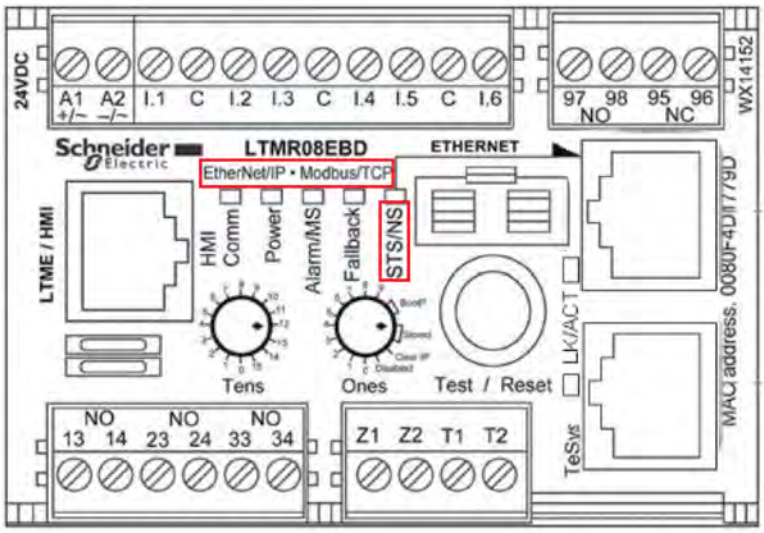
MBTCP Generation hardware is an earlier implementation of the Ethernet based TeSys T product. It can be identified by the following characteristics:

- There are no protocols labeled below the commercial reference number on the front face.
- The LED closest to the Ethernet Ports is labeled “STS”.



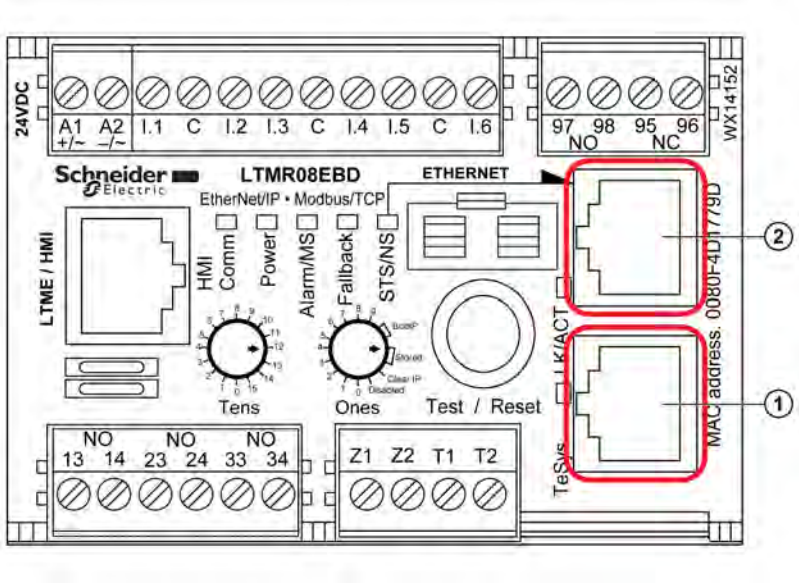
MBTCP+EIP Generation hardware is the latest implementation of the Ethernet based TeSys T product. It can be identified by the following characteristics:

- The words Ethernet/IP and Modbus/TCP appear below the commercial reference on the front face.
- The LED closest to the Ethernet Ports is labeled “STS/NS”.



Physical Interface and Connectors

The LTMR controller is equipped with threeRJ45 ports on its front face. Two of these ports (circled below) provide access to the controller's Ethernet network ports:

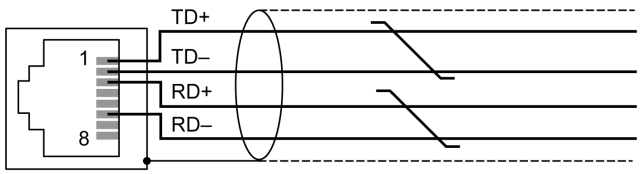


1 Ethernet port number 1

2 Ethernet port number 2

RJ45 Ethernet Network Connector Pinout

The LTMR controller is connected to the Ethernet network using either or both of its RJ45 Ethernet network port connectors in compliance with the following wiring:



The RJ45 wiring layout is:

Pin No.	Signal	Pair	Description
1	TD+	A	Transmit +
2	TD-	A	Transmit –
3	RD+	B	Receive +
4	Do not connect	–	–
5	Do not connect	–	–
6	RD-	B	Receive –
7	Do not connect	–	–
8	Do not connect	–	–

Auto-MDIX

Each RJ45 connector on the LTMR controller Ethernet network port is an MDIX (media-dependent interface crossover) interface. Each connector automatically senses the:

- Cable type-straight or crossed-plugged into the connector, and
- Pin requirements of the device to which the controller is connected

Using this information, each connector assigns transmit and receive functions to pin combinations 1 & 2 and 3 & 6 as necessary to communicate with the device on the other end of the cable.

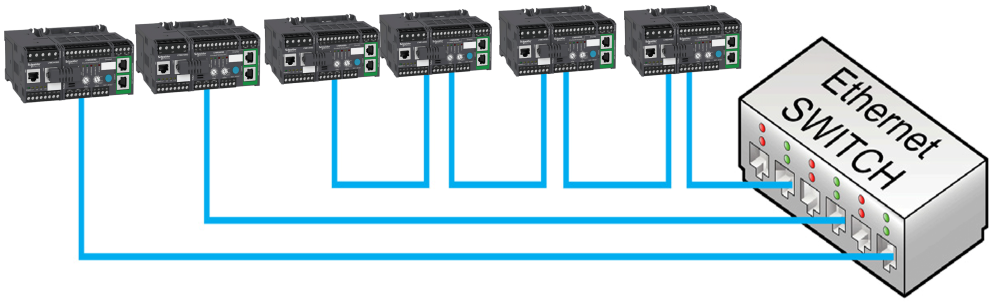
NOTE: Auto-MDIX allows using either straight or crossed category 5 twisted-pair Ethernet cable to connect an LTMR controller to another device.

Cable Routing Practice

Installation Topology

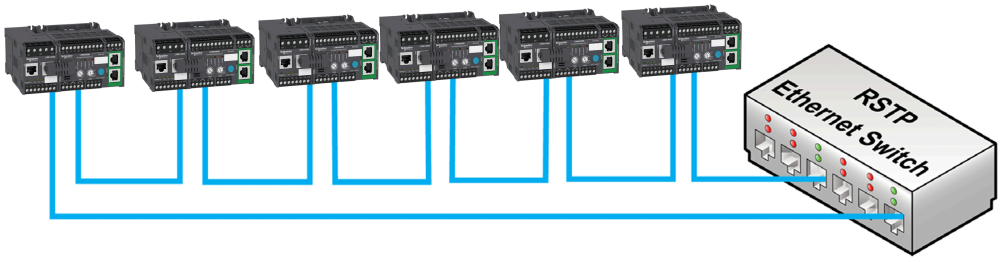
The Ethernet adapter enables several wiring solutions:

• Daisy chain and/or Star topology

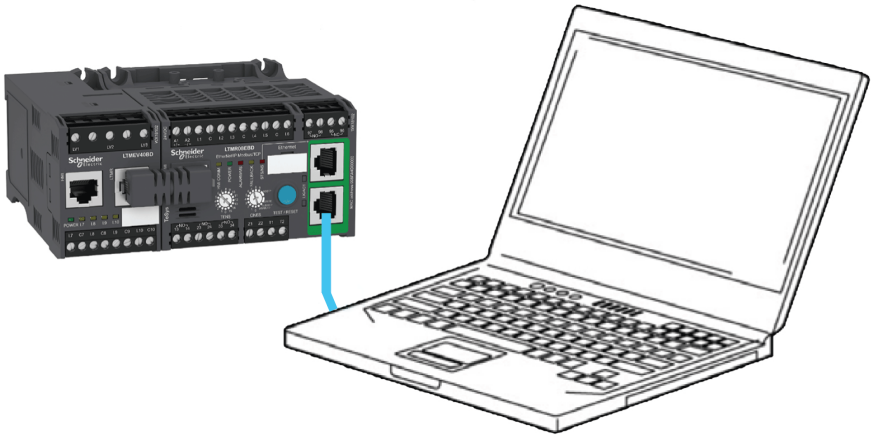


NOTE: To keep the integrity of Ethernet daisy chain network when one or more LTMR controllers are powered off, add an external permanent 24 Vdc power supply (not shown) to power the LTMR controller.

• Redundant ring topology with RSTP (with an RSTP switch)



The following figure shows the direct connection between the LTMR controller and PC.



Wiring of the Ethernet Network

Overview

This section describes how to connect an LTMR controller to an Ethernet network via the shielded RJ45 port.

Ethernet Wiring Rules

The following wiring rules must be respected in order to reduce disturbance due to EMC on the behavior of the LTMR controller:

- Keep a distance as large as possible between the communication cable and the power or control cables (minimum 30 cm or 11.8 in.).
- Cross over the Ethernet cable and the power cables at right angles, if necessary.
- Install the communication cables as close as possible to the grounded plate.
- Do not bend or damage the cables. The minimum bending radius is 10 times the cable diameter.
- Avoid sharp angles of paths or passage of the cable.
- Use the recommended cables only.
- All RJ45 connectors must be metallic.
- An Ethernet cable must be shielded:
  - The cable shield must be connected to a protective ground.
  - The connection of the cable shield to the protective ground must be as short as possible.
  - Connect the shields, if necessary.
  - Perform the grounding of the shield with a collar.
- When the LTMR controller is installed in a withdrawable drawer:
  - Connect all shield contacts of the withdrawable drawer part of the auxiliary connector to the ground of the withdrawable drawer to create an electromagnetic barrier. Refer to the *Okken Communications Cabling & Wiring Guide* (available on request).
  - Do not connect the cable shield at the fixed part of the auxiliary connector.
- Wire the bus between each connector directly, without intermediate terminal blocks.

- The common polarity (0 V) must be connected directly to protective ground, preferably at one point only for the entire bus. In general, this point is chosen either on the primary device or on the polarization device.

For more information, refer to the *Electrical Installation Guide* (available in English only), chapter *ElectroMagnetic Compatibility (EMC)*.

NOTICE
COMMUNICATION MALFUNCTION Respect all the wiring and grounding rules in order to avoid communication malfunctions due to EMC disturbance. **Failure to follow these instructions can result in equipment damage.**

Connection to the Network

Every LTMR controller includes an embedded two-port Ethernet switch, with two ports and one IP address.

NOTE: The two Ethernet ports have the same IP address.

The IEEE 802.3 standard defines Ethernet as implemented in the LTMR controller.

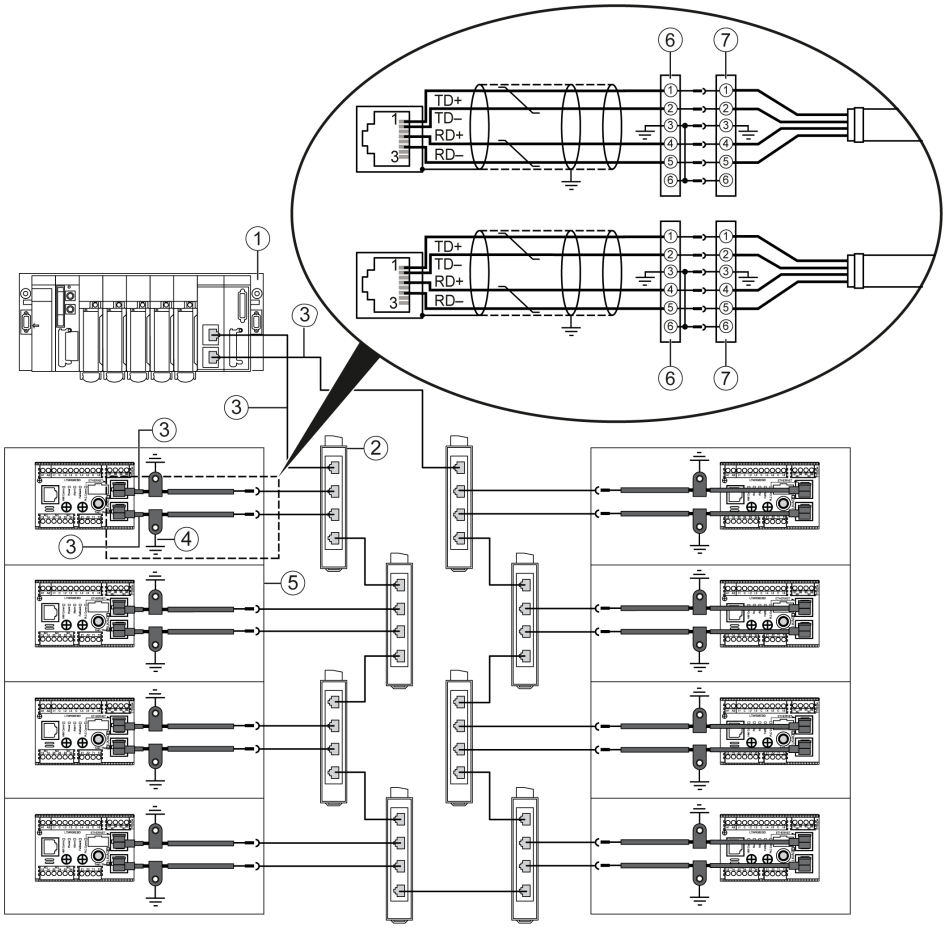
LTMR Controllers Installed in a Blokset or Okken Motor Control Switchboard

The installation of LTMR controllers in withdrawable drawers of a switchboard presents constraints specific to the type of switchboard:

- For installation of LTMR controllers in an Okken switchboard, refer to the *Okken Communications Cabling & Wiring Guide* (available on request).
- For installation of LTMR controllers in a Blokset switchboard, refer to the *Blokset Communications Cabling & Wiring Guide* (available on request).
- For installation of LTMR controllers in other types of switchboard, follow the specific EMC instructions described in this guide and refer to the relative instructions specific to your type of switchboard.

Wiring Diagram Example

The wiring diagram below indicates how to connect LTMR controllers installed in withdrawable drawers to the Ethernet network via the RJ45 connector and hardwired cables.



1 Primary (PLC, PC, or communication module) with line terminator

2 Connexium Lite Managed Switch TCSESL043F23F0 (recommended), or Bypass Switch LTM9BPS

3 Ethernet shielded cable 590 NTW 000

4 Grounding of the Ethernet cable shield

5 Withdrawable drawer

6 Withdrawable drawer part of the auxiliary connector

7 Fixed part of the auxiliary connector

Using the Ethernet Communication Network

Overview

This chapter describes the user interface devices and the hardware configurations you can use to operate the LTMR controller.

Using Ethernet Services

Overview

This section describes the Ethernet services, and the related Ethernet configuration parameters, supported by EtherNet/IP and Modbus/TCP.

NOTE: Changes in parameter settings for any Ethernet service take effect only after a power cycle of the LTMR controller.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical 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.
- 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 anticipated transmission delays or failures of the link. (1)
- Each implementation of an LTMR controller 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".

⚠WARNING

UNEXPECTED RESTART OF THE MOTOR

Check that the PLC application software:

- Considers the change from local to remote control
- Manages appropriately the motor control commands during those changes
- Manages appropriately the motor control to avoid contradictory commands from all possible Ethernet connections

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

When switching to the Network control channels, depending on the communication protocol configuration, the LTMR controller can take into account the latest known state of the motor control commands issued from the PLC and restart automatically the motor.

Configuration of the LTMR Ethernet Network Port

Communication Parameters

Before network port communication can begin, configure the following Ethernet communication services and settings:

- Primary IP address setting
- Frame type setting
- Stored IP addressing settings
- Network port endian setting
- Fast device replacement (FDR) service
- Network Protocol selection
- Rapid Spanning Tree Protocol (RSTP)
- SNMP service
- Communication loss settings
- Configuration control
- IP Allowlist

NOTE: Only the TeSys T DTM software can configure the LTMR services and settings. The LTMCU and other HMI devices can configure most services and settings except SNMP, RSTP, and IP Allowlist.

Primary IP Address Setting

Configure the Ethernet Primary IP Address Setting parameter to add the IP address of the client device, page 29 dedicated to remotely control the motor. This parameter consists of four integer values, from 0-255, separated by dots (xxx.xxx.xxx.xxx).

Frame Type Setting

Configure the Network Port Frame Type Setting parameter by selecting an Ethernet frame type:

- Ethernet II (Factory setting)
- 802.3 (recommended)

IP Addressing Settings

Unique IP address settings must be assigned to the LTMR controller (including an IP address, a subnet mask, and a gateway address) to be able to communicate over an Ethernet network. The positions of the controller's two rotary switches determine the source of the controller's IP address settings, page 30, which can be:

- A DHCP server
- A BootP server
- Stored IP address settings

If the controller's *Ones* rotary switch is set to **Stored IP**, the controller will apply its stored IP address settings, page 32.

To input the LTMR controller's stored IP address settings, configure the following parameters:

- Ethernet IP Address Setting

- Ethernet Subnet Mask Setting
- Ethernet Gateway Address Setting

Each of these parameters consists of four integer values, from 0-255, separated by dots (xxx.xxx.xxx.xxx).

Network Port Endian Setting

The Network port endian setting allows to swap the two words in a double word.

- 0 = least significant word first (little endian)
- 1 = most significant word first (big endian, factory setting)

Fast Device Replacement Service

The Fast Device Replacement (FDR) , page 35 service stores the LTMR controller's operating parameters on a remote server and, if the controller is replaced, sends the replacement controller a copy of the original device's operating parameters.

To enable the automatic backup of the controller's operating parameters to the FDR server, configure the following parameters:

- Network Port FDR Auto Backup Enable parameter. It can be set to:
  - No auto backup
  - Automatic backup (copies the parameters from the controller to the FDR server)
- Network Port FDR Controller Interval parameter: the time (in seconds) between automatic backup transmissions.
  - Range = 30...3600 s
  - Increments = 10 s
  - Factory setting = 120 s

Network Protocol Setting

Select with this parameter the network protocol you want to use:

- Modbus/TCP
- EtherNet/IP

  NOTE: Enabling EtherNet/IP does not disable Modbus/TCP which is still available for use with commissioning software such as SoMove. Only Modbus Function Code 23 is disabled when enabling EtherNet/IP.

Rapid Spanning Tree Protocol

The Rapid Spanning Tree Protocol (RSTP) service manages the state on every port of each device in the local area network (LAN) loop. The RSTP loop configured with 16 LTMR controllers and two RSTP-enabled switches typically perform to resolve a communication loss at the LTMR controller is 100 ms...200 ms. Reconnection performances vary depending on PLC, services used, and IP address mode.

To configure the Rapid Spanning Tree Protocol (RSTP) service, set the following parameters:

- RSTP Enable: to enable/disable the RSTP feature. Values include:
  - 0 = Disable (factory setting)
  - 1 = Enable

- RSTP Bridge Priority: determines which bridge is elected as the root bridge. If the switch has a bridge priority that is lower than all the other switches, the other switches automatically select the switch as the root switch.
  - Range = 0x0000 (highest priority)...0xF000 (lowest priority)
  - Increments = 0x1000
  - Factory setting = 0x8000
- RSTP Hello Time: the time between each bridge protocol data unit (BPDU) that is sent on a port.
  - Range = 1...10 s
  - Increments = 1 s
  - Factory setting = 2 s
- RSTP Max Age Time: the max age timer controls the maximum length of time that passes before a bridge port saves its configuration BPDU information.
  - Range = 6...40 s
  - Increments = 1 s
  - Factory setting = 36 s
- RSTP Max Transmit Count: the number of BPDUs that can be transmitted within the hello time interval to avoid flooding the network.
  - Range = 3...100
  - Increments = 1
  - Factory setting = 6
- RSTP Forward Delay: the time that is spent in the listening and learning state to avoid unstable topology changes.
  - Range = 4...30 s
  - Increments = 1 s
  - Factory setting = 20 s
- RSTP Port Count: number of RSTP ports. Constant value of 2. Values include:
  - Factory setting = 2
- RSTP Port [1 or 2] Priority: Used to determine highest priority port in a multi-port device.
  - Range = 0...240
  - Increments = 16
  - Factory setting = 128
- RSTP Port [1 or 2] Path Cost: the path cost of this device used by each network device to calculate topology based on minimizing total path cost. Values include:
  - 200,000 = 100 Mbit/s (factory setting)
  - 2,000,000 = 10 Mbit/s
- RSTP Port [1 or 2] Disable: to enable/disable RSTP feature on each port individually. Values include:
  - 0x0001 = disabled
  - 0x0100 = enabled (factory setting)

On every network topology change, RSTP recalculates the optimum network path. It is recommended that network configuration does not change again during an RSTP operation. Following actions must be avoided on an operating network or network performance can be temporarily impacted:

- A network cable plug-out /plug-in or device power OFF/ON in less than 2 s
- In a daisy chain loop, remove/add two nodes in less than 30 s

Each device in an RSTP loop must have RSTP enabled for the feature to perform correctly. When RSTP is enabled, at least one port must be connected to another RSTP port to start any further Ethernet service.

Each RSTP device is setup with Configured Parameters to initiate calculation of the best BPDU (Bridge Protocol Data Unit) which will then be used by the full RSTP network as their Learned Parameters.

The algorithm to determine the best received BPDU, which is used to calculate the root bridge and the best path to it, is as follows:

1. Lowest root bridge ID (BID) - Determines the root bridge.
   - Bridge ID = bridge priority (4 bits) + System ID extension (12 bits, all zeros) + MAC address (48 bits); the default bridge priority is 32768
2. Lowest path cost to the root bridge – Favors the upstream switch with the least path cost to root
3. Lowest sender bridge ID - Serves as a tiebreaker if multiple upstream switches have equal cost to root
4. Lowest sender port ID - Serves as a tiebreaker if a switch has multiple links to a single upstream switch, where:
   - Port ID = port priority (4 bits) + Interface ID (12 bits, all zeros); the default port priority is 128

Network Port Comm Loss Settings

Configure the following parameters to determine how the LTMR controller will handle communication loss with the PLC:

- Ethernet Primary IP address setting: declares which PLC will be the Primary for Network Port Comm loss strategy. For more information, refer to the explanation of the Primary IP, page 29
- Network Port Comm Loss Timeout: the length of time communication with the PLC defined as Primary IP must be lost before the controller will signal a Communication Loss trip or alarm as well as activate Fallback strategy.
  - Range = 0...9999 s
  - Increments = 0.01 s
  - Factory setting = 2 s
- Network Port Fallback Action Setting: determines, with the controller's operating mode, the behavior of logic outputs 1 and 2 when communication with the PLC that is declared as Primary IP is lost. For more information, refer to the explanation of the Primary IP, page 29. Values include:
  - Hold
  - Run
  - O.1, O.2 OFF
  - O.1, O.2 ON
  - O.1 ON
  - O.2 ON

  The factory setting is O.1, O.2 OFF.
- Network Port Trip Enable: signals a network communication interruption trip after the Network Port Comm Loss Timeout setting has expired.

  The factory setting is disable.
- Network Port Alarm Enable: signals a network alarm after the Network Port Comm Loss Timeout setting has expired.

  The factory setting is disable.

IP Allowlist

The IP Allowlist feature enables you to configure an Access Control List (ACL) of IP addresses that are allowed to communicate with the LTMR. When enabled, device addresses that are not inside the Allowlist will be blocked from communicating with the LTMR using Modbus/TCP, EtherNet/IP, or FTP. There are five configurable IP Allowlist ranges. If configured, the Primary IP address is automatically included as an additional entry in the Allowlist. Configure with the following settings:

- IP Allowlist Enable setting: Enables or disables the IP Allowlist feature. Disable by default.

  NOTE: At least one address has to be configured among the Primary IP or Allowlist ranges to be enabled.
- IP Allowlist Range [N=1-5] Address setting: Host identifier address used in conjunction with the subnet mask. Must be within the device operating subnet. Valid values 0.0.0.0 through 255.255.255.255. Default value 0.0.0.0.
- IP Allowlist Range [N=1-5] Subnet Mask setting: Bitmask with most significant values contiguously set to 1, the least significant bits set to 0 define the size of the available address range. Valid values 255.255.255.0 (subnet size = 256) through 255.255.255.255 (subnet size = 1). Default value 255.255.255.0.

Subnet Mask	Addresses in Subnet
255.255.255.255	1
255.255.255.254	2
255.255.255.252	4
255.255.255.248	8
255.255.255.240	16
255.255.255.224	32
255.255.255.192	64
255.255.255.128	128
255.255.255.0 (default)	256

Ethernet Link Management

Overview

The LTMR controller can receive or provide Ethernet services only if an Ethernet communications link exists. An Ethernet communications link can exist only when a cable connects one of the controller's network ports to the network. If no network cable connection exists, no Ethernet service can start.

The behavior of the controller is described in each of the following situations:

- The LTMR powers up with no Ethernet communications link.
- An Ethernet Communications Link is connected to a previously unconnected controller after startup.
- All Ethernet Communication Links disconnected from the controller after startup.
- One (or more) Ethernet Communication Links are re-established to a controller after all Ethernet Communication Links had previously been disconnected.

No Ethernet Communications Link while LTMR is Powered Up

When the LTMR powers up with no network cable connected, the LTMR

- Signals an FDR trip if the rotary switches are in DHCP position,
- Signals an FDR trip for 10 s and then clears the trip automatically if the rotary switches are in Stored, BootP, ClearIP, or Disabled positions.

No Ethernet Communications Link at Startup

When, after controller startup, an Ethernet network cable is initially attached to a previously unconnected controller

- The controller starts its IP addressing service, page 30, which
  - Obtains IP address settings,
  - Validates IP address settings,
  - Checks that the obtained IP address settings are not duplicate,
  - Assigns the received IP address settings to the controller.
- After its IP address settings are assigned, the controller
  - Starts the FDR service and obtains its operating parameter settings, then
  - Starts its Modbus service.

The time to recover the link and start Ethernet services takes about 1 second.

Ethernet Communications Link Disconnected After Startup

When all Ethernet Communication Links are disconnected from the controller after startup:

- The IP addressing service is disabled and a Network Port Configuration Alarm (alarm code 555) is generated,
- All Modbus service connections are reset,
- If a Primary IP connection exists and:
  - The link cannot be re-established before the Network Port Comm Loss Timeout expires, the controller enters its pre-configured fallback state if the LTMR is in Network control,
  - The link is re-established before the Network Port Comm Loss Timeout expires, the connection to the Primary IP is maintained, and the controller does not enter its fallback state.

Link Reconnected After Disconnection

When one or more Ethernet Communication Links are re-established to the controller, after all Ethernet Communication Links had been disconnected after startup, the controller performs many, but not all, of the same tasks as when there is no Ethernet Communication Link at Startup , page 28. Specifically, the controller

- Presumes the previously obtained IP address settings remain valid, then
  - Checks that the IP address settings are not duplicate,
  - Re-assigns the IP address settings to the controller.
- After the IP address settings are assigned, the controller
  - Starts its FDR service and obtains its operating parameter settings, then
  - Starts its Modbus service.

The time to recover the link and start Ethernet services takes about 1 second.

Primary IP

Overview

Each LTMR controller, in its role as communication server, could be configured to recognize another Ethernet device (typically a PLC) as the client device that controls the motor. This device is usually a device that initiates communication to exchange Process Data (control and status). The Primary IP is the IP address of this device.

The PLC should continuously maintain at least one connection, called a virtual connection, page 51 or socket, with the communication server.

If the virtual connection between the Primary IP device and the LTMR server is interrupted, the LTMR controller waits a prescribed time, the Network Port Comm Loss Timeout, for a new connection to be established and application level messages sent between the Primary IP device and the LTMR controller.

If a connection is not reopened and messages are not received from the Primary IP before the timeout expires, the LTMR controller enters its fallback state, set by the Network Port Fallback Setting.

If application level communication is never established with the Primary IP, then the Comm Loss Timeout timer is never started; As a result Comm Loss Event and Fallback states can never be reached.

⚠WARNING

LOSS OF CONTROL

- Configure a server IP on the Ethernet network.
- Do not use an IP address other than Primary IP to send network start and stop commands to the LTMR controller.
- Design the Ethernet network to block unauthorized network start and stop commands sent to the LTMR controller.

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

Prioritized Primary IP Connections with Modbus/TCP

Connections between the LTMR controller and the Modbus client has a priority over connections between the controller and other Ethernet devices.

After the controller has reached its maximum number of eight simultaneous Modbus connections, the controller must close an existing connection to be able to open a new connection. If an additional connection is requested after the maximum number has been established, then the LTMR controller will close the connection whose most recent transaction is the oldest (least fresh) in order to establish the new connection.

All connections (up to eight) between the LTMR controller and the Primary IP client are preserved once communication has been established between them. The controller will not close a connection with the Primary IP address in order to open a new connection from a non-Primary IP address.

Configuring Primary IP

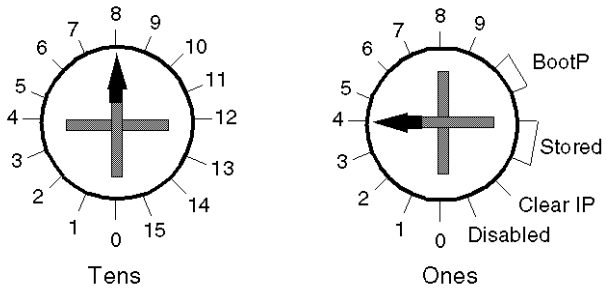
To enable connections to be made to a Modbus client, use a configuration tool to configure the following parameters:

Parameter	Setting Range	Factory Setting
Ethernet Primary IP address setting (3010-3011)	Valid Class A, B, and C addresses in the range: 0.0.0.0 - 255.255.255.255 where 0.0.0.0 = Fallback disabled	0.0.0.0 = No Primary IP
Network port comm loss timeout (693)	Range = 0.010...99.99 s Register value = 1...9999 in units of 10 ms	2 s
Network port fallback setting (682)	• Hold • Run • O.1, O.2 OFF • O.1, O.2 ON • O.1 ON • O.2 ON	O.1, O.2 OFF

IP Addressing

Overview

The LTMR controller must obtain a unique IP address, subnet mask, and gateway address to communicate over an Ethernet network. The settings of the two rotary switches on the front of the LTMR controller determine the source of these required settings. These settings are applied only on power-up. The rotary switches look like this:



The settings of the rotary switches determine the source of the LTMR controller's IP address parameters and the FDR service activation, as follows:

Left Switch (Tens)	Right Switch (Ones)	Source of IP Parameters
0-15[2]	0-9[2]	DHCP server and FDR service
N/A[3]	BootP	BootP server
N/A[3]	Stored	LTMR configured settings are used. If not set then, IP parameters are derived from the MAC address.

2. The two switches yield a value from 000-159, which uniquely identifies the device to the DHCP server. In the above figure, this value is 084, which is the concatenation ofL the Tens switch (08) and the Ones switch (4). The individual values of the of each rotary switch, in this case 08 and 4, are incorporated into the device name as described in Getting IP Parameters from a DHCP Server, page 31.
3. The left (Tens) rotary switch is not used. The right (Ones) rotary switch alone determines the source of IP parameters.

Left Switch (Tens)	Right Switch (Ones)	Source of IP Parameters
N/A[4]	Clear IP	Clears the stored IP settings. No IP addressing settings are assigned. The network port is disabled.
N/A[4]	Disabled	The LTMR controller is not available for network communication. The LTMR controller does not initiate any IP acquisition process (host register, DHCP...) or announcements of IP on the network. Detection of network related trips and alarms does not occur. However, the LTMR controller stays active on at the Ethernet switch level allowing the daisy chain to function normally.

IP settings are assigned to the following parameters:

- Ethernet IP Address
- Ethernet subnet Mask
- Ethernet Gateway

Getting IP Parameters from a DHCP Server

To obtain IP parameters from a DHCP server, point each rotary switch to a numerical setting, as follows:

Step	Description
1	Set the left (Tens) rotary switch to a value from 0-15, and
2	Set the right (Ones) rotary switch to a value from 0-9

Device Name: The settings of the two rotary switches are used to determine each LTMR controller's device name. The device name consists of a fixed part ("TeSysT") and a dynamic part, composed of:

The two-digit value (00-15) of the Tens rotary switch (*xx*)

The one-digit value (0-9) of the Ones rotary switch (*y*)

The DCHP server must be pre-configured with the LTMR controller's device name and its associated IP parameters. When the DHCP server receives the LTMR controller's broadcast request, it returns:

- The LTMR controller's:
  - IP address
  - Subnet mask
  - Gateway address
- The DHCP server's IP address

  NOTE: While the IP address is not provided by the DHCP server, the TeSys T signals a network port FDR major trip (Alarm LED steady red).

  NOTE: The LTMR controller uses the DHCP server's IP address during the Fast Device Replacement (FDR) process , page 30, when making an TFTP request for device configuration parameters.

In the figure, above, the device name is: TeSysT084.

NOTE: The DHCP server can provide an IP address to a client device only after the DHCP server has been configured with the Device Name, described above, for a client device.

4. The left (Tens) rotary switch is not used. The right (Ones) rotary switch alone determines the source of IP parameters.

Getting IP Parameters from a BootP Server

To obtain IP parameters from a BootP server, point the right (Ones) rotary switch to either of the two **BootP** settings. (The left (Tens) rotary switch is not used.) The LTMR controller broadcasts a request for IP parameters to a BootP server, and includes its MAC address in the request.

The BootP server must be pre-configured with the LTMR controller's MAC address and associated IP parameters. When the BootP server receives the LTMR controller's broadcast request, it returns to the LTMR controller it's:

- IP address
- Subnet mask
- Gateway address

NOTE: The Fast Device Replacement (FDR) service is not available if the LTMR controller is configured to receive IP parameters from a BootP server.

Using Stored IP Parameters

You can configure the LTMR controller to apply IP settings that have been previously configured and stored in the device itself. These stored IP parameters can be configured using your choice of configuration tool.

To apply stored IP parameters set the right (Ones) rotary switch to either of the two **Stored** positions. (The left (Tens) rotary switch is not used.)

The LTMR controller uses as its:

- IP address: the Ethernet IP Address Setting parameter
- Subnet mask: the Ethernet Subnet Mask Setting parameters
- Gateway address: the Ethernet Gateway Address Setting parameter

NOTE: If these parameters are not pre-configured, the LTMR controller cannot apply stored settings, but instead applies default IP parameters, as described below.

NOTE: The FDR service is not available when the LTMR controller is configured to use stored IP parameters.

Configuring Default IP Parameters from the MAC Address

The LTMR controller derives its default IP parameters from its MAC address (stored in the device's Ethernet MAC Address parameter). The MAC address is a unique identifier associated with the device's network interface card (NIC).

As a prerequisite for using the default IP address, all bytes of the configured IP address must be set to zero.

To apply the LTMR controller's default IP parameters, you must proceed in two steps:

Step	Action
1	Clear the existing IP address by setting the right (Ones) rotary switch to **Clear IP**, then cycle power.
2	Apply the stored IP address settings by setting the right (Ones) rotary switch to **Stored**, then cycle power.

The default IP parameters are generated as follows:

- The first two byte values of the IP address are always 85.16
- The last two byte values of the IP address are derived from the last two bytes of the MAC address
- The default subnet masks are always 255.0.0.0

- The default gateway is the same as the device's default IP address

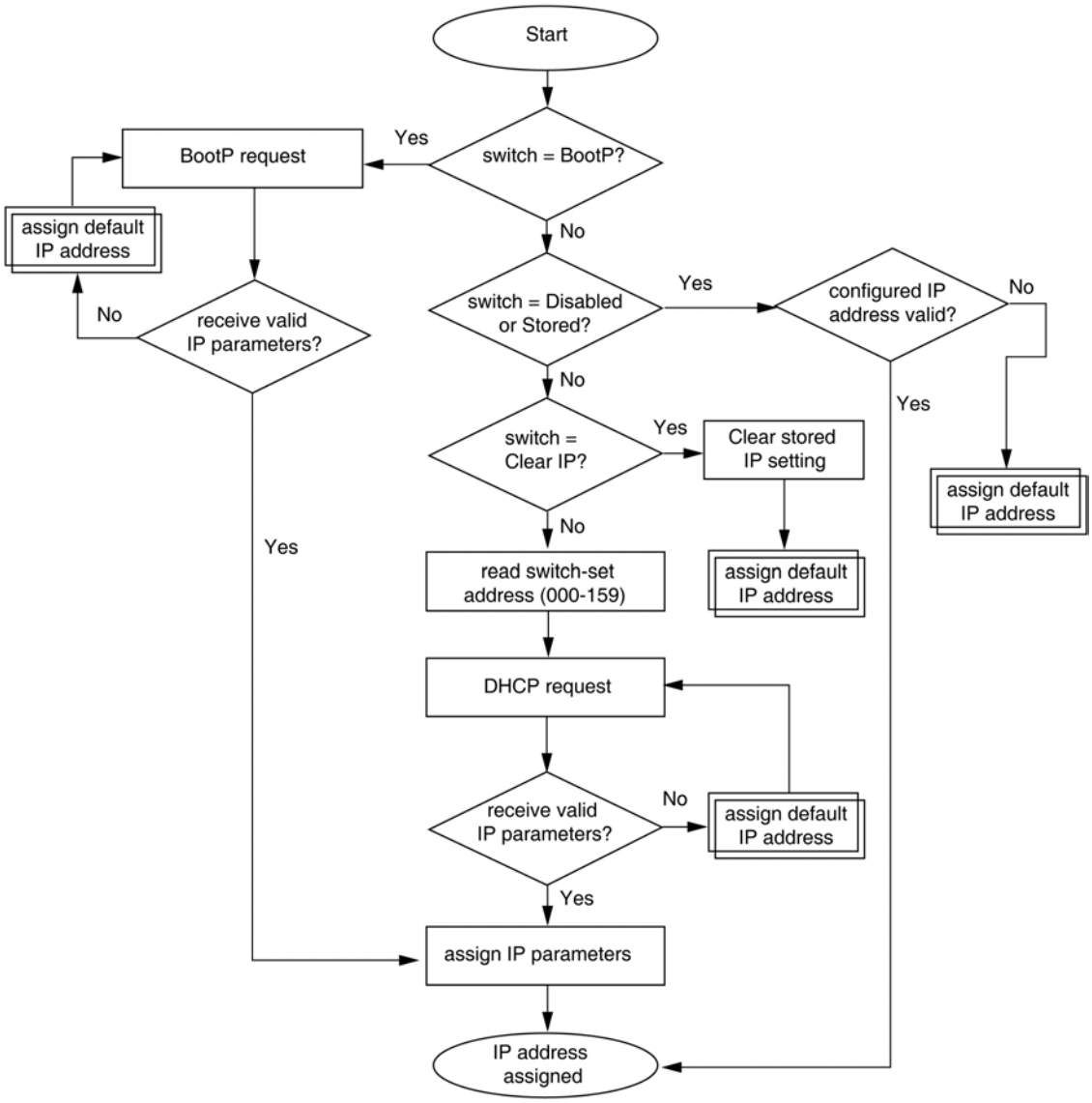
For example, for a device with a hexadecimal MAC address of 0x000054EF1001, the last two bytes are 0x10 and 0x01. These hexadecimal values translate to decimal values of 16 and 01. The default IP parameters for this MAC address are:

- IP address: 85.16.16.01
- Subnet mask: 255.0.0.0
- Gateway address: 85.16.16.01

NOTE: The Fast Device Replacement (FDR) service is not available when the default IP parameters are used.

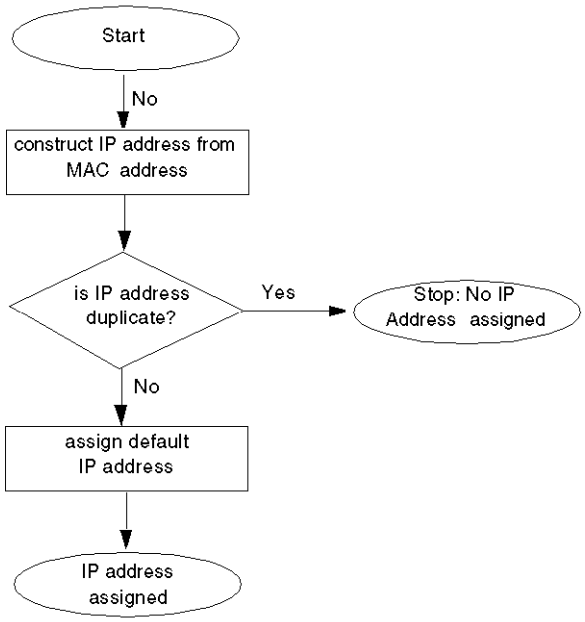
IP Assignment Process

As depicted in the following graphic, the LTMR controller performs a sequence of inquiries to determine its IP address:



NOTE: The Fast Device Replacement (FDR) service is not available when the default IP parameters are used.

The following diagram depicts the *assign default IP address* process, referenced above:



IP Assignment and STS/NS LED

During the IP address assignment process while the LTMR is operating normally, is not in a trip state, and has not detected an alarm, the green STS/NS LED may indicate the following conditions:

Switch Setting(s)	STS/NS LED Behavior	Description
BootP	Flashes five times, then repeats	The controller sent a BootP request, but the BootP server did not deliver valid, unique IP address settings. Waiting for BootP server.
	Flashes five times, then solid ON	The controller sent a BootP request, and the BootP server delivered valid and unique IP address settings.
Stored	Solid ON	The LTMR controller is configured with valid, unique stored IP address settings.
	Flashes six times, then repeats	No valid, unique IP parameters are stored. Default IP settings are generated using the MAC address.
Clear IP	Flashes two times, then repeats	IP address settings have been cleared. No IP address settings are available. Controller cannot communicate using its Ethernet network ports.
Disabled	STS/NS LED = Solid OFF	The LTMR controller is not available for network communication. The LTMR controller does not initiate any IP acquisition process (host register, DHCP, and so on) or announcements of IP on the network. Network error detection is not enabled. However, the LTMR controller stays active at the Ethernet switch level allowing the daisy chain to function normally.
Left (Tens) switch set to 0-15 (*xx*) Right (Ones) switches set to 0-9 (*y*)	Flashes five times, then repeats	The controller sent a DHCP request for device name (TeSysT*xxy*), but the DHCP server did not deliver valid, unique IP address settings. Waiting for DHCP server.
	Flashes five times, then solid ON	The controller sent a DHCP request for device name (TeSysT*xxy*), and the DHCP server delivered valid and unique IP address settings.

NOTE: A repeating series of eight flashes by the STS/NS LED indicates the system recoverableFDR trip. The causes and potential cures for system recoverableFDR trip include:

- The detection of an internal communication error by the LTMR controller: Cycle power to the controller; if that does not clear the trip, replace the controller.
- An invalid configuration of the Ethernet properties (typically IP address settings or the Primary IP address): Verify the IP address parameter settings.
- An invalid or corrupt operating parameter file: Transfer a corrected parameter file from the controller to the parameter file server, page 39. The transfer of a parameter file to the FDR server is only available with the LTMR controller Ethernet version.

Fast Device Replacement

Overview

The FDR service employs a central server to store both the IP addressing parameters and the operating parameters for an LTMR controller. When a LTMR controller is replaced, the server automatically configures the replacement LTMR controller with the same IP addressing and operating parameters as the replaced controller.

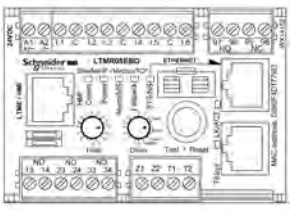
NOTE: The FDR service is available only when the controller's Ones rotary switch is set to integers. The FDR service is not available when the Ones rotary switch is set to *BootP*, *Stored*, *Clear IP*, or *Disabled*.

The FDR service includes configurable commands and settings that you can access using your choice of configuration tool. These commands and settings include:

- Commands that let you manually:
  - Backup the LTMR controller's operating parameters, by uploading a copy of the device's parameter file to the server from the controller, or
  - Restore the LTMR controller's parameters, by downloading a copy of the device's operating parameter file from the server to the controller.
- Settings that cause the FDR server to automatically synchronize the operating parameter files, in both the LTMR controller and the server, at configurable time intervals. If a difference is detected, a parameter file is sent from the controller to the FDR server (auto backup).

FDR Compatibility

TeSys T



FDR Server

The table below describes the compatibility of firmware versions between the data stored on an FDR server (PLC) and the new FDR client (TeSys T). Firmware 2.9 and above manages compatibility with previous versions of stored FDR files. Firmware 2.8 and below does not manage compatibility, so the firmware and hardware versions must match as illustrated in the following table:

		FDR Client (TeSys T)		
		FW 2.6 and below	**FW 2.7 and 2.8**	**FW 2.9+**
FDR Server (Stored File)	**FW 2.6 and below**	✓	✗	✓
	FW 2.7 and 2.8	✗	✓[5]	✓
	FW 2.9+	✗	✗	✓

NOTE:

- Accessories/Expansion module versions do not affect FDR compatibility.
- Custom Logic backup using FDR is included since FW 2.4.
- FW 2.6 device will only accept an FDR file version 2.6.
- FW 2.7 device will only accept an FDR file version 2.7, and HW generation must match.
- FW 2.9+ device can accept any previous/current version FDR file.

Preconditions to FDR

Before the FDR services can function, the FDR server must be configured with:

- The LTMR controller's network address and related IP addressing parameters, this is done as part of the IP addressing service, page 30,
- A copy of the LTMR controller's operating parameter file, this can be sent from the controller to the server either manually or automatically, as described below. This will be a zero size file when unconfigured.

FDR and Custom Logic File

The FDR service stores custom logic to the operating parameters file if the custom logic file size is less than 3 kB (1.5 k Tokens as compiled in SoMove).

If the custom logic file size is more than 3 kB (1.5 k Tokens as compiled in SoMove), only the operating parameters are saved.

In this case, when you are replacing a device with a custom logic file size bigger than 3 kB (1.5 k Tokens as compiled in SoMove), the STS/NS LED of the new device flashes eight times signaling the detection of an system recoverable FDR trip condition.

To clear the trip and resume operations:

5. The replacement TeSys T must have the same hardware generation (MBTCP or MBTCP+EIP) , page 16.

Step	Action
1	Use the TeSys T DTM software to download the custom logic file
2	Cycle power to the LTMR controller

FDR Process

The FDR process consists of three parts:

- The assignment of IP address settings,
- A check of the operating parameter file at every LTMR controller startup,
- If auto synchronization is enabled, periodic checks of the LTMR controller's operating parameter file from the FDR server.

These three processes are described below:

IP address settings assignment process:

Sequence	Event
1	Service personnel use the rotary switches on the front of the replacement LTMR controller to assign it the same network address (000-159) as the replaced device.
2	Service personnel place the replacement LTMR controller on the network.
3	The LTMR controller automatically sends a DHCP request to the server for its IP parameters.
4	The server sends the LTMR controller: • IP parameters, including: ◦ IP address ◦ Subnet mask ◦ Gateway address • The server's IP address
5	The LTMR controller applies its IP parameters.

FDR startup process:

Sequence	Event	
6	• If **FDR Auto Restore** is **enabled** in the FDR configuration screen:	
	a	The controller sends a request to the FDR server for a copy of the served configuration file.
	b	The FDR server sends the controller a copy of the served file.
	c	The controller checks the served file's version number and size for compatibility with the device. If the served file is • Compatible, the served file is applied, • Not compatible, the controller will attempt to manage the compatibility and upload the new file to the server. If not able to manage the compatibility, the controller then signals a system recoverable FDR trip.[6].
	Notes: **1.** Because the factory setting of **FDR Auto Restore** is **enabled**, a new LTMR controller always downloads and attempts to apply a served file on initial startup. **2.** If the downloaded file is empty, the controller will use its local file and send a copy of that file to the server.	
	• If **FDR Auto Restore** is disabled: The controller applies the operating parameter file stored in the LTMR controller's non-volatile memory.	
7	The LTMR controller resumes operation.	

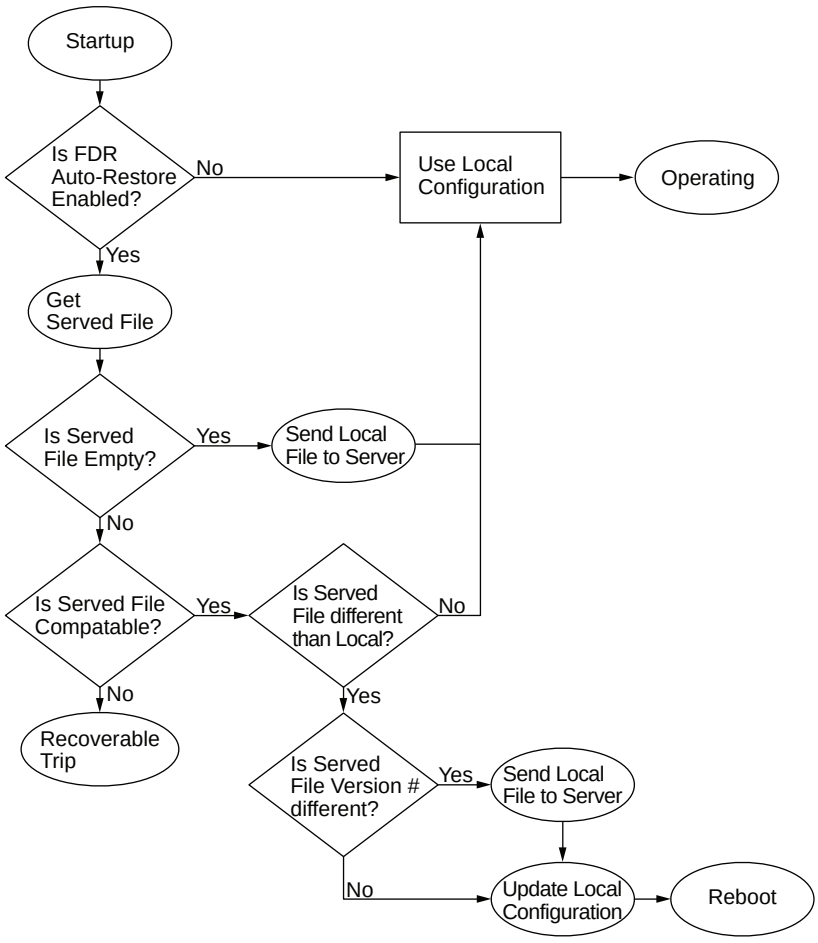
FDR Auto Backup process:

6. In the event the controller enters the Not Ready state, the underlying problem must be resolved, and power must be cycled to the controller before operations can resume.

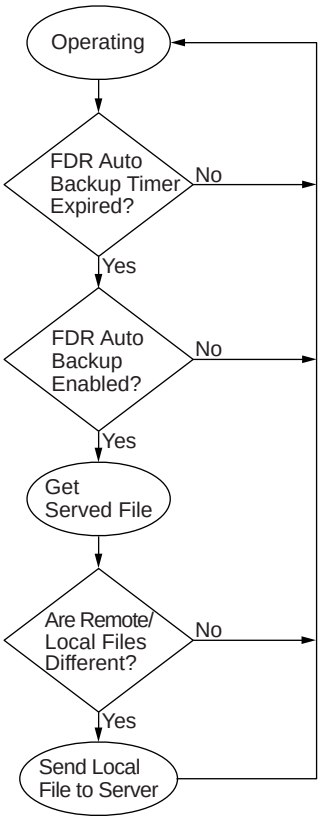
Sequence	Event
8	The controller checks the *Network Port FDR Auto Backup Period Setting* (697) parameter to determine if the FDR auto-synchronization timer has expired.
9	If the timer has: • **Not expired**: No action is taken. • **Expired**: The controller checks the *Network Port FDR Auto Backup Enable* (690.3) parameter.
10	If the *Network Port FDR Auto Backup Enable* (690.3) parameter is: • **Auto backup (1)**: The controller sends a copy of the local file to the FDR server. • **No synchro (0)**: The controller takes no action.
11	The LTMR controller resumes operation.

The following diagrams describe the controller's FDR processes after the assignment of an IP address (see IP Assignment Process, page 33):

FDR Auto Restore Diagram



FDR Auto Backup Diagram



Configuring FDR

The FDR service monitors the operating parameter file maintained in your LTMR controller and compares it against the corresponding operating parameter file stored in the server.

When the FDR service detects a discrepancy between these two files:

- The Network Port FDR Status, page 41 parameter is set, and
- The two operating parameter files, one in the server, the other in the controller, must be synchronized.

Synchronizing operating parameter files can be performed either automatically or manually, using your choice of configuration tool.

NOTE: A new configuration file can cause the LTMR to reboot. This can affect other devices such as other LTMR downstream in a daisy chain topology.

Automatically Backup Settings: By setting the following parameters, you can configure your LTMR controller to automatically synchronize its operating parameters with the FDR server:

Parameter Name	Description
Network Port FDR Auto Backup Enable	Use this setting to enable/disable automatic synchronization of the operating parameter files. Selections are: • **No auto backup:** Automatic file synchronization is turned OFF (parameter = 0). • **Auto backup:** Automatic file synchronization is turned ON, and the file in the controller will be copied to the server in case of discrepancy (parameter = 1).
Network Port FDR Auto Backup Period Setting	The frequency, in seconds, between comparisons of the parameter file in the controller against the parameter file stored in the server. • Range = 30...3600 s • Increments = 10 s • Factory setting = 120 s

NOTE: When automatic synchronization is enabled, it is recommended to set the *Network Port FDR Auto Backup Period Setting* parameter to a value greater than **120 s**.

Manually Backup and Restore Settings: By executing the commands described below, you can manually synchronize the operating parameter files in the controller and server:

Command Name	Description
FDR Manual Backup Command	Copies the operating parameter file in the controller to the server.
FDR Manual Restore Command	Copies the operating parameter file in the server to the controller.

NOTE:

- If the FDR Manual Backup Command and FDR Manual Restore Command bits are set to 1 simultaneously, only the FDR Manual Restore Command is processed.
- FDR Manual Restore Command is available whether Config via network is enabled or not.
- FDR Manual Restore Command cannot be triggered while the LTMR detects current.
- Any time the LTMR controller configuration changes, you should manually backup the new configuration file to the server by following the LTMCU menu structure or using SoMove and clicking **Device > File transfer > backup command**.

FDR Trip Recovery

When the LTMR controller detects a trip condition that requires intervention during the FDR startup process, the STS/NS LED flashes as follows:

Number of Flashes...	Indicates the Trip is...
Eight flashes per second	LTMR Recoverable
10 flashes per second	System Recoverable

System recoverable trips:

Operations can resume after fixing the cause of the trip outside of the LTMR. System recoverable trips include:

- No response from IP server (Network Port FDR Status = 1).
- The parameter file server, or TFTP service, is unavailable (Network Port FDR Status = 2)
- No file on the parameter server (Network Port FDR Status = 3)

LTMR recoverable trips:

When the parameter file in the server is invalid or corrupt, the trip requires manual intervention to be cleared. Operations can resume only after a new parameter file is manually copied from the controller to the server using the FDR Data Backup Command and power is cycled to the controller. LTMR recoverable trips include:

- Version mismatch of the parameter file on the parameter server and the LTMR controller (Network Port FDR Status = 13)
- CRC mismatch between parameter file on the server and the LTMR controller (Network Port FDR Status = 9)
- Content of the parameter file is invalid (Network Port FDR Status = 4)

Incompatible FDR File on Server

This method updates an incompatible FDR file stored on the FDR server when an existing LTMR controller is replaced.

Step	Action
1	Configure new LTMR offline.
2	Validate that “FDR disable” = yes (so that the old file will not be loaded to the new LTMR).
3	Cycle power to the LTMR for network settings to take effect.
4	Connect new LTMR to network with DHCP (code wheels).
5	After IP Address is assigned, you can re-enable FDR. **NOTE:** Do not power off in this step.
6	From SoMove or LTMCU, select “backup” to store/overwrite the file on the FDR server.
7	Cycle power to the LTMR.

FDR Status

The Network Port FDR Status parameter describes the state of the FDR service, as described below.

FDR Status:

Value	Description
0	Ready, IP available
1	No response from IP server
2	No response from parameter server
3	No file on parameter server
4	Corrupt file on parameter server
5	Empty file on parameter server
6	Detection of Internal Communication error.
7	Backup of settings from Device to Parameter Server unsuccessful
8	Invalid settings provided by the controller
9	CRC mismatch between parameter server and controller
10	Invalid IP
11	Duplicate IP

Value	Description
12	FDR disabled
13	Device Parameter File Version Mismatch (for example, when attempting to replace an LTMR 08 EBD with an LTMR 100 EBD)

FDR Restore Status

The FDR Restore Status parameter describes the state of the most recent FDR Restore process as described below:

Value	Description
0	OK, Success
1–600	Index into the FDR stored settings which is unable to write
0xFFFD	Incorrect load CT values
0xFFFE	Incorrect ground current CT values
0xFFFF	Incorrect commercial reference number

Discovery Procedure

Overview

Discovery is an automated method to identify and connect to a device with an unknown IP address, using a direct PC connection and a webpage access interface.

Discovery is only available on Microsoft Windows Vista, 7, 8, and 10 operating systems.

Step	Automated Action
1	Connect the PC to the TeSys T using a RJ45 cable.
2	• Open Windows Explorer • Expand Network to view all network connections • The Connected device appears in the list within a few seconds
3	Double-click the connected TeSys T. The name of the TeSys T is: • **TeSys T-XXYYZZ** (where XXYYZZ are the last three bytes of MAC address in hexadecimal format) if TeSys T is not configured in DHCP mode. • **TeSys T-XYZ** (where XY is the position of Tens rotary switch and Z is the position of Ones rotary switch) if TeSys T is configured in DHCP mode.
4	Access the TeSys T in the webpage interface.

NOTE: If the product cannot be detected, temporarily deactivate the antivirus and the firewall and then retry.

Ethernet Diagnostics

Overview

The LTMR controller reports diagnostic data describing its Ethernet network communications interface, including:

- Data parameters that describe the controller's:
  - IP addressing settings
  - IP address assignment processes
  - Virtual connections
  - Communication history
  - Communication services and their status
- One parameter that describes the validity of the data in each data parameter

  NOTE: It is recommended to read the diagnostics registers every second.

  NOTE: The response to the first request contains either all zeros or old data. The response to the second and subsequent requests contains current network port diagnostic data.

Ethernet Basic Diag Validity

The Ethernet Basic Diag Validity parameter evaluates and reports the validity of Ethernet network diagnostic data. A bit in this parameter represents the state of an associated Ethernet network data parameter.

Bit values are:

Value	Indicates the Parameter Data is...
0	Invalid
1	Valid

The Ethernet Basic Diag Validity parameter is 32 bits long.

The bits of this parameter represent the validity of the following Ethernet data parameters:

Bit	Describes the Validity of Data in this Parameter...
0	IP address assignment mode
1	Ethernet device name
2	Ethernet MB messages received counter
3	Ethernet MB messages sent counter
4	Ethernet MB detected error messages sent counter
5	Ethernet opened servers counter
6	Ethernet opened clients counter
7	Ethernet transmitted correct frames counter
8	Ethernet received correct frames counter
9	Ethernet frame format
10	Ethernet MAC address
11	Ethernet gateway
12	Ethernet subnet mask
13	Ethernet IP address
14	Ethernet service status
15	(not applicable - always 0)
16	Ethernet services
17	Ethernet global status
18-31	(*Reserved* - always 0)

Ethernet Global Status

The Ethernet Global Status parameter indicates the status of the following services provided by the LTMR controller:

- Fast device replacement (FDR)
- SNMP network management
- Modbus port 502 messaging (Modbus/TCP only)

This parameter is 2 bits long.

Parameter values are:

Bit	Indicates...
0	At least one enabled service is operating with an unresolved detected error
1	All enabled services are operating properly

Ethernet Global Status is cleared on power cycle and controller reset.

Ethernet Services Validity

The Ethernet Services Validity parameter indicates whether the LTMR controller supports the port 502 messaging service.

NOTE: Port 502 is exclusively reserved for Modbus messages.

The Ethernet Supported Services parameter is 1 bit long.

Parameter values are:

Value	Indicates the Port 502 Messaging Service is...
0	Not supported
1	Supported

Ethernet Services Status

The Ethernet Services Status parameter indicates the status of the Ethernet Supported Services parameter, that is, the status of the controller's port 502 messaging service.

This parameter is 3 bits long.

Parameter values are:

Value	Indicates the Port 502 Messaging Service is...
1	Idle
2	Operational

Ethernet Services Status is cleared on power cycle and controller reset.

Ethernet IP Address

The Ethernet IP Address parameter describes the IP address that has been assigned to the LTMR controller by the IP address assignment process, page 30.

The Ethernet IP Address consists of 4 byte values, in dot-decimal notation. Each byte value is an integer from 000-255.

Ethernet Subnet Mask

The Ethernet Subnet Mask parameter is applied to the Ethernet IP Address value to define the host address of the LTMR controller.

The Ethernet Subnet Mask consists of 4 byte values, in dot-decimal notation. Each byte value is an integer from 000-255.

Ethernet Gateway Address

The Ethernet Gateway Address parameter describes the address of the default gateway, that is, the node that serves as an access point to other networks for communications from or to the LTMR controller.

The Ethernet Gateway Address consists of 4 byte values, in dot-decimal notation. Each byte value is an integer from 000-255.

Ethernet MAC Address

The Ethernet MAC Address parameter describes the media access control (MAC) address, or hardware identifier, uniquely assigned to an LTMR controller.

The Ethernet MAC Address consists of six hexadecimal byte values, from 0x00-0xFF.

Ethernet II Framing

The Ethernet II Framing parameter describes the Ethernet frame formats supported by the LTMR controller, including:

- Capability: can the device support a frame format?
- Configuration: is the device configured to support a frame format?
- Operational: is the configured frame format operating successfully?

NOTE: The Ethernet frame type, Ethernet II or 802.3, is configured using the Network Port Frame Type Setting parameter.

This parameter is three words long.

Ethernet II framing data is stored as follows:

Word	Bit	Description	Values
1	0	Ethernet II framing **supported**	• 0 = not supported • 1 = supported
	1	Ethernet II framing receiver **supported**	• 0 = not supported • 1 = supported
	2	Ethernet II framing sender **supported**	• 0 = not supported • 1 = supported
	3	Ethernet auto detection **supported**	• 0 = not supported • 1 = supported
	4-15	(*Reserved*)	always 0
2	0	Ethernet II framing **configured**	• 0 = not configured • 1 = configured
	1	Ethernet II framing receiver **configured**	• 0 = not configured • 1 = configured
	2	Ethernet II framing sender **configured**	• 0 = not configured • 1 = configured
	3	Ethernet auto detection **configured**	• 0 = not configured • 1 = configured
	4-15	(*Reserved*)	always 0
3	0	Ethernet II framing **operational**	• 0 = not operational • 1 = operational
	1	Ethernet II framing receiver **operational**	• 0 = not operational • 1 = operational
	2	Ethernet II framing sender **operational**	• 0 = not operational • 1 = operational
	3	Ethernet auto detection **operational**	• 0 = not operational • 1 = operational
	4-15	(*Reserved*)	always 0

Ethernet Received Correct Frames Counter

The Ethernet Received Correct Frames Counter parameter contains a count of the total number of Ethernet frames that have been successfully received by the LTMR controller.

This parameter is an UDInt parameter. It is cleared on power cycle and controller reset.

The Ethernet Received Correct Frames Counter consists of four hexadecimal values, from 0x00-0xFF.

Ethernet Transmitted Correct Frames Counter

The Ethernet Transmitted Correct Frames Counter parameter contains a count of the total number of Ethernet frames that have been successfully transmitted by the LTMR controller.

This parameter is an UDInt parameter. It is cleared on power cycle and controller reset.

The Ethernet Transmitted Correct Frames Counter consists of four hexadecimal values, from 0x00-0xFF.

Ethernet Opened Clients Counter

The Ethernet Opened Clients Counter parameter contains a count of the number of open TCP client connections. It applies only to devices with TCP clients.

This parameter is an UInt parameter. It is cleared on power cycle and controller reset.

The Ethernet Opened Clients Counter consists of two hexadecimal values, from 0x00-0xFF.

Ethernet Opened Servers Counter

The Ethernet Opened Servers Counter parameter contains a count of the number of open TCP server connections. It applies only to devices with TCP servers.

This parameter is an UInt parameter. It is cleared on power cycle and controller reset.

The Ethernet Opened Servers Counter consists of two hexadecimal values, from 0x00-0xFF.

Ethernet MB Detected Error Messages Sent Counter

The Ethernet MB Detected Error Messages Sent Counter parameter contains a count of the number of:

- EtherNet/IP or Modbus/TCP request packets with detected errors in the header that have been received by this LTMR controller (does not count detected errors in the data portion of EtherNet/IP or Modbus/TCP request packets)
- EtherNet/IP or Modbus/TCP exceptions due to incorrect combination of physical port and Unit ID , page 51

This parameter is an UDInt parameter. It is cleared on power cycle and controller reset.

Ethernet MB Messages Sent Counter

The Ethernet MB Messages Sent Counter parameter contains the total number of Modbus messages, excluding Modbus error messages, that have been sent by this LTMR controller.

This parameter is an UDInt parameter. It is cleared on power cycle and controller reset.

Ethernet MB Messages Received Counter

The Ethernet MB Messages Received Counter parameter contains the total number of Modbus messages that have been received by this LTMR controller.

This parameter is an UDInt parameter. It is cleared on power cycle and controller reset.

Ethernet Device Name

The Ethernet Device Name parameter contains the 16 character string used to identify the LTMR controller.

This parameter is 16 bytes long.

Ethernet IP Assignment Capability

The Ethernet IP Assignment Capability parameter describes the available IP addressing sources for the LTMR controller. Up to four different IP addressing sources can be described.

This parameter is 4 bits long.

The Ethernet IP Assignment Capability parameter stores data as follows:

Bit	IP Addressing Source...	Values
0	A DHCP server, using the device name set by the two rotary switches	• 0 = not available • 1 = available
1	Derived from the MAC address. The Ones rotary switch is set to BootP, but no IP address was received from the server.	• 0 = not available • 1 = available
2	Derived from the MAC address. Both rotary switches are set to integers, but no IP address was received from the DHCP server.	• 0 = not available • 1 = available
3	The stored configuration parameters: • Ethernet IP Address Setting • Ethernet Subnet Mask Setting • Ethernet Gateway Address Setting	• 0 = not available • 1 = available

Ethernet IP Assignment Operational

The Ethernet IP Assignment Operational parameter describes how the current IP address was assigned to the LTMR controller. Only 1 (of 4) different IP address sources can be operational at any one time.

This parameter is 4 bits long.

The Ethernet IP Assignment Operational parameter stores data as follows:

Bit	IP Addressing Source...	Values
0	A DHCP server, using the device name set by the two rotary switches	• 0 = not operational • 1 = operational
1	Derived from the MAC address. The Ones rotary switch is set to BootP, but no IP address was received from the server.	• 0 = not operational • 1 = operational
2	Derived from the MAC address. Both rotary switches are set to integers, but no IP address was received from the DHCP server.	• 0 = not operational • 1 = operational
3	The stored configuration parameters: • Ethernet IP Address Setting • Ethernet Subnet Mask Setting • Ethernet Gateway Address Setting	• 0 = not operational • 1 = operational

Using the Modbus/TCP Communication Protocol

Overview

This section describes how to use the controller over a Modbus/TCP communication protocol network.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical 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.
- 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 anticipated transmission delays or failures of the link. (1)
- Each implementation of an LTMR controller 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".

⚠WARNING

UNEXPECTED RESTART OF THE MOTOR

Check that the PLC application software considers the change from local to remote control and appropriately manages the motor control commands during those changes.

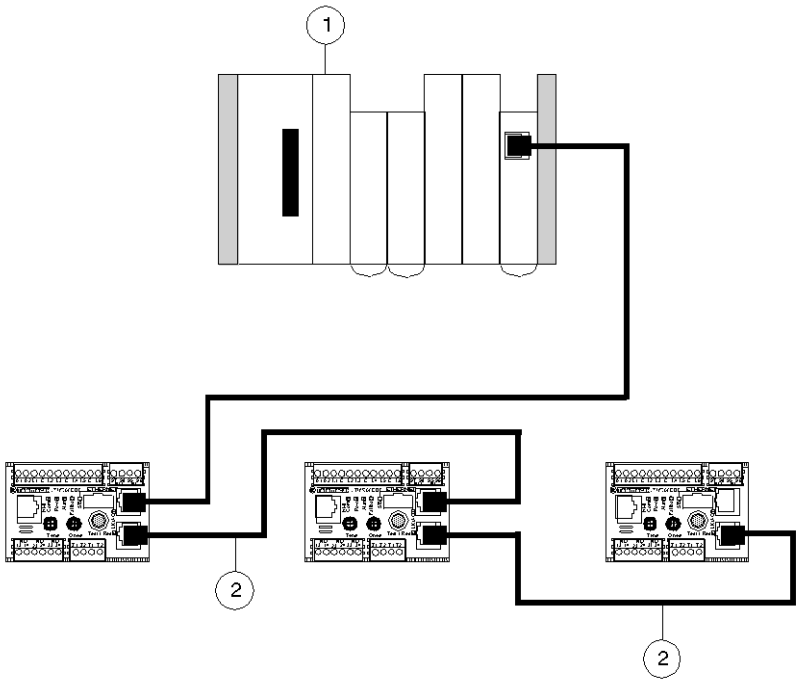
Failure to follow these instructions can result in death, serious injury, or equipment damage.

When switching to the Network control channels, depending on the communication protocol configuration, the LTMR controller can take into account the latest known state of the motor control commands issued from the PLC and automatically restart the motor.

Modbus/TCP Protocol Principle

Overview

The Modbus/TCP protocol is a client/server protocol:



1 Client (PLC, PC, or communication module)

2 Straight or crossed category 5 shielded/unshielded twisted-pair Ethernet cable with RJ45 connector

Only one device can transmit in one direction over a segment at any time.

The client manages and initiates the exchange. It interrogates each of the servers in succession. No server can send a message unless it is invited to do so.

The client repeats the question when there is an incorrect exchange, and declares the interrogated server absent if no response is received within a given time period.

If a server does not understand a message, it does nothing. It sends an exception response to the client when a message is understood but contains errors, or when the server is not able to handle the request (for example, due to resource problems). The client may or may not retransmit the request.

NOTE: For further details on Modbus function codes visit the website: **http://modbus.org/specs.php**

Modbus/TCP Dialog

Modbus/TCP supports only unicast dialogs, comprising requests made by a client to a server and the server's response.

Direct server-to-server communications are not possible. For server-to-server communication, the client must therefore interrogate a server and send back data received to the other server.

Modbus/TCP Messaging

Modbus/TCP is the Modbus protocol encapsulated in TCP. The Modbus/TCP communications protocol combines the:

- Modbus application layer protocol (layer 7 of OSI model), which provides the messaging structure for organizing and interpreting data, and
- TCP transport layer protocol (layer 4 of the TCP/IP stack), which provides a transmission medium for communications between devices on an Ethernet network

The TCP frame, with embedded Modbus data, is sent via TCP to system port 502, which is exclusively reserved for Modbus applications, and added to a TCP/IP Ethernet data packet for network transmission.

Virtual Connections

Although there can be either one or two *physical* connections between a client and a server-depending upon the network topology Modbus/TCP supports the use of multiple *virtual* connections.

A virtual connection - or socket - combines:

- The client IP address (for example, the Modbus/TCP client)
- A unique port on the server
- The server IP address (the LTMR controller server)
- A unique port on the client
- The TCP protocol

Multiple virtual connections enable multiple simultaneous - instead of serial - transactions between the client and the server.

Modbus/TCP supports several types of simultaneous client/server transactions, as follows:

Transaction Type	Limits on the Number of Simultaneous Virtual Connections
Modbus	Eight maximum Notes: • If a new connection is created when eight connections already exist, the new connection replaces the pre-existing connection, whose most recent transaction is the oldest. • You can identify a connection as a Primary IP connection, making it ineligible to be automatically replaced when the maximum number of connections is exceeded.
SNMP	at least one
FDR	one maximum
FTP	at least one

Modbus Requests

Modbus Requests

All physical communication ports–the LTME/HMI port and the two Ethernet network ports are available for Modbus messaging:

- Modbus/TCP using the network ports
- Modbus RTU using the LTME/HMI port

The LTMR controller supports the following Modbus requests, which can be performed using the physical ports and Unit ID/Slave address combinations described below:

Function Code/ Subcode	Request Description	Using These Port and Unit ID Combinations...	
		Network Port Modbus/ TCP	LTME/HMI Port Modbus RTU
3/-	Read N output words (multiple registers)	Unit ID = 0-254	Modbus address = 1-247
6/-	Write one output word (single register)	Unit ID = 0-254	Modbus address = 1-247
8/22	Read or clear diagnostic data	Unit ID = 255	(Not available)
16/-	Write N output words (multiple registers)	Unit ID = 0-254	Modbus address = 1-247
23/-	Read/write multiple registers	Unit ID = 0-254	Modbus address = 1-247
43/14	Read identification (identification register)	(*Reserved*)	Modbus address = 1-247

NOTE: Not using the correct combination of physical port and Unit ID/Slave address will cause the LTMR controller to respond with a Modbus exception.

The maximum number of registers per request is limited to 100.

NOTE: For further details on Modbus function codes visit the following website: http://modbus.org/specs.php

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Use of this device on a Modbus network that uses the broadcast function should be considered with caution.
- This device has a large number of registers that must not be modified during normal operation. Unintended writing of these registers by the broadcast function may cause unexpected and unwanted product operation.
- For more information, refer to the list Communication Variables, page 94.

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

Modbus Exception Management

Overview

The LTMR controller generally follows the Modbus requirements for the Exception Management.

Three special cases apply to the LTMR controller:

- Bit-Field Registers
- Exception Code 02 - Illegal Data Address
- Exception Code 03 - Illegal Data Value

Bit-Field Registers

Some registers in the Register Map are Bit field. Based on the LTMR controller state, some bits in those registers shall not be writable. In this case, the LTMR controller shall reject the write to those bits meaning that no exception shall be returned. For example, bits that can be written only in configuration mode will be ignored (no

exception returned) if the LTMR controller is out of the configuration mode. The write to the bits not constrained by the LTMR controller state shall however occur.

Exception Code 02 - Illegal Data Address

In general, the LTMR controller shall return an illegal data address exception code if the address is out of range or inaccessible. Specifically, the LTMR controller shall return an illegal data address if:

- A Write request is sent to a Read only register.
- The permission to write a register is not granted because of the LTMR controller state: this is the case, for example, when a register that can be written only in configuration mode is written while the LTMR controller is out of configuration mode.

Exception Code 03 - Illegal Data Value

In general, the LTMR controller shall return an illegal data value exception code if there is a problem with the structure of the message, such as an invalid length. The LTMR controller shall also use this exception code if:

- The data to be written is out of range (for standard and Bit field registers): this is the case if a write request of 100 is sent to a R/W register with a range of 0-50.
- A reserved bit or register is written to a value different than 0.
- Motor low speed command (bit 704.6) is set while the motor controller mode selected is not a two-speed mode of operation.

I/O Scanning Configuration

Mirroring High Priority Registers

The LTMR controller provides a block of nine contiguous registers dedicated to scanning that mirror the values and functionality of selected high priority registers, page 145.

The LTMR controller reads the values of all high priority registers whenever it detects a change to any single high priority register, and writes the values of all high priority registers to the mirroring registers.

Because the mirroring registers are contiguous, it is possible to execute a single Modbus block read or block write request to these registers, thereby saving the time it would take to make separate Modbus read/write requests directly to each underlying high priority register.

Mirroring Status

Mirroring status, page 145 is the first register, in the sequence of eight contiguous mirroring registers. Bits 0-2 of this register describe the status of read-only commands, and bits 8-10 describe the status of read/write commands, page 145.

NOTE: Use only the two Ethernet ports to read mirroring status register bit values. Using the HMI/LTME port produces an invalid, constant value of 0 for each bit.

All other mirroring status registers can be read accurately using either the HMI/LTME port or the two Ethernet ports.

Configuring I/O Scanning

Your success in configuring I/O scanning of registers depends upon:

- The register type
- The I/O scanning period
- The I/O scanning health timeout period

Total number of registers accessed (read and write) in I/O scan (counting the repeated registers also) shall not exceed 500 registers per second. This limit shall be calculated with all the combinations of request and also take into account multiple connections. If there are multiple connections to the LTMR Controller, the I/O scanning and I/O scanning health timeout settings for read and write transactions for registers are reduced. Any settings for I/O scan period or I/O scan health timeout, lower than described below, can cause the LTMR controller to send Modbus exception packets.

For higher performance, it is recommended to use the mirror registers when possible. Using the mirror registers decreases the load on LTMR controller as the registers are managed more efficiently in the mirror registers. For example:

- Instead of register 457 use mirroring register 2504
- Instead of register 704 use mirroring register 2507

I/O scanning is to be used for fast monitoring and control. Setting parameters and diagnostics should be done by acyclic requests. Keep in mind that cyclic writing to registers will overwrite values or commands that are sent via acyclic messages. For example, setting register 705 to zero via cyclic messaging will cancel out an acyclic FDR Backup Command before it is acted upon.

The following table describes the I/O scanning and I/O scanning health timeout settings for read and write transactions for registers of varying types with only one connection on the LTMR controller:

Transaction	Register Type	I/O Scan Period (Minimum)	I/O Scan Health Timeout (Minimum)
Standard Register read/ write	Any standard register except Mirror register	200 ms	600 ms
Fast read only	Monitoring Registers: 2500 to 2505 address range	5 ms	100 ms
Fast read/write	Mirror Registers: • 2500 to 2505 address range: read • 2506 to 2508 address range: write	50 ms	200 ms

NOTE: All connections and I/O scanning lines should not exceed limit of 500 registers per second for one LTMR controller. Each PLC has its own data connection limits and register per second limit. I/O scanning table should be built considering the LTMR controller performance as well as the PLC and network constraints.

Example for a Valid I/O Scanning Configuration

Example 1: For a large site with 150 LTMR controllers and PLC connections at 3,400 words: Per LTMR: 10 read and 3 write, 200 register per second.

Register Type	Registers	I/O Scan Period	Health Timeout
Mirroring register 2500...2505 Register 2506...2508	6 read 3 write	50 ms	200 ms
Monitoring register 450...539	4 read	200 ms	600 ms

Example 2: For a small site with less than 50 LTMR controllers and PLC connection at 3,400 words: Per LTMR: 30 read and 3 write, 300 register per second.

Register Type	Registers	I/O Scan Period	Health Timeout
Mirroring register 2500...2505 Register 2506...2508	6 read 3 write	50 ms	200 ms
Monitoring register 450...539	20 read	200 ms	600 ms
Statistics register 100...149	4 read	200 ms	600 ms

Using the EtherNet/IP Communication Protocol

Overview

This section describes how to use the controller over an EtherNet/IP communication protocol network.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical 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.
- 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 anticipated transmission delays or failures of the link. (1)
- Each implementation of an LTMR controller 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".

⚠WARNING

UNEXPECTED RESTART OF THE MOTOR

Check that the PLC application software considers the change from local to remote control, and appropriately manages the motor control commands during those changes.

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

When switching to the Network control channels, depending on the communication protocol configuration, the LTMR controller can take into account the latest known state of the motor control commands issued from the PLC and automatically restart the motor.

EtherNet/IP Protocol Principles

Overview

EtherNet/IP is an application layer protocol treating devices on the network as a series of objects. It is an implementation of the Common Industrial Protocol (CIP) over TCP/IP.

The network carries control data and the properties of the device being controlled. It enables you to operate either in a client/server mode or a peer-to-peer mode.

Two main types of messages can be exchanged:

- I/O messaging, dedicated to fast exchanges of process data. Also called Class 1 Messaging or Implicit Messaging.
- Explicit messaging, dedicated to slower exchanges such as configuration, settings, or diagnostics data. Also called Class 3 Messaging.

Connections and Data Exchange

I/O Messaging

I/O messages contain application-specific data. They are communicated across single or multicast connections between an application producer and its corresponding consuming application. Because I/O messages can carry time-critical messages, they have high-priority identifiers.

An I/O Message consists of a Connection ID and associated I/O data. The meaning of the data within an I/O Message is implied by the associated Connection ID. The connection endpoints are assumed to have knowledge of the intended use or meaning of the I/O Message.

Connection ID

Connection ID is the identifier assigned to a transmission that is associated with a particular connection between producers and consumers that identifies a specific piece of an application information.

I/O Message Types

EtherNet/IP devices are configured to produce a cyclic I/O message.

They produce their data at a precisely defined interval. This type of I/O messaging enables to configure the system to produce data at a rate appropriate for the application. Depending on the application, this can reduce the amount of traffic on the wire and more efficiently use the available bandwidth.

The following connections are defined:

ID	Name	Output Assembly	Input Assembly
1	Basic Overload	Instance 2	Instance 50
2	Extended Overload	Instance 2	Instance 51
3	Basic Motor Starter	Instance 3	Instance 52
4	Extended Contactor	Instance 4	Instance 53
5	Extended Motor Starter 1	Instance 4	Instance 54
6	Extended Motor Starter 2	Instance 5	Instance 54

ID	Name	Output Assembly	Input Assembly
7	LTMR Control and Monitoring	Instance 100	Instance 110
8	PKW	Instance 101	Instance 111
9	PKW and Extended Motor Starter	Instance 102	Instance 112
10	PKW and LTMR Management	Instance 103	Instance 113
11	E_TeSys T Fast Access	Instance 105	Instance 115
12	EIOS_TeSys T	Instance 106	Instance 116

For a full description of these defined Assembly Objects, see the Assembly Object section

Explicit Messaging

Explicit messaging connections provide multipurpose point-to-point communication paths between two particular devices. Explicit messages are used to command the performance of a particular task and to report the results of performing the task. You can, therefore, use explicit messaging connections to configure nodes and diagnose problems.

RPI Parameter

The Request Packet Interval (RPI) parameter defines the rate at which a remote device periodically sends its data.

In daisy chain, adapt RPI value according to number of information exchanged per device and number of devices connected:

- With five devices connected, the RPI value is 30 ms for five devices in Basic Overload profile selected (value is calculated with M340 and NOC card (BMX NOC0401)).
- With 16 devices connected, the RPI value is 80 ms for 16 devices in Basic Overload profile selected (value is calculated with M340 and NOC card (BMX NOC0401)).

Device Profiles and EDS Files

Device Profiles

EtherNet/IP's device models define the physical connections and promote interoperability among standard devices.

Devices that implement the same device model must support common identity and communications status data. Device-specific data is contained in *device profiles* that are defined for various device types. Typically, a device profile defines the device's:

- Object model
- I/O data format
- Configurable parameters

The above information is made available to other vendors through the device's EDS (electronic data sheet).

For a full description of the objects in the LTMR device profile, refer to LTMR Object Dictionary, page 59.

What is an EDS?

The EDS is a standardized ASCII file that contains information about a network device's communications functionalities and the contents of its object dictionary, page 59, as defined by ODVA (Open EtherNet/IP Vendor Association). The EDS also defines device-specific and manufacturer-specific objects.

Using the EDS, you can use standardized tools to:

- Configure EtherNet/IP devices
- Design networks for EtherNet/IP devices
- Manage project information on different platforms

The parameters of a particular device depend on those objects (parameter, application, communications, and other objects) that reside on the device.

LTMR Controller EDS Files

EDS files and associated icons that describe the various configurations of the LTMR controller can be downloaded from www.se.com website (Products and Services > Automation and Control > Product offers > Motor Control > TeSys T > Downloads > Software/Firmware > EDS&GSD).

EDS files and icons are grouped in a single compressed Zip file that you must unzip to a single directory on your hard disk drive.

Selection Criteria for TeSys T LTMR Controller Variants

There are four EDS files corresponding to the four possible configurations of the TeSys T Motor Management Controller system:

Choose...	When You Want to Use...
SE TeSys T MMC L EIP	A TeSys T Motor Management Controller system without an expansion module, configurable via the HMI port. This variant enables you to preserve your local configuration.
SE TeSys T MMC L EV40 EIP	A TeSys T Motor Management Controller system with expansion module, configurable via the HMI port. This variant enables you to preserve your local configuration.
SE TeSys T MMC R EIP	A TeSys T Motor Management Controller system without expansion module configurable via the network.
SE TeSys T MMC R EV40 EIP	A TeSys T Motor Management Controller system with expansion module configurable via the network.

In **local** configuration mode, the parameter Config via Network Port Enable must be disabled. This mode preserves the local configuration made using the LTMCU or SoMove with the TeSys T DTM through the HMI port and PLC configuration via the network is unavailable.

In **remote** configuration mode the parameter Config via Network Port Enable must be enabled. This enables the PLC to remotely configure the LTMR.

NOTE: The parameters overwritten by the PLC will be lost. Remote mode is useful when replacing devices.

The Config via Network Port Enable parameter is set by default.

Object Dictionary

Overview

The EtherNet/IP protocol is used for object modeling. Object modeling organizes related data and procedures into one entity: the object.

An object is a collection of related services and attributes. Services are procedures an object performs. Attributes are characteristics of objects represented by values, which can vary. Typically, attributes provide status information or govern the operation of an object. The value associated with an attribute may or may not affect the behavior of an object. An object's behavior is an indication of how the object responds to particular events.

Objects within a class are called object instances. An object instance is the actual representation of a particular object within a class. Each instance of a class has the same set of attributes, but has its own set of attribute values, which makes each instance in the class unique. The Object Dictionary describes the attribute values of each object in the device profile.

LTMR Object Dictionary

The general breakdown of the LTMR Ethernet brick object dictionary is the same for all EtherNet/IP devices:

Class Code	Object	Description
0x01	Identity Object	Identifiers, such as device type, vendor ID, and serial number.
0x02	Message Router Object	Provides a message connection point.
0x04	Assembly Object	Provides collection of other object's attributes (frequently used for I/O messaging).
0x06	Connection Manager Object	Provides for and manages the run-time exchange of messages.
0x64 - 0x96	Communication Variables	Provides access to all configuration, monitoring, and control parameters defined by Modbus registers.
0xF4	Port Object	Describes the communication interfaces that are present on the device and visible to CIP.
0xF5	TCP/IP Object	Provides description of an opened explicit connection and associated communicator.
0xF6	Ethernet link Object	Manages the functionality of the physical attachment to the Ethernet network.
0x29	Control Supervisor Object	Manages controller functions, operational states, and control.
0x2C	Overload Object	Implements overload behavior.
0xC5	Periodically Kept Acyclic Words (PKW) Object	Enables cyclic I/O messaging for manufacturer-specific registers.
0xC6	EtherNet/IP Monitoring Object	Used to select monitoring data available on Assembly 110.
0x350	EtherNet/IP Interface Diagnostic Object	Provides an overall diagnostic of the EIP communication of the EIP Interface of a device.
0x352	I/O Connection Diagnostic Object	Provides the detailed diagnostic of each configured CIP I/O connection viewed from a scanner, and of each opened CIP I/O connection viewed from an adapter.
0x353	Explicit Connection Diagnostic Object	Provides a description of an opened Explicit Connection and associated communication.
0x354	Explicit Connection Diagnostic List Object	Provides a snapshot of the list of instantiated "Explicit Connection Diagnostic" objects.

These objects are described in detail in the following pages.

Identity Object

Description

The Identity Object, present in all EtherNet/IP products, provides identification of, and general information about, the device.

Class Code

The Identity Object class code is 0x01 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The Identity Objects implementation revision. Returns 0x01.
0x02	Max Instance	R	The largest instance number. Returns 0x01.
0x03	Number of Instances	R	The number of object instances. Returns 0x01.
0x06	Max Class Attribute	R	The largest class attributes value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attributes value. Returns 0x07.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Vendor ID	R	Vendor ID (243: Schneider Electric)
0x02	Device Type	R	Motor starter profile (22)
0x03	Device Code	R	TeSys T EtherNet/IP code: • 48: LTMR in Remote configuration mode • 49: LTMR and LTMEV40 in Remote configuration mode • 304: LTMR in Local configuration mode • 305: LTMR and LTMEV40 in Local configuration mode

Attribute ID	Name	Access	Description
0x04	Identity Revision	R	Product version. product communication version
0x05	Identity Status	R	Current status of the device
0x06	Device Serial Number	R	Based on device entity and MAC: • 0x20: Byte 0 (Entity ID for TeSys T) • Bytes 1-3: Last 3 bytes of MAC address
0x07	Product Name	R	Commercial reference

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes with the access type of R.
0x05	Reset	Reboots the device (only type 0 Power Cycle is supported).
0x0E	Get Attribute Single	Returns the value of the specified identity attribute with the access type of R.

Message Router Object

Description

The Message Router Object provides a messaging connection point through which a Client may address a service to any object class or instance in the physical device.

Class Code

The Message Router Object class code is 0x02 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The Message Router Object implementation revision. Returns 0x01.
0x02	Max Instance	R	The largest instance number. Returns 0x01.
0x03	Number of Instances	R	The number of object instances. Returns 0x01.
0x05	Optional Service List	R	The number and list of any implemented optional services. Only the Multiple Service request (0x0A) is supported for now.
0x06	Max Class Attribute	R	The largest Class Attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest Instance Attribute value. Returns 0x77.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Implemented Object List	R	The first two bytes contain the number of implemented objects. The following data lists the implemented objects as defined in the table LTMR Object Dictionary, page 58
0x02	Max Connection Number Supported	R	Maximum number of concurrent CIP (Class 1 or Class 3) connections supported. Returns 32.
0x64	Total incoming Class 1 packets received during the last second	R	Total number of incoming packets received for all implicit (Class 1) connections during the last second.
0x65	Total outgoing Class 1 packets sent during the last second	R	Total number of outgoing packets sent for all implicit (Class 1) connections during the last second.
0x66	Total incoming Class 3 packets received during the last second	R	Total number of incoming packets for all explicit (Class 3) connections during the last second.
0x67	Total outgoing Class 3 packets sent during the last second	R	Total number of Class 3 packets sent for all explicit connections.
0x68	Total incoming unconnected packets received during the last second	R	Total number of incoming unconnected packets received during the last second.
0x69	Total outgoing unconnected packets sent during the last second	R	Total number of unconnected responses sent during the last second.
0x6A	Total incoming EtherNet/IP packets received during the last second	R	Total unconnected, Class 1, or Class 3 packets received during the last second.
0x6B	Total outgoing EtherNet/IP packets sent during the last second	R	Total unconnected, Class 1, or Class 3 packets sent during the last second.
0x6C	Total incoming Class 1 packets received	R	Total number of incoming packets received for all implicit (Class 1) connections.
0x6D	Total outgoing Class 1 packets sent	R	Total number of outgoing packets sent for all implicit (Class 1) connections.
0x6E	Total incoming Class 3 packets received	R	Total number of incoming packets for all explicit (Class 3) connections. This number includes the packets that would return with a detected error (listed in the next two rows).
0x6F	Total incoming Class 3 packets Invalid Parameter Value	R	Total number of incoming Class 3 packets that targeted not supported service/class/instance/attribute/member.
0x70	Total incoming Class 3 packets invalid format	R	Total number of incoming Class 3 packets that had an invalid format.
0x71	Total outgoing Class 3 packets sent	R	Total number of packets sent for all explicit (Class 3) connections.
0x72	Total incoming unconnected packets received	R	Total number of incoming unconnected packets. This number includes the packets that returns with a detected error (listed in the next two rows).
0x73	Total incoming unconnected packets Invalid Parameter Value	R	Total number of incoming unconnected packets that targeted not supported service/class/instance/attribute/member.

Attribute ID	Name	Access	Description
0x74	Total incoming unconnected packets Invalid Format	R	Total number of incoming unconnected packets that had an invalid format.
0x75	Total outgoing unconnected packets sent	R	Total number of all unconnected packets sent.
0x76	Total incoming EtherNet/IP packets	R	Total unconnected, Class 1 or Class 3 packets received.
0x77	Total outgoing EtherNet/IP packets	R	Total unconnected, Class 1 or Class 3 packets sent.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes.
0x0A	Multiple Service	Provides an option to execute the Multiple Service request.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.

Assembly Object

Description

The Assembly Object binds attribute of multiple objects, which enables each object's data to be sent or received over a single connection. Assembly objects can be used to bind input data or output data. The terms "input" and "output" are defined from the network's point of view. An input sends (produces) data on the network, and an output receives (consumes) data from the network.

Only static assemblies are supported.

Class Code

The Assembly Object class code is 0x04 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The revision of the Assembly Object. Returns 0x02.
0x02	Max Instance	R	The maximum numeric value of the instance number. Returns 116.
0x03	Number of Instances	R	The number of supported assembly instances. Returns 21.
0x04	Optional Attribute List	R	The number and list of the optional attributes. The first word contains the number of attributes to follow and every word that follows contains another attribute code. One optional attribute is supported ((ASSEMBLY_INSTANCE_SIZE (4)).
0x06	Max Class Attribute	R	The numeric value of the highest class attributes (7).
0x07	Max Instance Attribute	R	The numeric value of the highest instance attributes (4).

Class Services

Service Code	Name	Description
0x0E	Get Attribute Single	Returns the value of the specified attribute.
0x10	Set Attribute Single	Sets the value of the specified instance attribute.

Instance Codes

Only one active cyclic connection at a time is supported per instance.

Instance Attributes

Attribute ID	Name	Access	Description
0x03	Assembly_Instance_Data	R/W	Instance data returned as an array of bytes. Access is Read Only for the input data assemblies and Read/Write for the output data assemblies.
0x04	Instance Data Size	R	A word representing the instance data size in bytes.

NOTE:

- Setting of Assembly Instance Data (attribute 3) is not supported for producing assembly instances (input assemblies).

Instance Services

Service Code	Name	Description
0x0E	Get Attribute Single	Returns the value of the specified attribute.
0x10	Set Attribute Single	Sets the value of the specified instance attribute.

Output Assembly Data

Instance 2: Basic Overload

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	TripReset	*Reserved*	*Reserved*

Instance 3: Basic Motor Starter

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	TripReset	*Reserved*	Run 1

Instance 4: Extended Contactor

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	Run 2	Run 1

Instance 5: Extended Motor Starter

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	TripReset	Run 2	Run 1

NOTE: TripReset, Run1, and Run2 are commands in the Control register 1.

Instance 100: LTMR Control Registers

This assembly contains several control registers commonly used with an LTMR device.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
path: 6C : 01 : 05 (Register 704)		path: 6C : 01 : 04 (Register 703)		path: 6C : 01 : 01 (Register 700)	
LSB (least significant byte)	MSB (most significant byte)	LSB Reserved (value = 0)	MSB Reserved (value = 0)	LSB	MSB

Instance 101: PKW Request Object

This assembly is vendor-specific. It is used to implement the request object of PKW protocol.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
See PKW, page 81 for details.							

Instance 102: PKW Request and Extended Motor Starter

This assembly is vendor-specific.

Bytes 0 to 7	Byte 8	Byte 9
See Instance 101 above.	Reserved (value=0)	See Instance 5 above.

Instance 103: PKW Request and LTMR Control Registers

This assembly is vendor-specific.

Bytes 0 to 7	Byte 8 to 13
See Instance 101 above.	See Instance 100 above.

Instance 105: E_TeSys T FastAccess Output

This assembly is vendor-specific. All registers are in little endian.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
path: 8C : 01 : 07 (Register 2506)		path: 8C : 01 : 08 (Register 2507)		path: 8C : 01 : 09 (Register 2508)	

Instance 106: EIOS_TeSys T Output

This assembly is vendor-specific. All registers are in little endian.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
path: 6C : 01 : 01 (Register 700)		path: 6C : 01 : 02 Reserved (value = 0)		path: 6C : 01 : 03 Reserved (value = 0)	

Byte 6	Byte 7	Byte 8	Byte 9
path: 6C : 01 : 04 Reserved (value = 0)		path: 6C : 01 : 05 (Register 704)	

Input Assembly Data

Instance 50: Basic Overload

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	Tripped

Instance 51: Extended Overload

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	Trip Reset	Alarm	Tripped

Instance 52: Basic Motor Starter

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	*Reserved*	*Reserved*	*Reserved*	Running1	*Reserved*	Tripped

Instance 53: Extended Motor Starter 1

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	CntrlfromNet	Ready	*Reserved*	Running1	Alarm	Tripped

Instance 54: Extended Motor Starter 2

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	*Reserved*	*Reserved*	CntrlfromNet	Ready	Running2	Running1	Alarm	Tripped

NOTE: The instances contain data processed from the System status register 1 and the Control register 1:

- CntrlfromNet = In remote (status bit)
- Ready = System ready (status bit)
- Running2 = Motor running (status bit) AND Motor run reverse command (control bit)
- Running1 = Motor running (status bit) AND Motor run forward command (control bit)
- Alarm = System alarm (status bit)
- Trip = System Trip (status bit) OR System Tripped (status bit)

Instance 110: LTMR Monitoring Registers (with dynamic configuration)

This assembly contains several monitoring registers commonly used with an LTMR device. You can choose registers by setting attributes 1...4 of TeSys T Monitoring Control Object. See TeSys T Monitoring and Control Object, page 84 for more information.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Value of register pointed to in path: C6 : 01 : 01 Register 455 at power-up		Value of register pointed to in path: C6: 01 : 02 Register 456 at power-up		Value of register pointed to in path: C6 : 01 : 03 Register 457 at power-up		Value of register pointed to in path: C6 : 01 : 04 Register 459 at power-up	
LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB

Instance 111: PKW Response Object

This assembly is vendor-specific. It is used to implement the response object of PKW protocol.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
See PKW, page 81 for details.							

Instance 112: PKW Response and Extended Motor Starter

This assembly is vendor-specific.

Bytes 0 to 7	Byte 8	Byte 9
See Instance 111 above.	Reserved (value=0)	See Instance 54 above.

Instance 113: PKW Response and LTMR Monitoring Registers

This assembly is vendor-specific.

Bytes 0 to 7	Byte 8 to 15
See Instance 111 above.	See Instance 110 above.

Instance 115: E_TeSys T FastAccess Input

This assembly is vendor-specific. All registers are in little endian.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
path: 8C : 01 : 01 (Register 2500)		path: 8C : 01 : 02 (Register 2501)		path: 8C : 01 : 03 (Register 2502)	

Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
path: 8C : 01 : 04 (Register 2503)		path: 8C : 01 : 05 (Register 2504)		path: 8C : 01 : 06 (Register 2505)	

Instance 116: EIOS_TeSys T Input

This assembly is vendor specific. All registers are in little endian.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
path: 68 : 01 : 02 (Register 451)		path: 68 : 01 : 03 (Register 452)		path: 68 : 01 : 04 (Register 453)		path: 68 : 01 : 05 (Register 454)	

Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
path: 68 : 01 : 06 (Register 455)		path: 68 : 01 : 07 (Register 456)		path: 68 : 01 : 08 (Register 457)		path: 68 : 01 : 09 (Register 458)	

Byte 16	Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22	Byte 23
path: 68 : 01 : 0A (Register 459)		path: 68 : 01 : 0B (Register 460)		path: 68 : 01 : 0C (Register 461)		path: 68 : 01 : 0D (Register 462)	

Byte 24	Byte 25	Byte 26	Byte 27	Byte 28	Byte 29	Byte 30	Byte 31
path: 68 : 01 : 0E (Register 463)		path: 68 : 01 : 0F (Register 464)		path: 68 : 01 : 10 (Register 465)		path: 68 : 01 : 11 (Register 466)	

Byte 32	Byte 33	Byte 34	Byte 35	Byte 36	Byte 37	Byte 38	Byte 39
path: 68 : 01 : 12 (Register 467)		path: 68 : 01 : 13 (Register 468)		path: 68 : 01 : 14 (Register 469)		path: 68 : 01 : 15 (Register 470)	

Byte 40	Byte 41	Byte 42	Byte 43	Byte 44	Byte 45	Byte 46	Byte 47
path: 68 : 01 : 16 (Register 471)		path: 68 : 01 : 17 (Register 472)		path: 68 : 01 : 18 (Register 473)		path: 68 : 01 : 19 (Register 474)	

Byte 48	Byte 49	Byte 50	Byte 51	Byte 52	Byte 53	Byte 54	Byte 55
path: 68 : 01 : 1A (Register 475)		path: 68 : 01 : 1B (Register 476)		path: 68 : 01 : 1C (Register 477)		path: 68 : 01 : 1D (Register 478)	

Byte 56	Byte 57	Byte 58	Byte 59	Byte 60	Byte 61	Byte 62	Byte 63
path: 68 : 01 : 1E (Register 479)		path: 68 : 01 : 1F (Register 480)		path: 68 : 01 : 20 (Register 481)		path: 68 : 01 : 21 (Register 482)	

Byte 64	Byte 65	Byte 66	Byte 67	Byte 68	Byte 69	Byte 70	Byte 71
path: 68 : 01 : 22 (Register 483)		path: 68 : 01 : 23 (Register 484)		path: 68 : 01 : 24 (Register 485)		path: 68 : 01 : 25 (Register 486)	

Byte 72	Byte 73	Byte 74	Byte 75	Byte 76	Byte 77	Byte 78	Byte 79
path: 68 : 01 : 26 (Register 487)		path: 68 : 01 : 27 (Register 488)		path: 68 : 01 : 28 (Register 489)		path: 68 : 01 : 29 (Register 490)	

Byte 80	Byte 81	Byte 82	Byte 83	Byte 84	Byte 85	Byte 86	Byte 87
path: 68 : 01 : 2A (Register 491)		path: 68 : 01 : 2B (Register 492)		path: 68 : 01 : 2C (Register 493)		path: 68 : 01 : 2D (Register 494)	

Byte 88	Byte 89	Byte 90	Byte 91	Byte 92	Byte 93	Byte 94	Byte 95
path: 68 : 01 : 2E (Register 495)		path: 68 : 01 : 2F (Register 496)		path: 68 : 01 : 30 (Register 497)		path: 68 : 01 : 31 (Register 498)	

Byte 96	Byte 97	Byte 98	Byte 99	Byte 100	Byte 101	Byte 102	Byte 103
path: 68 : 01 : 32 (Register 499)		path: 68 : 01 : 33 (Register 500)		path: 68 : 01 : 34 (Register 501)		path: 68 : 01 : 35 (Register 502)	

Byte 104	Byte 105	Byte 106	Byte 107	Byte 108	Byte 109	Byte 110	Byte 111
path: 68 : 01 : 36 (Register 503)		path: 68 : 01 : 37 (Register 504)		path: 68 : 01 : 38 (Register 505)		path: 68 : 01 : 39 (Register 506)	

Byte 112	Byte 113	Byte 114	Byte 115	Byte 116	Byte 117	Byte 118	Byte 119
path: 68 : 01 : 3A (Register 507)		path: 68 : 01 : 3B (Register 508)		path: 68 : 01 : 3C (Register 509)		path: 68 : 01 : 3D (Register 510)	

Byte 120	Byte 121	Byte 122	Byte 123	Byte 124	Byte 125	Byte 126	Byte 127
path: 68 : 01 : 3E (Register 511)		path: 68 : 01 : 3F (Register 512)		path: 68 : 01 : 40 (Register 513)		path: 68 : 01 : 41 (Register 514)	

Connection Manager Object

Description

The Connection Manager Object provides for and manages the run-time exchange of messages.

Class Code

The Connection Manager Object class code is 0x06 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The Connection Manager implementation revision. Returns 0x01.
0x02	Max Instance	R	The largest instance number. Returns 0x01.
0x03	Number of Instances	R	The number of object instances. Returns 0x01.

Attribute ID	Name	Access	Description
0x04	Optional Attribute List	R	The number and list of the optional attributes. The first word contains the number of attributes to follow and every word that follows contains another attribute code. Following optional attributes are included in this list: • Total number of incoming connection open requests. • The number of incoming connection open requests rejected because of the unexpected format of the Forward Open. • The number of incoming connection open requests rejected because of the insufficient resources. • The number of incoming connection open requests rejected because of the parameter value sent with the Forward Open. • The number of Forward Close requests received. • The number of Forward Close requests with invalid format. • The number of Forward Close requests that could not be matched to an active connection. • The number of connections that has timed out because the other side stopped producing or there was a network interruption.
0x06	Max Class Attribute	R	The largest class attributes value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attributes value. Returns 0x08.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Incoming Forward Open requests count	R/W	Total number of incoming connection open requests.
0x02	Forward Open Format Unsuccessful count	R/W	The number of Forward Open requests rejected because of the unexpected format of the Forward Open request.
0x03	Forward Open Resource Unsuccessful count	R/W	The number of Forward Open requests rejected because of insufficient resources.
0x04	Forward Open Parameter Value count	R/W	The number of Forward Open requests rejected because of the parameter value sent with Forward Open.
0x05	Incoming Forward Close requests count	R/W	Total number of incoming connection close requests.
0x06	Forward Close Format Unsuccessful count	R/W	The number of Forward Close requests that has invalid format.
0x07	Forward Close Matching Unsuccessful count	R/W	The number of Forward Close requests that could not be matched to an active connection.
0x08	Timed out Connections count	R/W	The number of connections that has timed out because the other side stopped producing or there was a network interruption.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes.
0x02	Set Attribute All	Sets the values of all instance attributes.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.
0x10	Set Attribute Single	Sets the value of the specified instance attribute.
0x4E	Forward Close	Closes an existing connection.
0x52	Unconnected Send	Used to send a multi-hop not connected request.
0x54	Forward Open	Opens a new connection.
0x5A	Get Connection Server	Returns the owner information for the specified connection.
0x5B	Large Forward Open	Opens a new connection with maximum size buffer.

TCP/IP Object

Description

The TCP/IP Object provides description of an opened explicit connection and associated communicator.

Class Code

The TCP/IP Object class code is 0xF5 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The TCP/IP Object implementation revision. Returns 0x04.
0x02	Max Instance	R	Indicate that there is only one host IP address. Returns 0x01.
0x03	Number of Instances	R	The number of object instances. Returns 0x01.
0x04	Optional Instance Attribute List	R	The first two bytes contain the number of optional instance attributes. Each byte pair that follows represents the number of a different optional instance attribute. Not supported.
0x06	Max Class Attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attribute value. Returns 0x0D.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Configuration Status	R	Indicates whether you configured TCP/IP object and its parameters or not.
0x02	Configuration Capability	R	Indicates whether TCP/IP object with all parameters can be configured using DHCP or BOOTP, and whether it can resolve the host names using the DNS server. Returns 0x00000025. BootP client DHCP client Hardware configurable
0x03	Configuration Control	R	Indicates the configuration of device on startup, that is, the first attempt initiated. This returns the following values: • 0: To use stored IP address. • 1: To attempt the BootP first. • 2: To use the DHCP attempt first.
0x04	Physical Link	R	Returns electronic path to the physical link object, which is the Ethernet Link class. The first word contains the size of the EPATH in words. The path that follows specifies instance 1 of the Ethernet Link object (0x20 0xF6 0x24 0x01).
0x05	Configuration Parameters	R	TCP/IP parameters including the following: • DWORD containing the device IP address. • DWORD containing the subnet mask. • DWORD containing the gateway address. • DWORD containing the name server IP address. • DWORD containing the second name server IP address. • WORD containing number of ASCII characters in the domain name. • ASCII string which contains the domain name.
0x06	Host Name	R	The first word contains the number of ASCII bytes in the device host name. The ASCII host name string follows. Returns the product name as the identity object.
0x0D	Encapsulation Inactivity Timeout	R	Number of seconds of inactivity before TCP connection is closed.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.

Ethernet Link Object

Description

The Ethernet Link Object provides the characteristics for each Ethernet links of the product.

Class Code

The Ethernet Link Object class code is 0xF6 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The Ethernet Link Object implementation revision. Returns 0x04.
0x02	Max Instance	R	Returns 0x02 to represent two Ethernet port instances.
0x03	Number of Instances	R	The number of object instances. Returns 0x02 to represent two Ethernet port instances.
0x04	Optional Instance Attribute List	R	The first two bytes contain the number of optional instance attributes. Each byte pair that follows represents the number of a different optional instance attribute. Returns 0x07, 0x08, and 0x0A as 3 optional attributes.
0x06	Max Class Attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attribute value. Returns 0x0B.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Two instances are implemented for the Ethernet Link object. Each instance represents one of the two Ethernet ports.

Instance 1 for Port 1, and Instance 2 for Port 2.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Interface Speed	R	Interface speed in Mbps (10 or 100 Mbps).
0x02	Interface Flags	R	Returns a word, where the bits are set depending on: • Link state (active/inactive). • Negotiation state. • Link detected trips. • Full/half duplex connection type. Duplex mode is reflected in bit 1.
0x03	MAC Address	R	Returns 6 bytes with the device MAC address.
0x07	Interface Type	R	Indicates the type of interface, for example, twisted pair, fiber, internal. Returns 0x02 to indicate twisted pair.
0x08	Interface State	R	Indicates the current state of the interface, for example, operational (0x01), disabled (0x02).
0x0A	Interface Label	R	Readable identification. • Port 1: “Port 1” • Port 2: “Port 2”
0x0B	Interface Capability	R	Indication of capabilities of the interface.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.

Control Supervisor Object

Description

The Control Supervisor Object models all the management functions for devices within the Hierarchy of Motor Control Devices.

Class Code

The Control Supervisor Object class code is 0x29 as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The Control Supervisor Object implementation revision. Returns 0x01.
0x02	Max Instance	R	Returns 0x01 to represent a single instance.
0x03	Number of Instances	R	Returns 0x01 to represent a single instance.

Attribute ID	Name	Access	Description
0x06	Max Class Attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attribute value. Returns 0x14.

Class Services

Service Code	Name	Description
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x03	Run 1	Get/Set	Motor run forward command
0x04	Run 2	Get/Set	Motor run reverse command
0x06	State	Get	0 = Vendor specific 1 = Startup 2 = Not ready 3 = Ready 4 = Enabled 5 = Stopping 6 = Trip stop 7 = Tripped
0x07	Running 1	Get	Motor running and Motor run forward command
0x08	Running 2	Get	Motor running and Motor run reverse command
0x09	Ready	Get	System ready
0x0A	Tripped	Get	System trip
0x0B	Alarm	Get	System alarm
0x0C	Trip Reset	Get/Set	Trip reset command
0x0D	Trip Code	Get	Trip code
0x0E	Alarm Code	Get	Alarm code
0x0F	Control from Network	Get	0 = Control is local 1 = Control is from network

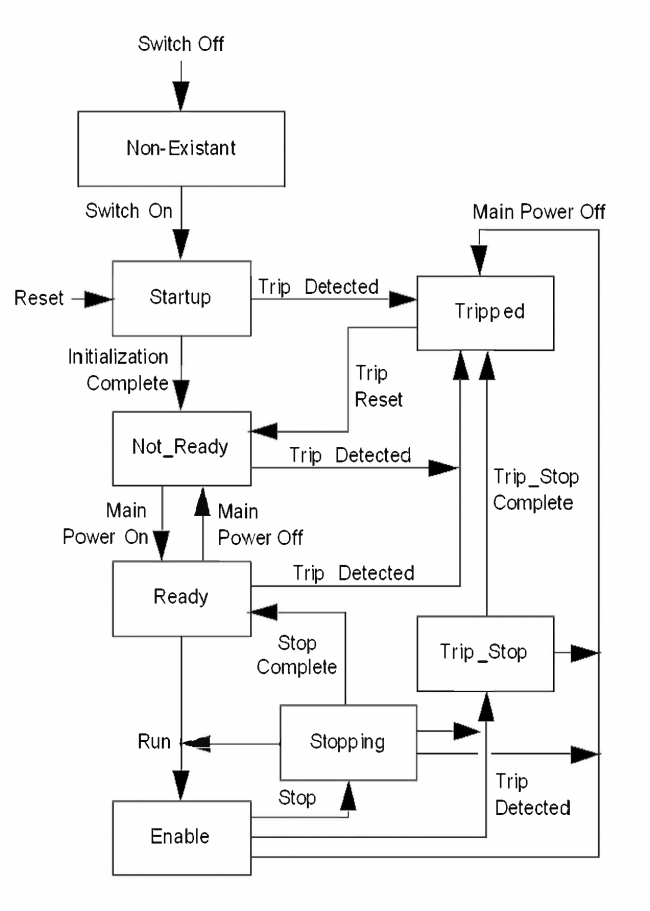
Attribute ID	Name	Access	Description
0x10	Net Trip Mode	Get	Action on of EtherNet/IP: 0 = Trip + Stop (Network Port Fallback Setting NPFS = 2) 1 = Ignore (NPFS = 0) 2 = Manufacturer specific Signal following fallbacks: • Frozen (NPFS = 1) • Unchanged (NPFS = 3) • Force FW (NPFS = 4) • Force RV (NPFS = 5)
0x14	Net Idle Mode		Mode on reception of CIP communication IDLE event. 0 = Trip + Stop (Network Port Fallback Setting NPFS = 2) 1 = Ignore (NPFS = 0) 2 = Manufacturer specific Signal following fallbacks: • Frozen (NPFS = 1) • Unchanged (NPFS = 3) • Force FW (NPFS = 4) • Force RV (NPFS = 5)

Instance Service

Service Code	Name	Description
0x05	Reset	Resets the device to the start-up state. **NOTE:** This service is not identical to Reset of the Identity object.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.
0x10	Set Attribute Single	Sets the value of the specified instance attribute.

Control Supervisor State Event

The following diagram shows the control supervisor state event matrix:



The following table describes the run/stop event matrix:

Event	State (N/A = No Action)							
	Non-exist	**Startup**	**Not_Ready**	**Ready**	**Enabled**	**Stopping**	**Trip-Stop**	**Tripped**
Switch OFF	N/A	Transition to Non-exist	Transition to Non-exist	Transition to Non-exist	Transition to Non-exist	Transition to Non-exist	Transition to Non-exist	Transition to Non-exist
Switch ON	Transi-tion to Startup	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Initialization Complete	N/A	Transition to Not_Ready	N/A	N/A	N/A	N/A	N/A	N/A
Main Power ON	N/A	N/A	Transition to Ready	N/A	N/A	N/A	N/A	N/A
Run	N/A	N/A	N/A	Transition to Enable	N/A	Transition to Enable	N/A	N/A
Stop	N/A	N/A	N/A	N/A	Transition to Stopping	N/A	N/A	N/A
Stop Complete	N/A	N/A	N/A	N/A	N/A	Transition to Ready	N/A	N/A
Reset	N/A	N/A	Transition to Startup	Transition to Startup	Transition to Startup	Transition to Startup	Transition to Startup	Transition to Startup
Main Power OFF	N/A	N/A	N/A	Transition to Not Ready	Transition to Tripped	Transition to Tripped	Transition to Tripped	N/A

Event	State (N/A = No Action)							
	Non-exist	**Startup**	**Not_Ready**	**Ready**	**Enabled**	**Stopping**	**Trip-Stop**	**Tripped**
Trip Detected	N/A	Transition to Tripped	Transition to Tripped	Transition to Tripped	Transition to Trip_Stop	Transition to Trip_Stop	N/A	N/A
Trip_Stop Complete	N/A	N/A	N/A	N/A	N/A	N/A	Transition to Tripped	
Trip Reset	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Transition to Not_Ready

If attribute 15 (CtrlFromNet) is 1, then the events Run and Stop are triggered by a combination of the Run1 and Run2 attributes, as shown in the following table. Note that Run1 and Run2 have different contexts for different device types.

The following table shows the Run1 and Run2 contexts for the devices within the motor control hierarchy:

Run	**Drives and Servos**
Run1	RunFwd
Run2	RunRev

If Control From Network is 0, Run and Stop events must be controlled using local input(s) provided by the vendor.

Run1	**Run2**	**Trigger Event**	**Run Type**
0	0	Stop	N/A
0 -> 1	0	Run	Run1
0	0 -> 1	Run	Run2
0 -> 1	0 -> 1	No action	N/A
1	1	No action	N/A
1 -> 0	1	Run	Run2
1	1 -> 0	Run	Run1

NOTE: Local stop and run signals could override or be interlocked with the run/stop control through Ethernet/IP.

Overload Object

Description

The Overload Object models all the functions specific to an AC motor overload protection device.

Class Code

The Overload Object class code is 0x2C as defined by CIP.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The Overload Object implementation revision. Returns 0x01.
0x02	Max Instance	R	Returns 0x01 to represent a single instance.
0x03	Number of Instances	R	Returns 0x01 to represent a single instance.
0x06	Max Class Attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attribute value. Returns 0xB2.

Class Service

Service Code	Name	Description
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Attribute count	R	Returns the supported attribute count (46).
0x02	Attribute list	R	Returns the list of supported instance attributes.
0x03	TripFLCSet	R/W	% of FLA max
0x04	TripClass	R/W	Trip Class Setting (5, 10, 15, 20, 25, 30)
0x05	AvgCurrent	R	0.1 A
0x06	%PhImbal	R	% Phase imbalance
0x07	%Thermal	R	% Thermal capacity
0x08	IL1 Current	R	0.1 A
0x09	IL2 Current	R	0.1 A
0x0A	IL3 Current	R	0.1 A
0x0B	Ground Current	R	0.1 A
0x65	IL1 Current	R	0.1 A
0x66	IL2 Current	R	0.1 A
0x67	IL3 Current	R	0.1 A
0x68	Ground Current	R	0.1 A
0x69	IL1 Current Ratio	R	% of FLC
0x6A	IL2 Current Ratio	R	% of FLC
0x6B	IL3 Current Ratio	R	% of FLC
0x6C	IAV Average Current Ratio	R	% of FLC

Attribute ID	Name	Access	Description
0x6D	Thermal Capacity Level	R	% TripLevel
0x6E	Ground Current	R	0.1 A
0x6F	Current phase imbalance	R	% Imbalance
0x70	Time to trip	R	Seconds
0x71	Time to Reset	R	Seconds
0x7F	Single/Three Ph	R/W	0 = Single phase 1 = Three phases
0x80	TripFLCSet	R/W	% of FLA max
0x81	Trip Class	R/W	Seconds
0x84	Thermal Alarm Level	R/W	% Trip Level
0x85	PL Inhibit Time	R/W	0.1 seconds
0x86	PL Trip Delay	R/W	0.1 seconds
0x88	Ground Current Trip Delay	R/W	0.1...25.0 seconds
0x89	Ground Current Trip Level	R/W	20...500% FLC
0x8A	Ground Current Alarm Level	R/W	20...500% FLC
0x8B	Stall Enabled Time	R/W	1...200 seconds
0x8C	Stall Trip Level	R/W	100...800 % FLC
0x8E	Jam Trip Delay	R/W	1...30 seconds
0x8F	Jam Trip Level	R/W	100...800 % FLC
0x90	Jam Alarm Level	R/W	100...800 % FLC
0x92	UL Trip Delay	R/W	1...200 seconds
0x93	UL Trip Level	R/W	30...100 % FLC
0x94	UL Alarm Level	R/W	30...100 % FLC
0x95	CI Inhibit Time	R/W	0.1 seconds
0x96	CI Trip Delay	R/W	0.1 seconds
0x97	CI Trip Level	R/W	0...70 % Imbalance
0x98	CI Alarm Level	R/W	0...70 % Imbalance
0xB2	CT Ratio	R	–

NOTE: In the table above:

- PL = Current phase loss
- Stall = Long start
- UL = Underload
- CI = Current phase imbalance

Instance Service

Service Code	Name	Description
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.
0x10	Set Attribute Single	Sets the value of the specified instance attribute.

Periodically Kept Acyclic Words (PKW) Objects

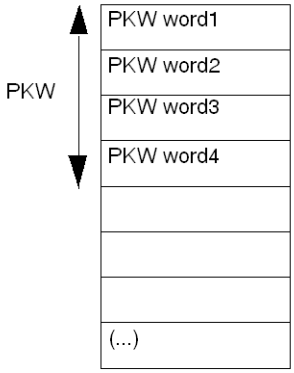
Overview

The LTMR controller supports PKW (**P**eriodically **K**ept in acyclic **W**ords). The PKW feature consists of:

- four input words mapped in input assembly objects 111, 112, and 113
- four output words mapped in output assembly objects 101, 102, and 103

These four words tables enable a EtherNet/IP scanner to read or write any register using I/O messaging.

As shown in the table below, the PKW area is located at the beginning of the corresponding assembly objects 112, 113, 102, and 103.



PKW OUT Data

PKW OUT data requests from the EtherNet/IP scanner to the LTMR are mapped in assembly objects 101, 102, and 103.

To access registers, select one of the following function codes:

- R_REG_16 (0x25) to read 1 register
- R_REG_32 (0x26) to read 2 registers
- W_REG_16 (0x2A) to write 1 register
- W_REG_32 (0x2B) to write 2 registers

Word 1	**Word 2**			**Word 3**	**Word 4**
	MSB		**LSB**		
Register address	Toggle bit (bit 15)	Function bits (bits 8 - 14)	Not used (bits 0 - 7)	Data to write	
Register number	0 / 1	R_REG_16Code 0x25	0x00	–	–
		R_REG_32Code 0x26		–	–
		W_REG_16Code 0x2A		Data to write in register	–
		W_REG_32Code 0x2B		Data to write in register 1	Data to write in register 2

Any change in the function code triggers the handling of the request (unless Function code [bit 8 to bit 14] = 0x00).

NOTE: The highest bit of function code (bit 15) is a toggle bit. It is changed for each consecutive request.

This mechanism enables the request initiator to detect that a response is ready by polling bit 15 of the function code in word 2. When this bit in the OUT data becomes equal to the response emitted toggle bit in the IN data (when starting the request), then the response is ready.

PKW IN Data

PKW IN data response from the LTMR to the EtherNet/IP scanner are mapped in assembly objects 111, 112, and 113.

The LTMR echoes the same register address and function code or, eventually, a detected error code.

<table>
<tr><th rowspan="2">Word 1</th><th colspan="3">Word 2</th><th rowspan="2">Word 3</th><th rowspan="2">Word 4</th></tr>
<tr><th colspan="2">MSB</th><th>LSB</th></tr>
<tr><td>Register address</td><td>Toggle bit (bit 15)</td><td>Function bits (bits 8 - 14)</td><td>Not used (bits 0 - 7)</td><td colspan="2">Data to write</td></tr>
<tr><td rowspan="5">Same register number as in the request</td><td rowspan="5">Same as in the request</td><td>ErrorCode 0x4E</td><td rowspan="5">0x00</td><td colspan="2">Error code</td></tr>
<tr><td>R_REG_16Code 0x25</td><td>–</td><td>–</td></tr>
<tr><td>R_REG_32Code 0x26</td><td>Data read in register</td><td>–</td></tr>
<tr><td>W_REG_16Code 0x2A</td><td>Data read in register 1</td><td>Data read in register 2</td></tr>
<tr><td>W_REG_32Code 0x2B</td><td>–</td><td>–</td></tr>
</table>

If the initiator tries to write a TeSys T object or register to an unauthorized value, or tries to access an inaccessible register, a detected error code is returned (Function code = toggle bit + 0x4E). The detected error code can be found in words 3 and 4. The request is not accepted and the object/register remains at the old value.

To retrigger exactly the same command, you need to:

1.	reset the Function code to 0x00,
2.	wait for the response frame with the function code equal to 0x00,
3.	reset it to its previous value.

This is useful for a limited primary like an HMI.

Another way of retriggering exactly the same command is to invert the toggle bit in the function code byte.

The response is valid when the toggle bit of the response is equal to the toggle bit written in the answer (this is a more efficient method, but it requires higher programming capabilities).

PKW Detected Error Codes

Case of a detected write error:

Detected Error Code	Detected Error Name	Explanation
1	FGP_ERR_REQ_STACK_FULL	External request: sends back an error frame
3	FGP_ERR_REGISTER_NOT_FOUND	Register not managed (or the request needs super user access rights)
4	FGP_ERR_BUSY	Too many concurrent requests. Response is delayed.
7	FGP_ERR_INVALID_FUNCTION_OR_ADDRESS	Using an undefined PWK function code or read/write to an undefined register address.
8	FGP_ERR_READ_ONLY	Register not authorized to be written
10	FGP_ERR_VAL_1WORD_TOOHIGH	Written value not in the range of the register (word value is too high)
11	FGP_ERR_VAL_1WORD_TOOLOW	Written value not in the range of the register (word value is too low)
12	FGP_ERR_VAL_2BYTES_INF_TOOHIGH	Written value not in the range of the register (MSB value is too high)
13	FGP_ERR_VAL_2BYTES_INF_TOOLOW	Written value not in the range of the register (MSB value is too low)
16	FGP_ERR_INVALID_DATA_VALUE	Writing to a read-only or reserved register or bit, or writing a value outside of the valid range.
20	FGP_ERR_BAD_ANSWER	External request: sends back an error frame

Case of a detected read error:

Detected Error Code	Detected Error Name	Explanation
1	FGP_ERR_REQ_STACK_FULL	External request: sends back an error frame
3	FGP_ERR_REGISTER_NOT_FOUND	Register not managed (or the request needs super user access rights)
4	FGP_ERR_ANSWER_DELAYED	External request: answer postponed
7	FGP_ERR_NOT_ALL_REGISTER_FOUND	One or both registers cannot be found

Class Code

The PKW Object class code is 0xC5, vendor specific definition.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The PKW Object implementation revision. Returns 0x01.
0x02	Max instance	R	Returns 0x01 to represent a single instance.
0x03	Number of instances	R	The number of object instances. Returns 0x01.

Attribute ID	Name	Access	Description
0x06	Max class attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max instance attribute	R	The largest instance attribute value. Returns 0x02.

Class Services

Service Code	Name	Description
0x01	Get attribute all	Returns the value of all class attributes.
0x0E	Get attribute single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	Request object	R/W	Array of eight bytes to represent the PKW request.
0x02	Response object	R	Array of eight bytes to represent the PKW response.

Instance Services

Service Code	Name	Description
0x0E	Get attribute single	Returns the value of the specified instance attribute.
0x10	Set attribute single	Modifies the instance attribute value with the access type of R/W.

TeSys T Monitoring Control Object

Description

The TeSys T Monitoring Control Object allows selection of four different LTMR internal data to monitor.

Class Code

The TeSys T Monitoring Control Object class code is 0xC6, vendor specific definition.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The TeSys T Monitoring Control Object implementation revision. Returns 0x01.
0x02	Max Instance	R	Returns 0x01 to represent a single instance.
0x03	Number of Instances	R	The number of object instances. Returns 0x01.
0x06	Max Class Attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attribute value. Returns 0x04.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1.

Instance Attributes

Attribute ID	Name	Access	Description
0x01	TeSys T Monitoring Word 0 Address	R/W	UINT type to represent the address of TeSys T Monitoring Word 0. At power up, it is defaulted to 455.
0x02	TeSys T Monitoring Word 1 Address	R/W	UINT type to represent the address of TeSys T Monitoring Word 1. At power up, it is defaulted to 456.
0x03	TeSys T Monitoring Word 2 Address	R/W	UINT type to represent the address of TeSys T Monitoring Word 2. At power up, it is defaulted to 457.
0x04	TeSys T Monitoring Word 3 Address	R/W	UINT type to represent the address of TeSys T Monitoring Word 3. At power up, it is defaulted to 459.

Instance Services

Service Code	Name	Description
0x10	Set Attribute Single	Modifies the instance attribute value with the access type of R/W.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.

EtherNet/IP Interface Diagnostic Object

Description

The EtherNet/IP Interface Diagnostic Object enables you to select the data that will be exchanged on the network through I/O messaging. A single instance (instance 1) of the EtherNet/IP Interface Object is supported.

Class Code

The EtherNet/IP Interface Diagnostic Object class code is 0x350, vendor specific definition.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	R	The EtherNet/IP Interface Diagnostic Object implementation revision. Returns 0x01.
0x02	Max Instance	R	Returns 0x01 to indicate that there is only one instance.
0x03	Number of Instances	R	The number of object instances. Returns 0x01.
0x04	Optional Instance Attribute List	R	Returns 0 to indicate no optional attributes.
0x05	Optional Services List	R	Returns 0 to indicate no optional services.
0x06	Max Class Attribute	R	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	R	The largest instance attribute value. Returns 0x04.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

Only one instance is implemented: Instance 1 for the EtherNet/IP Interface Diagnostic object.

Instance Attributes

The following instance attributes are supported:

Attribute ID	Name	Access	Description
0x01	Protocols supported	Get	Protocol(s) supported. Returns a 16 bit value with bits 0 and 1 set to indicate that EtherNet/IP and Modbus TCP/IP protocols are supported.
0x02	Connection diagnostics	Get	Returns all the connection diagnostics which includes the following information: • Max CIP I/O Connections opened (UINT): Maximum number of CIP I/O Connections opened. • Current CIP I/O Connections (UINT): Number of CIP I/O Connections currently opened. • Max CIP Explicit Connections opened (UINT): Maximum number of CIP Explicit Connections opened. • Current CIP Explicit Connections (UINT): Number of CIP Explicit Connections currently opened. • CIP Connections Opening Errors (UINT): Incremented at each attempt to open a CIP connection that does not succeed. • CIP Connections Timeout Errors (UINT): Incremented when a CIP connection is timed out. • Max EtherNet IP TCP Connections opened (UINT): Maximum number of TCP connections opened and used for EtherNet IP communication. • Current EtherNet IP TCP Connections (UINT): Number of TCP connections currently opened and used for EtherNet IP communication.
0x03	I/O Messaging Diagnostics	Get/Clear	Returns all the I/O messaging diagnostics which includes the following information: • I/O Production Counter (UDINT): Incremented each time a Class 0/1 CIP message is sent. • I/O Consumption Counter (UDINT): Incremented each time a Class 0/1 CIP message is received. • I/O Production Send Errors Counter (UINT): Incremented each time a Class 0/1 message is not sent. • I/O Consumption Receive Errors Counter (UINT): Incremented each time consumption is received with an error.
0x04	Explicit Messaging Diagnostics	Get/Clear	Returns all the explicit messaging diagnostics which includes the following information: • Class3 Message Send Counter (UDINT): Incremented each time a Class 3 CIP Message is sent. • Class3 Message Receive Counter (UDINT): Incremented each time a Class 3 CIP Message is received. • UCMM Message Send Counter (UDINT): Incremented each time an UCMM Message is sent. • UCMM Message Receive Counter (UDINT): Incremented each time an UCMM Message is received.
0x05	Communication Capacity	Get	Returns the communication capacity data which includes the following information: • Max CIP Connections (UINT): Max supported CIP Connections. • Max TCP Connections (UINT): Max supported TCP Connections. • Max Urgent priority rate (UINT): Max CIP transport class 0/1 Urgent priority messages packet(s). • Max Scheduled priority rate (UINT): Max CIP transport class 0/1 Scheduled priority messages Packet(s). • Max High priority rate (UINT): Max CIP transport class 0/1 High priority messages Packet(s).

Attribute ID	Name	Access	Description
0x06	Bandwidth Diagnostics	Get	Returns the bandwidth diagnostics which includes the following information: • Current sending Urgent priority rate (UINT): CIP transport class 0/1 Urgent priority messages Packet(s) sent. • Current reception Urgent priority rate (UINT): CIP transport class 0/1 Urgent priority messages Packet(s) received. • Current sending Scheduled priority rate (UINT): CIP transport class 0/1 Scheduled priority messages Packet(s) sent. • Current reception Scheduled priority rate (UINT): CIP transport class 0/1 Scheduled priority messages Packet(s) received. • Current sending High priority rate (UINT): CIP transport class 0/1 High priority messages Packet(s) sent. • Current sending Low priority rate (UINT): CIP transport class 0/1 Low priority messages Packet(s) sent. • Current reception low priority rate (UINT): CIP transport class 0/1 Low priority messages Packet(s) received. • Current sending Explicit rate (UINT): CIP transport class 2/3 or other EIP messages Packet(s) sent. • Current reception Explicit rate (UINT): CIP transport class 2/3 or other EIP messages Packet(s) received.
0x07	Modbus Diagnostic	Get	Returns the modbus diagnostics which includes the following information: • Max Modbus TCP Connections opened (UINT): Maximum number of TCP connections opened and used for Modbus communication. • Current Modbus TCP Connections (UINT): Number of TCP connections currently opened and used for Modbus communication. • Modbus TCP Message Send Counter (UDINT): Incremented each time a Modbus TCP/IP Message is sent. • Modbus TCP Message Receive Counter (UDINT): Incremented each time a Modbus TCP/IP Message is received.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.
0x4C	Get and Clear Single	Returns the value of the specified instance attribute and clears the same.

I/O Connection Diagnostic Object

Description

The I/O Connection Diagnostic Object provides the detailed diagnostic of each configured CIP I/O connection viewed from a Scanner and of each opened CIP I/O connection viewed from an adapter.

Class Code

The I/O Connection Diagnostic Object class code is 0x352, vendor specific definition.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	Get	The I/O Connection Diagnostic Object implementation revision. Returns 0x01.
0x02	Max Instance	Get	Returns the maximum instance number created that varies from 0 to N (N = maximum number of CIP I/O connections = 32).
0x03	Number of Instances	Get	Returns the number of instances created that varies from 0 to N (N = maximum number of CIP I/O connections = 32).
0x04	Optional Instance Attribute List	Get	Returns 0 to indicate no optional attributes.
0x05	Optional Services List	Get	Returns 0 to indicate no optional services.
0x06	Max Class Attribute	Get	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	Get	The largest instance attribute value. Returns 0x02.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

The number of instances created varies from 0...N, where N is the maximum number of CIP I/O connections.

Instance Attributes

The following instance attributes are supported:

Attribute ID	Name	Access	Description
0x01	I/O Communication Diagnostics	Get/Clear	Returns the I/O communication diagnostics data which contains the following information: • I/O Production Counter(UDINT): Incremented at each production. • I/O Consumption Counter (UDINT): Incremented at each consumption. • I/O Production Send Errors Counter (UINT): Incremented each time a production is not sent. • I/O Consumption Receive Errors Counter (UINT): Incremented each time consumption is received with an error. • CIP Connection Timeout Errors (UINT): Incremented when a connection is timed out. • CIP Connection Opening Errors (UINT): Incremented at each attempt to open a connection that does not succeed. • CIP Connection State (UINT): State of the CIP I/O connection. • CIP Last Error General Status (UINT): “General Status” of the last error detected on the connection. • CIP Last Error Extended Status (UINT): “Extended Status” of the last error detected on the connection. • Input Com Status (UINT): Communication status of the inputs. • Output Com status (UINT): Communication status of the outputs.
0x02	Connection Diagnostics	Get	Returns all the connection diagnostics which includes the following information: • Production Connection ID (UDINT): Connection ID for production. • Consumption Connection ID (UDINT): Connection ID for consumption. • Production RPI (UDINT): RPI for production. • Production API (UDINT): API for production. • Consumption RPI (UDINT): RPI for consumption. • Consumption API (UDINT): API for consumption. • Production Connection Parameters (UDINT): Connection parameters for production. • Consumption Connection Parameters (UINT): Connection parameters for consumption. • Local IP (UDINT). • Local UDP Port (UINT). • Remote IP (UDINT). • Remote UDP Port (UINT). • Production Multicast IP (UDINT): Multicast IP used for production. • Consumption Multicast IP (UDINT): Multicast IP used for consumption. • Protocols supported (UINT): Protocol(s) supported on the connection.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes.
0x0E	Get Attribute Single	Returns the value of the specified instance attribute.
0x4C	Get and Clear Single	Returns the value of the specified instance attribute and clears the same.

Explicit Connection Diagnostic Object

Description

The Explicit Connection Diagnostic Object provides a description of an opened Explicit Connection and associated communication.

Class Code

The Explicit Connection Diagnostic Object class code is 0x353, vendor specific definition.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	Get	The Explicit Connection Diagnostic Object implementation revision. Returns 0x01.
0x02	Max Instance	Get	Returns the maximum instance number created that varies from 0 to N (N = maximum number of CIP explicit connections = 32).
0x03	Number of Instances	Get	Returns the number of instances created that varies from 0 to N (N = maximum number of CIP explicit connections = 32).
0x04	Optional Instance Attribute List	Get	Returns 0 to indicate no optional attributes.
0x05	Optional Services List	Get	Returns 0 to indicate no optional services.
0x06	Max Class Attribute	Get	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	Get	The largest instance attribute value. Returns 0x08.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

The number of instances created varies from 0...N, where N is the maximum number of CIP explicit connections which is 32 at present.

Instance Attributes

The following instance attributes are supported:

Attribute ID	Name	Access	Description
0x01	Originator Connection ID	Get	O -> T Connection ID
0x02	Originator IP	Get	–
0x03	Originator TCP Port	Get	–
0x04	Target Connection ID	Get	T -> O Connection ID
0x05	Target IP	Get	–
0x06	Target TCP Port	Get	–
0x07	Message Send Counter	Get	Incremented each time a Class 3 CIP message is sent on the connection.
0x08	Message Receive Counter	Get	Incremented each time a Class 3 CIP message is received on the connection.

Instance Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all instance attributes.

Explicit Connection Diagnostic List Object

Description

The Explicit Connection Diagnostic List Object provides a snapshot of the list of instantiated Explicit Connection Diagnostic objects.

Class Code

The Explicit Connection Diagnostic List Object class code is 0x354, vendor specific definition.

Class Attributes

Attribute ID	Name	Access	Description
0x01	Revision	Get	The Explicit Connection Diagnostic List Object implementation revision. Returns 0x01.
0x02	Max Instance	Get	Returns the maximum instance number created that varies from 0 to N (N = maximum number of concurrent list access supported = 2).
0x03	Number of Instances	Get	Returns the number of instances created that varies from 0 to N (N = maximum number of concurrent list access supported = 2).
0x04	Optional Instance Attribute List	Get	Returns 0 to indicate no optional attributes.
0x05	Optional Services List	Get	Returns 0 to indicate no optional services.

Attribute ID	Name	Access	Description
0x06	Max Class Attribute	Get	The largest class attribute value. Returns 0x07.
0x07	Max Instance Attribute	Get	The largest instance attribute value. Returns 0x02.

Class Services

Service Code	Name	Description
0x01	Get Attribute All	Returns the value of all class attributes.
0x0E	Get Attribute Single	Returns the value of the specified attribute.

Instance Codes

The number of instances created varies from 0...N, where N is the maximum number of concurrent list access supported, which are 2.

Instance Attributes

The following instance attributes are supported:

Attribute ID	Name	Access	Description
0x01	Number of Connections	Get	Total number of opened Explicit connections.
0x02	Explicit Messaging Connections Diagnostic List	Get	Array of structures that represents the contents of instantiated “Explicit Connection Diagnostic” objects. Each of these objects has the following information: • Originator Connection ID (UDINT): O -> T Connection ID. • Originator IP (UDINT). • Originator TCP Port (UINT). • Target Connection ID (UDINT): T -> O Connection ID. • Target IP (UDINT). • Target TCP Port (UINT). • Message Send Counter (UDINT): Incremented each time a Class 3 CIP message is sent on the connection. • Message Receive Counter (UDINT): Incremented each time a Class 3 CIP message is received on the connection.

Instance Services

Service Code	Name	Description
0x08	Create	This service creates an instance of the “Explicit Connections Diagnostic List” object.
0x09	Delete	This service deletes an instance of the “Explicit Connections Diagnostic List” object.
0x33	Explicit Connections Diagnostic Read	This service reads the explicit connections diagnostics data from the list.

Communication Variables

Overview

This section describes the communication variables for EtherNet/IP and for Modbus/TCP communication protocols.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical 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.
- 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 anticipated transmission delays or failures of the link. (1)
- Each implementation of an LTMR controller 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".

⚠WARNING

UNEXPECTED RESTART OF THE MOTOR

Check that the PLC application software:

- Considers the change from local to remote control,
- Manages the motor control commands appropriately during those changes.

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

When switching to the Network control channel, depending on the communication protocol configuration, the LTMR controller can take into account the last known state of the motor control commands issued from the PLC and automatically restart the motor.

Communication Parameter Clear Commands

Clear Commands Overview

You can clear communication parameters as follows:

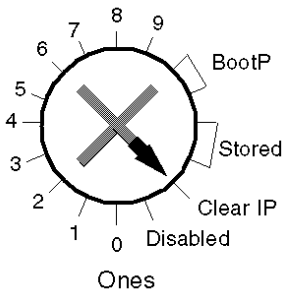
- Using the LTMR rotary switches to clear its IP addressing settings
- Using the following parameter-based commands:
  - Clear all command
  - Clear network port settings command

You can clear other parameters using the following parameter-based commands:

- Clear statistics command
- Clear thermal capacity level command
- Clear controller setting command

Clear IP Using the Rotary Switch

To clear IP addressing settings, set the Ones, or right, rotary switch on the LTMR controller to **Clear IP** (see below):



This clears the following Ethernet parameters:

- IP Address
- Subnet Mask
- Gateway

The position of the Tens, or left, switch does not affect the Clear IP function.

After the IP addressing parameters are cleared, power must be cycled to the LTMR controller for it to obtain new IP addressing parameters, page 30.

Clear All Command

If you want to change the configuration of the LTMR controller, you may want to clear all existing parameters in order to set new parameters for the controller.

To clear all parameters, set to 1 the bit 0 of:

- Modbus/TCP register address 705
- Or EtherNet/IP object address 6C: 01: 06

This forces the controller to enter configuration mode. A power-cycle is performed to restart correctly in this mode. This enables the controller to pick up the new values for the cleared parameters.

When you clear all parameters, static characteristics are also lost. Only the following parameters are not cleared after a Clear All Command:

- Motor LO1 Closings Count
- Motor LO2 Closings Count
- Controller Internal Temperature Max

Clear Statistics Command

To clear statistics parameters, set to 1 the bit 1 of:

- Modbus/TCP register address 705
- Or EtherNet/IP object address 6C: 01: 06

Statistics parameters are cleared without the LTMR controller being forced into configuration mode. Static characteristics are preserved.

The following parameters are not cleared after a Clear Statistics Command:

- Motor LO1 Closings Count
- Motor LO2 Closings Count
- Controller Internal Temperature Max

Clear Thermal Capacity Level Command

To clear thermal memory parameters, set to 1 the bit 2 of:

- Modbus/TCP register address 705
- Or EtherNet/IP object address 6C: 01: 06

This action clears the following parameters:

- Thermal Capacity Level
- Rapid Cycle Lockout Timeout

Thermal memory parameters are cleared without the LTMR controller being forced into configuration mode. Static characteristics are preserved.

NOTE: This bit is writable at any time, even when the motor is running.

Clear Controller Settings Command

The Clear Controller Settings Command restores the LTMR controller protection factory setting (timeouts and thresholds).

To clear controller settings parameters, set: to 1 the bit 3 of:

- Modbus/TCP register address 705
- Or EtherNet/IP object address 6C: 01: 06

The following settings are *not* cleared by this command:

- Controller characteristics
- Connections (CT, temperature sensor, and I/O settings)
- Operating mode

Controller setting parameters are cleared without the controller being forced into configuration mode. Static characteristics are preserved.

Clear Network Port Settings Command

The Clear Network Port Settings command restores the network port factory settings (address, and so on).

To clear controller settings parameters, set to 1 the bit 4 of:

- Modbus/TCP register address 705
- Or EtherNet/IP object address 6C: 01: 06

Controller setting parameters are cleared without the controller being forced into configuration mode. Static characteristics are preserved. Only the network communication becomes ineffective.

After the IP addressing parameters are cleared, power must be cycled to the LTMR controller for it to obtain new IP addressing parameters, page 30.

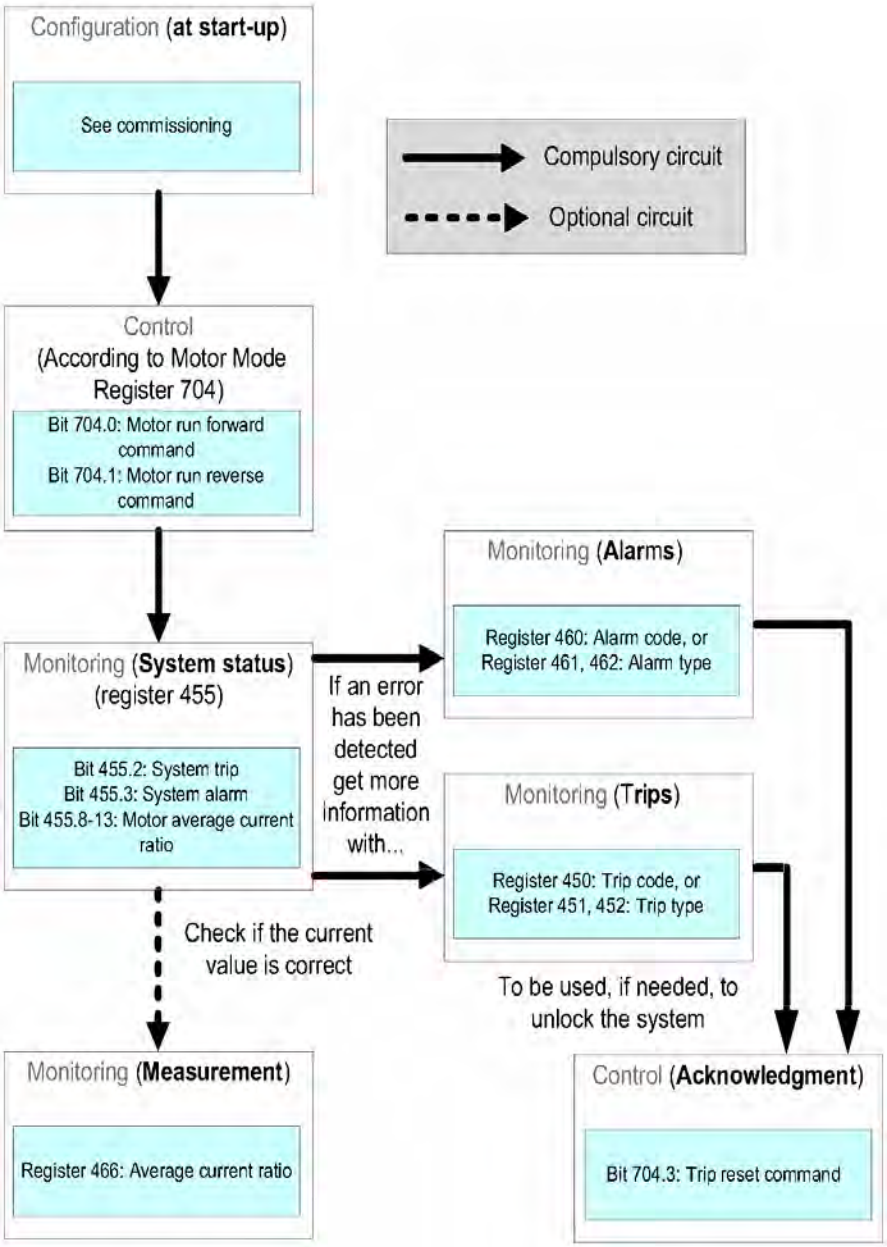
Simplified Control and Monitoring

Overview

In this section there are two simplified examples of the main registers which control and monitor a Motor Management Controller, one with Modbus/TCP communication protocol and one with EtherNet/IP communication protocol.

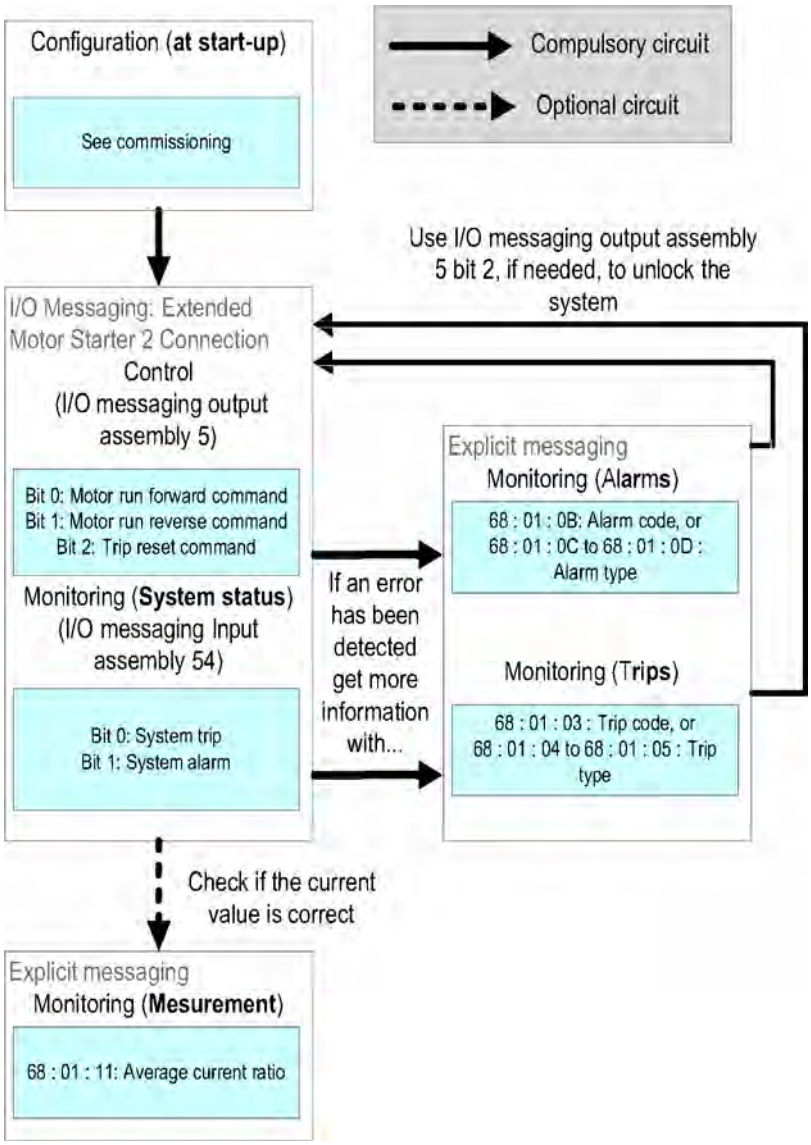
Modbus/TCP Registers for Simplified Operation

The illustration below provides basic setup information, using the following registers: configuration, control and monitoring (system status, measurements, trips, and alarms, acknowledgement).



EthernNet/IP Registers for Simplified Operation

The illustration below provides basic setup information, using the following registers: configuration, control and monitoring (system status, measurements, trips, alarms, and, acknowledgement).



Organization of Communication Variables

Introduction

Communication variables are listed in tables. They belong to groups (identification, statistics, monitoring,...). They are associated with an LTMR controller, which may or may not have an LTME expansion module attached.

Communication Variable Groups

Communication variables are grouped according to the following criteria:

Variable Groups	Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)
Identification variables	00-99	64 : 01 : 32 to 64 : 01 : 61
Statistics variables	100-449	65 : 01 : 01 to 67 : 01 : 83
Monitoring variables	450-539	68 : 01 : 01 to 68 : 01 : 4A
Configuration variables	540-699	69 : 01 : 01 to 6B : 01 : 32
Command variables	700-713	6C : 01 : 01 to 6C : 01 : 0A
User map variables	800–999	6D : 01 : 01 to 6E : 01 : 64
Custom logic variables	1250-1399	71 : 01 : 33 to 71 : 01 : C8
Extended monitoring variables for communication	2000-2099	82 : 01 : 01 to 82 : 01 : 27
Mirroring variables	2500-2599	8C : 01 : 01 to 8C : 01 : 15
Extended configuration variables for communication	3000-3120	96 : 01 : 01 to 96 : 01 : 77

Table Structure

Communication variables are listed in 5-column tables:

Column 1	Column 2	Column 3	Column 4	Column 5
Modbus/TCP Register address (in decimal)	EtherNet/IP Object address (class : instance : attribute)	Variable type: integer, word, word[n], DT_type (see Identification Variables, page 108)	Variable name and access via Read only or Read/Write requests	Note: code for additional information

Note

The Note column gives a code for additional information.

Variables without a code are available for all hardware configurations, and without functional restrictions.

The code can be:

- numerical (1-9), for specific hardware combinations
- alphabetical (A-Z), for specific system behaviors

If the Note is...	Then the Variable is...
1	available for the LTMR + LTMEV40 combination
2	always available but with a value equal to 0 if no LTMEV40 is connected
3-9	Not used
If the Note is...	**Then...**
A	the variable can be written only when the motor is OFF
B	the variable can be written only in configuration mode
C	the variable can be written only with no trip
D-Z	the variable is available for future exceptions

Unused Addresses

Unused addresses fall into three categories:

- **Not significant**, in Read only tables, means that you should ignore the value read, whether equal to 0 or not.
- **Reserved**, in Read/Write tables, means that you must write 0 in these variables.
- **Forbidden**, means that read or write requests are rejected, that these addresses are not accessible at all.

Data Formats

Overview

The data format of a communication variable can be integer, Word, or Word[n], as described below. For more information about a variable size and format, see Data Types, page 101.

Integer (Int, UInt, DInt, UDInt)

Integers fall into the following categories:

- **Int**: signed integer using one register (16 bits)
- **UInt**: unsigned integer using one register (16 bits)
- **DInt**: signed double integer using two registers (32 bits)
- **UDInt**: unsigned double integer using two registers (32 bits)

For all integer-type variables, the variable name is completed with its unit or format, if necessary.

Example:

Register 474 or object 68 : 01: 19, **UInt**, Frequency (x 0.01 Hz).

Word

Word: Set of 16 bits, where each bit or group of bits represents command, monitoring or configuration data.

Example:

Register 455 or object 68 : 01 : 06, Word, System Status Register 1.

bit 0	System ready
bit 1	System on
bit 2	System trip
bit 3	System alarm
bit 4	System tripped
bit 5	Trip reset authorized
bit 6	*(Not significant)*
bit 7	Motor running
bits 8-13	Motor average current ratio
bit 14	Local/Remote Active Channel0 = Remote, 1 = Local
bit 15	Motor starting (in progress)

Word[n]

Word[n]: Data encoded on contiguous registers.

Examples:

Registers 64-69 or objects 64 : 01 : 41 to 64 : 01 : 46, **Word[6]**, Controller Commercial Reference (see DT_CommercialReference, page 102).

Registers 655-658 or objects 6B : 01 : 06 to 6B : 01 : 09, **Word[4]**, Date and Time setting (see DT_DateTime, page 102).

Data Types

Overview

Data types are specific variable formats which are used to complement the description of internal formats (for instance, in case of a structure or of an enumeration). The generic format of data types is DT_xxx.

List of Data Types

Here is the list of the most commonly used data types:

- DT_ACInputSetting
- DT_CommercialReference
- DT_DateTime
- DT_ExtBaudRate
- DT_ExtParity
- DT_EventCode
- DT_FirmwareVersion
- DT_Language5
- DT_OutputFallbackStrategy
- DT_PhaseNumber
- DT_ResetMode
- DT_AlarmCode

These data types are described below.

DT_ACInputSetting

DT_ACInputSetting format is an **enumeration** that improves AC input detection:

Value	Description
0	None (factory setting)
1	< 170 V 50 Hz
2	< 170 V 60 Hz
3	> 170 V 50 Hz
4	> 170 V 60 Hz

DT_CommercialReference

DT_CommercialReference format is **Word[6]** and indicates a Commercial Reference:

Word	MSB	LSB
1	character 1	Character 2
2	character 3	Character 4
3	character 5	Character 6
4	character 7	Character 8
5	character 9	Character 10
6	character 11	Character 12

Example:

Registers 64-69 or objects 64 : 01 : 41 to 64 : 01 : 46, **Word[6]**, Controller Commercial Reference.

If Controller Commercial Reference = LTMR:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	MSB	LSB
64	64 : 01 : 41	L	T
65	64 : 01 : 42	M	(space)
66	64 : 01 : 43	R	
67	64 : 01 : 44		
68	64 : 01 : 45		
69	64 : 01 : 46		

DT_DateTime

DT_DateTime format is **Word[4]** and indicates Date and Time using Binary Coded Decimal digits:

Word	Bits 12-15	Bits 8-11	Bits 4-7	Bits 0-3
1	S	S	0	0
2	H	H	m	m
3	M	M	D	D
4	Y	Y	Y	Y

Where:

- S = second

  The format is two BCD digits.

  The value range is [00-59] in BCD.
- 0 = unused
- H = hour

  The format is two BCD digits.

  The value range is [00-23] in BCD.

- m = minute
  The format is two BCD digits.
  The value range is [00-59] in BCD.
- M = month
  The format is two BCD digits.
  The value range is [01-12] in BCD.
- D = day
  The format is two BCD digits.
  The value range is (in BCD):
  [01-31] for months 01, 03, 05, 07, 08, 10, and 12
  [01-30] for months 04, 06, 09, and 11
  [01-29] for month 02 in a leap year
  [01-28] for month 02 in a non-leap year.
- Y = year
  The format is four BCD digits.
  The value range is [2006-2099] in BCD.

Data entry format and value range are:

Data Entry Format	**DT#YYYY-MM-DD-HH:mm:ss**	
Minimum value	DT#2006-01-01:00:00:00	January 1, 2006
Maximum value	DT#2099-12-31-23:59:59	December 31, 2099
Note: If you give values outside the limits, the system will return a diagnostic message.		

Example:

Registers 655-658 or objects 6B : 01 : 06 to 6B : 01 : 09, **Word[4]**, Date and Time setting.

If date is September 4, 2008 at 7 a.m., 50 minutes and 32 seconds:

Modbus/TCP (Register Addresses)	**EtherNet/IP (Object Addresses)**	**15 12**	**11 8**	**7 4**	**3 0**
655	6B : 01 : 06	3	2	0	0
656	6B : 01 : 07	0	7	5	0
657	6B : 01 : 08	0	9	0	4
658	6B : 01 : 09	2	0	0	8

With data entry format: DT#2008-09-04-07:50:32.

DT_ExtBaudRate

DT_ExtbaudRate depends on the bus used:

DT_ModbusExtBaudRate format is an **enumeration** of possible baud rates with Modbus network:

Value	**Description**
1200	1200 Baud
2400	2400 Baud
4800	4800 Baud

Value	Description
9600	9600 Baud
19200	19,200 Baud
65535	Autodetection (factory setting)

DT_ProfibusExtBaudRate format is an **enumeration** of possible baud rates with PROFIBUS DP network:

Value	Description
65535	Autobaud (factory setting)

DT_DeviceNetExtBaudRate format is an **enumeration** of possible baud rates with DeviceNet network:

Value	Description
0	125 kBaud
1	250 kBaud
2	500 kBaud
3	Autobaud (factory setting)

DT_CANopenExtBaudRate format is an **enumeration** of possible baud rates with CANopen network:

Value	Description
0	10 kBaud
1	20 kBaud
2	50 kBaud
3	125 kBaud
4	250 kBaud (factory setting)
5	500 kBaud
6	800 kBaud
7	1000 kBaud
8	Autobaud
9	Factory setting

DT_ExtParity

DT_ExtParity depends on the bus used:

DT_ModbusExtParity format is an **enumeration** of possible parities with Modbus network:

Value	Description
0	None
1	Even
2	Odd

DT_TripCode

DT_TripCode format is an **enumeration** of trip codes:

Trip Code	Description
0	No detected error
3	Ground current
4	Thermal overload
5	Long start
6	Jam
7	Current phase imbalance
8	Undercurrent
10	Self test
12	HMI port communication loss
13	Network port internal trip
16	External trip
20	Overcurrent
21	Current phase loss
22	Current phase reversal
23	Motor temp sensor
24	Voltage phase imbalance
25	Voltage phase loss
26	Voltage phase reversal
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTME configuration
34	Temperature sensor short-circuit
35	Temperature sensor open-circuit
36	CT reversal
37	Out of boundary CT ratio
46	Start command check
47	Run check
48	Stop command check
49	Stop check
51	Controller internal temperature trip
55	Controller internal detected error (General)
56	Controller internal detected error (SPI)
57	Controller internal detected error (ADC)
58	Controller internal detected error (Hardware watchdog)

Trip Code	Description
60	L2 current detected in single-phase mode
64	Non volatile memory trip
65	Expansion module communication trip
66	Stuck reset button
67	Logic function trip
109	Network port communication loss
111	Fast device replacement trip
555	Network port configuration trip

DT_FirmwareVersion

DT_FirmwareVersion format is an **XY000 array** that describes a firmware revision:

- X = major revision
- Y = minor revision.

Example:

Register 76 or object 64 : 01 : 4D, **UInt**, Controller firmware version.

DT_Language5

DT_Language5 format is an **enumeration** used for language display:

Language Code	Description
1	English (factory setting)
2	Français
4	Español
8	Deutsch
16	Italiano

Example:

Register 650 or object 6B : 01 : 01, **Word**, HMI language.

DT_OutputFallbackStrategy

DT_OutputFallbackStrategy format is an **enumeration** of motor output states when losing communication.

Value	Description	Motor Operating Modes
0	Hold LO1 LO2	For all operating modes
1	Run	For two-step operating mode only
2	LO1, LO2 OFF	For all operating modes
3	LO1, LO2 ON	Only for overload, independent and custom operating modes
4	LO1 ON	For all operating modes except two-step
5	LO2 ON	For all operating modes except two-step

DT_PhaseNumber

DT_PhaseNumber format is an **enumeration**, with only one bit activated:

Value	Description
1	One phase
2	Three phases

DT_ResetMode

DT_ResetMode format is an **enumeration** of possible modes for event resets:

Value	Description
1	Manual or HMI
2	Remote by network
4	Automatic

DT_AlarmCode

DT_AlarmCode format is an **enumeration** of alarm codes:

Alarm Code	Description
0	No alarm
3	Ground current
4	Thermal overload
5	Long start
6	Jam
7	Current phase imbalance
8	Undercurrent
10	HMI port
11	LTMR internal temperature
20	Overcurrent
21	Current phase loss
23	Motor temp sensor
24	Voltage phase imbalance
25	Voltage phase loss
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTME configuration
34	Temperature sensor short circuit

Alarm Code	Description
35	Temperature sensor open circuit
36	CT reversal
46	Start command check
47	Run check
48	Stop command check
49	Stop check
109	Network port comm loss
555	Network port configuration

Identification Variables

Identification Variables

Identification variables are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
0-34	64 : 01 : 01 - 64 : 01 : 23		*(Not significant)*	
35-40	64 : 01 : 24 - 64 : 01 : 29	Word[6]	Expansion commercial reference (See DT_CommercialReference, page 102)	1
41-45	64 : 01 : 2A - 64 : 01 : 2E	Word[5]	Expansion serial number	1
46	64 : 01 : 2F	UInt	Expansion ID code	1
47	64 : 01 : 30	UInt	Expansion firmware version (See DT_FirmwareVersion, page 106)	1
48	64 : 01 : 31	UInt	Expansion compatibility code	1
49-60	64 : 01 : 32 - 64 : 01 : 3D		*(Not significant)*	
61	64 : 01 : 3E	UInt	Network port ID code	
62	64 : 01 : 3F	UInt	Network port firmware version (SeeDT_FirmwareVersion, page 106)	
63	64 : 01 : 40	UInt	Network port compatibility code	
64-69	64 : 01 : 41 - 64 : 01 : 46	Word[6]	Controller commercial reference (See DT_CommercialReference, page 102)	
70-74	64 : 01 : 47 - 64 : 01 : 4B	Word[5]	Controller serial number	
75	64 : 01 : 4C	UInt	Controller ID code	
76	64 : 01 : 4D	UInt	Controller firmware version (SeeDT_FirmwareVersion, page 106)	
77	64 : 01 : 4E	UInt	Controller compatibility code	
78	64 : 01 : 4F	UInt	Current scale ratio (0.1 %)	
79	64 : 01 : 50	UInt	Current sensor max	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
80	64 : 01 : 51		*(Not significant)*	
81	64 : 01 : 52	UInt	Current range max (x 0.1 A)	
82-94	64 : 01 : 53 - 64 : 01 : 5F		*(Not significant)*	
95	64 : 01 : 60	UInt	Load CT ratio (x 0.1 A)	
96	64 : 01 : 61	UInt	Full load current max (maximum FLC range, *FLC = Full Load Current*) (x 0.1 A)	
97-99	64 : 01 : 62 - 64 : 01 : 64		*(Forbidden)*	

Statistics Variables

Statistics Overview

Statistics variables are grouped according to the following criteria. Trip statistics are contained into a main table and an extension table.

Statistics Variable Groups	Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)
Global statistics	100-121	65 : 01 : 01 - 65 : 01 : 16
LTMR monitoring statistics	122-149	65 : 01 : 17 - 65 : 01 : 32
Last trip statistics	150-179	66 : 01 : 01 - 66 : 01 : 1E
and extension	300-309	67 : 01 : 01 - 67 : 01 : 0A
Trip n-1 statistics	180-209	66 : 01 : 1F - 66 : 01 : 3C
and extension	330-339	67 : 01 : 1F - 67 : 01 : 28
Trip n-2 statistics	210-239	66 : 01 : 3D - 66 : 01 : 5A
and extension	360-369	67 : 01 : 3D - 67 : 01 : 46
Trip n-3 statistics	240-269	66 : 01 : 5B - 66 : 01 : 78
and extension	390-399	67 : 01 : 5B - 67 : 01 : 64
Trip n-4 statistics	270-299	66 : 01 : 79 - 66 : 01 : 96
and extension	420-429	67 : 01 : 79 - 67 : 01 : 82

Global Statistics

The global statistics are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
100-101	65 : 01 : 01 - 65 : 01 : 02		*(Not significant)*	
102	65 : 01 : 03	UInt	Ground current trips count	
103	65 : 01 : 04	UInt	Thermal overload trips count	
104	65 : 01 : 05	UInt	Long start trips count	
105	65 : 01 : 06	UInt	Jam trips count	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
106	65 : 01 : 07	UInt	Current phase imbalance trips count	
107	65 : 01 : 08	UInt	Undercurrent trips count	
108	65 : 01 : 09	Uint	desc = (Not significant)	
109	65 : 01 : 0A	UInt	HMI port trips count	
110	65 : 01 : 0B	UInt	Controller internal trips count	
111	65 : 01 : 0C	UInt	Internal port trips count	
112	65 : 01 : 0D	UInt	*(Not significant)*	
113	65 : 01 : 0E	UInt	Network port config trips count	
114	65 : 01 : 0F	UInt	Network port trips count	
115	65 : 01 : 10	UInt	Auto-resets count	
116	65 : 01 : 11	UInt	Thermal overload alarms count	
117-118	65 : 01 : 12 - 65 : 01 : 13	UDInt	Motor starts count	
119-120	65 : 01 : 14 - 65 : 01 : 15	UDInt	Operating time (s)	
121	65 : 01 : 16	Int	Controller internal temperature max (°C)	

LTMR Monitoring Statistics

The LTMR monitoring statistics are described below:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
122	65 : 01 : 17	UInt	Trips count	
123	65 : 01 : 18	UInt	Alarms count	
124-125	65 : 01 : 19 - 65 : 01 : 1A	UDInt	Motor LO1 closings count	
126-127	65 : 01 : 1B - 65 : 01 : 1C	UDInt	Motor LO2 closings count	
128	65 : 01 : 1D	UInt	Diagnostic trips count	
129	65 : 01 : 1E	UInt	*(Reserved)*	
130	65 : 01 : 1F	UInt	Overcurrent trips count	
131	65 : 01 : 20	UInt	Current phase loss trips count	
132	65 : 01 : 21	UInt	Motor temperature sensor trips count	
133	65 : 01 : 22	UInt	Voltage phase imbalance trips count	1
134	65 : 01 : 23	UInt	Voltage phase loss trips count	1
135	65 : 01 : 24	UInt	Wiring trips count	1
136	65 : 01 : 25	UInt	Undervoltage trips count	1
137	65 : 01 : 26	UInt	Overvoltage trips count	1
138	65 : 01 : 27	UInt	Underpower trips count	1
139	65 : 01 : 28	UInt	Overpower trips count	1
140	65 : 01 : 29	UInt	Under power factor trips count	1

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
141	65 : 01 : 2A	UInt	Over power factor trips count	1
142	65 : 01 : 2B	UInt	Load sheddings count	1
143-144	65 : 01 : 2C - 65 : 01 : 2D	UDInt	Active power consumption (kWh)	1
145-146	65 : 01 : 2E - 65 : 01 : 2F	UDInt	Reactive power consumption (kVARh)	1
147	65 : 01 : 30	UInt	Auto restart immediate count	
148	65 : 01 : 31	UInt	Auto restart delayed count	
149	65 : 01 : 32	UInt	Auto restart manual count	

Last Trip (n-0) Statistics

The last trip statistics are completed by variables at register addresses 300 to 310.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
150	66 : 01 : 01	UInt	Trip code n-0	
151	66 : 01 : 02	UInt	Motor full load current ratio n-0 (% FLC max)	
152	66 : 01 : 03	UInt	Thermal capacity level n-0 (% trip level)	
153	66 : 01 : 04	UInt	Average current ratio n-0 (% FLC)	
154	66 : 01 : 05	UInt	L1 current ratio n-0 (% FLC)	
155	66 : 01 : 06	UInt	L2 current ratio n-0 (% FLC)	
156	66 : 01 : 07	UInt	L3 current ratio n-0 (% FLC)	
157	66 : 01 : 08	UInt	Ground current ratio n-0 (x 0.1 % FLC min)	
158	66 : 01 : 09	UInt	Full load current max n-0 (x 0.1 A)	
159	66 : 01 : 0A	UInt	Current phase imbalance n-0 (%)	
160	66 : 01 : 0B	UInt	Frequency n-0 (x 0.1 Hz)	
161	66 : 01 : 0C	UInt	Motor temperature sensor n-0 (x 0.1 Ω)	
162-165	66 : 01 : OD - 66 : 01 : 10	Word[4]	Date and time n-0 (See DT_DateTime, page 102)	
166	66 : 01 : 11	UInt	Average voltage n-0 (V)	1
167	66 : 01 : 12	UInt	L3-L1 voltage n-0 (V)	1
168	66 : 01 : 13	UInt	L1-L2 voltage n-0 (V)	1
169	66 : 01 : 14	UInt	L2-L3 voltage n-0 (V)	1
170	66 : 01 : 15	UInt	Voltage phase imbalance n-0 (%)	1
171	66 : 01 : 16	UInt	Active power n-0 (x 0.1 kW)	1
172	66 : 01 : 17	UInt	Power factor n-0 (x 0.01)	1
173-179	66 : 01 : 18 - 66 : 01 : 1E		*(Not significant)*	

N-1 Trip Statistics

The n-1 trip statistics are completed by variables at register addresses 330 to 340.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
180	66 : 01 : 1F	UInt	Trip code n-1	
181	66 : 01 : 20	UInt	Motor full load current ratio n-1 (% FLC max)	
182	66 : 01 : 21	UInt	Thermal capacity level n-1 (% trip level)	
183	66 : 01 : 22	UInt	Average current ratio n-1 (% FLC)	
184	66 : 01 : 23	UInt	L1 current ratio n-1 (% FLC)	
185	66 : 01 : 24	UInt	L2 current ratio n-1 (% FLC)	
186	66 : 01 : 25	UInt	L3 current ratio n-1 (% FLC)	
187	66 : 01 : 26	UInt	Ground current ratio n-1 (x 0.1 % FLC min)	
188	66 : 01 : 27	UInt	Full load current max n-1 (x 0.1 A)	
189	66 : 01 : 28	UInt	Current phase imbalance n-1 (%)	
190	66 : 01 : 29	UInt	Frequency n-1 (x 0.1 Hz)	
191	66 : 01 : 2A	UInt	Motor temperature sensor n-1 (x 0.1 Ω)	
192-195	66 : 01 : 2B - 66 : 01 : 2E	Word[4]	Date and time n-1 (See DT_DateTime, page 102)	
196	66 : 01 : 2F	UInt	Average voltage n-1 (V)	1
197	66 : 01 : 30	UInt	L3-L1 voltage n-1 (V)	1
198	66 : 01 : 31	UInt	L1-L2 voltage n-1 (V)	1
199	66 : 01 : 32	UInt	L2-L3 voltage n-1 (V)	1
200	66 : 01 : 33	UInt	Voltage phase imbalance n-1 (%)	1
201	66 : 01 : 34	UInt	Active power n-1 (x 0.1 kW)	1
202	66 : 01 : 35	UInt	Power factor n-1 (x 0.01)	1
203-209	66 : 01 : 36 - 66 : 01 : 3C	UInt	*(Not significant)*	

N-2 Trip Statistics

The n-2 trip statistics are completed by variables at register addresses 360 to 370.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
210	66 : 01 : 3D	UInt	Trip code n-2	
211	66 : 01 : 3E	UInt	Motor full load current ratio n-2 (% FLC max)	
212	66 : 01 : 3F	UInt	Thermal capacity level n-2 (% trip level)	
213	66 : 01 : 40	UInt	Average current ratio n-2 (% FLC)	
214	66 : 01 : 41	UInt	L1 current ratio n-2 (% FLC)	
215	66 : 01 : 42	UInt	L2 current ratio n-2 (% FLC)	
216	66 : 01 : 43	UInt	L3 current ratio n-2 (% FLC)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
217	66 : 01 : 44	UInt	Ground current ratio n-2 (x 0.1 % FLC min)	
218	66 : 01 : 45	UInt	Full load current max n-2 (x 0.1 A)	
219	66 : 01 : 46	UInt	Current phase imbalance n-2 (%)	
220	66 : 01 : 47	UInt	Frequency n-2 (x 0.1 Hz)	
221	66 : 01 : 48	UInt	Motor temperature sensor n-2 (x 0.1 Ω)	
222-225	66 : 01 : 49 - 66 : 01 : 4C	Word[4]	Date and time n-2 (See DT_DateTime, page 102)	
226	66 : 01 : 4D	UInt	Average voltage n-2 (V)	1
227	66 : 01 : 4E	UInt	L3-L1 voltage n-2 (V)	1
228	66 : 01 : 4F	UInt	L1-L2 voltage n-2 (V)	1
229	66 : 01 : 50	UInt	L2-L3 voltage n-2 (V)	1
230	66 : 01 : 51	UInt	Voltage phase imbalance n-2 (%)	1
231	66 : 01 : 52	UInt	Active power n-2 (x 0.1 kW)	1
232	66 : 01 : 53	UInt	Power factor n-2 (x 0.01)	1
233-239	66 : 01 : 54 - 66 : 01 : 5A		*(Not significant)*	

N-3 Trip Statistics

The n-3 trip statistics are completed by variables at register addresses 390 to 400.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
240	66 : 01 : 5B	UInt	Trip code n-3	
241	66 : 01 : 5C	UInt	Motor full load current ratio n-3 (% FLC max)	
242	66 : 01 : 5D	UInt	Thermal capacity level n-3 (% trip level)	
243	66 : 01 : 5E	UInt	Average current ratio n-3 (% FLC)	
244	66 : 01 : 5F	UInt	L1 current ratio n-3 (% FLC)	
245	66 : 01 : 60	UInt	L2 current ratio n-3 (% FLC)	
246	66 : 01 : 61	UInt	L3 current ratio n-3 (% FLC)	
247	66 : 01 : 62	UInt	Ground current ratio n-3 (x 0.1 % FLC min)	
248	66 : 01 : 63	UInt	Full load current max n-3 (0.1 A)	
249	66 : 01 : 64	UInt	Current phase imbalance n-3 (%)	
250	66 : 01 : 65	UInt	Frequency n-3 (x 0.1 Hz)	
251	66 : 01 : 66	UInt	Motor temperature sensor n-3 (x 0.1 Ω)	
252-255	66 : 01 : 67 -66 : 01 : 6A	Word[4]	Date and time n-3 (See DT_DateTime, page 102)	
256	66 : 01 : 6B	UInt	Average voltage n-3 (V)	1
257	66 : 01 : 6C	UInt	L3-L1 voltage n-3 (V)	1
258	66 : 01 : 6D	UInt	L1-L2 voltage n-3 (V)	1

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
259	66 : 01 : 6E	UInt	L2-L3 voltage n-3 (V)	1
260	66 : 01 : 6F	UInt	Voltage phase imbalance n-3 (%)	1
261	66 : 01 : 70	UInt	Active power n-3 (x 0.1 kW)	1
262	66 : 01 : 71	UInt	Power factor n-3 (x 0.01)	1
263-269	66 : 01 : 72 - 66 : 01 : 78		*(Not significant)*	

N-4 Trip Statistics

The n-4 trip statistics are completed by variables at register addresses 420 to 430.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
270	66 : 01 : 79	UInt	Trip code n-4	
271	66 : 01 : 7A	UInt	Motor full load current ratio n-4 (% FLC max)	
272	66 : 01 : 7B	UInt	Thermal capacity level n-4 (% trip level)	
273	66 : 01 : 7C	UInt	Average current ratio n-4 (% FLC)	
274	66 : 01 : 7D	UInt	L1 current ratio n-4 (% FLC)	
275	66 : 01 : 7E	UInt	L2 current ratio n-4 (% FLC)	
276	66 : 01 : 7F	UInt	L3 current ratio n-4 (% FLC)	
277	66 : 01 : 80	UInt	Ground current ratio n-4 (x 0.1 % FLC min)	
278	66 : 01 : 81	UInt	Full load current max n-4 (x 0.1 A)	
279	66 : 01 : 82	UInt	Current phase imbalance n-4 (%)	
280	66 : 01 : 83	UInt	Frequency n-4 (x 0.1 Hz)	
281	66 : 01 : 84	UInt	Motor temperature sensor n-4 (x 0.1 Ω)	
282-285	66 : 01 : 85 - 66 : 01 : 88	Word[4]	Date and time n-4 (See DT_DateTime, page 102)	
286	66 : 01 : 89	UInt	Average voltage n-4 (V)	1
287	66 : 01 : 8A	UInt	L3-L1 voltage n-4 (V)	1
288	66 : 01 : 8B	UInt	L1-L2 voltage n-4 (V)	1
289	66 : 01 : 8C	UInt	L2-L3 voltage n-4 (V)	1
290	66 : 01 : 8D	UInt	Voltage phase imbalance n-4 (%)	1
291	66 : 01 : 8E	UInt	Active power n-4 (x 0.1 kW)	1
292	66 : 01 : 8F	UInt	Power factor n-4 (x 0.01)	1
293-299	66 : 01 : 90 - 66 : 01 : 96		*(Not significant)*	

Last Trip (n-0) Statistics Extension

The last trip main statistics are listed at register addresses 150 to 179.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
300-301	67 : 01 : 01 - 67 : 01 : 02	UDInt	Average current n-0 (x 0.01 A)	
302-303	67 : 01 : 03 - 67 : 01 : 04	UDInt	L1 current n-0 (x 0.01 A)	
304-305	67 : 01 : 05 - 67 : 01 : 06	UDInt	L2 current n-0 (x 0.01 A)	
306-307	67 : 01 : 07 - 67 : 01 : 08	UDInt	L3 current n-0 (x 0.01 A)	
308-309	67 : 01 : 09 - 67 : 01 : 0A	UDInt	Ground current n-0 (mA)	
310	67 : 01 : 0B	UInt	Motor temperature sensor degree n-0 (°C)	

N-1 Trip Statistics Extension

The n-1 trip main statistics are listed at register addresses 180 to 209.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
330-331	67 : 01 : 1F - 67 : 01 : 20	UDInt	Average current n-1 (x 0.01 A)	
332-333	67 : 01 : 21 - 67 : 01 : 22	UDInt	L1 current n-1 (x 0.01 A)	
334-335	67 : 01 : 23 - 67 : 01 : 24	UDInt	L2 current n-1 (x 0.01 A)	
336-337	67 : 01 : 25 - 67 : 01 : 26	UDInt	L3 current n-1 (x 0.01 A)	
338-339	67 : 01 : 27 - 67 : 01 : 28	UDInt	Ground current n-1 (mA)	
340	67 : 01 : 29	UInt	Motor temperature sensor degree n-1 (°C)	

N-2 Trip Statistics Extension

The n-2 trip main statistics are listed at register addresses 210 to 239.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
360-361	67 : 01 : 3D - 67 : 01 : 3E	UDInt	Average current n-2 (x 0.01 A)	
362-363	67 : 01 : 3F - 67 : 01 : 40	UDInt	L1 current n-2 (x 0.01 A)	
364-365	67 : 01 : 41 - 67 : 01 : 42	UDInt	L2 current n-2 (x 0.01 A)	
366-367	67 : 01 : 43 - 67 : 01 : 44	UDInt	L3 current n-2 (x 0.01 A)	
368-369	67 : 01 : 45 - 67 : 01 : 46	UDInt	Ground current n-2 (mA)	
370	67 : 01 : 47	UInt	Motor temperature sensor degree n-2 (°C)	

N-3 Trip Statistics Extension

The n-3 trip main statistics are listed at register addresses 240 to 269.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
390-391	67 : 01 : 5B - 67 : 01 : 5C	UDInt	Average current n-3 (x 0.01 A)	
392-393	67 : 01 : 5D - 67 : 01 : 5E	UDInt	L1 current n-3 (x 0.01 A)	
394-395	67 : 01 : 5F - 67 : 01 : 60	UDInt	L2 current n-3 (x 0.01 A)	
396-397	67 : 01 : 61 - 67 : 01 : 62	UDInt	L3 current n-3 (x 0.01 A)	
398-399	67 : 01 : 63 - 67 : 01 : 64	UDInt	Ground current n-3 (mA)	
400	67 : 01 : 65	UInt	Motor temperature sensor degree n-3 (°C)	

N-4 Trip Statistics Extension

The n-4 trip main statistics are listed at register addresses 270 to 299.

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
420-421	67 : 01 : 79 - 67 : 01 : 7A	UDInt	Average current n-4 (x 0.01 A)	
422-423	67 : 01 : 7B - 67 : 01 : 7C	UDInt	L1 current n-4 (x 0.01 A)	
424-425	67 : 01 : 7D - 67 : 01 : 7E	UDInt	L2 current n-4 (x 0.01 A)	
426-427	67 : 01 : 7F - 67 : 01 : 80	UDInt	L3 current n-4 (x 0.01 A)	
428-429	67 : 01 : 81 - 67 : 01 : 82	UDInt	Ground current n-4 (mA)	
430	67 : 01 : 83	UInt	Motor temperature sensor degree n-4 (°C)	

Monitoring Variables

Monitoring Overview

Monitoring variables are grouped according to the following criteria:

Monitoring Variable groups	Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)
Monitoring of trips	450-454	68 : 01 : 01 to 68 : 01 : 05
Monitoring of status	455-459	68 : 01 : 06 to 68 : 01 : 0A
Monitoring of alarms	460-464	68 : 01 : 0B to 68 : 01 : 0F
Monitoring of measurements	465-539	68 : 01 : 10 to 68 : 01 : 5A
Extended monitoring for communication	2000-2099	82 : 01 : 01 to 82 : 01 : 64

Monitoring of Trips

Variables for monitoring of trips are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
450	68 : 01 : 01	UInt	Minimum wait time (s)	
451	68 : 01 : 02	UInt	Trip code (code of the last trip, or of the trip that takes priority) (See DT_EventCode, page 105.)	
452	68 : 01 : 03	Word	Trip register 1	
			bits 0-1 (Reserved)	
			bit 2 Ground current trip	
			bit 3 Thermal overload trip	
			bit 4 Long start trip	
			bit 5 Jam trip	
			bit 6 Current phase imbalance trip	
			bit 7 Undercurrent trip	
			bit 8 (Reserved)	
			bit 9 Test trip	
			bit 10 HMI port trip	
			bit 11 Controller internal temperature trip	
			bit 12 Internal port trip	
			bit 13 (Not significant)	
			bit 14 Network port config trip	
			bit 15 Network port trip	
453	68 : 01 : 04	Word	Trip register 2	
			bit 0 External system trip	
			bit 1 Diagnostic trip	
			bit 2 Wiring trip	
			bit 3 Overcurrent trip	
			bit 4 Current phase loss trip	
			bit 5 Current phase reversal trip	
			bit 6 Motor temperature sensor trip	1
			bit 7 Voltage phase imbalance trip	1
			bit 8 Voltage phase loss trip	1
			bit 9 Voltage phase reversal trip	1
			bit 10 Undervoltage trip	1
			bit 11 Overvoltage trip	1
			bit 12 Underpower trip	1
			bit 13 Overpower trip	1
			bit 14 Under power factor trip	1
			bit 15 Over power factor trip	1

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
454	68 : 01 : 05	Word	Trip register 3	
			bit 0 LTME configuration trip	
			bit 1 = LTMR configuration trip	
			bits 2-15 (Reserved)	

Monitoring of Status

Variables for monitoring of status are described below:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
455	68 : 01 : 06	Word	System status register 1	
			bit 0 System ready	
			bit 1 System on	
			bit 2 System trip	
			bit 3 System alarm	
			bit 4 System tripped	
			bit 5 trip reset authorized	
			bit 6 Controller power	
			bit 7 Motor running 0 = Stopped, average current below 5% FLCmin 1 = Running, average current above 20% FLCmin	
			bits 8-13 Motor average current ratio 32 = 100% FLC - 63 = 200% FLC	
			bit 14 Local/Remote Active Channel0 = Remote, 1 = Local	
			bit 15 Motor starting (start in progress) 0 = descending current was above the long start trip threshold, then crossed below 1 = ascending current is greater than 20% FLCmin	
456	68 : 01 : 07	Word	System status register 2	
			bit 0 Auto-reset active	
			bit 1 (Not significant)	
			bit 2 Controller power cycle requested	
			bit 3 Motor restart time undefined	
			bit 4 Rapid cycle lockout	
			bit 5 Load shedding	1
			bit 6 Motor speed 0 = FLC1 setting is used 1 = FLC2 setting is used	
			bit 7 HMI port comm loss	
			bit 8 Network port comm loss	
			bit 9 Motor transition lockout	
			bits 10-15 (Not significant)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
457	68 : 01 : 08	Word	Logic inputs status	
			bit 0 Logic input 1	
			bit 1 Logic input 2	
			bit 2 Logic input 3	
			bit 3 Logic input 4	
			bit 4 Logic input 5	
			bit 5 Logic input 6	
			bit 6 Logic input 7	
			bit 7 Logic input 8	1
			bit 8 Logic input 9	1
			bit 9 Logic input 10	1
			bit 10 Logic input 11	1
			bit 11 Logic input 12	1
			bit 12 Logic input 13	1
			bit 13 Logic input 14	1
			bit 14 Logic input 15	1
			bit 15 Logic input 16	1
458	68 : 01 : 09	Word	Logic outputs status	
			bit 0 Logic output 1	
			bit 1 Logic output 2	
			bit 2 Logic output 3	
			bit 3 Logic output 4	
			bit 4 Logic output 5	1
			bit 5 Logic output 6	1
			bit 6 Logic output 7	1
			bit 7 Logic output 8	1
			bits 8-15 (Reserved)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
459	68 : 01 : 0A	Word	I/O status	
			bit 0 Input 1	
			bit 1 Input 2	
			bit 2 Input 3	
			bit 3 Input 4	
			bit 4 Input 5	
			bit 5 Input 6	
			bit 6 Input 7	
			bit 7 Input 8	
			bit 8 Input 9	
			bit 9 Input 10	
			bit 10 Input 11	
			bit 11 Input 12	
			bit 12 Output 1 (13-14)	
			bit 13 Output 2 (23-24)	
			bit 14 Output 3 (33-34)	
			bit 15 Output 4 (95-96, 97-98)	

Monitoring of Alarms

Variables for monitoring of alarms are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
460	68 : 01 : 0B	UInt	Alarm code (See DT_IndicationCode, page 107.)	
461	68 : 01 : 0C	Word	Alarm register 1	
			bits 0-1 (Not significant)	
			bit 2 Ground current alarm	
			bit 3 Thermal overload alarm	
			bit 4 (Not significant)	
			bit 5 Jam alarm	
			bit 6 Current phase imbalance alarm	
			bit 7 Undercurrent alarm	
			bits 8-9 (Not significant)	
			bit 10 HMI port alarm	
			bit 11 Controller internal temperature alarm	
			bits 12-14 (Not significant)	
			bit 15 Network port alarm	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
462	68 : 01 : 0D	Word	Alarm register 2	
			bit 0 (Not significant)	
			bit 1 Diagnostic alarm	
			bit 2 (Not significant)	
			bit 3 Overcurrent alarm	
			bit 4 Current phase loss alarm	
			bit 5 Current phase reversal alarm	
			bit 6 Motor temperature sensor alarm	
			bit 7 Voltage phase imbalance alarm	1
			bit 8 Voltage phase loss alarm	1
			bit 9 (Not significant)	
			bit 10 Undervoltage alarm	1
			bit 11 Overvoltage alarm	1
			bit 12 Underpower alarm	1
			bit 13 Overpower alarm	1
			bit 14 Under power factor alarm	1
			bit 15 Over power factor alarm	1
463	68 : 01 : 0E	Word	Alarm register 3	
			bit 0 LTME configuration alarm	
			bits 1-15 (Reserved)	
464	68 : 01 : 0F	UInt	Motor temperature sensor degree (°C)	

Monitoring of Measurements

Variables for monitoring of measurements are described below:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
465	68 : 01 : 10	UInt	Thermal capacity level (% trip level)	
466	68 : 01 : 11	UInt	Average current ratio (% FLC)	
467	68 : 01 : 12	UInt	L1 current ratio (% FLC)	
468	68 : 01 : 13	UInt	L2 current ratio (% FLC)	
469	68 : 01 : 14	UInt	L3 current ratio (% FLC)	
470	68 : 01 : 15	UInt	Ground current ratio (x 0.1 % FLC min)	
471	68 : 01 : 16	UInt	Current phase imbalance (%)	
472	68 : 01 : 17	Int	Controller internal temperature (°C)	
473	68 : 01 : 18	UInt	Controller config checksum	
474	68 : 01 : 19	UInt	Frequency (x 0.01 Hz)	2
475	68 : 01 : 1A	UInt	Motor temperature sensor (x 0.1 Ω)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
476	68 : 01 : 1B	UInt	Average voltage (V)	1
477	68 : 01 : 1C	UInt	L3-L1 voltage (V)	1
478	68 : 01 : 1D	UInt	L1-L2 voltage (V)	1
479	68 : 01 : 1E	UInt	L2-L3 voltage (V)	1
480	68 : 01 : 1F	UInt	Voltage phase imbalance (%)	1
481	68 : 01 : 20	UInt	Power factor (x 0.01)	1
482	68 : 01 : 21	UInt	Active power (x 0.1 kW)	1
483	68 : 01 : 22	UInt	Reactive power (x 0.1 kVAR)	1
484	68 : 01 : 23	Word	Auto restart status register	
			bit 0 Voltage dip occurred	
			bit 1 Voltage dip detection	
			bit 2 Auto restart immediate condition	
			bit 3 Auto restart delayed condition	
			bit 4 Auto restart manual condition	
			bits 5-15 (Not significant)	
485	68 : 01 : 24	Word	Controller last power OFF duration	
486-489	68 : 01 : 25 - 68 : 01 : 28		*(Not significant)*	
490	68 : 01 : 29	Word	Network port monitoring	
			bits 0–7 (Not significant)	
			bits 8–11 Network port FDR status (refer to FDR Status, page 41)	
			bits 12–15 (Not significant)	
491	68 : 01 : 2A	UInt	Network port baud rate (See DT_ExtBaudRate, page 103.)	
492	68 : 01 : 2B		*(Not significant)*	
493	68 : 01 : 2C	UInt	Network port parity (See DT_ExtParity, page 104.)	
494-499	68 : 01 : 2D - 68 : 01 : 32		*(Not significant)*	
500-501	68 : 01 : 33 - 68 : 01 : 34	UDInt	Average current (x 0.01 A)	
502-503	68 : 01 : 35 - 68 : 01 : 36	UDInt	L1 current (x 0.01 A)	
504-505	68 : 01 : 37 - 68 : 01 : 38	UDInt	L2 current (x 0.01 A)	
506-507	68 : 01 : 39 - 68 : 01 : 3A	UDInt	L3 current (x 0.01 A)	
508-509	68 : 01 : 3B - 68 : 01 : 3C	UDInt	Ground current (mA)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
510	68 : 01 : 3D	UInt	Controller port ID	
511	68 : 01 : 3E	UInt	Time to trip (x 1 s)	
512	68 : 01 : 3F	UInt	Motor last start current ratio (% FLC)	
513	68 : 01 : 40	UInt	Motor last start duration (s)	
514	68 : 01 : 41	UInt	Motor starts per hour count	
515	68 : 01 : 42	Word	Phase imbalances register	
			bit 0 L1 current highest imbalance	
			bit 1 L2 current highest imbalance	
			bit 2 L3 current highest imbalance	
			bit 3 L1-L2 voltage highest imbalance	1
			bit 4 L2-L3 voltage highest imbalance	1
			bit 5 L3-L1 voltage highest imbalance	1
			bits 6-15 (Not significant)	
516-523	68 : 01 : 43 - 68 : 01 : 5A		*(Reserved)*	
524-539	68 : 01 : 4B - 68 : 01 : 5A		*(Forbidden)*	

Extended Monitoring for Communication

Variables for extended monitoring for communication are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2000-2001	82 : 01 : 01 - 82 : 01 : 02	Word[2]	Ethernet Basic Diag Validity	
			Register 2000:	
			bit 0: Ethernet services available (1=Yes)	
			bit 1: Ethernet global status available (1=Yes)	
			bits 2-14: *(Reserved)*	
			bit 15: Ethernet field extended 1 available (1=Yes)	
			Register 2001:	
			bit 0: Ethernet IP assignment mode available (1=Yes)	
			bit 1: Ethernet device name available (1=Yes)	
			bit 2: Ethernet MB messages received counter available (1= Yes)	
			bit 3: Ethernet MB messages sent counter available (1=Yes)	
			bit 4: Ethernet MB detected error messages sent counter available (1=Yes)	
			bit 5: Ethernet opened servers counter available (1=Yes)	
			bit 6: Ethernet opened clients counter available (1=Yes)	
			bit 7: Ethernet transmitted correct frames counter available (1=Yes)	
			bit 8: Ethernet received correct frames counter available (1= Yes)	
			bit 9: Ethernet frame format available (1=Yes)	
			bit 10: Ethernet MAC address available (1=Yes)	
			bit 11: Ethernet gateway available (1=Yes)	
			bit 12: Ethernet subnet mask available (1=Yes)	
			bit 13: Ethernet IP address available (1=Yes)	
			bit 14: Ethernet services status available (1=Yes)	
			bit 15: Ethernet field extended 2 available (1=Yes)	
2002	82 : 01 : 03	Word	Ethernet global status	
			bits 0-1: Ethernet global status 1= at least 1 enabled service is operating with an unresolved detected error 2 = all enabled services are operating properly	
			bits 2-15: *(Reserved)*	
2003	82 : 01 : 04	Word	Ethernet services validity	
			bit 0: Ethernet port 502 messaging available (1=Yes)	
			bits 1-15: *(Reserved)*	
2004	82 : 01 : 05	Word	Ethernet services status	
			bits 0-2: Ethernet port 502 messaging 1 = idle 2 = operational	
			bits 3-15: *(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2005-2006	82 : 01 : 06 - 82 : 01 : 07	UDInt	Ethernet IP address	
			Register 2005:	
			bits 0-7: first byte	
			bits 8-15: second byte	
			Register 2006:	
			bits 0-7: third byte	
			bits 8-15: fourth byte	
2007-2008	82 : 01 : 08 - 82 : 01 : 09	UDInt	Ethernet subnet mask	
			Register 2007:	
			bits 0-7: first byte	
			bits 8-15: second byte	
			Register 2008:	
			bits 0-7: third byte	
			bits 8-15: fourth byte	
2009-2010	82 : 01 : 0A - 82 : 01 : 0B	UDInt	Ethernet gateway address	
			Register 2009:	
			bits 0-7: first byte	
			bits 8-15: second byte	
			Register 2010:	
			bits 0-7: third byte	
			bits 8-15: fourth byte	
2011-2013	82 : 01 : 0C - 82 : 01 : 0E	Word[3]	Ethernet MAC Address	
			Register 2011:	
			bits 0-7: first hex byte	
			bits 8-15: second hex byte	
			Register 2012:	
			bits 0-7: third hex byte	
			bits 8-15: fourth hex byte	
			Register 2013:	
			bits 0-7: fifth hex byte	
			bits 8-15: sixth hex byte	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2014-2016	82 : 01 : 0F- 82 : 01 : 11	Word[3]	Ethernet II framing registers	
			Register 2014:	
			bit 0: Ethernet II framing supported (1=Yes)	
			bit 1: Ethernet II framing receiver supported (1=Yes)	
			bit 2: Ethernet II framing sender supported (1=Yes)	
			bit 3: Ethernet auto-detection supported (1=Yes)	
			bits 4-15: *(Reserved)*	
			Register 2015:	
			bit 0: Ethernet II framing configured (1=Yes)	
			bit 1: Ethernet II framing receiver configured (1=Yes)	
			bit 2:Ethernet II framing sender configured (1=Yes)	
			bit 3: Ethernet auto-detection configured (1=Yes)	
			bits 4-15: *(Reserved)*	
			Register 2016:	
			bit 0: Ethernet II framing operational (1=Yes)	
			bit 1: Ethernet II framing receiver operational (1=Yes)	
			bit 2: Ethernet II framing sender operational (1=Yes)	
			bit 3: Ethernet auto-detection operational (1=Yes)	
			bits 4-15: *(Reserved)*	
2017-2018	82 : 01 : 12 - 82 : 01 : 13	UDInt	Ethernet received correct frames counter	
2019-2020	82 : 01 : 14 - 82 : 01 : 15	UDInt	Ethernet transmitted correct frames counter	
2021	82 : 01 : 16	UInt	Ethernet opened clients counter	
2022	82 : 01 : 17	UInt	Ethernet opened servers counter	
2023-2024	82 : 01 : 18	UDInt	Ethernet MB error messages sent counter EIP address 82: 01 : 18-82: 01 : 19	
2025-2026	82 : 01 : 1A - 82 : 01 : 1B	UDInt	Ethernet MB messages sent counter	
2027-2028	82 : 01 : 1C - 82 : 01 : 1D	UDInt	Ethernet MB messages received counter	
2029-2036	82 : 01 : 1E - 82 : 01 : 25	Word[8]	Ethernet device name	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2037	82 : 01 : 26	Word	Ethernet IP assignment capability	
			bit 0: Ethernet IP served by name available (1 = Yes)	
			bit 1: Ethernet IP served by MAC BootP available (1 = Yes)	
			bit 2: Ethernet IP served by MAC DHCP available (1= Yes)	
			bit 3: Ethernet IP served by stored assignment available (1 = Yes)	
			bits 4-15: *(Reserved)*	
2038	82 : 01 : 27	Word	Ethernet IP assignment operational	
			bit 0: Ethernet IP served by name available (1 = Yes)	
			bit 1: Ethernet IP served by MAC BootP available (1 = Yes)	
			bit 2: Ethernet IP served by MAC DHCP available (1 = Yes)	
			bit 3: Ethernet IP served by stored assignment available (1 = Yes)	
			bits 4-15: *(Reserved)*	
2039-2099	82 : 01 : 28 - 82 : 01 : 64		*(Reserved)*	

Configuration Variables

Configuration Overview

Configuration variables are grouped according to the following criteria

Configuration Variable groups	Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)
Configuration	540-649	69 : 01 : 01 to 6A : 01 : 32
Setting	650-699	6B : 01 : 01 to 6B : 01 : 32
Extended settings for communication	3000-3120	96 : 01 : 01 to 96 : 01 : 79

Configuration Variables

The configuration variables are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
540	69 : 01 : 01	UInt	Motor operating mode 2 = 2-wire overload 3 = 3-wire overload 4 = 2-wire independent 5 = 3-wire independent 6 = 2-wire reverser 7 = 3-wire reverser 8 = 2-wire 2-step 9 = 3-wire 2-step 10 = 2-wire 2-speed 11 = 3-wire 2-speed 256-511 = Custom logic program (0-255)	B
541	69 : 01 : 02	UInt	Motor transition timeout (s)	
542-544	69 : 01 : 03 - 69 : 01 : 05		*(Reserved)*	
545	69 : 01 : 06	Word	Controller AC inputs setting register	
			bits 0-3 Controller AC logic inputs configuration (See DT_ACInputSetting, page 101)	
			bits 4-15 *(Reserved)*	
546	69 : 01 : 07	UInt	Thermal overload setting	B
			bits 0-2 Motor temperature sensor type: 0 = None 1 = PTC binary 2 = PT100 3 = PTC analog 4 = NTC analog	
			bits 3-4 Thermal overload mode: 0 = Definite 2 = Inverse thermal	
			bits 5-15 *(Reserved)*	
547	69 : 01 : 08	UInt	Thermal overload trip definite timeout (s)	
548	69 : 01 : 09		*(Reserved)*	
549	69 : 01 : 0A	UInt	Motor temperature sensor trip threshold (x 0.1 Ω)	
550	69 : 01 : 0B	UInt	Motor temperature sensor alarm threshold (x 0.1 Ω)	
551	69 : 01 : 0C	UInt	Motor temperature sensor trip threshold degree (°C)	
552	69 : 01 : 0D	UInt	Motor temperature sensor alarm threshold degree (°C)	
553	69 : 01 : 0E	UInt	Rapid cycle lockout timeout (s)	
554	69 : 01 : 0F		*(Reserved)*	
555	69 : 01 : 10	UInt	Current phase loss timeout (x 0.1 s)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
556	69 : 01 : 11	UInt	Overcurrent trip timeout (s)	
557	69 : 01 : 12	UInt	Overcurrent trip threshold (% FLC)	
558	69 : 01 : 13	UInt	Overcurrent alarm threshold (% FLC)	
559	69 : 01 : 14	Word	Ground current trip configuration	B
			bit 0 Ground current mode	
			bits 1-15 *(Reserved)*	
560	69 : 01 : 15	UInt	Ground CT primary	
561	69 : 01 : 16	UInt	Ground CT secondary	
562	69 : 01 : 17	UInt	External ground current trip timeout (x 0.01 s)	
563	69 : 01 : 18	UInt	External ground current trip threshold (x 0.01 A)	
564	69 : 01 : 19	UInt	External ground current alarm threshold (x 0.01 A)	
565	69 : 01 : 1A	UInt	Motor nominal voltage (V)	1
566	69 : 01 : 1B	UInt	Voltage phase imbalance trip timeout starting (x 0.1 s)	1
567	69 : 01 : 1C	UInt	Voltage phase imbalance trip timeout running (x 0.1 s)	1
568	69 : 01 : 1D	UInt	Voltage phase imbalance trip threshold (% imb)	1
569	69 : 01 : 1E	UInt	Voltage phase imbalance alarm threshold (% imb)	1
570	69 : 01 : 1F	UInt	Overvoltage trip timeout (x 0.1 s)	1
571	69 : 01 : 20	UInt	Overvoltage trip threshold (% Vnom)	1
572	69 : 01 : 21	UInt	Overvoltage alarm threshold (% Vnom)	1
573	69 : 01 : 22	UInt	Undervoltage trip timeout (x 0.1 s)	1
574	69 : 01 : 23	UInt	Undervoltage trip threshold (% Vnom)	1
575	69 : 01 : 24	UInt	Undervoltage alarm threshold (% Vnom)	1
576	69 : 01 : 25	UInt	Voltage phase loss trip timeout (x 0.1 s)	1
577	69 : 01 : 26	Word	Voltage dip setting	1
			bit 0 Load shedding enable	
			bit 1 Auto-restart enable	
			bits 2-15 *(Reserved)*	
578	69 : 01 : 27	UInt	Load shedding timeout (s)	1
579	69 : 01 : 28	UInt	Voltage dip threshold (% Vnom)	1
580	69 : 01 : 29	UInt	Voltage dip restart timeout (s)	1
581	69 : 01 : 2A	UInt	Voltage dip restart threshold (% Vnom)	1
582	69 : 01 : 2B	UInt	Auto restart immediate timeout (x 0.1 s)	
583	69 : 01 : 2C	UInt	Motor nominal power (x 0.1 kW)	1
584	69 : 01 : 2D	UInt	Overpower trip timeout (s)	1
585	69 : 01 : 2E	UInt	Overpower trip threshold (% Pnom)	1
586	69 : 01 : 2F	UInt	Overpower alarm threshold (% Pnom)	1
587	69 : 01 : 30	UInt	Underpower trip timeout (s)	1
588	69 : 01 : 31	UInt	Underpower trip threshold (% Pnom)	1
589	69 : 01 : 32	UInt	Underpower alarm threshold (% Pnom)	1

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
590	69 : 01 : 33	UInt	Under power factor trip timeout (x 0.1 s)	1
591	69 : 01 : 34	UInt	Under power factor trip threshold (x 0.01 PF)	1
592	69 : 01 : 35	UInt	Under power factor alarm threshold (x 0.01 PF)	1
593	69 : 01 : 36	UInt	Over power factor trip timeout (x 0.1 s)	1
594	69 : 01 : 37	UInt	Over power factor trip threshold (x 0.01 PF)	1
595	69 : 01 : 38	UInt	Over power factor alarm threshold (x 0.01 PF)	1
596	69 : 01 : 39	UInt	Auto restart delayed timeout (s)	
597-599	69 : 01 : 3A - 69 : 01 : 3C		*(Reserved)*	
600	6A : 01 : 01		*(Reserved)*	
601	6A : 01 : 02	Word	General configuration register 1	
			bit 0 Controller configuration required: 0 = exit the configuration menu 1 = go to the configuration menu	A
			bits 1-7 *(Reserved)*	
			Configuration access control, bits 8-10 (one bit is set to 1)	
			bit 8 Config via HMI keypad enable	
			bit 9 Config via HMI engineering tool enable	
			bit 10 Config via network port enable	
			bit 11 Motor star-delta	B
			bit 12 Motor phases sequence: 0 = A B C 1 = A C B	
			bits 13-14 Motor phases (See DT_PhaseNumber, page 107)	B
			bit 15 Motor auxiliary fan cooled (factory setting = 0)	
602	6A : 01 : 03	Word	General configuration register 2	
			bits 0-2 trip reset mode (See DT_ResetMode, page 107)	C
			bit 3 HMI port parity setting: 0 = none 1 = even (factory setting)	
			bits 4-8 *(Reserved)*	
			bit 9 HMI port endian setting	
			bit 10 Network port endian setting	
			bit 11 HMI motor status LED color	
			bits 12-15 *(Reserved)*	
603	6A : 01 : 04	UInt	HMI port address setting	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
604	6A : 01 : 05	UInt	HMI port baud rate setting (Baud)	
605	6A : 01 : 06		*(Reserved)*	
606	6A : 01 : 07	UInt	Motor trip class (s)	
607	6A : 01 : 08		*(Reserved)*	
608	6A : 01 : 09	UInt	Thermal overload trip reset threshold (% trip level)	
609	6A : 01 : 0A	UInt	Thermal overload alarm threshold (% trip level)	
610	6A : 01 : 0B	UInt	Internal ground current trip timeout (x 0.1 s)	
611	6A : 01 : 0C	UInt	Internal ground current trip threshold (% FLCmin)	
612	6A : 01 : 0D	UInt	Internal ground current alarm threshold (% FLCmin)	
613	6A : 01 : 0E	UInt	Current phase imbalance trip timeout starting (x 0.1 s)	
614	6A : 01 : 0F	UInt	Current phase imbalance trip timeout running (x 0.1 s)	
615	6A : 01 : 10	UInt	Current phase imbalance trip threshold (% imb)	
616	6A : 01 : 11	UInt	Current phase imbalance alarm threshold (% imb)	
617	6A : 01 : 12	UInt	Jam trip timeout (s)	
618	6A : 01 : 13	UInt	Jam trip threshold (% FLC)	
619	6A : 01 : 14	UInt	Jam alarm threshold (% FLC)	
620	6A : 01 : 15	UInt	Undercurrent trip timeout (s)	
621	6A : 01 : 16	UInt	Undercurrent trip threshold (% FLC)	
622	6A : 01 : 17	UInt	Undercurrent alarm threshold (% FLC)	
623	6A : 01 : 18	UInt	Long start trip timeout (s)	
624	6A : 01 : 19	UInt	Long start trip threshold (% FLC)	
625	6A : 01 : 1A		*(Reserved)*	
626	6A : 01 : 1B	UInt	HMI display contrast setting	
			bits 0-7 HMI display contrast setting	
			bits 8-15 HMI display brightness setting	
627	6A : 01 : 1C	UInt	Contactor rating (0.1 A)	
628	6A : 01 : 1D	UInt	Load CT primary	B
629	6A : 01 : 1E	UInt	Load CT secondary	B
630	6A : 01 : 1F	UInt	Load CT multiple passes (passes)	B

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
631	6A : 01 : 20	Word	Trip enable register 1	
			bits 0-1 *(Reserved)*	
			bit 2 Ground current trip enable	
			bit 3 Thermal overload trip enable	
			bit 4 Long start trip enable	
			bit 5 Jam trip enable	
			bit 6 Current phase imbalance trip enable	
			bit 7 Undercurrent trip enable	
			bit 8 *(Reserved)*	
			bit 9 Self test enable 0 = disable 1 = enable (factory setting)	
			bit 10 HMI port trip enable	
			bits 11-14 *(Reserved)*	
			bit 15 Network port trip enable	
632	6A : 01 : 21	Word	alarm enable register 1	
			bit 0 *(Reserved)*	
			bit 1 *(Reserved)*	
			bit 2 Ground current alarm enable	
			bit 3 Thermal overload alarm enable	
			bit 4 *(Reserved)*	
			bit 5 Jam alarm enable	
			bit 6 Current phase imbalance alarm enable	
			bit 7 Undercurrent alarm enable	
			bits 8-9 *(Reserved)*	
			bit 10 HMI port alarm enable	
			bit 11 Controller internal temperature alarm enable	
			bits 12-14 *(Reserved)*	
			bit 15 Network port alarm enable	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
633	6A : 01 : 22	Word	Trip enable register 2	
			bit 0 *(Reserved)*	
			bit 1 Diagnostic trip enable	
			bit 2 Wiring trip enable	
			bit 3 Overcurrent trip enable	
			bit 4 Current phase loss trip enable	
			bit 5 Current phase reversal trip enable	
			bit 6 Motor temperature sensor trip enable	
			bit 7 Voltage phase imbalance trip enable	1
			bit 8 Voltage phase loss trip enable	1
			bit 9 Voltage phase reversal trip enable	1
			bit 10 Undervoltage trip enable	1
			bit 11 Overvoltage trip enable	1
			bit 12 Underpower trip enable	1
			bit 13 Overpower trip enable	1
			bit 14 Under power factor trip enable	1
			bit 15 Over power factor trip enable	1
634	6A : 01 : 23	Word	alarm enable register 2	
			bit 0 *(Reserved)*	
			bit 1 Diagnostic alarm enable	
			bit 2 *(Reserved)*	
			bit 3 Overcurrent alarm enable	
			bit 4 Current phase loss alarm enable	
			bit 5 *(Reserved)*	
			bit 6 Motor temperature sensor alarm enable	
			bit 7 Voltage phase imbalance alarm enable	1
			bit 8 Voltage phase loss alarm enable	1
			bit 9 *(Reserved)*	1
			bit 10 Undervoltage alarm enable	1
			bit 11 Overvoltage alarm enable	1
			bit 12 Underpower alarm enable	1
			bit 13 Overpower alarm enable	1
			bit 14 Under power factor alarm enable	1
			bit 15 Over power factor alarm enable	1
635-636	6A : 01 : 24 - 6A : 01 : 25		*(Reserved)*	
637	6A : 01 : 26	UInt	Auto-reset attempts group 1 setting	
638	6A : 01 : 27	UInt	Auto-reset group 1 timeout	
639	6A : 01 : 28	UInt	Auto-reset attempts group 2 setting	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
640	6A : 01 : 29	UInt	Auto-reset group 2 timeout	
641	6A : 01 : 2A	UInt	Auto-reset attempts group 3 setting	
642	6A : 01 : 2B	UInt	Auto-reset group 3 timeout	
643	6A : 01 : 2C	UInt	Motor step 1 to 2 timeout	
644	6A : 01 : 2D	UInt	Motor step 1 to 2 threshold	
645	6A : 01 : 2E	UInt	HMI port fallback setting (See DT_OutputFallbackStrategy, page 106)	
646-649	6A : 01 : 2F - 6A : 01 : 32		*(Reserved)*	

Setting Variables

The setting variables are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
650	6B : 01 : 01	Word	HMI language setting register:	
			bit 0-4 HMI language setting (See DT_Language5, page 106)	
			bits 5-15 *(Not significant)*	
651	6B : 01 : 02	Word	HMI display items register 1	
			bit 0 HMI display average current enable	
			bit 1 HMI display thermal capacity level enable	
			bit 2 HMI display L1 current enable	
			bit 3 HMI display L2 current enable	
			bit 4 HMI display L3 current enable	
			bit 5 HMI display ground current enable	
			bit 6 HMI display motor status enable	
			bit 7 HMI display current phase imbalance enable	
			bit 8 HMI display operating time enable	
			bit 9 HMI display I/O status enable	
			bit 10 HMI display reactive power enable	
			bit 11 HMI display frequency enable	
			bit 12 HMI display starts per hour enable	
			bit 13 HMI display control mode enable	
			bit 14 HMI display start statistics enable	
			bit 15 HMI motor temperature sensor enable	
652	6B : 01 : 03	UInt	Motor full load current ratio, FLC1 (% FLCmax)	
653	6B : 01 : 04	UInt	Motor high speed full load current ratio, FLC2 (% FLCmax)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
654	6B : 01 : 05	Word	HMI display items register 2	
			bit 0 HMI display L1-L2 voltage enable	1
			bit 1 HMI display L2-L3 voltage enable	1
			bit 2 HMI display L3-L1 voltage enable	1
			bit 3 HMI display average voltage enable	1
			bit 4 HMI display active power enable	1
			bit 5 HMI display power consumption enable	1
			bit 6 HMI display power factor enable	1
			bit 7 HMI display average current ratio enable	
			bit 8 HMI display L1 current ratio enable	1
			bit 9 HMI display L2 current ratio enable	1
			bit 10 HMI display L3 current ratio enable	1
			bit 11 HMI display thermal capacity remaining enable	
			bit 12 HMI display time to trip enable	
			bit 13 HMI display voltage phase imbalance enable	1
			bit 14 HMI display date enable	
			bit 15 HMI display time enable	
655-658	6B : 01 : 06 - 6B : 01 : 09	Word[4]	Date and time setting (See DT_DateTime, page 102)	
659	6B : 01 : 0A	Word	HMI display items register 3	
			bit 0 HMI display temperature sensor degree CF	
			bits 1-15 *(Reserved)*	
660-681	6B : 01 : 0B - 6B : 01 : 20		Range : 1.....360	
682	6B : 01 : 21	UInt	Network port fallback setting (See DT_OutputFallbackStrategy, page 106)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
683	6B : 01 : 22	Word	Control setting register	
			bits 0-1 *(Reserved)*	
			bit 2 Control remote local default mode (with LTMCU) 0 = remote 1 = local	
			bit 3 *(Reserved)*	
			bit 4 Control remote local buttons enable (with LTMCU) 0 = disable 1 = enable	
			bits 5-6 Control remote channel setting (with LTMCU) 0 = network 1 = terminal strip 2 = HMI	
			bit 7 *(Reserved)*	
			bit 8 Control local channel setting 0 = terminal strip 1 = HMI	
			bit 9 Control direct transition 0 = stop required during transition 1 = stop not required during transition	
			bit 10 Control transfer mode 0 = bump 1 = bumpless	
			bit 11 Stop terminal strip disable 0 = enable 1 = disable	
			bit 12 Stop HMI disable 0 = enable 1 = disable	
			bits 13-15 *(Reserved)*	
684-689	6B : 01 : 23 - 6B : 01 : 28		*(Reserved*)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
690	6B : 01 : 29	Word	bits 0-1 Network frame type 00 = Ethernet II 01= IEEE 802.3	
			bit 2 FDR auto-restore upon power-up 0 = Enable (default) 1 = Disable	
			bit 3 FDR auto-backup synchronization 0 = Disable (default) 1 = Enable	
			bits 4-15 (Reserved)	
691-692			*(Reserved)*	
693	6B : 01 : 2B	UInt	Network port comm loss timeout (x 0.01 s)	
694-696			*(Reserved)*	
697	6B : 01 : 30		Network port FDR auto backup period setting	
698-699	6B : 01 : 31 - 6B : 01 : 32		*(Not significant)*	

Extended Configuration Variables for Communication

The extended configuration variables are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
3000-3001	96 : 01 : 01 - 96 : 01 : 02	UDInt	EtherNet/IP address setting	
3002-3003	96 : 01 : 03 - 96 : 01 : 04	UDInt	Ethernet subnet mask setting	
3004-3005	96 : 01 : 05 - 96 : 01 : 06	UDInt	Ethernet gateway address setting	
3006-3009	96 : 01 : 07 - 96 : 01 : 09		*(Reserved)*	
3010-3011	96 : 01 : 0B - 96 : 01 : 0C	UDInt	Ethernet primary IP address setting	
3012-3013	96 : 01 : 0D - 96 : 01 : 0E	UDInt	Ethernet SNMP manager address 1 setting	
3014-3015	96 : 01 : 0F - 96 : 01 : 10	UDInt	Ethernet SNMP manager address 2 setting	
3016-3031	96 : 01 : 11 - 96 : 01 : 20	Word[16]	Ethernet SNMP system name setting	
3032–3047	96 : 01 : 21 - 96 : 01 : 30	Word[16]	Ethernet SNMP system location setting	
3048–3063	96 : 01 : 31 - 96 : 01 : 40	Word[16]	Ethernet SNMP system contact setting	
3064–3071	96 : 01 : 41 - 96 : 01 : 48	Word[8]	Ethernet SNMP community name get setting	
3072–3079	96 : 01 : 49 - 96 : 01 : 50	Word[8]	Ethernet SNMP community name set setting	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
3080–3087	96 : 01 : 51 - 96 : 01 : 58	Word[8]	Ethernet SNMP community name trap setting	
3088	96 : 01 : 59	Word	RSTP Enable	
3089	96 : 01 : 5A	Word	Ethernet RSTP bridge priority	
3090	96 : 01 : 5B	Word	Ethernet RSTP hello time	
3091	96 : 01 : 5C	Word	Ethernet RSTP max age time	
3092	96 : 01 : 5D	Word	Ethernet RSTP transmit count	
3093	96 : 01 : 5E	Word	Ethernet RSTP forward delay	
3094	96 : 01 : 5F	Word	Ethernet RSTP port count	
3095	96 : 01 : 60	Word	Ethernet RSTP port 1 priority	
3096-3097	96 : 01 : 61 - 96 : 01 : 62	UDInt	Ethernet RSTP port 1 past cost	
3098	96 : 01 : 63	Word	Ethernet RSTP port 1 select	
3099	96 : 01 : 64	Word	Ethernet RSTP port 2 priority	
3100-3101	96 : 01 : 65 - 96 : 01 : 66	UDInt	Ethernet RSTP port 2 path cost	
3102	96 : 01 : 67	Word	Ethernet RSTP port 2 select	
3103	96 : 01 : 68	Word	Ethernet extended configuration control	
3104	96 : 01 : 69	Word	Ethernet broadcast storm protection	
			1: 64 kbps Bandwidth (Default Value)	
			2: 128 kbps Bandwidth	
			3: 256 kbps Bandwidth	
			4: 512 kbps Bandwidth	
			5: 1000 kbps Bandwidth	
			6: 2000 kbps Bandwidth	
3105	96 : 01 : 6A	Word	Ethernet QoS control	
3106	96 : 01 : 6B	Word	Ethernet QoS CIP class 0/1 urgent	
			bits 0-3 Ethernet QoS CIP class 0/1 urgent queue priority	
			bits 4-7 Ethernet QoS CIP class 0/1 urgent 8021 priority	
			bits 8-11 Ethernet QoS CIP class 0/1 urgent DSCP	
			bits 12-15 *(Reserved)*	
3107	96 : 01 : 6C	Word	Ethernet QoS CIP class 0/1 scheduled	
			bits 0-3 Ethernet QoS CIP class 0/1 scheduled queue priority	
			bits 4-7 Ethernet QoS CIP class 0/1 scheduled 8021 priority	
			bits 8-11 Ethernet QoS CIP class 0/1 scheduled DSCP	
			bits 12-15 *(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
3108	96 : 01 : 6D	Word	Ethernet QoS CIP class 0/1 high	
			bits 0-3 Ethernet QoS CIP class 0/1 high queue priority	
			bits 4-7 Ethernet QoS CIP class 0/1 high 8021 priority	
			bits 8-11 Ethernet QoS CIP class 0/1 high DSCP	
			bits 12-15 *(Reserved)*	
3109	96 : 01 : 6E	Word	Ethernet QoS CIP class 0/1 low	
			bits 0-3 Ethernet QoS CIP class 0/1 low queue priority	
			bits 4-7 Ethernet QoS CIP class 0/1 low 8021 priority	
			bits 8-11 Ethernet QoS CIP class 0/1 low DSCP	
			bits 12-15 *(Reserved)*	
3110	96 : 01 : 6F	Word	Ethernet QoS CIP UCMM class 3	
			bits 0-3 Ethernet QoS CIP UCMM class 3 queue priority	
			bits 4-7 Ethernet QoS CIP UCMM class 3 8021 priority	
			bits 8-11 Ethernet QoS CIP UCMM class 3 DSCP	
			bits 12-15 *(Reserved)*	
3111	96 : 01 : 70	Word	Ethernet QoS PTP general	
			bits 0-3: Ethernet QoS PTP general queue priority	
			bits 4-7: Ethernet QoS PTP general 8021 priority	
			bits 8-11: Ethernet QoS PTP general DSCP	
			bits 12-15 *(Reserved)*	
3112	96 : 01 : 71	Word	Ethernet QoS PTP event	
			bits 0-3: Ethernet QoS PTP event queue priority	
			bits 4-7: Ethernet QoS PTP event 8021 priority	
			bits 8-11: Ethernet QoS PTP event DSCP	
			bits 12-15 *(Reserved)*	
3113	96 : 01 : 72	Word	Ethernet QoS default outbound priority	
3114	96 : 01 : 73	Word	Ethernet QoS number of ports	
3115	96 : 01 : 74	Word	Ethernet QoS port 1 default inbound priority	
3116	96 : 01 : 75	Word	Ethernet QoS port 2 default inbound priority	
3117	96 : 01 : 76	Word	Ethernet QoS device control	
3118	96 : 01 : 77	UDInt	EtherNet/IP capabilities control	
03120	96 : 01 : 79	Word	IP Allowlist Enable	
			0 = disable	
			1 = enable	
03121	96 : 01 : 7A	UDInt	IP Allowlist Address 1	
03123	96 : 01 : 7C	UDInt	IP Allowlist Subnet Mask 1	
03125	96 : 01 : 7E	UDInt	IP Allowlist Address 2	
03127	96 : 01 : 80	UDInt	IP Allowlist Subnet Mask 2	
03129	96 : 01 : 82	UDInt	IP Allowlist Address 3	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
03131	96 : 01 : 84	UDInt	IP Allowlist Subnet Mask 3	
03133	96 : 01 : 86	UDInt	IP Allowlist Address 4	
03135	96 : 01 : 88	UDInt	IP Allowlist Subnet Mask 4	
03137	96 : 01 : 8A	UDInt	IP Allowlist Address 5	
03139	96 : 01 : 8C	UDInt	IP Allowlist Subnet Mask 5	

Command Variables

Command Variables

Command variables are described in the following table:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
700	6C : 01 : 01	Word	Register available to remotely write commands that can be processed in a specific Custom Logic Behavior for comm loss when Comm Loss Alarms & Trips are disabled • no comms from Primary IP = no alarm, no trip • all link down = Alarm (network port alarm), no trip	
			Logic outputs command register	
			bit 0 Logic output 1 command	
			bit 1 Logic output 2 command	
			bit 2 Logic output 3 command	
			bit 3 Logic output 4 command	
			bit 4 Logic output 5 command	1
			bit 5 Logic output 6 command	1
			bit 6 Logic output 7 command	1
			bit 7 Logic output 8 command	1
			bits 8-15 *(Reserved)*	
701-703	6C : 01 : 02 - 6C : 01 : 04		*(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
704	6C : 01 : 05	Word	Control register 1	
			bit 0 Motor run forward command [7]	
			bit 1 Motor run reverse command[7]	
			bit 2 (Reserved)	
			bit 3 Trip reset command	
			bit 4 (Reserved)	
			bit 5 Self test command	
			bit 6 Motor low speed command	
			bits 7-15 (Reserved)	
705	6C : 01 : 06	Word	Control register 2	
			bit 0 Clear all command Clear all parameters, except: • Motor LO1 closings count • Motor LO2 closings count • Controller internal temperature max • Thermal capacity level	
			bit 1 Clear statistics command	
			bit 2 Clear thermal capacity level command	
			bit 3 Clear controller settings command	
			bit 4 Clear network port settings command	
			bit 5 FDR manual backup command	
			bit 6 FDR manual restore command	
			bits 7-15 (Reserved)	
706-709	6C : 01 : 07 - 6C : 01 : 0A		*(Reserved)*	
710-799	6C : 01 : 08 - 6C : 01 : 64		*(Forbidden)*	

User Map Variables

Overview

User Map variables are designed to optimize the access to several non-contiguous registers in one single request.

You can define several read and write areas.

The user map can be defined via:

- A PC running SoMove with TeSys T DTM
- A PLC via the network port

7. Even in overload mode, bits 0 and 1 of register 704 can be used to remotely control LO1 and LO2.

User Map Variables

User Map Variables are described in the following table:

User Map Variable Groups	Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)
User Map addresses	800-899	6D : 01 : 01 - 6D : 01 : 64
User Map values	900-999	6E : 01 : 01 - 6E : 01 : 64

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
800-898	6D : 01 : 01 - 6D : 01 : 63	Word[99]	User map addresses setting	
899	6D : 01 : 64	Word	*(Reserved)*	
Modbus/TCP (Register Addresses)	**EtherNet/IP (Object Addresses)**	**Variable Type**	**Read/Write Variables**	**Note, page 99**
900-998	6E : 01 : 01 - 6E : 01 : 63	Word[99]	User map values	
999	6E : 01 : 64	Word	*(Reserved)*	

The User Map Address group is used to select a list of addresses to read or write. It can be considered as a configuration area.

The User Map Value group is used to read or write values associated to addresses configured in the User Map Address area:

- Read or write of register 900 allows to read or write the register address defined in register 800
- Read or write of register 901 allows to read or write the register address defined in register 801,-

Example of Use

The User Map Address configuration below gives an example of user map address configuration to access non-contiguous registers:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Value Configured	Read/Write Variables
800	6D : 01 : 01	452	Trip register 1
801	6D : 01 : 02	453	Trip register 2
802	6D : 01 : 03	461	Alarm register 1
803	6D : 01 : 04	462	Alarm register 2
804	6D : 01 : 05	450	Minimum wait time
805	6D : 01 : 06	500	Average current (0.01 A) MSW
806	6D : 01 : 07	501	Average current (0.01 A) LSW
850	6D : 01 : 51	651	HMI display items register 1
851	6D : 01 : 52	654	HMI display items register 2
852	6D : 01 : 53	705	Control register 2

With this configuration, monitoring information is accessible with one single read request through register addresses 900 to 906.

Configuration and command can be written with one single write using register addresses 950 to 952.

Custom Logic Variables

Custom Logic Variables

Custom logic variables are described in the following tables:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
1200		Word	Custom logic status register	
			bit 0 Custom logic run	
			bit 1 Custom logic stop	
			bit 2 Custom logic reset	
			bit 3 Custom logic second step	
			bit 4 Custom logic transition	
			bit 5 Custom logic phase reverse	
			bit 6 Custom logic network control	
			bit 7 Custom logic FLC selection	
			bit 8 (Reserved)	
			bit 9 Custom logic auxiliary 1 LED	
			bit 10 Custom logic auxiliary 2 LED	
			bit 11 Custom logic stop LED	
			bit 12 Custom logic LO1	
			bit 13 Custom logic LO2	
			bit 14 Custom logic LO3	
			bit 15 Custom logic LO4	
1201		Word	Custom logic version	
1202		Word	Custom logic memory space	
1203		Word	Custom logic memory used	
1204		Word	Custom logic temporary space	
1205		Word	Custom logic non volatile space	
1206-1249			*(Reserved)*	
1250	71:01:33	Word	Custom logic setting register 1	
			bit 0 (Reserved)	
			bit 1 Logic input 3 external ready enable	
			bits 2-15 (Reserved)	
1251-1269	71:01:34 - 71:01:46		*(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
1270	71:01:47	Word	Custom logic command register 1	
			bit 0 Custom logic external trip command	
			bits 1-15 (Reserved)	
1271-1279	71:01:48 - 71:01:50		*(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
1280	71:01:51	Word	Custom logic monitoring register 1	
			bit 0 (Reserved)	
			bit 1 Custom logic system ready	
			bits 2-15 (Reserved)	
1281-1300	71:01:52 - 71:01:65		*(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
1301-1399	71:01:66 - 71: 01: C8	Word[99]	General purpose registers for logic functions	

Mirroring Variables

Mirroring Variables

Mirroring variables are updated to present—in a series of contiguous registers—the values of other high priority status, I/O and control registers, as follows:

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2500	8C : 01 : 01	Word	Mirror status register **NOTE:** Valid only for Ethernet. Values will read 0 over Modbus RTU (HMI port).	
			bit 0 Input table freshness 0 = table has been read within 100 ms 1 = table has not been read within 100 ms	
			bit 1 Input table validity 0 = table data is invalid 1 = table data is valid	
			bit 2 Input table changed 0 = table data is unchanged from last read 1 = table data is changed from last read	
			bits 3-7 (Reserved)	
			bit 8 Output table freshness 0 = table has been read within 100 ms 1 = table has not been read within 100 ms	
			bit 9 Output table validity 0 = table data is invalid 1 = table data is valid	
			bit 10 Output table changed 0 = table data is unchanged from last read 1 = table data is changed from last read	
			bits 11-15 (Reserved)	
2501	8C : 01 : 02	Word	*(Reserved)*	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2502	8C : 01 : 03	Word	Mirrors System Status Register 1 (register 455 or object 68 : 01 : 06)	
			bit 0 mirrors System Ready	
			bit 1 mirrors System On	
			bit 2 mirrors System Trip	
			bit 3 mirrors System Alarm	
			bit 4 mirrors System Tripped	
			bit 5 mirrors trip Reset Authorized	
			bit 6 mirrors Controller Power	
			bit 7 mirrors Motor Running 0 = Stopped, average current below 5% FLCmin 1 = Running, average current above 20% FLCmin	
			bits 8-13 mirrors Motor Average Current Ratio 32 = 100% FLC - 63 = 200% FLC	
			bit 14 mirrors In remote	
			bit 15 mirrors Motor Starting (start in progress) 0 = descending current was above the long start trip threshold, then crossed below 1 = ascending current is greater than 20% FLCmin	
2503	8C : 01 : 04	Word	Mirrors System Status Register 2 (register 456 or object 68 : 01 : 07)	
			bit 0 mirrors Auto-reset Active	
			bit 1 *(Not significant)*	
			bit 2 mirrors Controller Power Cycle Requested	
			bit 3 mirrors Motor Restart Time Undefined	
			bit 4 mirrors Rapid Cycle Lockout	
			bit 5 mirrors Load Shedding	1
			bit 6 mirrors Motor Speed 0 = FLC1 setting is used 1 = FLC2 setting is used	
			bit 7 mirrors HMI Port Comm Loss	
			bit 8 mirrors Network Port Comm Loss	
			bit 9 mirrors Motor Transition Lockout	
			bits 10-15 (Not significant)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read-only Variables	Note, page 99
2504	8C : 01 : 05	Word	Mirrors Logic Inputs Status (register 457 or object 68 : 01 : 08)	
			bit 0 mirrors Logic Input 1	
			bit 1 mirrors Logic Input 2	
			bit 2 mirrors Logic Input 3	
			bit 3 mirrors Logic Input 4	
			bit 4 mirrors Logic Input 5	
			bit 5 mirrors Logic Input 6	
			bit 6 mirrors Logic Input 7	
			bit 7 mirrors Logic Input 8	1
			bit 8 mirrors Logic Input 9	1
			bit 9 mirrors Logic Input 10	1
			bit 10 mirrors Logic Input 11	1
			bit 11 mirrors Logic Input 12	1
			bit 12 mirrors Logic Input 13	1
			bit 13 mirrors Logic Input 14	1
			bit 14 mirrors Logic Input 15	1
			bit 15 mirrors Logic Input 16	1
2505	8C : 01 : 06	Word	Logic outputs status (register 458 or object 68 : 01 : 09)	
			bit 0 mirrors Logic Output 1	
			bit 1 mirrors Logic Output 2	
			bit 2 mirrors Logic Output 3	
			bit 3 mirrors Logic Output 4	
			bit 4 mirrors Logic Output 5	1
			bit 5 mirrors Logic Output 6	1
			bit 6 mirrors Logic Output 7	1
			bit 7 mirrors Logic Output 8	1
			bits 8-15 (Reserved)	

Modbus/TCP (Register Addresses)	EtherNet/IP (Object Addresses)	Variable Type	Read/Write Variables	Note, page 99
2506	8C : 01 : 07	Word	Logic Outputs Command Register for Custom Logic (register 700 or object 6C : 01 : 01)	
			bit 0 mirrors Logic Output 1 Command	
			bit 1 mirrors Logic Output 2 Command	
			bit 2 mirrors Logic Output 3 Command	
			bit 3 mirrors Logic Output 4 Command	
			bit 4 mirrors Logic Output 5 Command	1
			bit 5 mirrors Logic Output 6 Command	1
			bit 6 mirrors Logic Output 7 Command	1
			bit 7 mirrors Logic Output 8 Command	1
			bits 8-15 (Reserved)	
2507	8C : 01 : 08	Word	Control Register 1 (register 704 or object 6C : 01 : 05)	
			bit 0 mirrors Motor Run Forward Command	
			bit 1 mirrors Motor Run Reverse Command	
			bit 2 (Reserved)	
			bit 3 mirrors trip Reset Command	
			bit 4 (Reserved)	
			bit 5 mirrors Self Test Command	
			bit 6 mirrors Motor Low Speed Command	
			bits 7-15 (Reserved)	
2508	8C : 01 : 09	Word	Analog Output 1 Command (register 706 or object 6C : 01 : 07)	
2509-2599	8C : 01 : 0A - 8C : 01 : 64	–	*(Reserved)*	

Using the Standard Web Server User Interface

Overview

This chapter describes the functions of the standard Web server pages and how to use the data to operate an LTMR controller with or without an LTME expansion module.

Description of the Standard Web Server User Interface

Overview

The standard Web server pages provide an LTMR embedded HMI which can be accessed using a standard web browser supported by:

- Microsoft Internet Explorer version 8 or later
- Mozilla Firefox version 13 or later
- Google Chrome version 19 or later

Java Free Web Pages

The latest versions of web pages are developed on a technology called as Lightweight Web App (LWA). The web pages are independent from Java backbone, works under any environment (XP, Windows 7, Windows 8, and so on), and also on all web browsers (Microsoft Internet Explorer, Mozilla Firefox, and Google Chrome). TeSys T new web pages works on PC without Java installation.

Functions of the Web Server User Interface

The following table describes all the functions of the Web server pages. Some functions are available according to the configuration (for example functions available only if LTME is connected).

NOTE: After making changes in the settings, some data (such as Motor Temperature Measurement) will not be valid until after a power cycle.

Menu	Information Displayed	Function
HOME	Home page	Identification of the connected product: LTMR controller with/without LTME expansion module
	Language	Display of the pages in the selected language
	Identification	Activation and deactivation of data modification mode
DOCUMENTATION	References	Link to the https://www.se.com website
MONITORING	Product status	Display of information from input/output status and the internal product status
	Metering	Display of measured data with numerical value and graphical representation

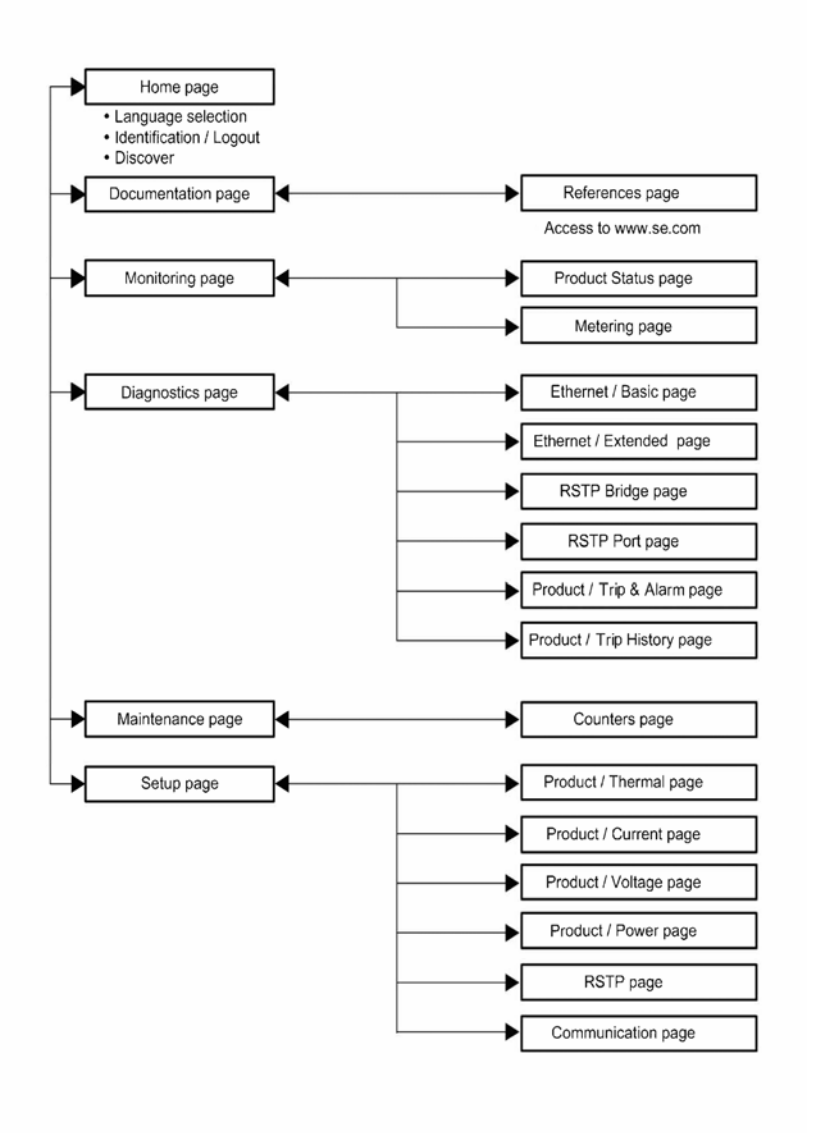
Menu	Information Displayed	Function
DIAGNOSTICS	Ethernet basic diagnostics	Display of information on the IP parameters, FDR, device name and the protocol
	Ethernet extended diagnostics	Display of communication statistics for each port
	RSTP bridge	Display and reset (password-protected) of statistics
	RSTP port	Display and reset (password-protected) of statistics and status for the ports 1 and 2
	Trips and Alarms	Display Trips, and Alarm status. Alarm and trips count, if any.
	Trip history	Display and reset (password-protected) of the thermal, current, voltage, and power detected trip history
MAINTENANCE	Counters	Display of statistics
SETUP[8]	Thermal settings	Display thermal settings
	Current settings	Display current settings
	Voltage settings	Display voltage settings
	Power settings	Display power settings
	RSTP settings	Display RSTP settings
	Communication	Display communication settings

NOTE: Some data such as Motor Temperature measurement will not be up to date until after a power cycle.

8. All SETUP web pages functionality has been disabled for Cybersecurity.

Standard Web Server Structure

The diagram below shows the navigation in the standard Web server pages:

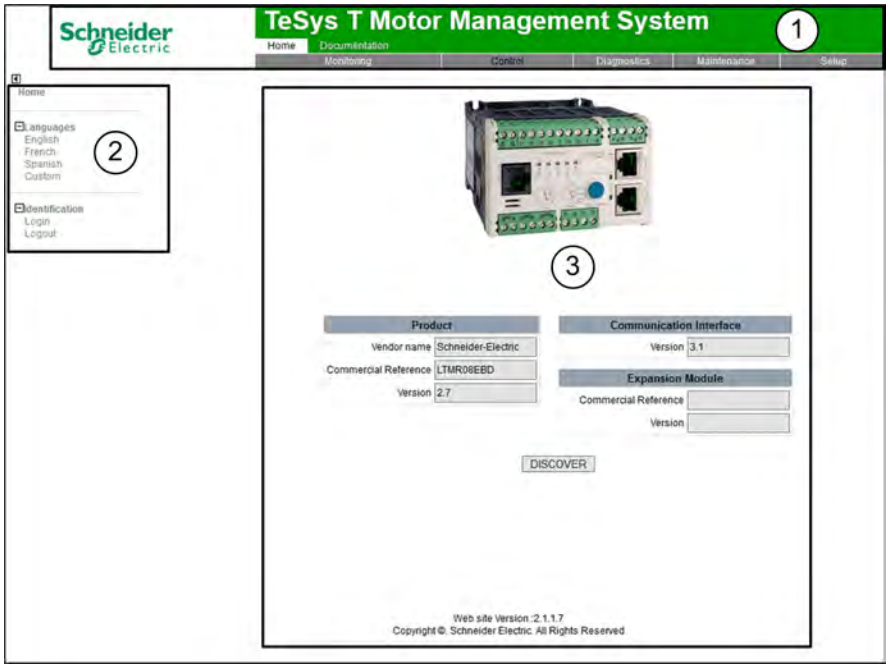


Access to the Standard Web Server

Step	Action
1	Connect the LTMRModbus/TCP controller to your PC.
2	Open a Web browser.
3	In the address bar, enter the IP address assigned to the LTMR controller. If necessary, refer to the LTMR IP addressing procedure , page 30.
4	If connection is accepted, the Home page displays. You can navigate in the different pages via menus and submenus.

Standard Web Server User Interface

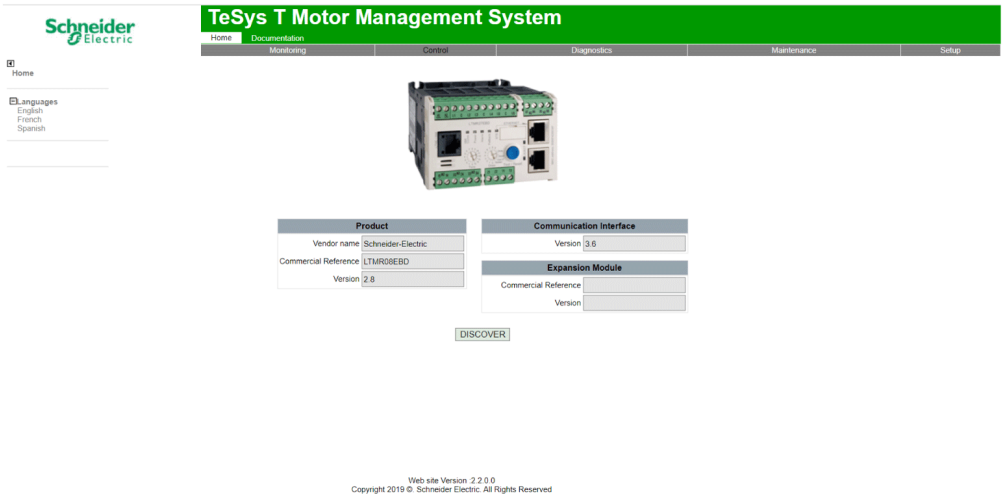
All Web server pages have the same appearance. A window is divided into three areas, as follows:



Legend	Area	Description
1	Menus	Banner displayed on every page, showing links to the menus: • Home • Documentation • Monitoring • Diagnostics • Maintenance • Setup
2	Submenu treeview	Links to the pages related to the selected menu. The treeview • Always displays the menu name in which the user is navigating, • Allows the user to expand or collapse functions.
3	Page body	Information related to the contextual page selected in the menu or submenu.

Home Page

Overview



Access to the Home Page

The Home page is displayed:

- After you connect to the standard Web server,
- When you click Home in the menu headers at any moment during navigation and from any page displayed.

Home Page Submenu

The Home page submenu contains the following items:

Level 1	Level 2	Function
Languages	English	Switch the page language to English
	French	Switch the page language to French
	Spanish	Switch the page language to Spanish
	Custom	Switch the page language to the Custom language (English by default)
Identification	Login	Display the Login page to enter the password
	Logout	Deactivate the data modification mode

Language Selection

From the submenu zone, click one of the following languages to display the page content in this language:

- English
- French
- Spanish

- Custom (English by default)

Home Page Body

The Home page displays the following product elements:

- A view of the LTMR controller and LTME expansion module when connected
- LTMR controller data:
  - Vendor name: Schneider Electric
  - Commercial reference
  - Version
- Version of the communication interface
- LTME expansion module data:
  - Commercial reference
  - Version
  - DISCOVER button

NOTE: LTME data is blank if no LTME is connected.

DISCOVER Button

The DISCOVER button is displayed in the following pages:

- Home page
- Documentation page
- Monitoring page
- Diagnostics page
- Maintenance page
- Setup page

When clicking this button, the Network status LED of the LTMR controller blinks 10 times alternatively red and green.

There is no visual modification on the Web page.

Documentation Page

Overview

Access to the Documentation Page

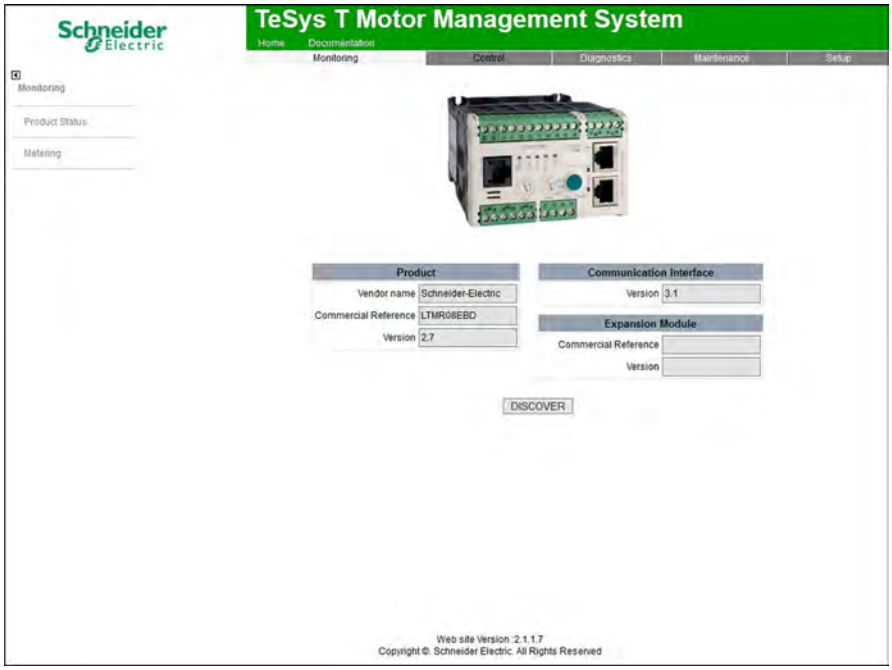
The Documentation page displays when you click Documentation in the menu headers at any moment during navigation and from any page displayed.

Documentation Page Submenu

The Documentation page submenu allows you to access the References page. You can download LTMR technical publications and other technical information from our website at www.se.com using the hyperlink on the References page.

Monitoring Page

Overview



Access to the Monitoring Page

The Monitoring page displays when you click Monitoring in the menu headers at any moment during navigation and from any page displayed.

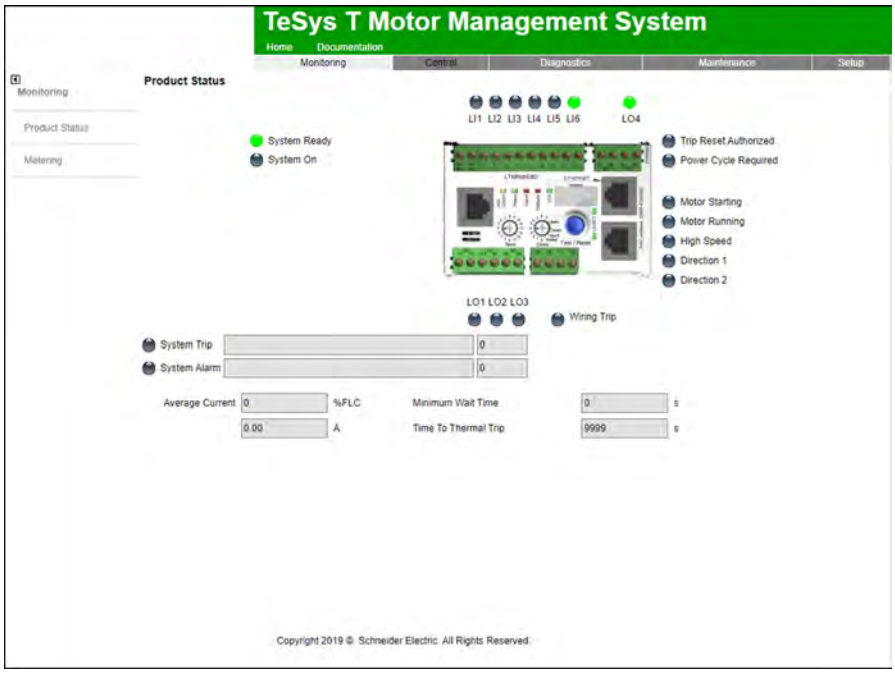
Monitoring Page Submenu

The Monitoring page submenu allows you to access the following pages:

- Product Status , page 158
- Metering , page 160

Product Status Page

Overview



Product Status Page Body

The page displays

- the state of each I/O related to the dedicated connector pin on the product view (LTMR controller + LTME expansion module),
- general states and values.

The state indicators depend on the following color code:

- Inactive states are in gray.
- Active states are in green, orange, or red depending on the data.

The Product Status page contains the following read-only data:

Data Name	Parameter Name
LI1	Logic Input 1
LI2	Logic Input 2
LI3	Logic Input 3
LI4	Logic Input 4
LI5	Logic Input 5
LI6	Logic Input 6
LI7[9]	Logic Input 7
LI8[9]	Logic Input 8
LI9[9]	Logic Input 9
LI10[9]	Logic Input 10

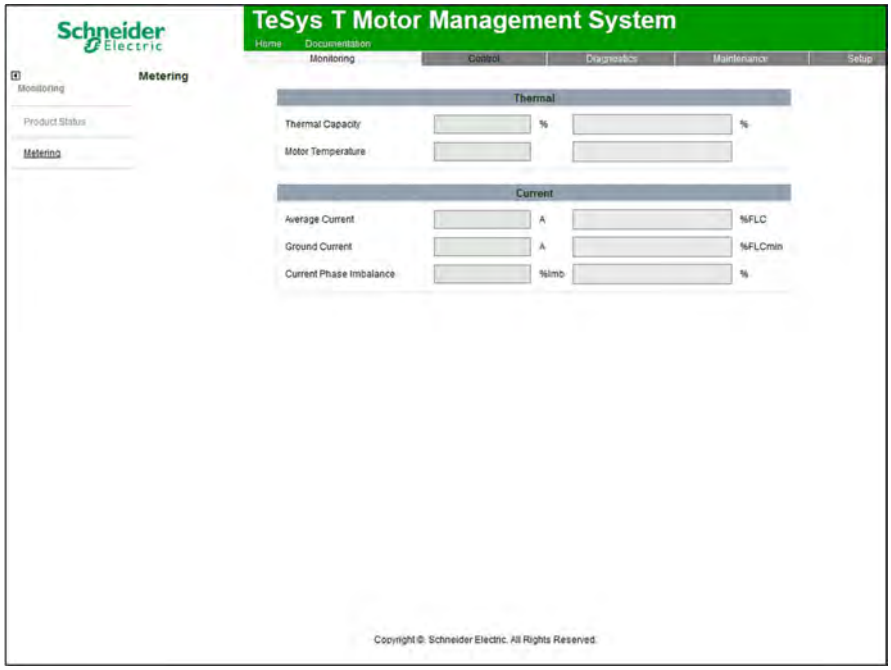
9. If no LTME expansion module is connected, the indicator is not displayed.

Data Name	Parameter Name
LO1	Logic Output 1
LO2	Logic Output 2
LO3	Logic Output 3
LO4	Logic Output 4
Wiring Trip	Wiring Trip
System Ready	System Ready
System ON	System ON
System Trip	System Trip
System Alarm	System Alarm
Trip Reset Authorized	Trip Reset Authorized
Power Cycle Required	Power Cycle Required
Minimum Wait Time	Minimum Wait Time
Time To Thermal Trip	Time To Trip
Motor Starting	Motor Starting
Motor Running	Motor Running
High Speed	High Speed
Direction 1[10]	Direction 1
Direction 2[10]	Direction 2
Average Current (%FLC)	Average Current
Average Current (A)	Average Current

10. The color in active state depends on the value of the HMI Motor Status LED Color parameter: red if value is 0, green if 1, gray if inactive.

Metering Page

Overview



Metering Page Body

The page displays the numerical value and graphical representation next to each data name.

The Metering page contains the following read-only data:

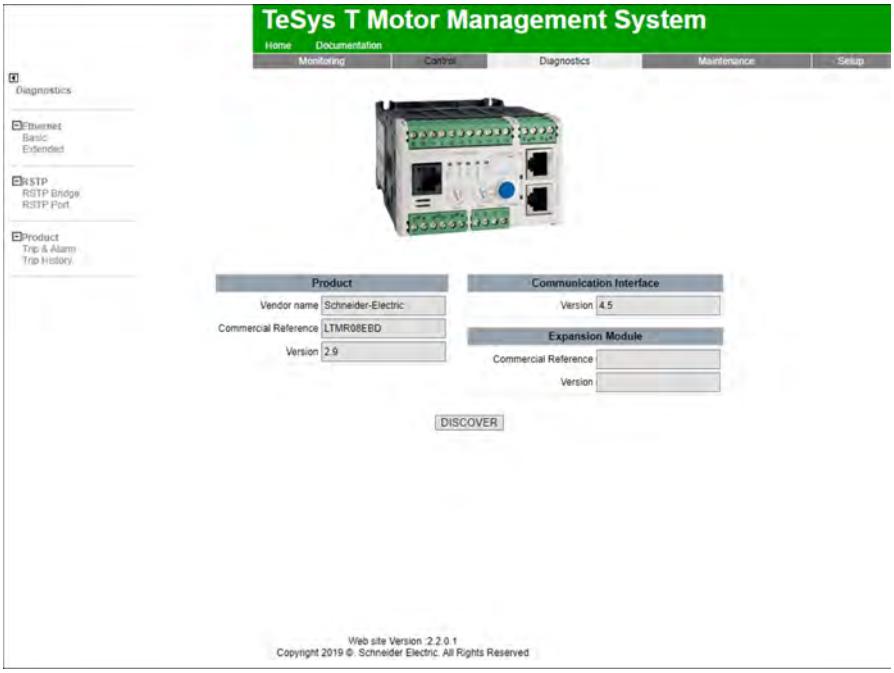
Group Name	Data Name	Parameter Name
Thermal	Thermal Capacity Level	Thermal Capacity Level
	Motor Temperature	• Motor Temperature Sensor Degree: ◦ Motor Temperature Sensor Type is PT100 ◦ Motor temperature displayed in °C or °F according to the value of the HMI Display Temperature Sensor Degree CF parameter • Motor Temperature Sensor Ohm: ◦ Motor Temperature Sensor Type is not PT100 ◦ Motor temperature displayed in Ohms • No Motor Temperature Detected: ◦ Motor Temperature Data displays not connected ◦ Graph indicator shows 100%
Current	Average Current	Average Current
	Ground Current	Ground Current
	Current Phase Imbalance	Current Phase Imbalance
Voltage	Average Voltage[11]	Average Voltage
	Frequency[11]	Frequency
	Voltage Phase Imbalance[11]	Voltage Phase Imbalance

11. Not displayed if no LTME expansion module is connected.

Group Name	Data Name	Parameter Name
Power	Active Power[12]	Active Power
	Power Factor[12]	Power Factor
	Reactive Factor[12]	Reactive Power

Diagnostics Page

Overview



Access to the Diagnostics Page

The Diagnostics page displays when you click Diagnostics in the menu headers at any moment during navigation and from any page displayed.

Diagnostics Page Submenu

The Diagnostics page submenu allows you to access the following pages:

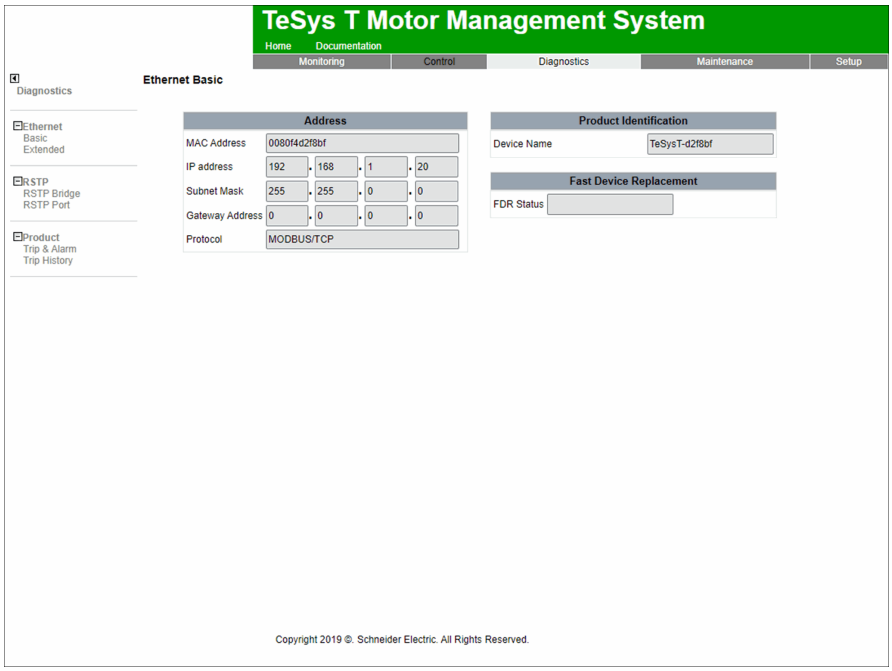
Level 1	Level 2
Ethernet	Basic , page 162
	Extended , page 163
RSTP	RSTP Bridge , page 164
	RSTP Port , page 165

12. Not displayed if no LTME expansion module is connected.

Level 1	Level 2
Product	Trips & Alarms , page 166
	Trip & Alarm History , page 167

Ethernet Basic Page

Overview



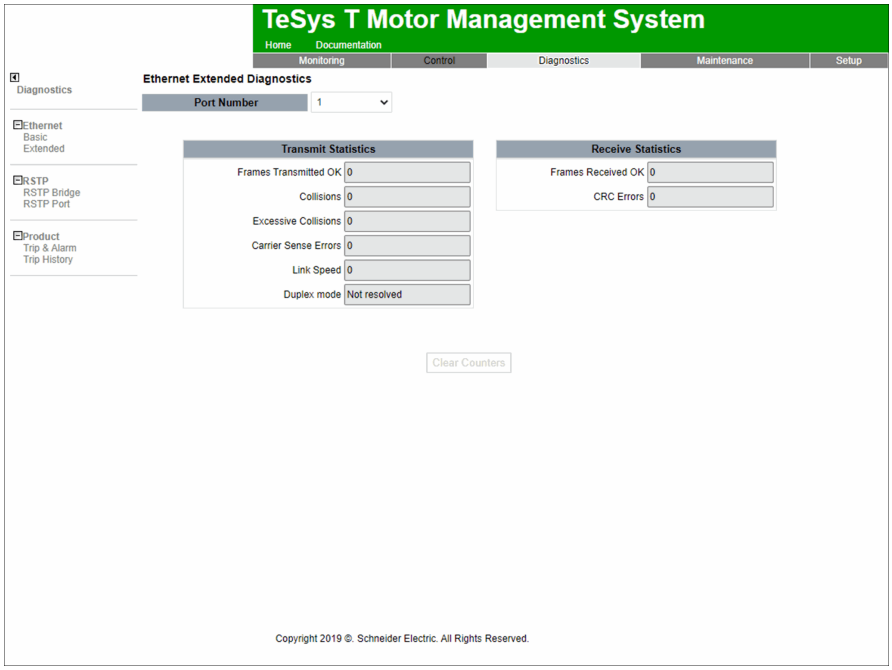
Ethernet Basic Page Body

The Ethernet Basic page contains the following read-only data:

Group Name	Data Name	Parameter Name
Address	MAC Address	Ethernet MAC Address
	IP Address	Ethernet IP Address
	Subnet Mask	Ethernet Subnet Mask
	Gateway Address	Ethernet Gateway Address
	Protocol	Ethernet Capabilities Control
Product Identification	Device Name	Ethernet Device Name
Fast Device Replacement Status	FDR Status	Network Port FDR Status

Ethernet Extended Diagnostics Page

Overview



Ethernet Extended Diagnostics Page Body

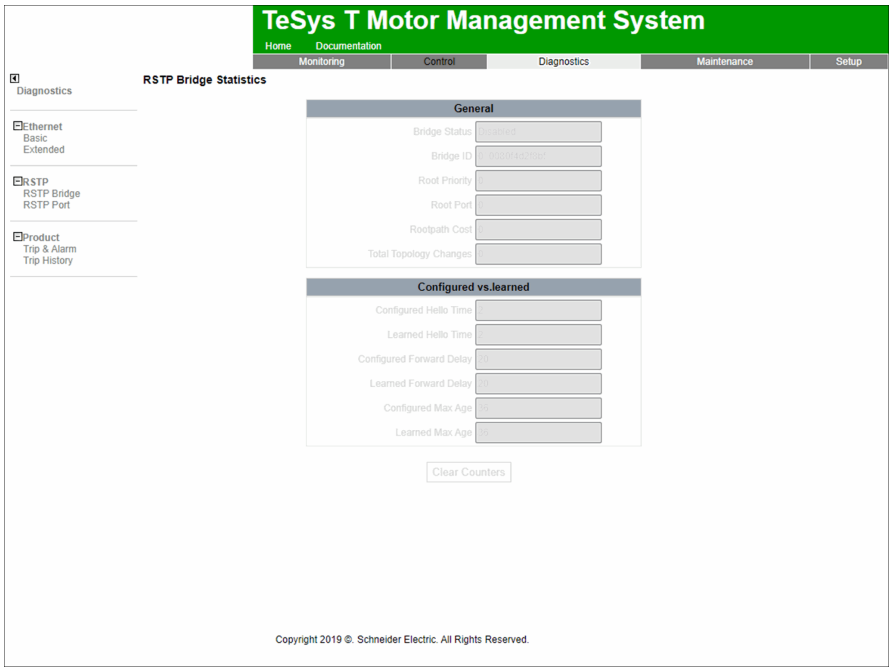
In the Port Number list, select the Ethernet port to display the related diagnostics.

The Ethernet Extended Diagnostics page contains the following read-only data for each port:

Group Name	Data Name
Transmit Statistics	Frames Transmitted OK
	Collisions
	Excessive Collisions
	Carrier Sense Errors
	Link Speed
	Duplex Mode
Receive Statistics	Frames Received OK
	CRC Errors

RSTP Bridge Statistics Page

Overview



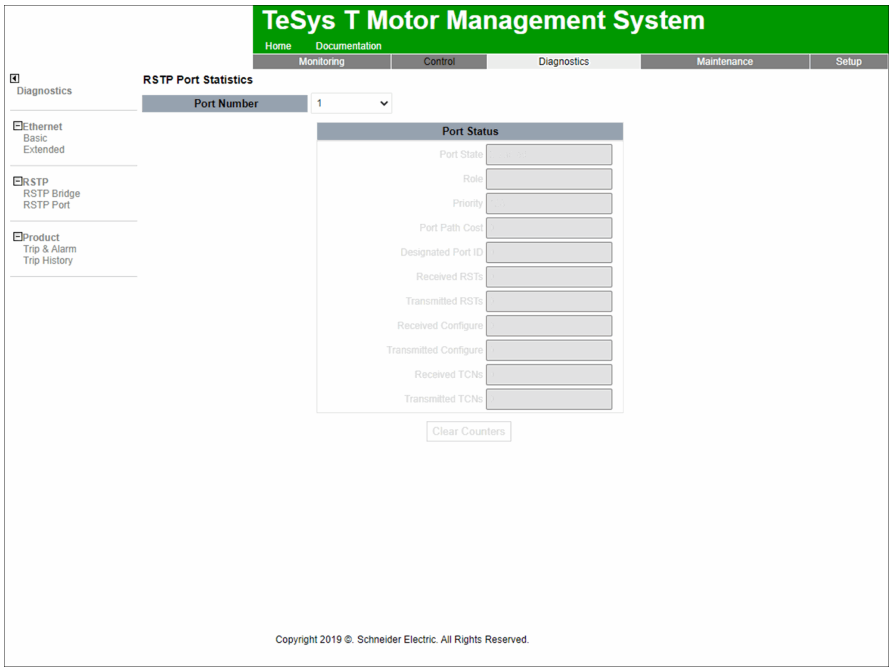
RSTP Bridge Statistics Page Body

The RSTP Bridge Statistic page contains the following data:

Group Name	Data Name
General	Bridge Status
	Bridge ID
	Designated Root ID
	Designated Root Port
	Rootpath Cost
	Total Topology Changes
Configured vs. learned	Configured Hello Time
	Learned Hello Time
	Configured Forward Delay
	Learned Forward Delay
	Configure Max Age
	Learned Max Age

RSTP Port Statistics Page

Overview



RSTP Port Statistics Page Body

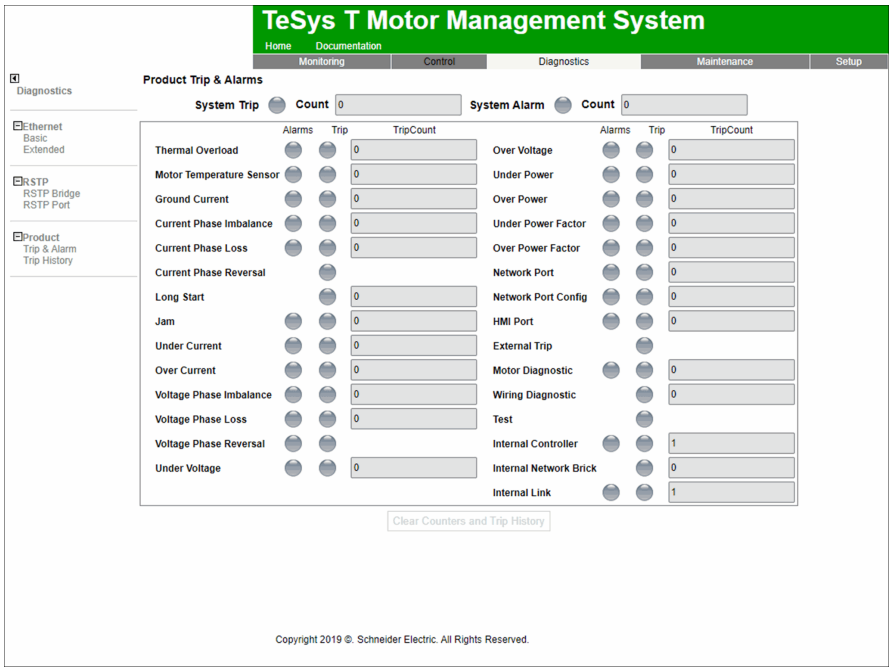
In the Port Number list, select the RSTP port number in the field to display the related diagnostics.

The RSTP Port Statistics page contains the following data for each port:

Group Name	Data Name
Port Status	Status
	Role
	Priority
	Port Path Cost
	Designated Port ID
	Received RSTs
	Transmitted RSTs
	Received Configure
	Transmitted Configure
	Received TCNs
	Transmitted TCNs

Trips & Alarms Page

Overview



Trips & Alarms Page Body

The following items are displayed next to each data name: the alarm or trip status and the trips counter value, if any.

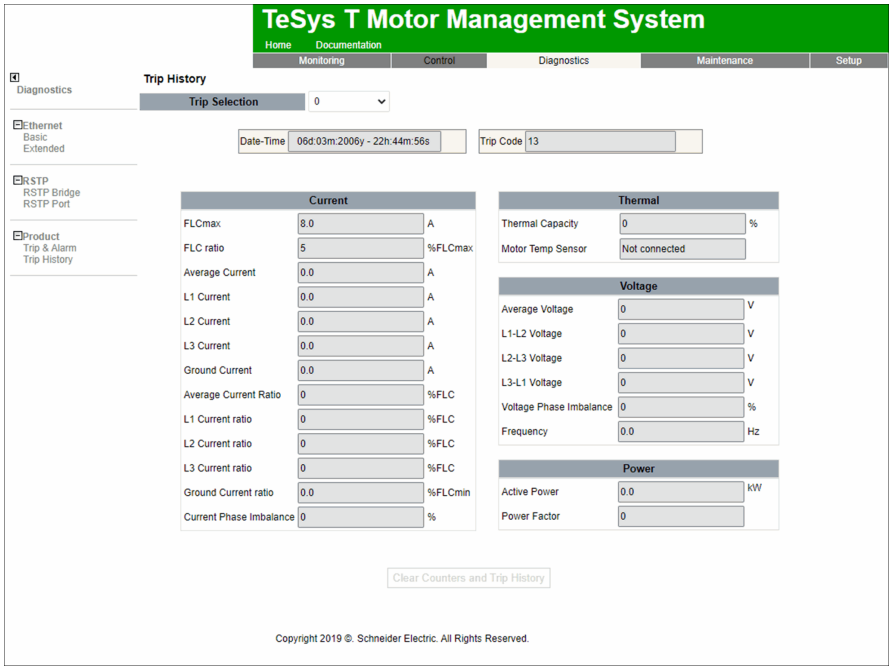
The color code of the indicators is as follows:

In Case of...	The Indicator is...
alarm	Orange
Trip	Red
Inactive alarm or trip	Gray

The Trips & Alarms page contains read-only data.

Trip History Page

Overview



Trip History Page Body

In the Trip History list, select a trip number to display the history of LTMR controller data recorded at the time of the last five detected trips. Trip N0 contains the most recent trip record, and trip N4 contains the oldest retained trip record.

The Trip History page contains the following read-only parameters for trip N0:

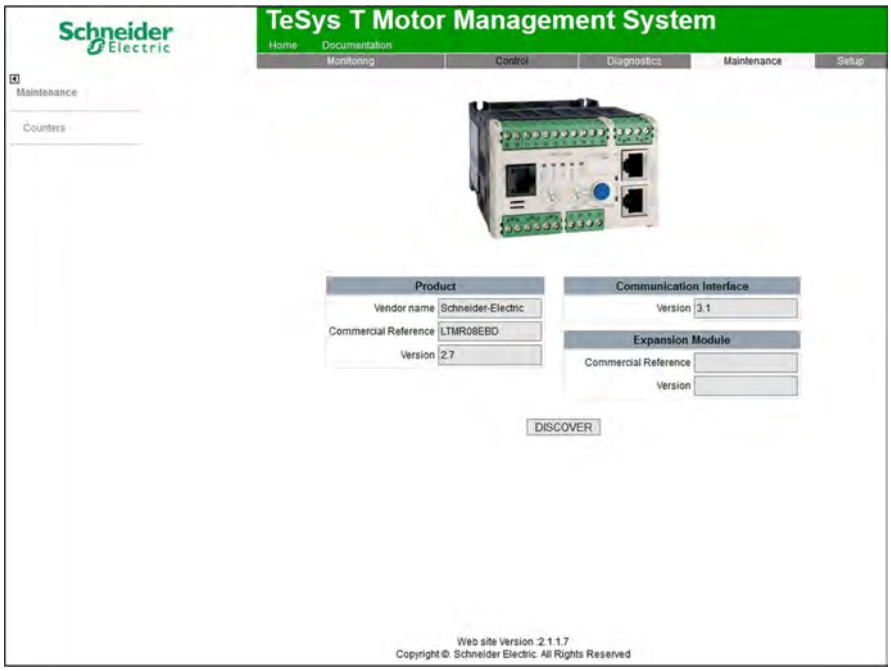
Group Name	Data Name	Parameter Name
Trip Selection	Date-Time	Date and Time N0
	Trip Code	Trip Code N0
Current	FLC max	Full Load Current max
	FLC Ratio	Motor Full Load Current Ratio
	Average Current	Average Current N0
	L1 Current	L1 Current N0
	L2 Current	L2 Current N0
	L3 Current	L3 Current N0
	Ground Current	Ground Current N0
	Average Current Ratio	Average Current ratio N0
	L1 Current Ratio	L1 Current Ratio N0
	L2 Current Ratio	L2 Current Ratio N0
	L3 Current Ratio	L3 Current Ratio N0
	Ground Current Ratio	Ground Current Ratio N0
	Current Phase Imbalance	Current Phase Imbalance N0

Group Name	Data Name	Parameter Name
Thermal	Thermal Capacity	Thermal Capacity Level N0
	Motor Temp Sensor	Motor Temperature Sensor Degree N0
Voltage	Average Voltage	Average Voltage N0
	L1-L2 Voltage	L1L2 Voltage N0
	L2-L3 Voltage	L2L3 Voltage N0
	L3-L1 Voltage	L3L1 Voltage N0
	Voltage Phase Imbalance	Voltage Phase Imbalance N0
	Frequency	Frequency N0
Power	Active Power	Active Power N0
	Power Factor	Power Factor N0

Trips N1–N4 trip record information in the same way as Trip N0. See corresponding N1–N4 parameters.

Maintenance Page

Overview



Access to the Maintenance Page

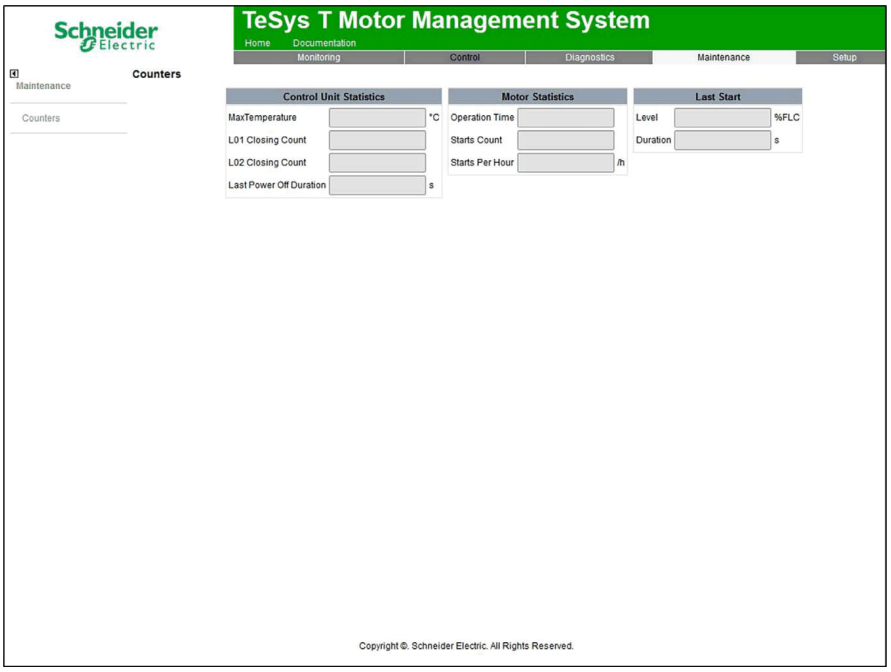
The Maintenance page displays when you click Maintenance in the menu headers at any moment during navigation and from any page displayed.

Maintenance Page Submenu

The Maintenance page submenu allows you to access the Counters page.

Counters Page

Overview



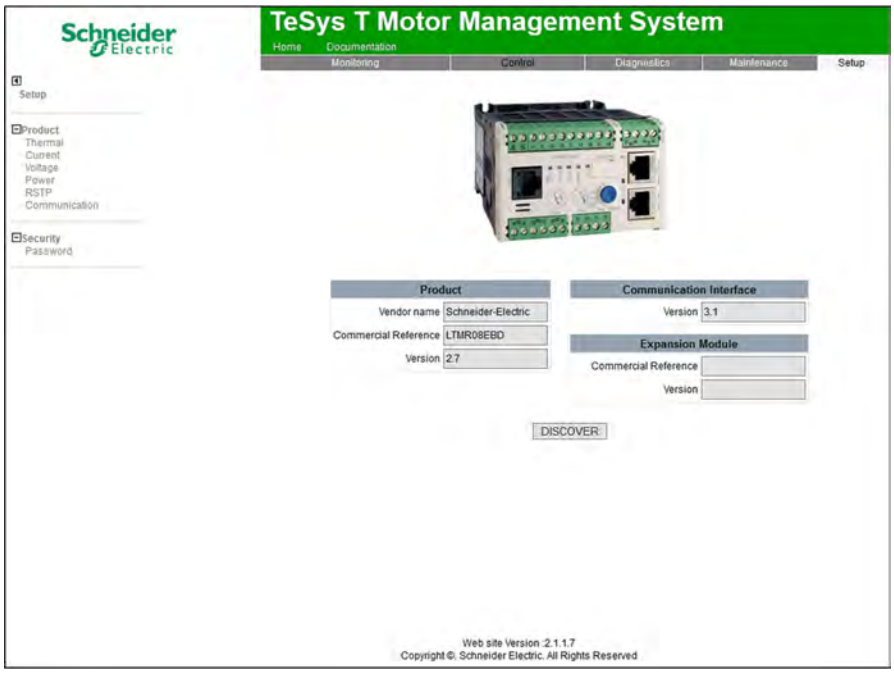
Counters Page Body

The Counters page contains the following read-only data:

Group Name	Data Name	Parameter Name
Control Unit Statistics	MaxTemperature	Controller Internal Temperature Maximum
	LO1 Closing Count	Motor LO1 Closings Count
	LO2 Closing Count	Motor LO2 Closings Count
	Last Power OFF Duration	Controller Last Power OFF Duration
Motor Statistics	Operation Time	Operating Time
	Starts Count	Motor Starts Count
	Starts Per Hour	Motor Starts Per Hour Count
Last Start	Level	Motor Last Start Current Ratio
	Duration	Motor Last Start Duration

Setup Page

Overview



Functionality

All SETUP web pages functionality has been disabled for Cybersecurity.

Access to the Setup Page

The Setup page displays when you click Setup in the menu headers at any moment during navigation and from any page displayed.

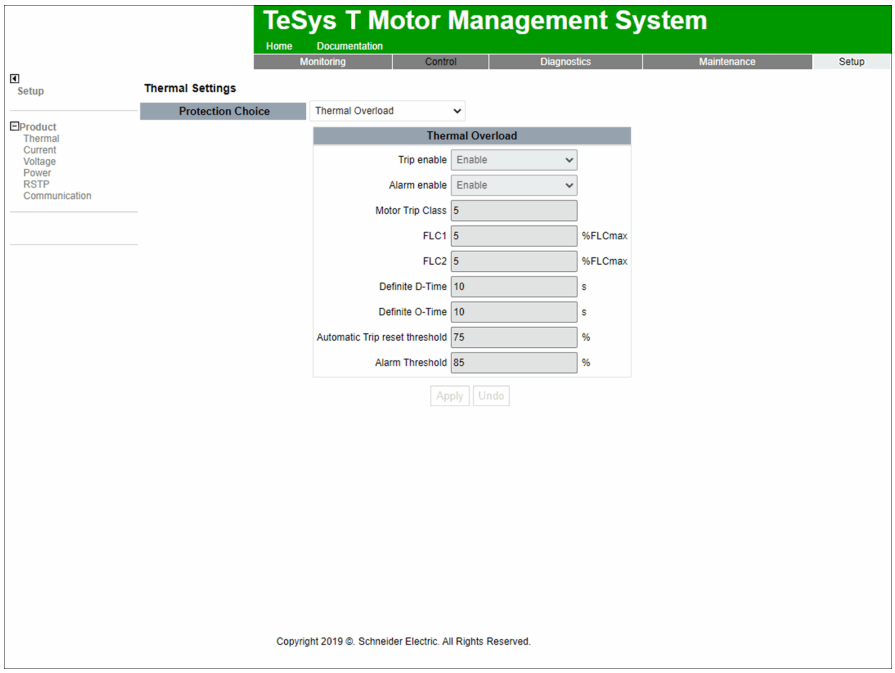
Setup Page Submenu

The Setup page submenu allows you to access the following pages:

Level 1	Level 2
Product	Thermal , page 171
	Current , page 172
	Voltage , page 173
	Power , page 174
	RSTP Configuration , page 175
	Communication , page 176
Security	Password

Product Thermal Settings Page

Overview

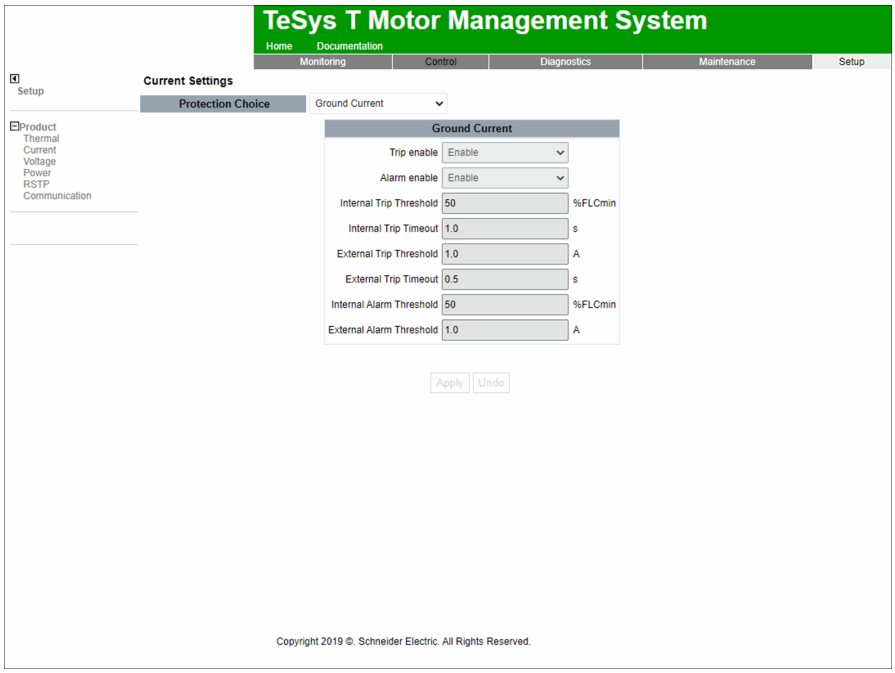


Thermal Settings Page Body

In the Protection Choice list, select the name of the desired protection group.

Product Current Settings Page

Overview

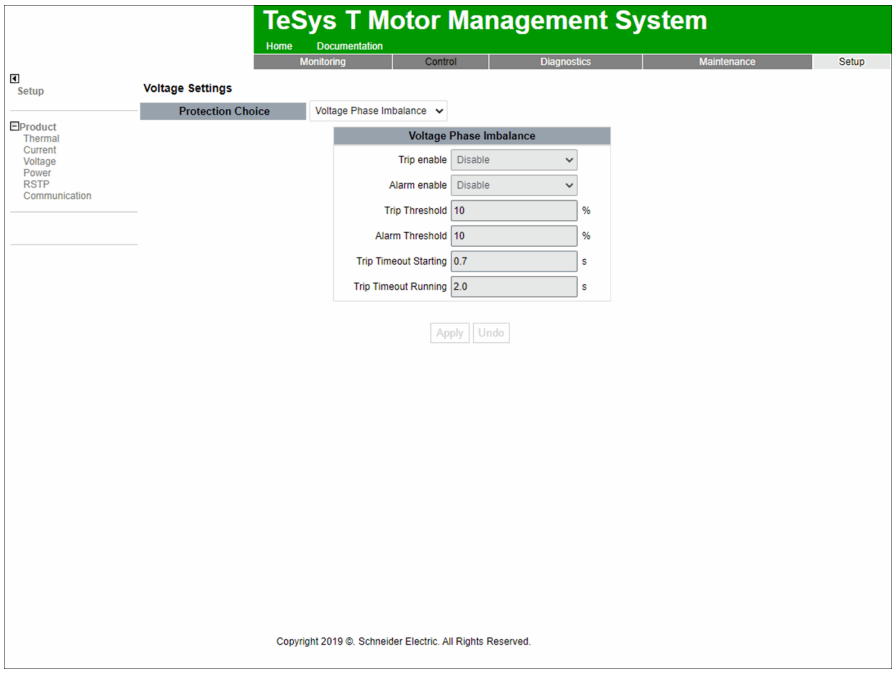


Current Settings Page Body

In the Protection Choice list, select the name of the desired protection group.

Product Voltage Settings Page

Overview

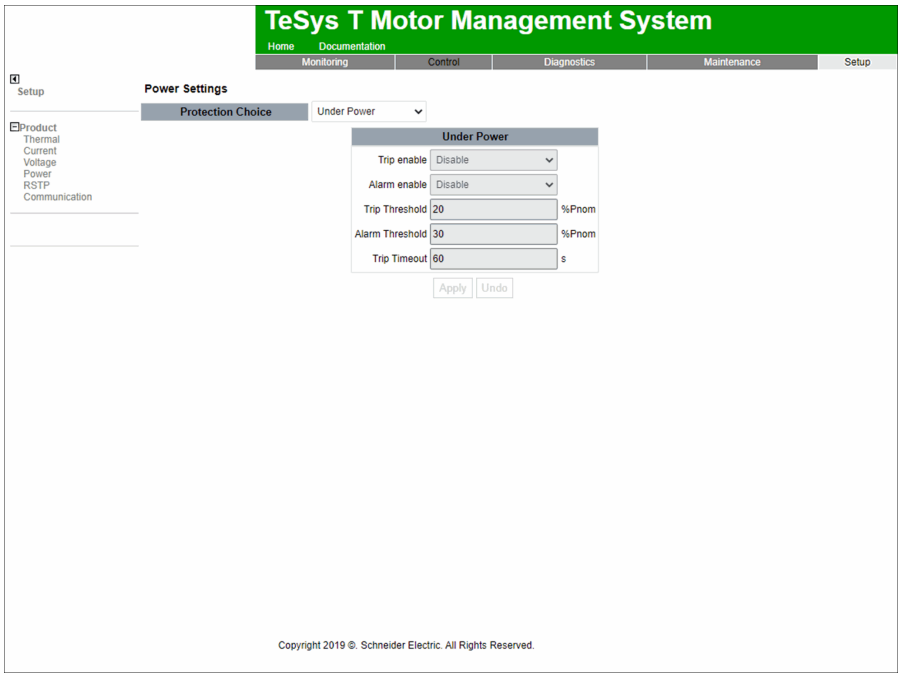


Voltage Settings Page Body

In the Protection Choice list, select the name of the desired protection group.

Product Power Settings Page

Overview

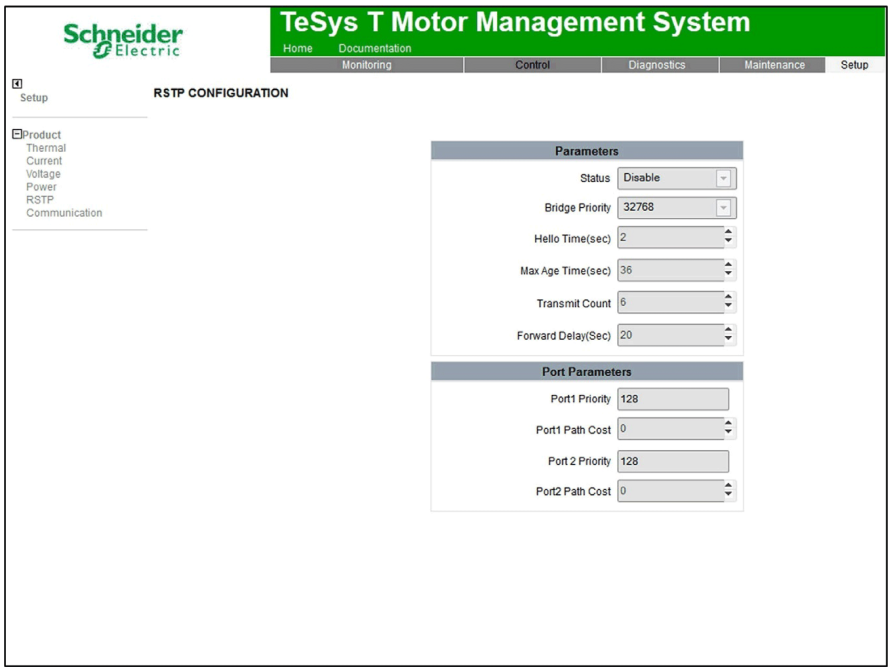


Power Settings Page Body

In the Protection Choice list, select the name of the desired protection group.

RSTP Configuration Page

Overview

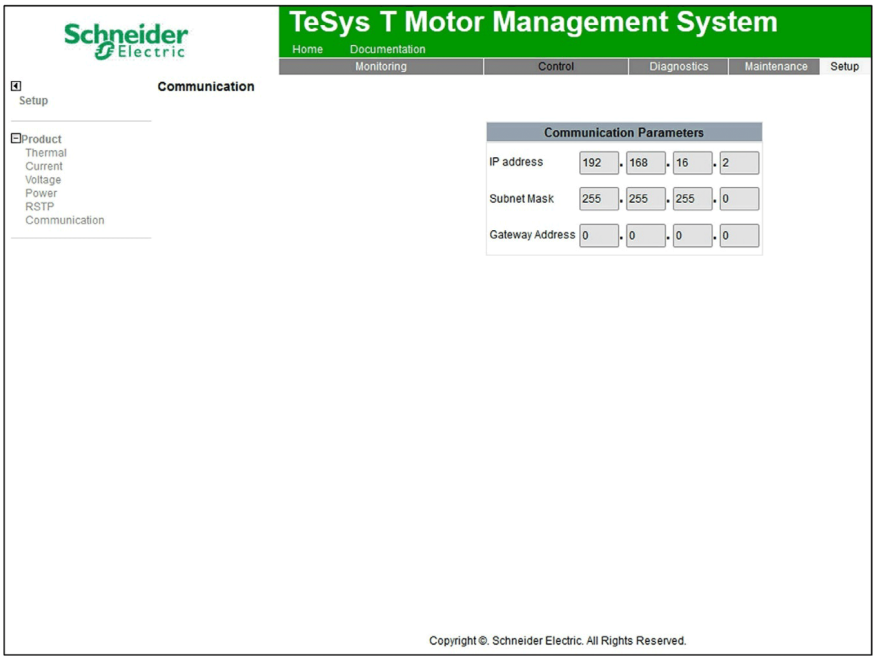


RSTP Configuration Page Body

The RSTP configuration data is displayed on this page.

Communication Page

Overview



NOTE: This IP address is used only if the product is in stored IP mode, page 30. Restart the device in stored IP mode for the parameters in the page to take effect.

Communication Page Body

The Communication Settings page contains the following (password-protected) data:

Group Name	Data Name
Communication Parameters	IP Address
	Subnet Mask
	Gateway Address

Glossary

A

active power:

Also known as *real power*, active power is the rate of producing, transferring or using electrical energy. It is measured in watts (W) and often expressed in kilowatts (kW) or megawatts (MW).

analog:

Describes inputs (e.g. temperature) or outputs (e.g. motor speed) that can be set to a range of values. Contrast with discrete.

apparent power:

The product of current and voltage, apparent power consists of both active power and reactive power. It is measured in volt-amperes and often expressed in kilovolt-amperes (kVA) or megavolt-amperes (MVA).

C

CANopen:

An open industry standard protocol used on the internal communication bus. The protocol allows the connection of any standard CANopen device to the island bus.

CT:

current transformer.

D

definite time:

A variety of TCC or TVC where the initial magnitude of the trip time delay remains a constant, and does not vary in response to changes in the value of the measured quantity (e.g. current). Contrast with inverse thermal.

device:

In the broadest terms, any electronic unit that can be added to a network. More specifically, a programmable electronic unit (e.g. PLC, numeric controller or robot) or I/O card.

DeviceNet:

DeviceNet is a low-level, connection-based network protocol that is based on CAN, a serial bus system without a defined application layer. DeviceNet, therefore, defines a layer for the industrial application of CAN.

DIN rail:

A steel mounting rail, made pursuant to DIN standards (typically 35 mm wide) that allows for easier "snap-on" mounting of IEC electrical devices, including the LTMR controller and the expansion module. Contrast with screw mounting of devices to a control panel by drilling and tapping holes.

DIN:

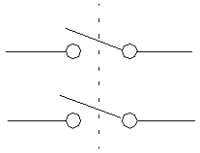
Deutsches Institut für Normung. The European organization that organizes the creation and maintenance of dimensional and engineering standards.

discrete:

Describes inputs (e.g. switches) or outputs (e.g. coils) that can be only *On* or *Off*. Contrast with analog.

DPST:

double-pole/single-throw. A switch that connects or disconnects 2 circuit conductors in a single branch circuit. A DPST switch has 4 terminals, and is the equivalent of 2 single-pole/single-throw switches controlled by a single mechanism, as depicted below:



DTM:

DTM Device Type Manager technology standardizes the communication interface between field devices and systems.

E

endian setting (big endian):

'big endian' means that the high-order byte/word of the number is stored in memory at the lowest address, and the low-order byte/word at the highest address (the big end comes first).

endian setting (little endian):

'little endian' means that the low-order byte/word of the number is stored in memory at the lowest address, and the high-order byte/word at the highest address (the little end comes first).

EtherNet/IP:

(Ethernet Industrial Protocol) is an industrial application protocol built on TCP/IP and CIP protocols. It is mainly used on automated networks, it defines network devices as network objects as to allow the communication between industrial control system and their components; (programmable automation controller, programmable logic controller, I/O systems).

F

FLC1:

Motor Full Load Current Ratio. FLC parameter setting for low or single speed motors.

FLC2:

Motor High Speed Full Load Current Ratio. FLC parameter setting for high-speed motors.

FLC:

full load current. Also known as *rated current*. The current the motor will draw at the rated voltage and rated load. The LTMR controller has 2 FLC settings: FLC1 (Motor Full Load Current Ratio) and FLC2 (Motor High Speed Full Load Current Ratio), each set as a percentage of FLC max.

FLCmax:

Full Load Current Max. Peak current parameter.

FLCmin:

Minimum Full Load Current. The smallest amount of motor current the LTMR controller will support. This value is determined by the LTMR controller model.

H

Hardware Generations:

There are two versions of the LTMR hardware, MBTCP and MTBTCP+EIP.for more details,refer to Hardware Generation , page 16.

hysteresis:

A value—added to lower limit threshold settings or subtracted from upper limit threshold settings—that delays the response of the LTMR controller before it stops measuring the duration of detected trips and alarms.

I

inverse thermal:

A variety of TCC where the initial magnitude of the trip time delay is generated by a thermal model of the motor and varies in response to changes in the value of the measured quantity (e.g. current). Contrast with definite time.

M

Modbus:

Modbus is the name of the client-server serial communications protocol developed by Modicon (now Schneider Automation, Inc.) in 1979, which has since become a standard network protocol for industrial automation.

N

nominal power:

Motor Nominal Power. Parameter for the power a motor will produce at rated voltage and rated current.

nominal voltage:

Motor Nominal Voltage. Parameter for rated voltage.

NTC analog:

Type of RTD.

NTC:

negative temperature coefficient. Characteristic of a thermistor—a thermally sensitive resistor—whose resistance increases as its temperature falls, and whose resistance decreases as its temperature rises.

P

PLC:

programmable logic controller.

power factor:

Also called *cosine phi* (or ϕ), power factor represents the absolute value of the ratio of active power to apparent power in AC power systems.

PROFIBUS DP:

An open bus system that uses an electrical network based on a shielded 2-wire line or an optical network based on a fiber-optic cable.

PT100:

Type of RTD.

PTC analog:

Type of RTD.

PTC binary:

Type of RTD.

PTC:

positive temperature coefficient. Characteristic of a thermistor—a thermally sensitive resistor—whose resistance increases as its temperature rises, and whose resistance decreases as its temperature falls.

R

reset time:

Time between a sudden change in the monitored quantity (e.g. current) and the switching of the output relay.

rms:

root mean square. A method of calculating average AC current and average AC voltage. Because AC current and AC voltage are bi-directional, the arithmetic average of AC current or voltage always equals 0.

RTD:

resistance temperature detector. A thermistor (thermal resistor sensor) used to measure the temperature of the motor. Required by the LTMR controller's Motor Temp Sensor motor protection function.

S

SNMP:

Simple Network Management Protocol is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior.

T

Trip Reset:

A function used to restore the motor management controller to an operational state after a detected error is cleared by removing the cause of the error so that the error is no longer active.

Index

A

C

D

E

F

G

H

I

J

L

M

N

O

P

R

S

T

U

V

W

Schneider Electric
800 Federal Street
Andover, MA 01810
USA

888–778–2733

www.se.com

As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

© 2020 – 2023 Schneider Electric. All rights reserved.

DOCA0129EN-03