TeSys™ T LTMR

Motor Management Controller

Modbus Communication Guide

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Table of Contents

Safety Information

Read these instructions carefully and examine the equipment to become familiar with the device before attempting 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.

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

Proposition 65 Notice

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.

About the Book

Document Scope

This guide describes the Modbus® network protocol version of the TeSys™ T LTMR motor management controller and LTME expansion module.

The purpose of this guide is to:

- Describe and explain the monitoring, protection, and control functions of the LTMR controller and LTME expansion module.
- Provide the information necessary to implement and support a solution that meets your application requirements.

The guide describes the four key parts of a successful system implementation:

- Installing the LTMR controller and LTME expansion module.
- Commissioning the LTMR controller by setting essential parameter values.
- Using the LTMR controller and LTME expansion module, both with and without additional human-machine interface devices
- Maintaining the LTMR controller and LTME expansion module.

This guide is intended for:

- Design engineers
- System integrators
- System operators
- Maintenance engineers

Validity Note

This guide is valid for LTMR Modbus 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 and LTME expansion module.	DOCA0128EN
TeSys T LTMR - Motor Management Controller - Ethernet Communication Guide	This guide describes the Ethernet network protocol version of the TeSys T LTMR motor management controller.	DOCA0129EN
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

Title of Documentation	Description	Reference Number
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
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 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 TeSys T DTM which allows the customization of the control functions of the TeSys T motor management system.	1672614EN
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
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.

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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 prevent system downtime.

The system offers diagnostic and statistics functions and configurable alarms and trips, 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.

Wiring of the Modbus Network

Overview

This chapter describes how to connect an LTMR controller to an RS 485 Modbus network with an RJ45 or an open-style connector.

It presents three possible network topologies.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for critical functions, provide a means to achieve an acceptable state during and after a path interruption. 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 interruptions 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*.

Modbus Network Characteristics

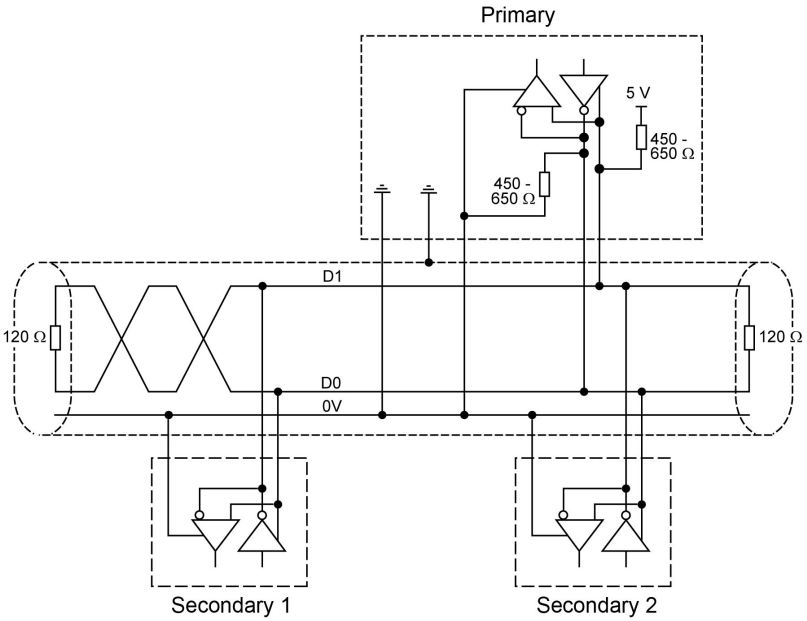
Overview

The *Modbus over Serial Line Specification and Implementation Guide*, published on www.modbus.org, defines the characteristics of the Modbus protocol over serial line. The LTMR Modbus controller complies with this specification.

Modbus Network Standard Diagram

The standard diagram corresponds to the Modbus specification on the www.modbus.org site and in particular to the two-wire multidrop serial bus diagram.

The simplified diagram is as follows:



Characteristics for Connection to the RS 485 Bus

The RS 485 standard allows variants of some characteristics:

- Polarization
- Line terminator
- Number of secondary devices
- Bus length

Characteristics	Value
Maximum number of stations (without repeater)	32 stations (31 secondary devices)
Type of trunk cable	Single, shielded, twisted pair cable, with 120 Ω characteristic impedance, and at least a third conductor
Maximum bus length	1,000 m (3,300 ft) at 19,200 Baud
Maximum length of tap-offs	• 20 m (66 ft) for one tap-off • 40 m (131 ft) divided by the number of tap-offs on the multiple junction box
Bus polarization	• A 450 to 650 Ω pull-up resistor at the 5 V • A 450 to 650 Ω pull-down resistor at the Common This polarization is recommended for the primary. There is no polarization at the RS 485 terminal on the LTMR controller.
Line terminator	A 120 Ω resistor +/- 5% at both ends of the bus
Common polarity	The common polarity is connected to the protective ground in at least one point on the bus.

Modbus Communication Port Wiring Terminal Characteristics

General

The main physical characteristics of a Modbus port are:

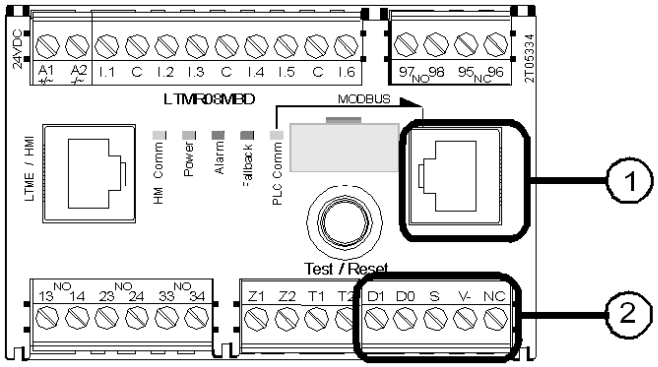
Physical interface	Multipoint 2-wire RS 485 - electrical networking
Connector	Terminal block and RJ45
Polarization	At primary level

Physical Interface and Connectors

The LTMR controller is equipped with two connector types, on the front face:

1. A female shielded RJ45 connector,
2. An open-style, pull-apart, terminal block.

The figure shows the LTMR front face with the Modbus connectors:



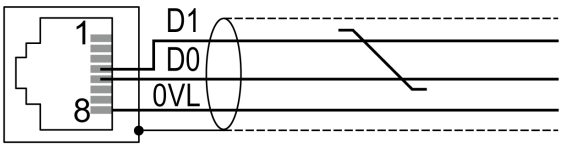
Both connectors are electrically identical. They follow the Modbus interoperability standards.

NOTE: The product must be connected through only one port. The use of the RJ45 connector is recommended.

RJ45 Connector Pinout

The LTMR controller is connected to the Modbus network with a shielded RJ45 connector in compliance with the following wiring:

Front view



The RJ45 wiring layout is:

Pin No.	Signal	Description
1	–	Not connected
2	–	Not connected

Pin No.	Signal	Description
3	–	Not connected
4	D1 or D(B)	Transceiver terminal 1
5	D0 or D(A)	Transceiver terminal 0
6	–	Not connected
7	–	Not connected
8	0VL	Signal and power supply common

Open-Style Terminal Block

The LTMR controller has the following Modbus network plug-in terminals and pin assignments.

Pin	Signal	Description
1	D1 or D(B)	Transceiver terminal 1
2	D0 or D(A)	Transceiver terminal 0
3	S	Modbus shield pin
4	V-	Signal and power supply common
5	NC	Modbus VP pin (not connected)

Open-Style Terminal Block Characteristics

Connector	Five pins
Pitch	5.08 mm (0.2 in.)
Tightening torque	0.5 to 0.6 N•m (5 lb-in)
Flat screwdriver	3 mm (0.10 in.)

Wiring of the Modbus Network

Overview

The recommended way to connect an LTMR controller to a Modbus network on the RS 485 bus is the connection via the female shielded RJ45 connector.

This section describes three typical cases of connection of LTMR controllers to the bus via its RJ45 connector:

- Connection of LTMR controllers installed in an enclosure via T-junction boxes.
- Connection of LTMR controllers installed in withdrawable drawers via T-junction boxes.
- Connection of LTMR controllers installed in withdrawable drawers via hardwired cables.

Modbus 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 (recommended 30 cm or 11.8 in.).
- Cross over the Modbus cables 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.
- A Modbus 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 together all the shields, if necessary.
  - Perform the grounding of the shield with a collar.
- When the LTMR controller is installed in a withdrawable drawer:
  - Connect together all the 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.
- Place a line terminator at each end of the bus to avoid malfunctions on the communication bus. A line terminator is generally already integrated in the primary device.
- 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

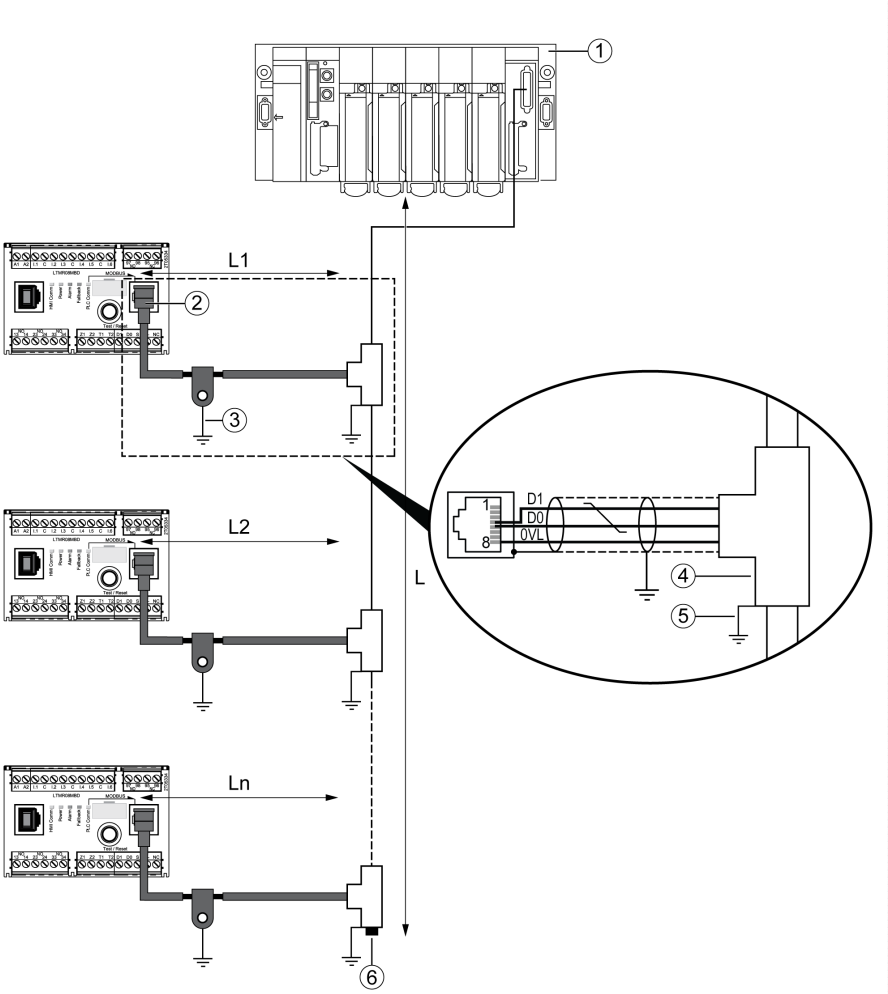
COMMUNICATION MALFUNCTION

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.

LTMR Controllers Installed in an Enclosure

The wiring diagram for connection of LTMR controllers installed in an enclosure to the RS 485 bus via the RJ45 connector is as follows:



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

2 Modbus shielded cable with two RJ45 connectors VW3 A8 306 R••

3 Grounding of the Modbus cable shield

4 Modbus T-junction boxes VW3 A8 306 TF•• (with cable)

5 Grounding of the Modbus T-junction boxes

6 Line terminator for RJ45 plug VW3 A8 306 R (120 Ω)

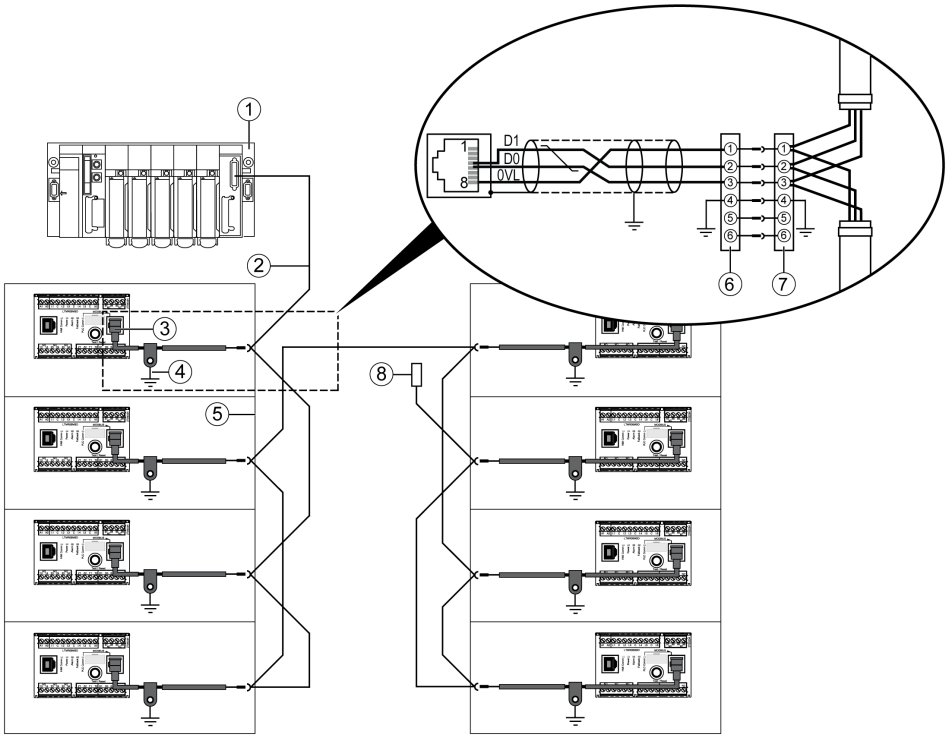
LTMR Controllers Installed in a Blokset or Okken Motor Control Switchboard

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 manual and refer to the relative instructions specific to your type of switchboard.

LTMR Controllers Installed in Withdrawable Drawers With Hardwired Cables

The wiring diagram for connection of LTMR controllers installed in withdrawable drawers to the RS 485 bus via the RJ45 connector and hardwired cables is as follows:



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

2 Modbus shielded cable TSX CSA •00

3 Modbus shielded cable with one RJ45 connector VW3 A8 306 D30

4 Grounding of the Modbus cable shield

5 Withdrawable drawer

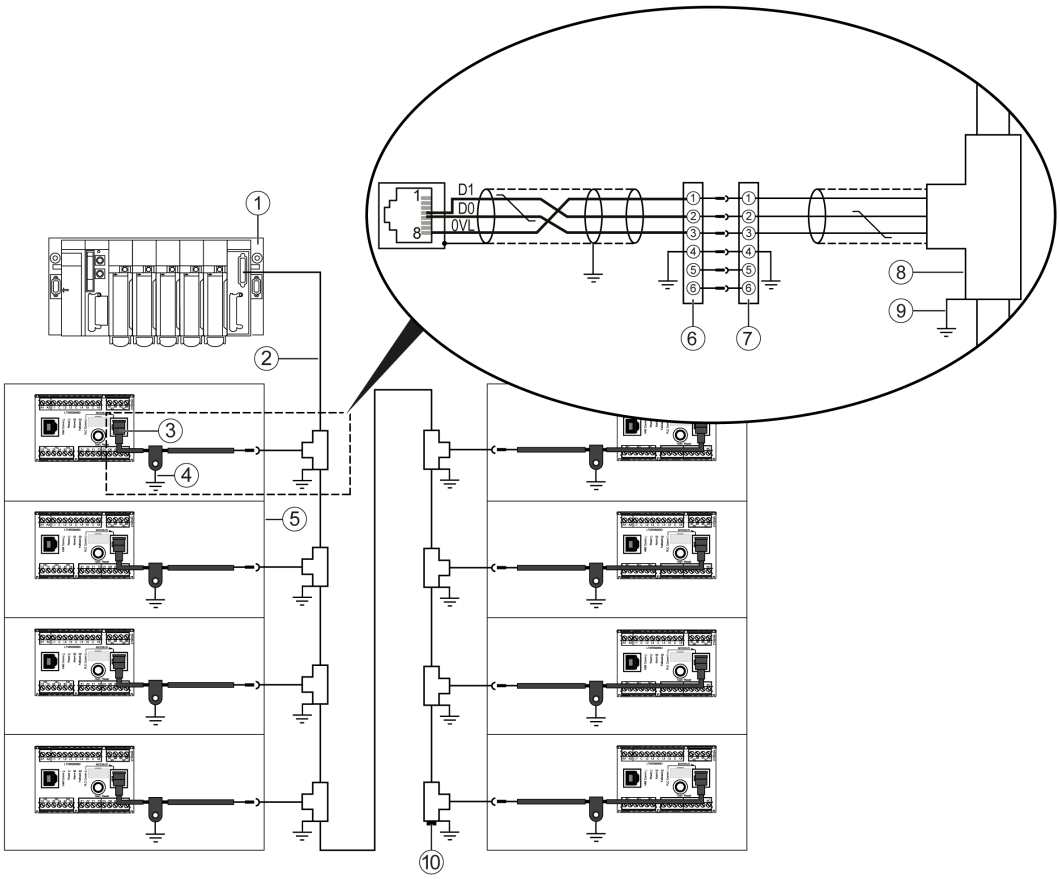
6 Withdrawable drawer part of the auxiliary connector

7 Fixed part of the auxiliary connector

8 Line terminator VW3 A8 306 DR (120 Ω)

LTMR Controllers Installed in Withdrawable Drawers With T-Junction Boxes

The wiring diagram for connection of LTMR controllers installed in withdrawable drawers to the RS 485 bus via the RJ45 connector and T-junction boxes is as follows:



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

2 Modbus shielded cable with two RJ45 connectors VW3 A8 306 R

3 Modbus shielded cable with one RJ45 connector VW3 A8 306 D30

4 Grounding of the Modbus cable shield

5 Withdrawable drawer

6 Withdrawable drawer part of the auxiliary connector

7 Fixed part of the auxiliary connector

8 Modbus T-junction boxes VW3 A8 306 TF• (with cable)

9 Grounding of the Modbus T-junction boxes

10 Line terminator VW3 A8 306 R (120 Ω)

List of Modbus Accessories

Designation	Description	Reference Number
T-junction boxes	Box with two RJ45 female connector for trunk cable and an integrated 0.3 m (1 ft) cable with one RJ45 male connector for tap-off	VW3 A8 306 TF03
	Box with two RJ45 female connector for trunk cable and an integrated 1 m (3.2 ft) cable with one RJ45 male connector for tap-off	VW3 A8 306 TF10
Line terminator for RJ45 connector	R = 120 Ω	VW3 A8 306 R
Line terminator for open-style connector	R = 120 Ω	VW3 A8 306 DR

List of Modbus Cables

Designation	Length	Reference Number
Shielded cable for Modbus bus, with two RJ45 connectors	0.3 m (1 ft)	VW3 A8 306 R03
	1 m (3.2 ft)	VW3 A8 306 R10
	3 m (9.8 ft)	VW3 A8 306 R30
Shielded cable for Modbus bus, with one RJ45 connectors and one stripped end	3 m (9.8 ft)	VW3 A8 306 D30
Shielded cable for Modbus bus, with two stripped ends	100 m (320 ft)	TSX CSA 100
	200 m (640 ft)	TSX CSA 200
	500 m (1600 ft)	TSX CSA 500
Belden cable	–	–

Using the Modbus Communication Network

Overview

This chapter describes how to use the LTMR controller via the network port using the Modbus protocol.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for critical functions, provide a means to achieve an acceptable state during and after a path interruption. 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 interruptions 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.

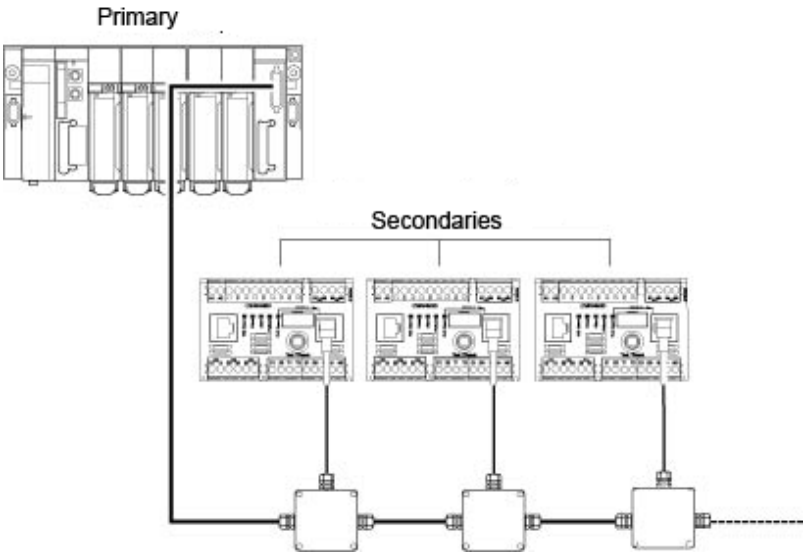
When switching to the Network control channels, depending on the communication protocol configuration, the LTMR controller can take into account the latest known state of the motor control commands issued from the PLC and restart automatically the motor.

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

Modbus Protocol Principle

Overview

The Modbus protocol is a primary secondary protocol:



Only one device can transmit on the line at any time.

The primary device manages and initiates the exchange. It interrogates each of the secondary devices in succession. No secondary device can send a message unless it is invited to do so.

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

If a secondary device does not understand a message, it sends an exception response to the primary device. The primary device may or may not retransmit the request.

Modbus Dialog

Two types of dialog are possible between primary and secondary devices:

- The primary device sends a request to a secondary device and waits for its response.
- The primary device broadcasts a request to all secondary devices without waiting for a response.

Direct secondary-to-secondary communication is not possible. For secondary-to-secondary communication, the primary device must interrogate a secondary device and send back data received to the other secondary device.

Transparent Ready

The controller LTMR Modbus is of class A05 (Transparent Ready).

Configuration of the LTMR Modbus Network Port

Communication Parameters

Before any communication can start, use the TeSys T DTM or the HMI to configure the Modbus port communication parameters:

- Network port address setting
- Network port baud rate setting
- Network port parity setting
- Network port comm loss timeout
- Network port endian setting

Network Port Address Setting

The device address can be set between 1 and 247.

Factory setting is 1, which corresponds to an undefined value.

Network Port Baud Rate Setting

Possible transmission rates are:

- 1200 Baud
- 2400 Baud
- 4800 Baud
- 9600 Baud
- 19,200 Baud
- Autodetection

Factory settings is Autodetection. In Autodetection, the controller is able to adapt its baud rate to that of the primary device. 19,200 Baud is the first baud rate to be tested.

Network Port Parity Setting

The parity can be selected from:

- Even
- Odd
- None

When Network port baud rate setting is in Autodetection, the controller is able to adapt its parity and stop bit to that of the primary device. Even parity is the first parity to be tested.

In Autodetection, the parity is set automatically; any previous setting is ignored.

Parity and stop bit behavior is linked:

If the Parity Is...	Then the Number of Stop Bits Is...
even or odd	1
none	2

Network Port Comm Loss Timeout

Network port comm loss timeout is used to determine the timeout value after a loss of communication with the PLC.

- Range: 1-9,999

Network Port Fallback Setting

Network port fallback setting is used to adjust the fallback mode in case of a loss of communication with the PLC.

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)

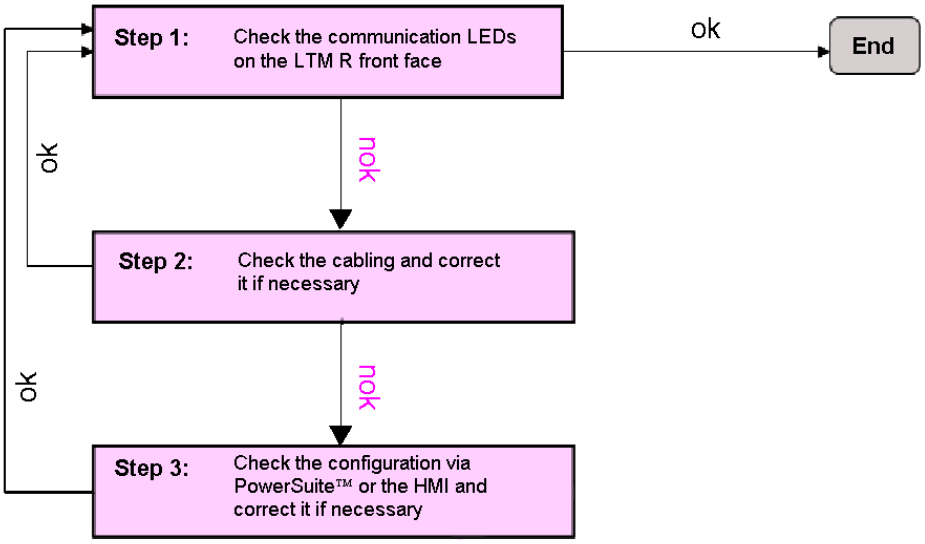
Modbus Communication Checking

Introduction

Configure the networking function last. Even when the connectors are plugged in, communication between the controller(s) and the PLC cannot start until you enter the correct communication parameters, page 22 via SoMove with the TeSys T DTM or the HMI.

You can then check whether your system can communicate properly.

The Modbus communication checking sequence is:

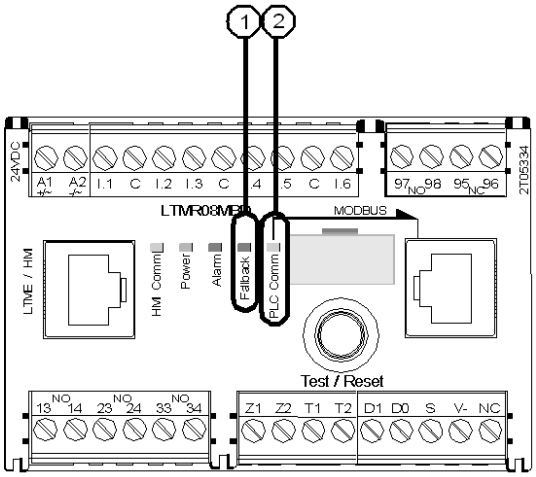


Step 1

On the LTMR front face, check the following two LEDs:

1. Fallback
2. PLC Comm

The figure shows the LTMR front face with both Modbus communication LEDs:



The communication **Fallback** is indicated by a **red LED** (1).

If the red Fallback LED is...	Then...
OFF	the LTMR is not in communication fallback mode
ON	the LTMR is in communication fallback mode

The Modbus communication status, marked as **PLC Comm**, is indicated by a **yellow LED** (2).

If the yellow PLC Comm LED is...	Then...
OFF	the LTMR is not communicating
Blinking	the LTMR is exchanging frames (receiving or sending)

Step 2

If the product should be communicating but the LEDs are not lit, check the cables and connectors and correct any connection problems.

Step 3

If the product is still not communicating, check the configuration via:

- SoMove with the TeSys T DTM, or
- The HMI.

The detected communication interruption can be the result of a wrong address, speed or parity; or an incorrect PLC configuration.

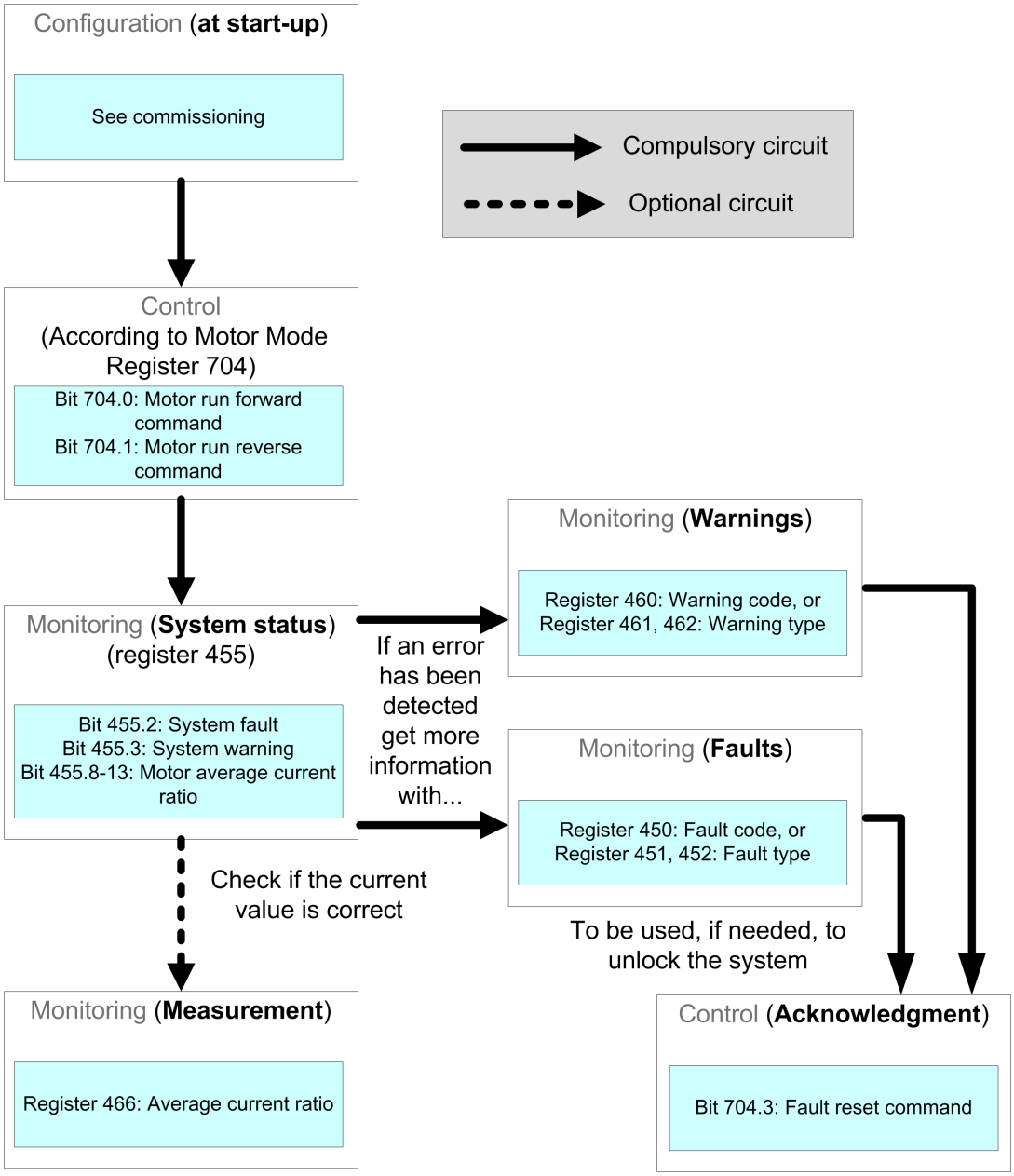
Simplified Control and Monitoring

Overview

This is a simplified example of the main registers which control and monitor a Motor Management Controller.

Modbus Registers for Simplified Operation

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



Modbus Request and Programming Examples

Modbus Request

The following table indicates which Modbus functions are managed by the LTMR controller, and specifies their limits:

Code value		Function Name	Broadcasting	Modbus Standard Name
Hexadecimal	Decimal			
0x03	3	Read N output words (multiple registers)	No	Read Holding Register
0x06	6	Write 1 output word (single register)	Yes	Preset Single Register

Code value		Function Name	Broadcasting	Modbus Standard Name
Hexadecimal	Decimal			
0x10	16	Write N output words (multiple registers)	Yes	Preset Multiple Registers
0x2B	43	Read identification (identification register)	No	Read Device Identification

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

⚠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 Communication variables list.

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

Example of a Read Operation (Modbus Request Code 3)

The following example describes a READ_VAR request, within a TSX Micro or Premium platform, in order to read the LTMR states at address 4 (secondary device n° 4) contained in internal word MW0:

```
If %M0 AND NOT %MW100:X0 THEN READ_VAR(ADR#3.0.4,'%MW',455,1,%MW0:1,%MW100:4) :RESET %M0;
EN_IF;
```

1 Address of the device with which you wish to communicate: 3 (device address), 0 (channel), 4 (device address on the bus)

2 Type of PL7 objects to be read: MW (internal word)

3 Address of the first register to be read: 455

4 Number of consecutive registers to be read: 1

5 Word table containing the value of the objects read: MW0:1

6 Read report: MW100:4

Example of a Write Operation (Modbus Request Code 16)

The following example describes a WRITE_VAR request, within a TSX Micro or Premium platform, in order to control an LTMR by sending the contents of internal word MW 502:

```
If %M0 AND NOT %MW200:X0 THEN WRITE_VAR(ADR#3.0.4,'%MW',704,1,%MW502:1,%MW200:4) :RESET %M10;
EN_IF;
```

1 Address of the device with which you wish to communicate: 3 (device address), 0 (channel), 4 (device address on the bus)

2 Type of PL7 objects to be written: MW (internal word)

3 Address of the first register to be written: 704

4 Number of consecutive registers to be written: 1

5 Word table containing the value of the objects to be sent: MW502:1

6 Write report: MW200:4

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 Sys Config State. 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 Sys Config state.

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 to 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.

User Map Variables (User Defined Indirect Registers)

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

User Map Variables

User Map variables are divided into two groups:

User Map Addresses	800 to 898
User Map Values	900 to 998

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 following table gives an example of user map address configuration to access non-contiguous registers:

User Map Address Register	**Value Configured**	**Register**
800	452	Trip register 1
801	453	Trip register 2
802	461	Alarm register 1
803	462	Alarm register 2
804	450	Minimum wait time
805	500	Average current (0.01 A) MSW
806	501	Average current (0.01 A) LSW
850	651	HMI display items register 1
851	654	HMI display items register 2
852	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 registers 950 to 952.

Register Map (Organization of Communication Variables)

Introduction

Communication variables are listed in tables, according to the group (such as identification, statistics, or monitoring) to which they belong. 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	Registers
Identification variables	00 to 99
Statistics variables	100 to 449
Monitoring variables	450 to 539
Configuration variables	540 to 699
Command variables	700 to 799
User Map variables	800 to 999
Custom Logic variables	1200 to 1399

Table Structure

Communication variables are listed in 4-column tables:

Column 1	Column 2	Column 3	Column 4
Register (in decimal format)	Variable type	Variable name and access via Read-only or Read/Write Modbus 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 to 9), for specific hardware combinations
- alphabetical (A to 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.[1]
B	The variable can be written only in configuration mode (e.g. static characteristics).[1]
C	The variable can be written only with no trip.[1]
D - Z	Not used

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.

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, refer to Data Types, page 31.

Integer (Int, UInt, DInt, IDInt)

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 2 registers (32 bits)
- **UDInt**: unsigned double integer using 2 registers (32 bits)

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

Example:

Address 474, **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.

1. Restrictions A, B, and C may apply only to bits, not to whole registers. If you try to write a value when a restriction is applied, the bit will not be changed and no exception code will be returned. Exception codes are returned at register level, not at bit level.

Example:

Address 455, **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	In remote
bit 15	Motor starting (in progress)

Word[n]

Word[n]: Data encoded on contiguous registers.

Examples:

Addresses 64 to 69, **Word[6]**, Controller Commercial Reference (DT_CommercialReference, page 32).

Addresses 655 to 658, **Word[4]**, (DT_DateTime, page 32).

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_TripCode
- 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:

Register	MSB	LSB
Register N	character 1	character 2
Register N+1	character 3	character 4
Register N+2	character 5	character 6
Register N+3	character 7	character 8
Register N+4	character 9	character 10
Register N+5	character 11	character 12

Example:

Addresses 64 to 69, **Word[6]**, Controller Commercial Reference.

If Controller Commercial Reference = LTMR:

Register	MSB	LSB
64	L	T
65	M	(space)
66	R	
67		
68		
69		

DT_DateTime

DT_DateTime format is **Word[4]** and indicates Date and Time:

Register	Bits 12-15	Bits 8-11	Bits 4-7	Bits 0-3
Register N	S	S	0	0
Register N+1	H	H	m	m

Register	Bits 12-15	Bits 8-11	Bits 4-7	Bits 0-3
Register N+2	M	M	D	D
Register N+3	Y	Y	Y	Y

Where:

- S = second
  The format is 2 BCD digits.
  The value range is [00-59] in BCD.
- 0 = unused
- H = hour
  The format is 2 BCD digits.
  The value range is [00-23] in BCD.
- m = minute
  The format is 2 BCD digits.
  The value range is [00-59] in BCD.
- M = month
  The format is 2 BCD digits.
  The value range is [01-12] in BCD.
- D = day
  The format is 2 BCD digits.
  The value range is (in BCD):
  [01-31] for months 01, 03, 05, 07, 08, 10, 12
  [01-30] for months 04, 06, 09, 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 4 Binary Coded Decimal (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 detected error.		

Example:

Addresses 655 to 658, **Word[4]**, Date and Time setting.

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

Register	15 12	11 8	7 4	3 0
655	3	2	0	0
656	0	7	5	0
657	0	9	0	4
658	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
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	Test
11	Detected HMI port error
12	HMI port communication loss
13	Detected HMI network port internal error
16	External trip
18	On-Off diagnostic
19	Wiring diagnostic
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 check
47	Run checkback
48	Stop check

Trip Code	Description
49	Stop checkback
51	Detected controller internal temperature error
55	Detected controller internal error (Stack overflow)
56	Detected controller internal error (RAM error)
57	Detected controller internal error (RAM checksum error)
58	Detected controller internal error (Hardware watchdog trip)
60	L2 current detected in single-phase mode
64	Detected non volatile memory error
65	Detected expansion module communication error
66	Stuck reset button
67	Detected logic function error
100-104	Detected network port internal error
109	Detected network port comm error
111	Fast device replacement trip
555	Detected network port configuration error

DT_FirmwareVersion

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

- X = major revision
- Y = minor revision.

Example:

Address 76, **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:

Address 650, **Word**, HMI language.

DT_OutputFallbackStrategy

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

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

DT_PhaseNumber

DT_PhaseNumber format is an **enumeration**, with only 1 bit activated:

Value	Description
1	1 phase
2	3 phases

DT_ResetMode

DT_ResetMode format is an **enumeration** of possible modes for thermal trip reset:

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
18	Diagnostic
19	Wiring
20	Overcurrent
21	Current phase loss
23	Motor temp sensor
24	Voltage phase imbalance

Alarm Code	Description
25	Voltage phase loss
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTME configuration
46	Start check
47	Run checkback
48	Stop check
49	Stop checkback
109	Network port comm loss
555	Network port configuration

Identification Variables

Identification Variables

Identification variables are described in the following table:

Register	Variable Type	Read-only Variables	Note, page 29
0-34		*(Not significant)*	
35-40	Word[6]	Expansion commercial reference (See DT_CommercialReference, page 32)	1
41-45	Word[5]	Expansion serial number	1
46	UInt	Expansion ID code	
47	UInt	Expansion firmware version (See DT_FirmwareVersion, page 36)	1
48	UInt	Expansion compatibility code	1
49-60		*(Not significant)*	
61	UInt	Network port ID code	
62	UInt	Network port firmware version (See DT_FirmwareVersion, page 36)	
63	UInt	Network port compatibility code	
64-69	Word[6]	Controller commercial reference (See DT_CommercialReference, page 32)	
70-74	Word[5]	Controller serial number	
75	UInt	Controller ID code	
76	UInt	Controller firmware version (See DT_FirmwareVersion, page 36)	
77	UInt	Controller compatibility code	

Register	Variable Type	Read-only Variables	Note, page 29
78	UInt	Current scale ratio (0.1 %)	
79	UInt	Current sensor max	
80		*(Not significant)*	
81	UInt	Current range max (x 0.1 A)	
82-94		*(Not significant)*	
95	UInt	Load CT ratio (x 0.1 A)	
96	UInt	Full load current max (maximum FLC range, *FLC = Full Load Current*) (x 0.1 A)	
97-99		*(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	Registers
Global statistics	100 to 121
LTM monitoring statistics	122 to 149
Last trip statistics	150 to 179
and extension	300 to 309
Trip n-1 statistics	180 to 209
and extension	330 to 339
Trip n-2 statistics	210 to 239
and extension	360 to 369
Trip n-3 statistics	240 to 269
and extension	390 to 399
Trip n-4 statistics	270 to 299
and extension	420 to 429

Global Statistics

The global statistics are described in the following table:

Register	Variable Type	Read-only Variables	Note, page 29
100-101		*(Not significant)*	
102	UInt	Ground current trips count	
103	UInt	Thermal overload trips count	
104	UInt	Long start trips count	
105	UInt	Jam trips count	
106	UInt	Current phase imbalance trips count	
107	UInt	Undercurrent trips count	
109	UInt	HMI port trips count	

Register	Variable Type	Read-only Variables	Note, page 29
110	UInt	Controller internal trips count	
111	UInt	Internal port trips count	
112	UInt	*(Not significant)*	
113	UInt	Network port config trips count	
114	UInt	Network port trips count	
115	UInt	Auto-resets count	
116	UInt	Thermal overload alarms count	
117-118	UDInt	Motor starts count	
119-120	UDInt	Operating time (s)	
121	Int	Controller internal temperature max (°C)	

LTM Monitoring Statistics

The LTM monitoring statistics are described in the following table:

Register	Variable Type	Read-only Variables	Note, page 29
122	UInt	Trips count	
123	UInt	Alarms count	
124-125	UDInt	Motor LO1 closings count	
126-127	UDInt	Motor LO2 closings count	
128	UInt	Diagnostic trips count	
129	UInt	*(Reserved)*	
130	UInt	Overcurrent trips count	
131	UInt	Current phase loss trips count	
132	UInt	Motor temperature sensor trips count	
133	UInt	Voltage phase imbalance trips count	1
134	UInt	Voltage phase loss trips count	1
135	UInt	Wiring trips count	1
136	UInt	Undervoltage trips count	1
137	UInt	Overvoltage trips count	1
138	UInt	Underpower trips count	1
139	UInt	Overpower trips count	1
140	UInt	Under power factor trips count	1
141	UInt	Over power factor trips count	1
142	UInt	Load sheddings count	1
143-144	UDInt	Active power consumption (kWh)	1
145-146	UDInt	Reactive power consumption (kVARh)	1
147	UInt	Auto restart immediate count	
148	UInt	Auto restart delayed count	
149	UInt	Auto restart manual count	

Last Trip (n-0) Statistics

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

Register	Variable Type	Read-only Variables	Note, page 29
150	UInt	Trip code n-0	
151	UInt	Motor full load current ratio n-0 (% FLC max)	
152	UInt	Thermal capacity level n-0 (% trip level)	
153	UInt	Average current ratio n-0 (% FLC)	
154	UInt	L1 current ratio n-0 (% FLC)	
155	UInt	L2 current ratio n-0 (% FLC)	
156	UInt	L3 current ratio n-0 (% FLC)	
157	UInt	Ground current ratio n-0 (x 0.1 % FLC min)	
158	UInt	Full load current max n-0 (x 0.1 A)	
159	UInt	Current phase imbalance n-0 (%)	
160	UInt	Frequency n-0 (x 0.1 Hz)	2
161	UInt	Motor temperature sensor n-0 (x 0.1 Ω)	
162-165	Word[4]	Date and time n-0 (See DT_DateTime, page 32)	
166	UInt	Average voltage n-0 (V)	1
167	UInt	L3-L1 voltage n-0 (V)	1
168	UInt	L1-L2 voltage n-0 (V)	1
169	UInt	L2-L3 voltage n-0 (V)	1
170	UInt	Voltage phase imbalance n-0 (%)	1
171	UInt	Active power n-0 (x 0.1 kW)	1
172	UInt	Power factor n-0 (x 0.01)	1
173-179		*(Not significant)*	

N-1 Trip Statistics

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

Register	Variable Type	Read-only Variables	Note, page 29
180	UInt	Trip code n-1	
181	UInt	Motor full load current ratio n-1 (% FLC max)	
182	UInt	Thermal capacity level n-1 (% trip level)	
183	UInt	Average current ratio n-1 (% FLC)	
184	UInt	L1 current ratio n-1 (% FLC)	
185	UInt	L2 current ratio n-1 (% FLC)	
186	UInt	L3 current ratio n-1 (% FLC)	
187	UInt	Ground current ratio n-1 (x 0.1 % FLC min)	
188	UInt	Full load current max n-1 (x 0.1 A)	
189	UInt	Current phase imbalance n-1 (%)	
190	UInt	Frequency n-1 (x 0.1 Hz)	2

Register	Variable Type	Read-only Variables	Note, page 29
191	UInt	Motor temperature sensor n-1 (x 0.1 Ω)	
192-195	Word[4]	Date and time n-1 (See DT_DateTime, page 32)	
196	UInt	Average voltage n-1 (V)	1
197	UInt	L3-L1 voltage n-1 (V)	1
198	UInt	L1-L2 voltage n-1 (V)	1
199	UInt	L2-L3 voltage n-1 (V)	1
200	UInt	Voltage phase imbalance n-1 (%)	1
201	UInt	Active power n-1 (x 0.1 kW)	1
202	UInt	Power factor n-1 (x 0.01)	1
203-209	UInt	*(Not significant)*	

N-2 Trip Statistics

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

Register	Variable Type	Read-only Variables	Note, page 29
210	UInt	Trip code n-2	
211	UInt	Motor full load current ratio n-2 (% FLC max)	
212	UInt	Thermal capacity level n-2 (% trip level)	
213	UInt	Average current ratio n-2 (% FLC)	
214	UInt	L1 current ratio n-2 (% FLC)	
215	UInt	L2 current ratio n-2 (% FLC)	
216	UInt	L3 current ratio n-2 (% FLC)	
217	UInt	Ground current ratio n-2 (x 0.1 % FLC min)	
218	UInt	Full load current max n-2 (x 0.1 A)	
219	UInt	Current phase imbalance n-2 (%)	
220	UInt	Frequency n-2 (x 0.1 Hz)	2
221	UInt	Motor temperature sensor n-2 (x 0.1 Ω)	
222-225	Word[4]	Date and time n-2 (See DT_DateTime, page 32)	
226	UInt	Average voltage n-2 (V)	1
227	UInt	L3-L1 voltage n-2 (V)	1
228	UInt	L1-L2 voltage n-2 (V)	1
229	UInt	L2-L3 voltage n-2 (V)	1
230	UInt	Voltage phase imbalance n-2 (%)	1
231	UInt	Active power n-2 (x 0.1 kW)	1
232	UInt	Power factor n-2 (x 0.01)	1
233-239		*(Not significant)*	

N-3 Trip Statistics

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

Register	Variable Type	Read-only Variables	Note, page 29
240	UInt	Trip code n-3	
241	UInt	Motor full load current ratio n-3 (% FLC max)	
242	UInt	Thermal capacity level n-3 (% trip level)	
243	UInt	Average current ratio n-3 (% FLC)	
244	UInt	L1 current ratio n-3 (% FLC)	
245	UInt	L2 current ratio n-3 (% FLC)	
246	UInt	L3 current ratio n-3 (% FLC)	
247	UInt	Ground current ratio n-3 (x 0.1 % FLC min)	
248	UInt	Full load current max n-3 (0.1 A)	
249	UInt	Current phase imbalance n-3 (%)	
250	UInt	Frequency n-3 (x 0.1 Hz)	2
251	UInt	Motor temperature sensor n-3 (x 0.1 Ω)	
252-255	Word[4]	Date and time n-3 (See DT_DateTime, page 32)	
256	UInt	Average voltage n-3 (V)	1
257	UInt	L3-L1 voltage n-3 (V)	1
258	UInt	L1-L2 voltage n-3 (V)	1
259	UInt	L2-L3 voltage n-3 (V)	1
260	UInt	Voltage phase imbalance n-3 (%)	1
261	UInt	Active power n-3 (x 0.1 kW)	1
262	UInt	Power factor n-3 (x 0.01)	1
263-269		*(Not significant)*	

N-4 Trip Statistics

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

Register	Variable Type	Read-only Variables	Note, page 29
270	UInt	Trip code n-4	
271	UInt	Motor full load current ratio n-4 (% FLC max)	
272	UInt	Thermal capacity level n-4 (% trip level)	
273	UInt	Average current ratio n-4 (% FLC)	
274	UInt	L1 current ratio n-4 (% FLC)	
275	UInt	L2 current ratio n-4 (% FLC)	
276	UInt	L3 current ratio n-4 (% FLC)	
277	UInt	Ground current ratio n-4 (x 0.1 % FLC min)	
278	UInt	Full load current max n-4 (x 0.1 A)	
279	UInt	Current phase imbalance n-4 (%)	
280	UInt	Frequency n-4 (x 0.1 Hz)	2

Register	Variable Type	Read-only Variables	Note, page 29
281	UInt	Motor temperature sensor n-4 (x 0.1 Ω)	
282-285	Word[4]	Date and time n-4 (See DT_DateTime, page 32)	
286	UInt	Average voltage n-4 (V)	1
287	UInt	L3-L1 voltage n-4 (V)	1
288	UInt	L1-L2 voltage n-4 (V)	1
289	UInt	L2-L3 voltage n-4 (V)	1
290	UInt	Voltage phase imbalance n-4 (%)	1
291	UInt	Active power n-4 (x 0.1 kW)	1
292	UInt	Power factor n-4 (x 0.01)	1
293-299		*(Not significant)*	

Last Trip (n-0) Statistics Extension

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

Register	Variable Type	Read-only Variables	Note, page 29
300-301	UDInt	Average current n-0 (x 0.01 A)	
302-303	UDInt	L1 current n-0 (x 0.01 A)	
304-305	UDInt	L2 current n-0 (x 0.01 A)	
306-307	UDInt	L3 current n-0 (x 0.01 A)	
308-309	UDInt	Ground current n-0 (mA)	
310	UInt	Motor temperature sensor degree n-0 (°C)	

N-1 Trip Statistics Extension

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

Register	Variable Type	Read-only Variables	Note, page 29
330-331	UDInt	Average current n-1 (x 0.01 A)	
332-333	UDInt	L1 current n-1 (x 0.01 A)	
334-335	UDInt	L2 current n-1 (x 0.01 A)	
336-337	UDInt	L3 current n-1 (x 0.01 A)	
338-339	UDInt	Ground current n-1 (mA)	
340	UInt	Motor temperature sensor degree n-1 (°C)	

N-2 Trip Statistics Extension

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

Register	Variable Type	Read-only Variables	Note, page 29
360-361	UDInt	Average current n-2 (x 0.01 A)	
362-363	UDInt	L1 current n-2 (x 0.01 A)	

Register	Variable Type	Read-only Variables	Note, page 29
364-365	UDInt	L2 current n-2 (x 0.01 A)	
366-367	UDInt	L3 current n-2 (x 0.01 A)	
368-369	UDInt	Ground current n-2 (mA)	
370	UInt	Motor temperature sensor degree n-2 (°C)	

N-3 Trip Statistics Extension

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

Register	Variable Type	Read-only Variables	Note, page 29
390-391	UDInt	Average current n-3 (x 0.01 A)	
392-393	UDInt	L1 current n-3 (x 0.01 A)	
394-395	UDInt	L2 current n-3 (x 0.01 A)	
396-397	UDInt	L3 current n-3 (x 0.01 A)	
398-399	UDInt	Ground current n-3 (mA)	
400	UInt	Motor temperature sensor degree n-3 (°C)	

N-4 Trip Statistics Extension

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

Register	Variable Type	Read-only Variables	Note, page 29
420-421	UDInt	Average current n-4 (x 0.01 A)	
422-423	UDInt	L1 current n-4 (x 0.01 A)	
424-425	UDInt	L2 current n-4 (x 0.01 A)	
426-427	UDInt	L3 current n-4 (x 0.01 A)	
428-429	UDInt	Ground current n-4 (mA)	
430	UInt	Motor temperature sensor degree n-4 (°C)	

Monitoring Variables

Monitoring Overview

Monitoring variables are grouped according to the following criteria:

Monitoring Variable Groups	Registers
Monitoring of trips	450 to 454
Monitoring of status	455 to 459
Monitoring of alarms	460 to 464
Monitoring of measurements	465 to 539

Monitoring of Trips

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

Register	Variable Type	Read-only Variables	Note, page 29
450	UInt	Minimum wait time (s)	
451	UInt	Trip code (code of the last trip, or of the trip that takes priority) (See DT_TripCode, page 35.)	
452	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 trip	
		bit 12 Internal port trip	
		bit 13 *(Not significant)*	
		bit 14 Network port config trip	
		bit 15 Network port trip	
453	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

Register	Variable Type	Read-only Variables	Note, page 29
454	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 in the following table:

Register	Variable Type	Read-only Variables	Note, page 29
455	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 (with detection of a current, if greater than 10% FLC)	
		bits 8-13 Motor average current ratio 32 = 100% FLC - 63 = 200% FLC	
		bit 14 In remote	
		bit 15 Motor starting (start in progress) 0 = descending current is less than 150% FLC 1 = ascending current is greater than 10% FLC	
456	Word	System status register 2	
		bit 0 Auto-reset active	
		bit 1 *(Not significant)*	
		bit 2 Trip 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)*	

Register	Variable Type	Read-only Variables	Note, page 29
457	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	1
		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	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)*	

Register	Variable Type	Read-only Variables	Note, page 29
459	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:

Register	Variable Type	Read-only Variables	Note, page 29
460	UInt	Alarm code (See DT_AlarmCode, page 37.)	
461	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	

Register	Variable Type	Read-only Variables	Note, page 29
462	Word	Alarm register 2	
		bit 0 *(Not significant)*	
		bit 1 Diagnostic alarm	
		bit 2 *(Reserved)*	
		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)*	1
		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	Word	Alarm register 3	
		bit 0 LTME configuration alarm	
		bits 1-15 *(Reserved)*	
464	UInt	Motor temperature sensor degree (°C)	

Monitoring of Measurements

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

Register	Variable Type	Read-only Variables	Note, page 29
465	UInt	Thermal capacity level (% trip level)	
466	UInt	Average current ratio (% FLC)	
467	UInt	L1 current ratio (% FLC)	
468	UInt	L2 current ratio (% FLC)	
469	UInt	L3 current ratio (% FLC)	
470	UInt	Ground current ratio (x 0.1 % FLC min)	
471	UInt	Current phase imbalance (%)	
472	Int	Controller internal temperature (°C)	
473	UInt	Controller config checksum	
474	UInt	Frequency (x 0.01 Hz)	2
475	UInt	Motor temperature sensor (x 0.1 Ω)	
476	UInt	Average voltage (V)	1
477	UInt	L3-L1 voltage (V)	1
478	UInt	L1-L2 voltage (V)	1
479	UInt	L2-L3 voltage (V)	1

Register	Variable Type	Read-only Variables	Note, page 29
480	UInt	Voltage phase imbalance (%)	1
481	UInt	Power factor (x 0.01)	1
482	UInt	Active power (x 0.1 kW)	1
483	UInt	Reactive power (x 0.1 kVAR)	1
484	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	Word	Controller last power off duration	
486-489	Word	*(Not significant)*	
490	Word	Network port monitoring	
		bit 0 Network port monitoring	
		bit 1 Network port connected	
		bit 2 Network port self-testing	
		bit 3 Network port self-detecting	
		bit 4 Network port bad config	
		bits 5-15 *(Not significant)*	
491	UInt	Network port baud rate (See DT_ExtBaudRate, page 34.)	
492		*(Not significant)*	
493	UInt	Network port parity (See DT_ExtParity, page 34.)	
494-499		*(Not significant)*	
500-501	UDInt	Average current (x 0.01 A)	
502-503	UDInt	L1 current (x 0.01 A)	
504-505	UDInt	L2 current (x 0.01 A)	
506-507	UDInt	L3 current (x 0.01 A)	
508-509	UDInt	Ground current (mA)	
510	UInt	Controller port ID	
511	UInt	Time to trip (x 1 s)	
512	UInt	Motor last start current ratio (% FLC)	
513	UInt	Motor last start duration (s)	
514	UInt	Motor starts per hour count	

Register	Variable Type	Read-only Variables	Note, page 29
515	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		*(Reserved)*	
524 - 539		*(Forbidden)*	

Configuration Variables

Configuration Overview

Configuration variables are grouped according to the following criteria:

Configuration Variable Groups	Registers
Configuration	540 to 649
Setting	650 to 699

Configuration Variables

The configuration variables are described in the following table:

Register	Variable Type	Read / Write Variables	Note, page 29
540	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	UInt	Motor transition timeout (s)	
542-544		*(Reserved)*	

Register	Variable Type	Read / Write Variables	Note, page 29
545	Word	Controller AC inputs setting register	
		bits 0-3 Controller AC logic inputs configuration (see DC_ACInputSetting, page 32)	
		bits 4-15 *(Reserved)*	
546	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	UInt	Thermal overload trip definite timeout (s)	
548		*(Reserved)*	
549	UInt	Motor temperature sensor trip threshold (x 0.1 Ω)	
550	UInt	Motor temperature sensor alarm threshold (x 0.1 Ω)	
551	UInt	Motor temperature sensor trip threshold degree (°C)	
552	UInt	Motor temperature sensor alarm threshold degree (°C)	
553	UInt	Rapid cycle lockout timeout (s)	
554		*(Reserved)*	
555	UInt	Current phase loss timeout (x 0.1 s)	
556	UInt	Overcurrent trip timeout (s)	
557	UInt	Overcurrent trip threshold (% FLC)	
558	UInt	Overcurrent alarm threshold (% FLC)	
559	Word	Ground current trip configuration	B
		bit 0 Ground current mode	
		bit 1 Ground trip disabled while starting	
		bits 2-15 *(Reserved)*	
560	UInt	Ground current sensor primary	
561	UInt	Ground current sensor secondary	
562	UInt	External ground current trip timeout (x 0.01 s)	
563	UInt	External ground current trip threshold (x 0.01 A)	
564	UInt	External ground current alarm threshold (x 0.01 A)	
565	UInt	Motor nominal voltage (V)	1
566	UInt	Voltage phase imbalance trip timeout starting (x 0.1 s)	1
567	UInt	Voltage phase imbalance trip timeout running (x 0.1 s)	1
568	UInt	Voltage phase imbalance trip threshold (% imb)	1
569	UInt	Voltage phase imbalance alarm threshold (% imb)	1
570	UInt	Overvoltage trip timeout (x 0.1 s)	1

Register	Variable Type	Read / Write Variables	Note, page 29
571	UInt	Overvoltage trip threshold (% Vnom)	1
572	UInt	Overvoltage alarm threshold (% Vnom)	1
573	UInt	Undervoltage trip timeout	1
574	UInt	Undervoltage trip threshold (% Vnom)	1
575	UInt	Undervoltage alarm threshold (% Vnom)	1
576	UInt	Voltage phase loss trip timeout (x 0.1 s)	1
577	Word	Voltage dip setting	1
		bits 0-1 Voltage dip mode 0 = None (factory setting) 1 = Load shedding 2 = Auto-restart	
		bits 3-15 *(Reserved)*	
578	UInt	Load shedding timeout (s)	1
579	UInt	Voltage dip threshold (% Vnom)	1
580	UInt	Voltage dip restart timeout (s)	1
581	UInt	Voltage dip restart threshold (% Vnom)	1
582	UInt	Auto restart immediate timeout (x 0.1 s)	
583	UInt	Motor nominal power (x 0.1 kW)	1
584	UInt	Overpower trip timeout (s)	1
585	UInt	Overpower trip threshold (% Pnom)	1
586	UInt	Overpower alarm threshold (% Pnom)	1
587	UInt	Underpower trip timeout (s)	1
588	UInt	Underpower trip threshold (% Pnom)	1
589	UInt	Underpower alarm threshold (% Pnom)	1
590	UInt	Under power factor trip timeout (x 0.1 s)	1
591	UInt	Under power factor trip threshold (x 0.01 PF)	1
592	UInt	Under power factor alarm threshold (x 0.01 PF)	1
593	UInt	Over power factor trip timeout (x 0.1 s)	1
594	UInt	Over power factor trip threshold (x 0.01 PF)	1
595	UInt	Over power factor alarm threshold (x 0.01 PF)	1
596	UInt	Auto restart delayed timeout (s)	
597-599		*(Reserved)*	
600		*(Not significant)*	

Register	Variable Type	Read / Write Variables	Note, page 29
601	Word	General configuration register 1	
		bit 0 Controller system config required 0 = exit the configuration menu 1 = go to the configuration menu	A
		bits 1-7 *(Reserved)*	
		Control mode configuration, 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 37)	B
		bit 15 Motor auxiliary fan cooled (factory setting = 0)	
602	Word	General configuration register 2	
		bits 0-2 Trip reset mode (see DT_ResetMode, page 37)	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	UInt	HMI port address setting	
604	UInt	HMI port baud rate setting (Baud)	
605		*(Reserved)*	
606	UInt	Motor trip class (s)	
607		*(Reserved)*	
608	UInt	Thermal overload trip reset threshold (% trip level)	
609	UInt	Thermal overload alarm threshold (% trip level)	
610	UInt	Internal ground current trip timeout (x 0.1 s)	
611	UInt	Internal ground current trip threshold (% FLCmin)	
612	UInt	Internal ground current alarm threshold (% FLCmin)	
613	UInt	Current phase imbalance trip timeout starting (x 0.1 s)	
614	UInt	Current phase imbalance trip timeout running (x 0.1 s)	
615	UInt	Current phase imbalance trip threshold (% imb)	
616	UInt	Current phase imbalance alarm threshold (% imb)	
617	UInt	Jam trip timeout (s)	

Register	Variable Type	Read / Write Variables	Note, page 29
618	UInt	Jam trip threshold (% FLC)	
619	UInt	Jam alarm threshold (% FLC)	
620	UInt	Undercurrent trip timeout (s)	
621	UInt	Undercurrent trip threshold (% FLC)	
622	UInt	Undercurrent alarm threshold (% FLC)	
623	UInt	Long start trip timeout (s)	
624	UInt	Long start trip threshold (% FLC)	
625		*(Reserved)*	
626	UInt	HMI display contrast setting	
		bits 0-7 HMI display contrast setting	
		bits 8-15 HMI display brightness setting	
627	UInt	Contactor rating (0.1 A)	
628	UInt	Load CT primary	B
629	UInt	Load CT secondary	B
630	UInt	Load CT multiple passes (passes)	B
631	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	

Register	Variable Type	Read / Write Variables	Note, page 29
632	Word	Alarm enable register 1	
		bit 0 *(Not significant)*	
		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	
633	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

Register	Variable Type	Read / Write Variables	Note, page 29
634	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
635-6		*(Reserved)*	
637	UInt	Auto-reset attempts group 1 setting (resets)	
638	UInt	Auto-reset group 1 timeout (s)	
639	UInt	Auto-reset attempts group 2 setting (resets)	
640	UInt	Auto-reset group 2 timeout (s)	
641	UInt	Auto-reset attempts group 3 setting (resets)	
642	UInt	Auto-reset group 3 timeout (s)	
643	UInt	Motor step 1 to 2 timeout (x 0.1 s)	
644	UInt	Motor step 1 to 2 threshold (% FLC)	
645	UInt	HMI port fallback setting (see DT_OutputFallbackStrategy, page 36)	
646-649		*(Reserved)*	

Setting Variables

The setting variables are described in the following table:

Register	Variable Type	Read / Write Variables	Note, page 29
650	Word	HMI language setting register:	
		bits 0-4 HMI language setting (see DT_Language5, page 36)	
		bits 5-15 *(Not significant)*	
651	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	UInt	Motor full load current ratio, FLC1 (% FLCmax)	
653	UInt	Motor high speed full load current ratio, FLC2 (% FLCmax)	
654	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	Word[4]	Date and time setting (See DT_DateTime, page 32)	

Register	Variable Type	Read / Write Variables	Note, page 29
659	Word	HMI display items register 3	
		bit 0 HMI display temperature sensor degree CF	
		bits 1-15 *(Reserved)*	
660-681		*(Reserved)*	
682	UInt	Network port fallback setting (see DT_OutputFallbackStrategy, page 36)	
683	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)*	
684-692		*(Reserved)*	
693	UInt	Network port comm loss timeout (x 0.01 s) (Modbus only)	
694	UInt	Network port parity setting (Modbus only)	
695	UInt	Network port baud rate setting (Baud) (see DT_ExtBaudRate, page 34)	
696	UInt	Network port address setting	
697-699		*(Not significant)*	

Command Variables

Command Variables

Command variables are described in the following table:

Register	Variable Type	Read / Write Variables	Note, page 29
700	Word	Register available to remotely write commands that can be processed in a specific custom logic	
701-703		*(Reserved)*	
704	Word	Control register 1	
		bit 0 Motor run forward command [2]	
		bit 1 Motor run reverse command [2]	
		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	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	
		bits 5-15 *(Reserved)*	
706-709		*(Reserved)*	
710-799		*(Forbidden)*	

User Map Variables

User Map Variables

User Map variables are described in the following table:

User map Variable Groups	Registers
User Map addresses	800 to 899
User Map values	900 to 999

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

Register	Variable Type	Read/Write Variables	Note, page 29
800-898	Word[99]	User map addresses setting	
899		*(Reserved)*	
Register	**Variable Type**	**Read/Write Variables**	**Note, page 29**
900-998	Word[99]	User map values	
999		*(Reserved)*	

Custom Logic Variables

Custom Logic Variables

Custom logic variables are described in the following table:

Register	Variable Type	Read-only Variables	Note, page 29
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)*	
Register	**Variable Type**	**Read/Write Variables**	**Note, page 29**
1250	Word	Custom logic setting register 1	
		bit 0 (Reserved)	
		bit 1 Logic input 3 external ready enable	
		bits 2-15 (Reserved)	
1251-1269		*(Reserved)*	

Register	Variable Type	Read/Write Variables	Note, page 29
1270	Word	Custom logic command register 1	
		bit 0 Custom logic external trip command	
		bits 1-15 (Reserved)	
1271-1279		*(Reserved)*	
Register	**Variable Type**	**Read-only Variables**	**Note, page 29**
1280	Word	Custom logic monitoring register 1	
		bit 0 (Reserved)	
		bit 1 Custom logic system ready	
		bits 2-15 (Reserved)	
1281-1300		*(Reserved)*	
Register	**Variable Type**	**Read/Write Variables**	**Note, page 29**
1301-1399	Word[99]	General purpose registers for logic functions	

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:

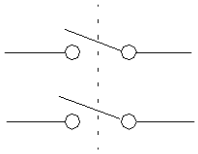
Deutsches Institut für Normung. The European organization that organizes the creation and maintenance of dimensional and engineering standards.

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:



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 two 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

hysteresis:

A value—added to lower limit threshold settings or subtracted from upper limit threshold settings—that retards the response of the LTMR controller before it stops measuring the duration of 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 primary-secondary/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.

T

TCC:

trip curve characteristic. The type of delay used to trip the flow of current in response to a trip condition. As implemented in the LTMR controller, all motor protection function trip time delays are definite time, except for the Thermal Overload function, which also offers inverse thermal trip time delays.

TVC:

trip voltage characteristic. The type of delay used to trip the flow of voltage in response to a trip condition. As implemented by the LTMR controller and the expansion module, all TVCs are definite time.

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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