TeSys™ T LTMR

Motor Management Controller

User Guide

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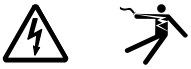
Table of Contents

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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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.

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 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 best 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 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 - 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 and LTME expansion module.	DOCA0129EN
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 and LTME expansion module.	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 and LTME expansion module.	DOCA0131EN

Title of Documentation	Description	Reference Number
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 and LTME expansion module.	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 and LTME expansion module.	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
XBT N/R/RT - Instruction Sheet	This document describes the mounting and connection of the Magelis XBT-N.	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 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

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

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.

Examples of Supported Machine Segments

The motor management system supports the following machine segments:

Machine Segment	Examples
Process and special machine segments	Water and waste water treatment • Water treatment (pump, blowers, and agitators) Metal, Minerals, and Mining • Cement • Glass • Steel • Ore extraction Oil and gas • Oil and gas processing ◦ Petrochemical ◦ Refinery, Offshore platform Microelectronic Pharmaceutical Chemical industry • Cosmetics • Detergents • Fertilizers • Paint Transportation industry • Automotive transfer lines • Airports • Subway Other industry • Tunnel machines
Complex machine segments	Includes highly automated or coordinated machines used in: • Pumping systems • Paper conversion • Printing lines • HVAC

Supported Industries

The motor management system supports the following industries and associated business sectors:

Industry	Sectors	Application
Building	• Office buildings • Shopping centers • Industrial buildings • Ships • Hospitals • Cultural facilities • Airports	Control and manage the building facilities: • Critical HVAC systems • Water • Air • Gas • Electricity • Steam
Industry	• Metal, mineral, and mining: cement, glass, steel, ore-extraction • Microelectronic • Petrochemical • Ethanol • Chemical: pulp and paper industry • Pharmaceutical • Food and beverage	• Control and monitor pump motors • Control ventilation • Control load traction and movements • View status and communicate with machines • Process and communicate the data captured • Remotely manage data for one or several sites via the Internet
Energy and Infrastructure	• Water treatment and transportation • Transportation infrastructure for people and freight: airports, road tunnels, subways, and tramways • Power generation and transport	• Control and monitor pump motors • Control ventilation • Remotely control wind turbine • Remotely manage data for one or several sites via the Internet

TeSys T Motor Management System

The two main hardware components of the system are the LTMR controller and the LTME expansion module.

The microprocessor-based LTMR controller is the central component in the system that manages the control, protection, and monitoring functions of single-phase or three-phase AC induction motors.

The LTMR controller is designed to work over the following networks:

- An Ethernet network either through Modbus/TCP communication protocol or through EtherNet/IP communication
- The Modbus network
- The PROFIBUS DP network
- The CANopen network
- The DeviceNet network

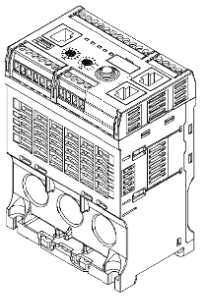
The system can be configured and controlled:

- Using an HMI (Human Machine Interface) device: Magelis™ XBT or TeSys T LTMCU.
- Using a PC running SoMove™ with the TeSys T DTM.
- Using a PLC connected to the system via the communication network.
- Using the Ethernet Web server (for LTMR Ethernet controller only.)

Components such as external motor load current transformers and ground current sensors add additional range to the system.

LTMR Controller

The following table introduces the functions of the LTMR controllers:

LTMR Controller	Functional Description
	• Current sensing 0.4...100 A • Single-phase or three-phase current inputs • Six discrete logic inputs • Four relay outputs: three SPST, one DPST • Connections for a ground current sensor • Connection for a motor temperature sensor • Connection for a communication network • Connection for HMI device or expansion module • Current protection, metering, and monitoring functions • Motor control functions • Power indicator and communication protocol selection indicator • Trip and alarm LED indicators • Network communication and alarm indicators • HMI communication LED indicator • Test and reset function

NOTE: LTMR Ethernet controllers communicating over an Ethernet network can communicate either using the Modbus/TCP communication protocol or using the Ethernet/IP communication protocol.

Both protocols are loaded in the controller. The controller is pre-configured to communicate through Modbus/TCP protocol. Changing its configuration allows to switch to Ethernet/IP protocol.

LTMR Controller Reference Number Description

The following tables describe the LTMR controller's reference number: LTMRxxyzz

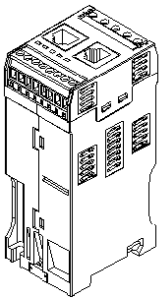
xx	Rating
08	0.4...8 A
27	1.36...27 A
100	5...100 A

y	Communication Protocol
E	Ethernet (Modbus/TCP and Ethernet/IP)
M	Modbus SL
P	PROFIBUS DP
C	CANopen
D	DeviceNet

zz	Control Voltage
BD	24 Vdc
FM	100...240 Vac

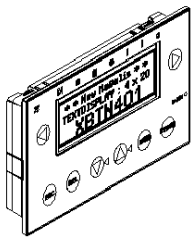
LTME Expansion Module

There are two models of LTME expansion modules that provide voltage monitoring functionality and four additional logic inputs. The LTME expansion modules are powered by the LTMR controller via a connector cable.

LTME Expansion Module	Functional Description	Reference Number
	• Voltage sensing 110...690 Vac, 47...63 Hz • Three-phase voltage inputs • Four additional discrete logic inputs • Additional voltage protection, metering, and monitoring functions • Power LED indicator • Logic input status LED indicators Additional components required for an optional expansion module: • LTMR controller to LTME connection cable	LTMEV40BD (24 Vdc logic inputs) LTMEV40FM (100...240 Vac logic inputs)

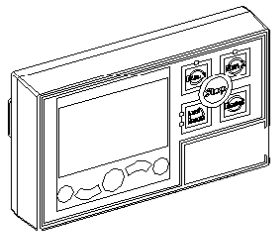
HMI Device: Magelis XBTN410 (Discontinued)

The system uses the Magelis XBTN410 HMI device with a liquid crystal display.

Magelis XBTN410	Functional Description	Reference Number
	• Configures the system through menu entries • Displays parameters, alarms, and trips Additional components required for an optional HMI device: • Separate power source • LTMR/LTME to HMI communication cable • Magelis XBTL1000 programming software	XBTN410 (HMI) XBTZ938 (cable) XBTL1000 (software)

HMI Device: LTMCU Control Operator Unit

The system uses the TeSys T LTMCU Control Operator Unit HMI device with a liquid crystal display and contextual navigation keys. The LTMCU is internally powered by the LTMR. Refer to the *TeSys T LTMCU Control Operator Unit User Manual* for more information.

LTMCU Control Operator Unit	Functional Description	Reference Number
	• Configures the system through menu entries • Displays parameters, alarms, and trips • Controls the motor • Provides the FDR (Fast Device Replacement) service (only with LTMCUF with embedded memory) Additional components required for an optional HMI device: • LTMR/LTME to HMI communication cable	LTMCU (HMI device) LTMCUF (HMI device with FDR service) LTM9CU•0 (HMI communication cable) TCSMCNAM3M002P (cable kit) LTM9KCU (Kit for portable LTMCU)

SoMove with the TeSys T DTM

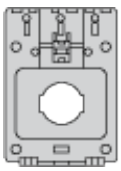
SoMove software is a Microsoft Windows® based application, using the open FDT/DTM technology.

SoMove contains many DTMs. A specific DTM exists for the TeSys T motor management system.

SoMove with the TeSys T DTM	Functional Description	Reference Number
	• configure the system through menu entries • Display parameters, alarms, and trips • Control the motor • Enable customization of operating modes Additional components required for the SoMove FDT container: • A PC • separate power source • LTMR / LTME / LTMCU to PC communication cables	SoMove with the TeSys T DTM TCSMCNAM3M002P (cable kit)

Load Current Transformers

External load current transformers expand the current range for use with motors greater than 100 full load Amperes.

Schneider Electric Load Current Transformers	Primary	Secondary	Inside Diameter		Reference Number
			mm	In.	
	100	1	35	1.38	LT6CT1001
	200	1	35	1.38	LT6CT2001
	400	1	35	1.38	LT6CT4001
	Note: The following current transformers are also available: Schneider Electric LUTC0301, LUTC0501, LUTC1001, LUTC2001, LUTC4001, and LUTC8001.				

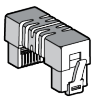
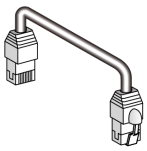
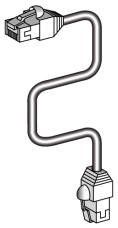
Ground Current Sensors

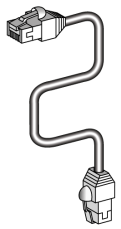
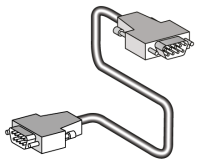
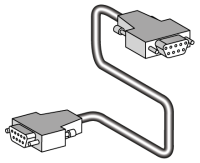
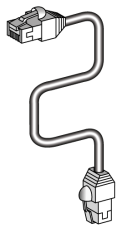
External ground current sensors measure ground current trip conditions.

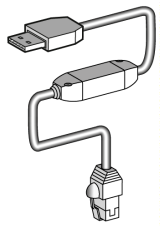
Schneider Electric Vigirex™ Ground Current Transformers	Type	Maximum Current	Inside Diameter		Transformation Ratio	Reference Number
			mm	In.		
	TA30	65 A	30	1.18	1000:1	50437
	PA50	85 A	50	1.97		50438
	IA80	160 A	80	3.15		50439
	MA120	250 A	120	4.72		50440
	SA200	400 A	200	7.87		50441
	PA300	630 A	300	11.81		50442
	POA	85 A	46	1.81		50485
	GOA	250 A	110	4.33		50486

Cables

System components require cables to connect to other components and communicate with the network.

Connection to....	Cable	Description	Reference Number
LTME expansion module		Connecting jumper 0.04 m (1.57 in.) length, for side by side connection of the LTMR and LTME	LTMCC004
		LTMR to LTME RJ45 connector cable 1.0 m (3.28 ft) length	LTM9CEXP10
Ethernet network		Category 5 shielded/unshielded twisted-pair network connection cables with two RJ45 connectors	490 NTW 000 •••

Connection to....	Cable	Description	Reference Number
Modbus network		Modbus network communication cable 0.3 m (11.81 in.) length	VW3A8306R03
		Modbus network communication cable 1.0 m (3.28 ft) length	VW3A8306R10
		Modbus network communication cable 3.0 m (9.84 ft) length	VW3A8306R30
PROFIBUS DP network		PROFIBUS DP network communication cable 100 m (328.08 ft) length	TSXPBSCA100
		PROFIBUS DP network communication cable 400 m (1,312.33 ft) length	TSXPBSCA400
CANopen network		LZSH CANopen network communication cable 0.3 m (11.81 in) length	TSXCANCADD03
		UL/IEC332-2 CANopen network communication cable 0.3 m (11.81 in) length	TSXCANCBDD03
		LZSH CANopen network communication cable 1.0 m (3.28 ft) length	TSXCANCADD1
		UL/IEC332-2 CANopen network communication cable 1.0 m (3.28 ft) length	TSXCANCBDD1
		LZSH CANopen network communication cable 3.0 m (9.84 ft) length	TSXCANCADD3
		UL/IEC332-2 CANopen network communication cable 3.0 m (9.84 ft) length	TSXCANCBDD3
		LZSH CANopen network communication cable 5.0 m (16.40 ft) length	TSXCANCADD5
		UL/IEC332-2 CANopen network communication cable 5.0 m (16.40 ft) length	TSXCANCBDD5
LTMCU HMI		LTMR/LTME to LTMCU HMI device connection cable 1.0 m (3.28 ft) length	LTM9CU10
		LTMR/LTME to LTMCU HMI device connection cable 3.0 m (9.84 ft) length	LTM9CU30

Connection to....	Cable	Description	Reference Number
PC		Cable kit, includes LTME / LTMR / LTMCU to PC communication cable 2.5 m (8.2 ft) length	TCSMCNAM3M002P

System Selection Guide

Overview

This section describes the LTMR controller with and without the optional LTME expansion module for metering and monitoring, protection, and control functions.

- **Metering and Monitoring functions**
  - Measurement
  - Trip and alarm counters
  - System and device monitoring trips
  - Motor history
  - System operating status
- **Protection functions**
  - Thermal motor protection
  - Current motor protection
  - Voltage and power motor protection
- **Control functions**
  - Control channels (local/remote control source selection)
  - Operating modes
  - Trip management

Metering Functions

The following table lists the equipment required to support the metering functions of the motor management system:

Function	LTMR Controller	LTMR with LTME
Measurement		
Line currents	X	X
Ground current	X	X
Average current	X	X
Current phase imbalance	X	X
Thermal capacity level	X	X
Motor temperature sensor	X	X

Function	LTMR Controller	LTMR with LTME
Frequency	–	X
Line-to-line voltage	–	X
Line voltage imbalance	–	X
Average voltage	–	X
Power factor	–	X
Active power	–	X
Reactive power	–	X
Active power consumption	–	X
Reactive power consumption	–	X
System and Device Monitoring Trips		
Controller internal trips	X	X
Controller internal temperature	X	X
Control command trip diagnostic	X	X
Wiring trip - Temperature sensor connections	X	X
Wiring trip - Current connections	X	X
Wiring trip - Voltage connections	–	X
Configuration checksum	X	X
Communication loss	X	X
Time to trip	X	X
Trip and alarm counters		
Protection trip counts	X	X
Protection alarm counts	X	X
Diagnostic trip counts	X	X
Motor control function counts	X	X
Trip history	X	X
Motor History		
Motor starts / O1 starts / O2 starts	X	X
Operating time	X	X
Motor starts per hour	X	X
Motor last start current ratio	X	X
Motor last start duration	X	X
System Operating Status		
Motor running	X	X
Motor ready	X	X
Motor starting	X	X
Minimum wait time	X	X
X The function is available **–** The function is not available		

Protection Functions

The following table lists the equipment required to support the protection functions of the motor management system:

Functions	LTMR Controller	LTMR with LTME
Thermal overload	X	X
Current phase imbalance	X	X
Current phase loss	X	X
Current phase reversal	X	X
Long start	X	X
Jam	X	X
Undercurrent	X	X
Overcurrent	X	X
Ground current	X	X
Motor temperature sensor	X	X
Rapid cycle lockout	X	X
Voltage phase imbalance	–	X
Voltage phase loss	–	X
Voltage phase reversal	–	X
Undervoltage	–	X
Overvoltage	–	X
Load shedding	–	X
Underpower	–	X
Overpower	–	X
Under power factor	–	X
Over power factor	–	X
X The function is available **–** The function is not available		

Control Functions

The following table lists the equipment required to support the control functions of the motor management system:

Control functions	LTMR Controller	LTMR with LTME
Motor control channels		
Terminal strip	X	X
HMI	X	X
Remote	X	X
Operating mode		
Overload	X	X
Independent	X	X
Reverser	X	X
Two-step	X	X

Control functions	LTMR Controller	LTMR with LTME
Two-speed	X	X
Custom	X	X
Trip Management		
Manual reset	X	X
Automatic reset	X	X
Remote reset	X	X
X The function is available **–** The function is not available		

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.

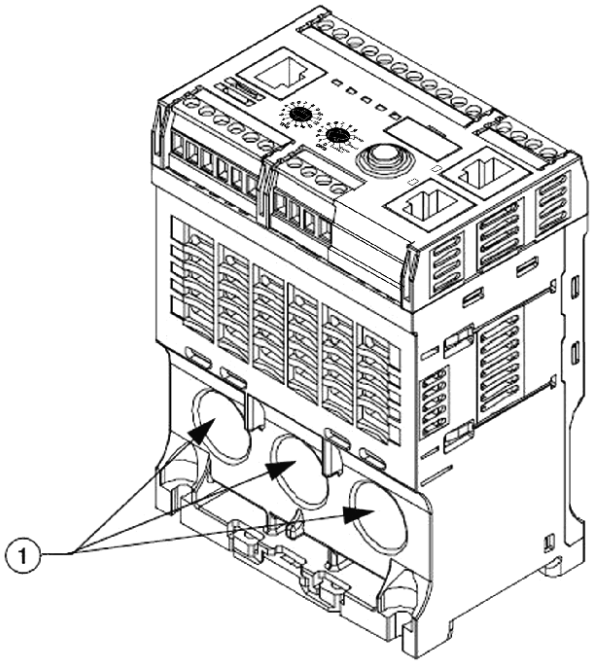
Firmware Update with TeSys Programmer

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.

Physical Description of the LTMR Ethernet Controller

Phase Current Inputs

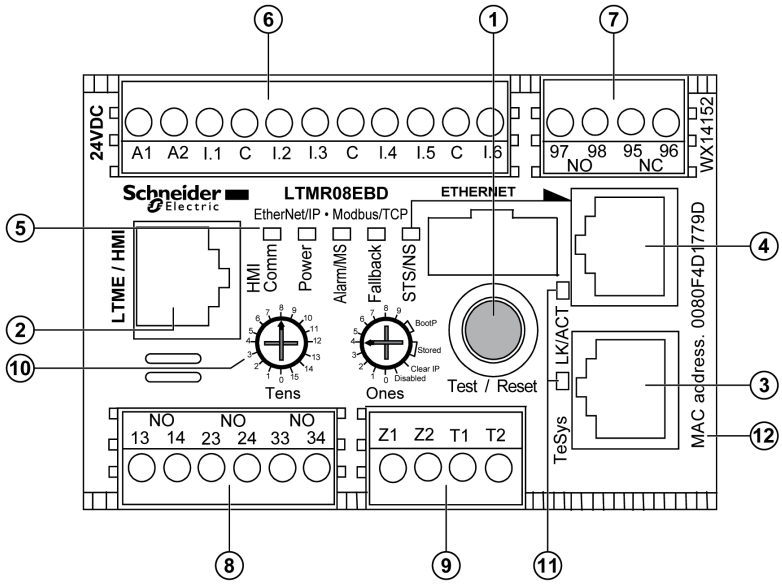
The LTMR controller includes internal current transformers for measuring the motor load phase current directly from the motor load power cables or from secondaries of external current transformers.



1 Windows for phase current measurement

Front Face

The LTMR controller front face includes the following features:



1 Test / Reset button

2 LTME / HMI port with RJ45 connector connecting the LTMR controller to an HMI, PC, or LTME expansion module

3 Ethernet port number 1 with RJ45 connector connecting the LTMR controller to a Modbus/TCP network

4 Ethernet port number 2 with RJ45 connector connecting the LTMR controller to a Modbus/TCP network

5 LTMR status-indicating LEDs

6 Plug-in terminal: control power, logic inputs, and commons

7 Plug-in terminal: double pole/single throw (DPST) output relay

8 Plug-in terminal output relay

9 Plug-in terminal: ground current trip input and temperature sensor input

10 Rotary switches (Tens and Ones) for IP addressing

11 Ethernet port link and activity LEDs

12 MAC address

Test / Reset Button

The Test / Reset button performs a reset, self-test, or places the LTMR controller in an internal trip state.

HMI Device/Expansion Module/PC Port

This port connects the LTMR controller to the following devices over the HMI port using an RJ45 connector:

- An expansion module
- A LTMCU/LTMCUF
- A PC running SoMove with the TeSys T DTM
- A Magelis XBTN410 HMI

LTMR Status Indicating LEDs

LED Name	Description
HMI Comm	Communication between LTMR controller and HMI device, PC, or LTME expansion module
Power	LTMR controller power or internal trip condition, motor status, and configured communication protocol
Alarm/MS	Protection alarm or trip, or internal trip indicator
Fallback	Indicates communication loss between the LTMR controller and network or HMI control source
STS/NS	Network status indicator

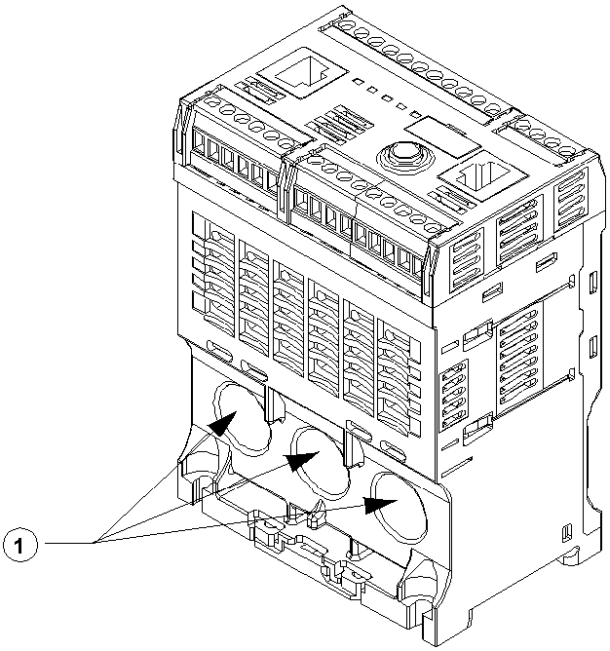
Ethernet Port Link and Activity LEDs

LED Name	Description
LK/ACT	Ethernet link status Ethernet communication activity status

Physical Description of the LTMR Modbus Controller

Phase Current Inputs

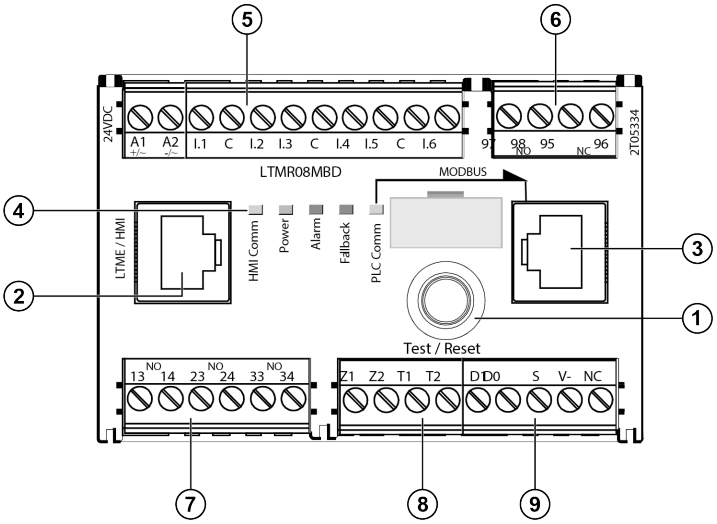
The LTMR controller includes internal current transformers for measuring the motor load phase current directly from the motor load power cables or from secondaries of external current transformers.



1 Windows for phase current measurement

Front Face

The LTMR controller front face includes the following features:



1 Test / Reset button

2 HMI port with RJ45 connector connecting the LTMR controller to an HMI, PC, or LTME expansion module

3 Network port with RJ45 connector connecting the LTMR controller to Modbus network

4 LTMR status-indicating LEDs

5 Plug-in terminal: control power, logic inputs, and commons

6 Plug-in terminal: double pole/single throw (DPST) output relay

7 Plug-in terminal output relay

8 Plug-in terminal: ground current trip input and temperature sensor input

9 Plug-in terminal: Modbus network

Test / Reset Button

The Test / Reset button performs a reset, self-test, or places the LTMR controller in an internal trip state.

HMI Device/Expansion Module/PC Port

This port connects the LTMR controller to the following devices over the HMI port using an RJ45 connector:

- An expansion module
- A LTMCU/LTMCUF
- A PC running SoMove with the TeSys T DTM
- A Magelis XBTN410 HMI

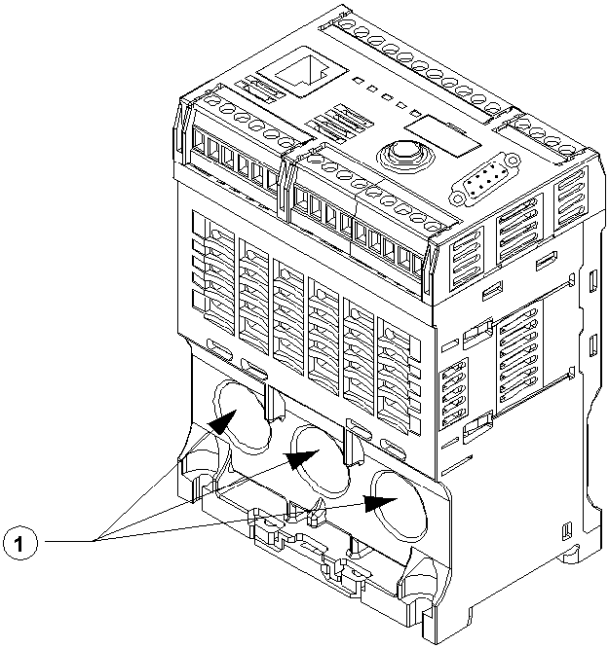
LTMR Status Indicating LEDs

LED Name	Description
HMI Comm	Communication between LTMR controller and HMI device, PC, or LTME expansion module
Power	LTMR controller power or internal trip condition
Alarm	Protection alarm or trip, or internal trip
Fallback	Communication loss between the LTMR controller and network or HMI control source
PLC Comm	Network activity

Physical Description of the LTMR PROFIBUS DP Controller

Phase Current Inputs

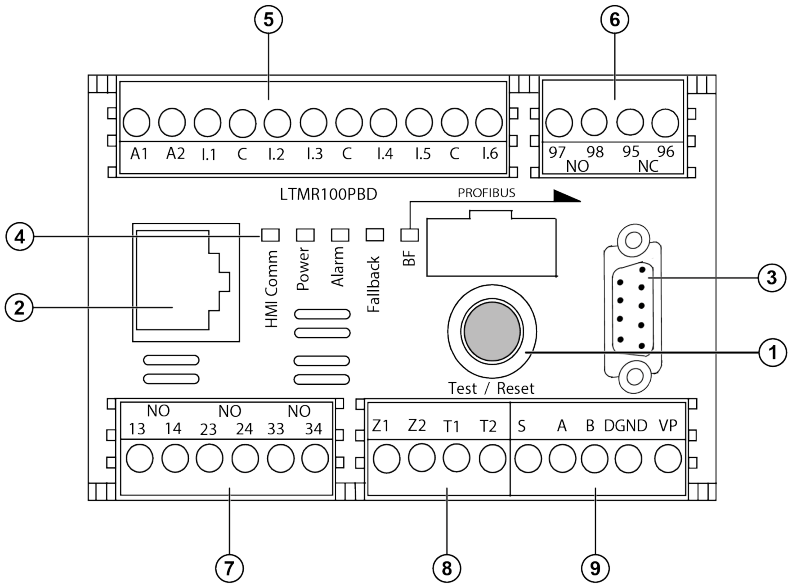
The LTMR controller includes internal current transformers for measuring the motor load phase current directly from the motor load power cables or from secondaries of external current transformers.



1 Windows for phase current measurement

Front Face

The LTMR controller front face includes the following features:



1 Test / Reset button

2 HMI port with RJ45 connector connecting the LTMR controller to an HMI, PC, or LTME expansion module

3 Network port with nine-pin sub-D connector connecting the LTMR controller to a PROFIBUS DP PLC

4 LTMR status-indicating LEDs

5 Plug-in terminal: control power, logic Input, and common

6 Plug-in terminal: double pole/single throw (DPST) relay output

7 Plug-in terminal relay output

8 Plug-in terminal: ground current trip input and temperature sensor input

9 Plug-in terminal: PLC network

Test / Reset Button

The Test / Reset button performs a reset, self-test, or places the LTMR controller in an internal trip state.

HMI Device/Expansion Module/PC Port

This port connects the LTMR controller to the following devices over the HMI port using an RJ45 connector:

- An expansion module
- A LTMCU/LTMCUF
- A PC running SoMove with the TeSys T DTM
- A Magelis XBTN410 HMI

Network Port

This port provides communication between the LTMR controller and a network PLC via a 9-pin sub-D socket connector.

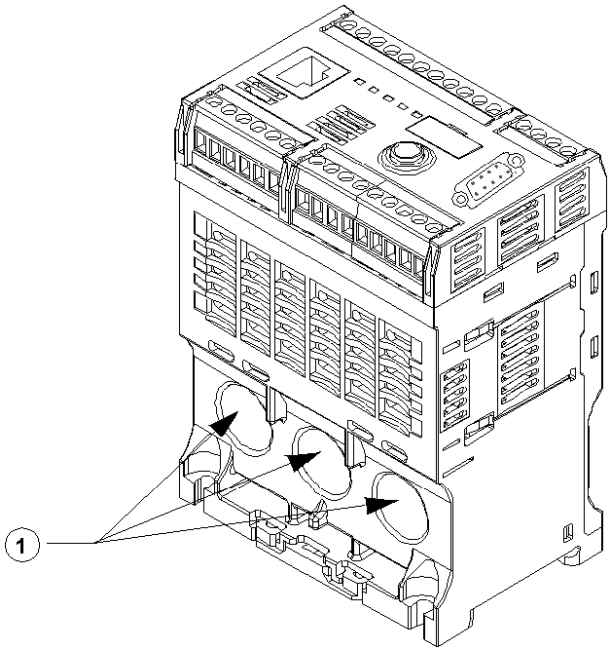
LTMR Status Indicating LEDs

LED Name	Describes	Appearance	Status
HMI Comm	Communication between LTMR controller and HMI device, PC, or LTME expansion module	Flashing yellow	Communication
		OFF	No communication
Power	LTMR controller power or internal trip condition	Solid green	Power ON, motor OFF, no internal trips
		Flashing green	Power ON, motor ON, no internal trips
		OFF	Power OFF or internal trips exist
Alarm	Protection alarm or trip, or internal trip	Solid red	Internal or protection trip
		Flashing red – 2 X per second	Alarm
		Flashing red – 5 X per second	Load shed or rapid cycle
		OFF	No trips, alarms, load shed, or rapid cycle (when power is ON)
Fallback	Indicates communications loss between the LTMR controller and network or HMI control source	Solid red	Fallback
		OFF	No power (not in fallback)
BF	Indicates network status	OFF	Communication
		Red	No communication

Physical Description of the LTMR CANopen Controller

Phase Current Inputs

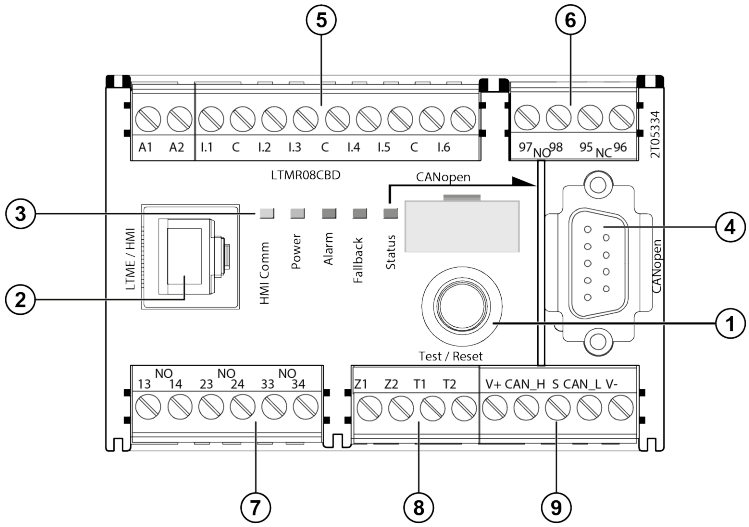
The LTMR controller includes internal current transformers for measuring the motor load phase current directly from the motor load power cables or from secondaries of external current transformers.



1 Windows for phase current measurement

Front Face

The LTMR controller front face includes the following features:



1 Test / Reset button

2 HMI port with RJ45 connector connecting the LTMR controller to an HMI, PC, or LTME expansion module

3 LTMR status-indicating LEDs

4 Network port with nine-pin sub-D connector connecting the LTMR controller to a CANopen PLC

5 Plug-in terminal: control power, logic Input, and common

6 Plug-in terminal: double pole/single throw (DPST) relay output

7 Plug-in terminal relay output

8 Plug-in terminal: ground current trip input and temperature sensor input

9 Plug-in terminal: PLC network

Test / Reset Button

The Test / Reset button performs a reset, self-test, or places the LTMR controller in an internal trip state.

HMI Device/Expansion Module/PC Port

This port connects the LTMR controller to the following devices over the HMI port using an RJ45 connector:

- An expansion module
- A LTMCU/LTMCUF
- A PC running SoMove with the TeSys T DTM
- A Magelis XBTN410 HMI

Network Port

This port provides communication between the LTMR controller and a network PLC via a 9-pin sub-D plug connector.

LTMR Status Indicating LEDs

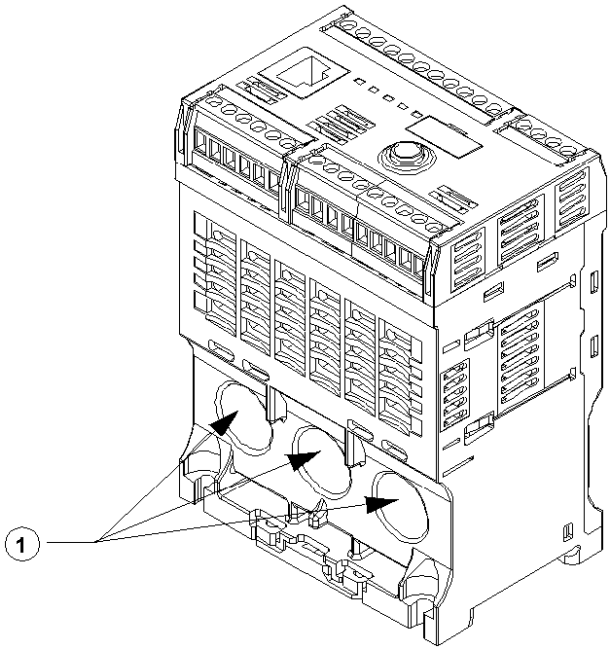
LED Name	Describes	Appearance	Status
HMI Comm	Communication between LTMR controller and HMI device, PC, or expansion module	Flashing yellow	Communication
		OFF	No communication
Power	LTMR controller power or internal trip condition	Solid green	Power ON, motor OFF, no internal trips
		Flashing green	Power ON, motor ON, no internal trips
		OFF	Power OFF or internal trips exist

LED Name	Describes	Appearance	Status
Alarm	Protection alarm or trip, or internal trip	Solid red	Internal or protection trip
		Flashing red – 2 X per second	Alarm
		Flashing red – 5 X per second	Load shed or rapid cycle
		OFF	No trips, alarms, load shed, or rapid cycle (when power is ON)
Fallback	Indicates communications loss between the LTMR controller and network or HMI control source	Solid red	Fallback
		OFF	No power (not in fallback)
Status	Indicates network status	Green	Communication
		Red	No communication

Physical Description of the LTMR DeviceNet Controller

Phase Current Inputs

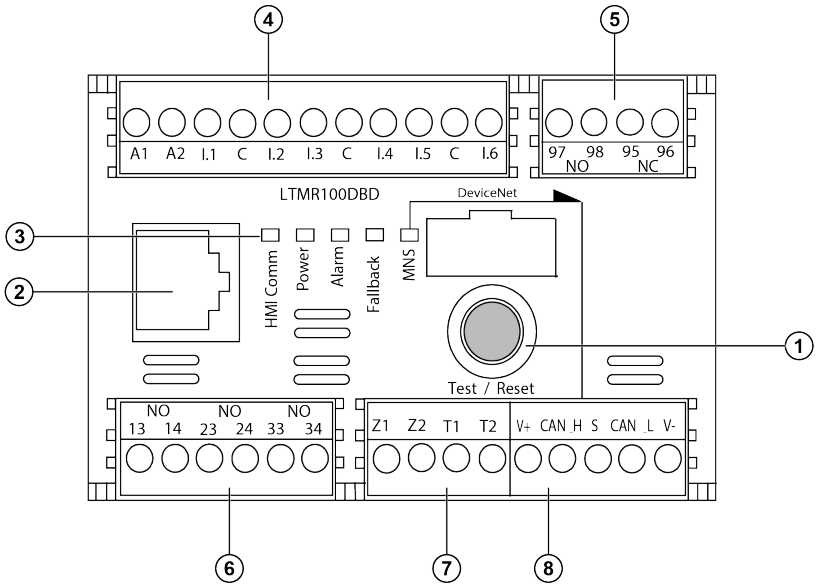
The LTMR controller includes internal current transformers for measuring the motor load phase current directly from the motor load power cables or from secondaries of external current transformers.



1 Windows for phase current measurement

Front Face

The LTMR controller front face includes the following features:



1 Test/Reset button

2 HMI port with RJ45 connector connecting the LTMR controller to an HMI, PC, or LTME expansion module

3 LTMR status-indicating LEDs

4 Plug-in terminal: control power, logic Input, and common

5 Plug-in terminal: double pole/single throw (DPST) relay output

6 Plug-in terminal relay output

7 Plug-in terminal: ground current trip input and temperature sensor input

8 Plug-in terminal: PLC network

Test / Reset Button

The Test / Reset button performs a reset, self-test, or places the LTMR controller in an internal trip state.

HMI Device/Expansion Module/PC Port

This port connects the LTMR controller to the following devices over the HMI port using an RJ45 connector:

- An expansion module
- A LTMCU/LTMCUF
- A PC running SoMove with the TeSys T DTM
- A Magelis XBTN410 HMI

Network Port

This port provides communication between the LTMR controller and a network PLC via terminal wiring.

LTMR Status Indicating LEDs

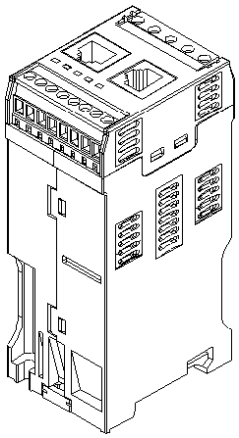
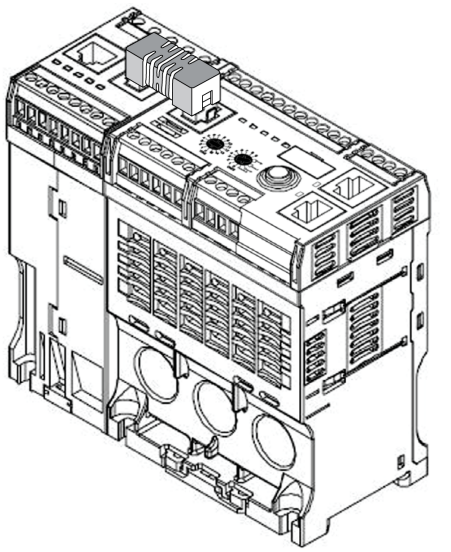
LED Name	Describes	Appearance	Status
HMI Comm	Communication between LTMR controller and HMI device, PC, or expansion module	Flashing yellow	Communication
		OFF	No communication
Power	LTMR controller power or internal trip condition	Solid green	Power ON, motor OFF, no internal trips
		Flashing green	Power ON, motor ON, no internal trips
		OFF	Power OFF or internal trips exist
Alarm	Protection alarm or trip, or internal trip	Solid red	Internal or protection trip
		Flashing red – 2 X per second	Alarm
		Flashing red – 5 X per second	Load shed or rapid cycle
		OFF	No trips, alarms, load shed, or rapid cycle (when power is ON)
Fallback	Indicates communications loss between the LTMR controller and network or HMI control source	Solid red	Fallback
		OFF	No power (not in fallback)
MNS	Indicates network status	Green/red alternating	Startup self-test
		Green flashing	Communication starting
		Green solid	Communication established
		Red flashing	Communication loss/timeout
		Red solid	Unable to start network due to addressing / baud rate issue

Physical Description of the LTME Expansion Module

Overview

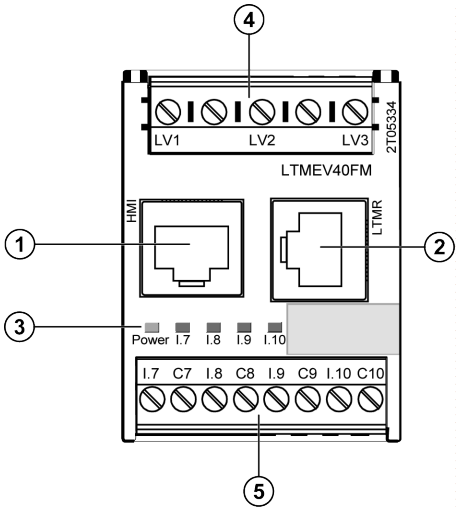
The LTME expansion module extends the monitoring and control functions of the LTMR controller by providing voltage measurement and additional logic inputs:

- Three-phase voltage inputs
- Four additional discrete logic inputs

LTME Expansion Module	LTME Expansion Module Connected to an LTMR Ethernet Controller
	

Front Face

The LTME expansion module front face includes the following features:



1 Port with RJ45 connector to HMI or PC

2 Port with RJ45 connector to LTMR controller

3 Status indicating LEDs

4 Plug-in terminal: voltage inputs

5 Plug-in terminal: logic inputs and common

NOTE: Logic inputs are externally powered according to input voltage ratings.

Status Indicating LEDs

LED Name	Description	Appearance	Status
Power	Power/Trip status	Green	Power ON, no trips
		Red	Power ON, trips
		OFF	Not powered
I.7	Logic Input I.7 status	Yellow	Activated
		OFF	Not activated
I.8	Logic Input I.8 status	Yellow	Activated
		OFF	Not activated
I.9	Logic Input I.9 status	Yellow	Activated
		OFF	Not activated
I.10	Logic Input I.10 status	Yellow	Activated
		OFF	Not activated

Metering and Monitoring Functions

Overview

The LTMR controller provides measurement, metering, and monitoring in support of the current, temperature, and ground current trip protection functions. When connected to an LTME expansion module, the LTMR controller also provides voltage and power measurement functions.

Measurement

Overview

The LTMR controller uses these measurements to perform protection, control, monitoring, and logic functions. Each measurement is detailed in this section.

The measurements can be accessed via:

- a PC running SoMove with the TeSys T DTM
- an HMI device
- a PLC via the network port

Line Currents

Description

The LTMR controller measures line currents and provides the value of each phase in amperes and as a percentage of Full Load Current (FLC).

The line currents function returns the rms value in amperes of the phase currents from the three CT inputs:

- L1: phase 1 current
- L2: phase 2 current
- L3: phase 3 current

The LTMR controller performs true rms calculations for line currents up to the seventh harmonic.

Single-phase current is measured from L1 and L3.

Line Current Characteristics

The line currents function has the following characteristics:

Characteristic	Value
Unit	A
Accuracy	• +/– 1% for 8 A and 27 A models • +/– 2% for 100 A models
Resolution	0.01 A
Refresh interval	100 ms

Line Current Ratio

The L1, L2, and L3 current ratio parameter provides the phase current as a percentage of FLC.

Line Current Ratio Formulas

The line current value for the phase is compared to the FLC parameter setting, where FLC is FLC1 or FLC2, whichever is active at that time.

Calculated Measurement	Formula
Line current ratio	100 x Ln/FLC
Where: • FLC = FLC1 or FLC2 parameter setting, whichever is active at the time • Ln = L1, L2, or L3 current value in amperes	

Line Current Ratio Characteristics

The line current ratio function has the following characteristics:

Characteristic	Value
Unit	% of FLC
Accuracy	Refer to Line Current Characteristics, page 38
Resolution	1% FLC
Refresh interval	100 ms

Ground Current

Description

The LTMR controller measures ground currents and provides values in Amperes and as a percentage of FLCmin.

- The internal ground current (Igr∑) is calculated by the LTMR controller from the three line currents measured by the load current transformers. It reports 0 when the current falls below 10% of FLCmin.
- The external ground current (Igr) is measured by the external ground current sensor connected to Z1 and Z2 terminals.

Configurable Parameters

The control channel configuration has the following configurable parameter settings:

Parameter	Setting Range	Factory Setting
Ground Current Mode	• Internal • External	Internal
Ground Current Ratio	• None • 100:1 • 200:1.5 • 1000:1	None

Parameter	Setting Range	Factory Setting
	• 2000:1 • Other Ratio	
Ground CT Primary	• 1…65,535	1
Ground CT Secondary	• 1…65,535	1

External Ground Current Formula

The external ground current value depends on the parameter settings:

Calculated Measurement	Formula
External ground current	(Current through Z1-Z2) x (Ground CT Primary) / (Ground CT Secondary)

Ground Current Characteristics

The ground current function has the following characteristics:

Characteristic		Value	
		Internal Ground Current (IgrΣ)	External Ground Current (Igr)
Unit		A	A
Accuracy			
LTMR 08xxx	Igr ≥ 0.3 A	+/– 10%	The greater of +/– 5% or +/– 0.01 A
	0.2 A ≤ Igr ≤ 0.3 A	+/– 15%	
	0.1 A ≤ Igr ≤ 0.2 A	+/– 20%	
	Igr < 0.1 A	N/A [1]	
LTMR 27xxx	Igr ≥ 0.5 A	+/– 10%	
	0.3 A ≤ Igr ≤ 0.5 A	+/– 15%	
	0.2 A ≤ Igr ≤ 0.3 A	+/– 20%	
	Igr < 0.2 A	N/A [1]	
LTMR 100xxx	Igr ≥ 1.0 A	+/– 10%	
	0.5 A ≤ Igr ≤ 1.0 A	+/– 15%	
	0.3 A ≤ Igr ≤ 0.5 A	+/– 20%	
	Igr < 0.3 A	N/A [1]	
Resolution		0.01 A	0.01 A
Refresh interval		100 ms	100 ms

Ground Current Ratio

The Ground Current Ratio parameter provides the ground current value as a percentage of FLCmin.

1. For currents of this magnitude or lower, the internal ground current function should not be used. Instead, use external ground current transformers.

Ground Current Ratio Formulas

The ground current value is compared to FLCmin.

Calculated Measurement	Formula
Ground current ratio	100 x ground current / FLCmin

Ground Current Ratio Characteristics

The ground current ratio function has the following characteristics:

Characteristic	Value
Unit	0…2,000% of FLCmin
Accuracy	Refer to Ground Current Characteristics, page 40
Resolution	0.1 % FLCmin
Refresh interval	100 ms

Average Current

Description

The LTMR controller calculates average current and provides the value for phase in amperes and as a percentage of FLC.

The average current function returns the rms value of the average current. It returns to 0 when the average current is below 20% of FLCmin.

Average Current Formulas

The LTMR controller calculates the average current using the measured line currents. The measured values are internally summed using the following formula:

Calculated Measurement	Formula
Average current, three-phase motor	Iavg = (L1 + L2 + L3) / 3
Average current, single-phase motor	Iavg = (L1 + L3) / 2

Average Current Characteristics

The average current function has the following characteristics:

Characteristic	Value
Unit	A
Accuracy	• +/– 1% for 8 A and 27 A models • +/– 2% for 100 A models
Resolution	0.01 A
Refresh interval	100 ms

Average Current Ratio

The Average Current Ratio parameter provides the average current value as a percentage of FLC.

Average Current Ratio Formulas

The average current value for the phase is compared to the FLC parameter setting, where FLC is FLC1 or FLC2, whichever is active at that time.

Calculated Measurement	Formula
Average current ratio	100 x Iavg / FLC
Where: • FLC = FLC1 or FLC2 parameter setting, whichever is active at the time • Iavg = average current value in amperes	

Average Current Ratio Characteristics

The average current ratio function has the following characteristics:

Characteristic	Value
Unit	% of FLC
Accuracy	Refer to Average Current Characteristics, page 41
Resolution	1% FLC
Refresh interval	100 ms

Current Phase Imbalance

Description

The current phase imbalance function measures the maximum percentage of deviation between the average current and the individual phase currents.

Formulas

The current phase imbalance measurement is based on imbalance ratio calculated from the following formulas:

Calculated Measurement	Formula
Imbalance ratio of current in phase 1 (in %)	Ii1 = (| L1 - Iavg | x 100) / Iavg
Imbalance ratio of current in phase 2 (in %)	Ii2 = (| L2 - Iavg | x 100) / Iavg
Imbalance ratio of current in phase 3 (in %)	Ii3 = (| L3 - Iavg | x 100) / Iavg
Current imbalance ratio for three phases (in %)	Iimb = Max(Ii1, Ii2, Ii3)

Characteristics

The line current imbalance function has the following characteristics:

Characteristic	Value
Unit	%
Accuracy	• +/- 1.5% for 8 A and 27 A models • +/- 3% for 100 A models
Resolution	1%
Refresh interval	100 ms

Thermal Capacity Level

Description

The thermal capacity level function uses two thermal models to calculate the amount of thermal capacity used: one for copper stator and rotor windings of the motor and the other for the iron frame of the motor. The thermal model with the maximum utilized capacity is reported.

This function also estimates and displays:

- The time remaining before a thermal overload trip is triggered (refer to Time to Trip, page 58), and
- The time remaining until the trip condition is cleared after a thermal overload trip has been triggered (refer to Minimum Wait Time, page 67).

Trip Current Characteristics

The thermal capacity level function uses one of the following selected trip current characteristics (TCCs):

- Definite time
- Inverse thermal (factory setting)

Thermal Capacity Level Models

Both copper and iron models use the maximum measured phase current and the Motor Trip Class parameter value to generate a non-scaled thermal image. The reported thermal capacity level is calculated by scaling the thermal image to FLC.

Thermal Capacity Level Characteristics

The thermal capacity level function has the following characteristics:

Characteristic	Value
Unit	%
Accuracy	+/– 1%
Resolution	1%
Refresh interval	100 ms

Motor Temperature Sensor

Description

The motor temperature sensor function displays:

- The resistance value in ohms measured by a PTC or NTC resistance temperature sensor.
- The temperature value in °C or °F measured by a PT100 temperature sensor.

Refer to the product documentation for the specific temperature sensor being used. One of four types of temperature sensors can be used:

- PTC Binary
- PT100
- PTC Analog
- NTC Analog

Characteristics

The motor temperature sensor function has the following characteristics:

Characteristic	PT100 Temperature Sensor	Other Temperature Sensor
Unit	°C or °F, according to the value of the HMI Display Temperature Sensor Degree CF parameter	Ω
Accuracy	+/- 2%	+/– 2%
Resolution	1 °C or 1 °F	0.1 Ω
Refresh interval	500 ms	500 ms

Frequency

Description

The frequency function provides the value measured based on the line voltage measurements. If the frequency is unstable (+/– 2 Hz variations), the value reported is 0 until the frequency stabilizes.

If no LTME expansion module is present, the frequency value is 0.

Characteristics

The frequency function has the following characteristics:

Characteristic	Value
Unit	Hz
Accuracy	+/– 2%
Resolution	0.1 Hz
Refresh interval	30 ms

Line-to-Line Voltages

Description

The line-to-line voltages function provides the rms value of the phase-to-phase voltage (V1 to V2, V2 to V3, and V3 to V1):

- L1-L2 voltage: phase 1 to phase 2 voltage
- L2-L3 voltage: phase 2 to phase 3 voltage
- L3-L1 voltage: phase 3 to phase 1 voltage

The expansion module performs true rms calculations for line-to-line voltage up to the seventh harmonic.

Single phase voltage is measured from L1 and L3.

Characteristics

The line-to-line voltages function has the following characteristics:

Characteristic	Value
Unit	Vac
Accuracy	+/- 1%
Resolution	1 Vac
Refresh interval	100 ms

Line Voltage Imbalance

Description

The line voltage imbalance function displays the maximum percentage of deviation between the average voltage and the individual line voltages.

Formulas

The line voltage imbalance calculated measurement is based on the following formulas:

Calculated Measurement	Formula
Imbalance ratio of voltage in phase 1 in %	Vi1 = 100 x | V1 - Vavg | / Vavg
Imbalance ratio of voltage in phase 2 in %	Vi2 = 100 x | V2 - Vavg | / Vavg
Imbalance ratio of voltage in phase 3 in %	Vi3 = 100 x | V3 - Vavg | / Vavg
Voltage imbalance ratio for three phases in %	Vimb = Max (Vi1, Vi2, Vi3)
Where: • V1 = L1-L2 voltage (phase 1 to phase 2 voltage) • V2 = L2-L3 voltage (phase 2 to phase 3 voltage) • V3 = L3-L1 voltage (phase 3 to phase 1 voltage) • Vavg = average voltage	

Characteristics

The line voltage imbalance function has the following characteristics:

Characteristic	Value
Unit	%
Accuracy	+/– 1.5%
Resolution	1%
Refresh interval	100 ms

Average Voltage

Description

The LTMR controller calculates average voltage and provides the value in volts. The average voltage function returns the rms value of the average voltage.

Formulas

The LTMR controller calculates average voltage using the measured line-to-line voltages. The measured values are internally summed using the following formula:

Calculated Measurement	Formula
Average voltage, three-phase motor	Vavg = (L1-L2 voltage + L2-L3 voltage + L3-L1 voltage) / 3
Average voltage, single-phase motor	Vavg = L3-L1 voltage

Characteristics

The average voltage function has the following characteristics:

Characteristic	Value
Unit	Vac
Accuracy	+/- 1%
Resolution	1 Vac
Refresh interval	100 ms

Power Factor

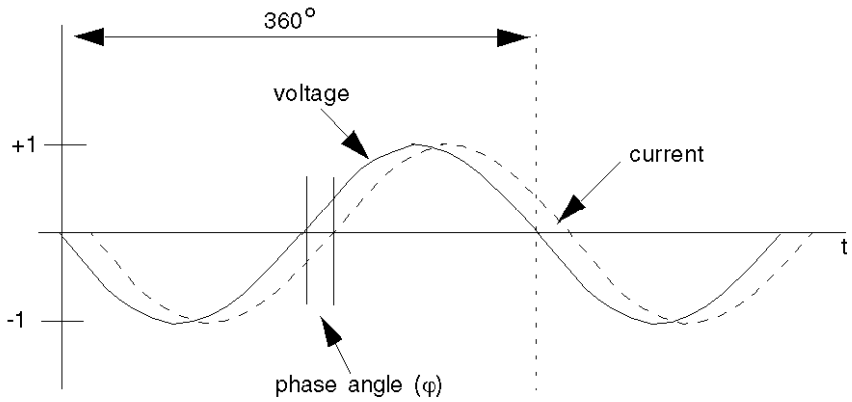
Description

The power factor function displays the phase displacement between the phase currents and phase voltages.

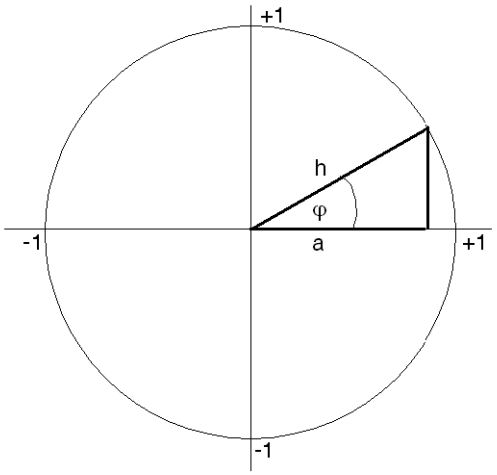
Formula

The Power Factor parameter (also called cosine phi or cos ϕ) represents the absolute value of the ratio of Active Power to Apparent Power.

The following diagram displays an example of the average rms current sinusoidal curve lagging slightly behind the average rms voltage sinusoidal curve, and the phase angle difference between the two curves:



After the phase angle (ϕ) is measured, the power factor can be calculated as the cosine of the phase angle (ϕ)-the ratio of side a (Active Power) over the hypotenuse h (Apparent Power):



Characteristics

The power factor function has the following characteristics:

Characteristic	Value
Accuracy	+/- 10% for cos ϕ ≥ 0.6
Resolution	0.01
Refresh interval	30 ms (typical)[2]

2. The refresh interval depends on the frequency.

Active Power and Reactive Power

Description

The calculation of the active power and reactive power is based on the:

- Average rms phase voltage of L1, L2, L3
- Average rms phase current of L1, L2, L3
- Power factor
- Number of phases

Formulas

Active power, also known as true power, measures average rms power. It is derived from the following formulas:

Calculated Measurement	Formula
Active power for three-phase motor	$\sqrt{3} \times I_{avg} \times V_{avg} \times \cos\phi$
Active power for single-phase motor	$I_{avg} \times V_{avg} \times \cos\phi$
Where: • I_{avg} = Average rms current • V_{avg} = Average rms voltage	

The reactive power measurement is derived from the following formulas:

Calculated Measurement	Formula
Reactive power for three-phase motor	$\sqrt{3} \times I_{avg} \times V_{avg} \times \sin\phi$
Reactive power for single-phase motor	$I_{avg} \times V_{avg} \times \sin\phi$
Where: • I_{avg} = Average rms current • V_{avg} = Average rms voltage	

Characteristics

The active and reactive power functions have the following characteristics:

Characteristic	Active Power	Reactive Power
Unit	kW	kVAR
Accuracy	+/- 15%	+/- 15%
Resolution	0.1 kW	0.1 kVAR
Refresh interval	100 ms	100 ms

Active Power Consumption and Reactive Power Consumption

Description

The active and reactive power consumption functions display the accumulated total of the active and reactive electrical power delivered, and used or consumed by the load.

Characteristics

The active and reactive power consumption functions have the following characteristics:

Characteristic	Active Power Consumption	Reactive Power Consumption
Unit	kWh	kVARh
Accuracy	+/- 15%	+/- 15%
Resolution	1 kWh	1 kVARh
Refresh interval	100 ms	100 ms

System and Device Monitoring Trips

Overview

The LTMR controller and the LTME expansion module detect trips which affect the LTMR controller ability to work properly (internal controller check and check of communications, wiring, and configuration detected errors).

The system and device monitoring trip records can be accessed via:

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

Controller Internal Trip

Description

The LTMR controller detects and records trips that are internal to the device itself. Internal trips can be either major or minor. Major and minor trips can change the state of output relays. Cycling power to the LTMR controller may clear an internal trip.

When an internal trip occurs, the Controller Internal Trip parameter is set.

Major Internal Trips

During a major trip, the LTMR controller is unable to reliably execute its own programming and can only attempt to shut itself down. During a major trip, communication with the LTMR controller is not possible. Major internal trips include:

- Stack overflow trip
- Stack underflow trip
- Watchdog time-out
- Firmware checksum detected error
- CPU detected error
- Internal temperature trip (at 100 °C/212 °F)
- RAM test detected error

Minor Internal Trips

Minor internal trips indicate that the data being provided by the LTMR controller is unreliable and protection could be compromised. During a minor trip, the LTMR controller continues to attempt to monitor status and communications, but does not accept any start commands and Custom Logic functions are halted. During a minor trip condition, the LTMR controller continues to detect and report major trips, but not additional minor trips. Minor internal trips include:

- Internal network communications trip
- EEPROM detected error
- A/D out of range detected error
- Reset button stuck
- Internal temperature trip (at 85 °C/185 °F)
- Invalid configuration detected error (conflicting configuration)
- Detected improper logic function action (for example, attempting to write to a read-only parameter)

Controller Internal Temperature

Description

The LTMR controller monitors its Controller Internal Temperature, and reports alarm, minor trip, and major trip conditions. Trip detection cannot be disabled. Alarm detection can be enabled or disabled.

The controller retains a record of the highest attained internal temperature.

Characteristics

The Controller Internal Temperature measured values have the following characteristics:

Characteristic	Value
Unit	°C
Accuracy	+/- 4 °C (+/- 7.2 °F)
Resolution	1 °C (1.8 °F)
Refresh interval	100 ms

Parameters

The Controller Internal Temperature function includes one editable parameter:

Parameter	Setting Range	Factory Setting
Controller internal temperature alarm enable	• Enable • Disable	Enable

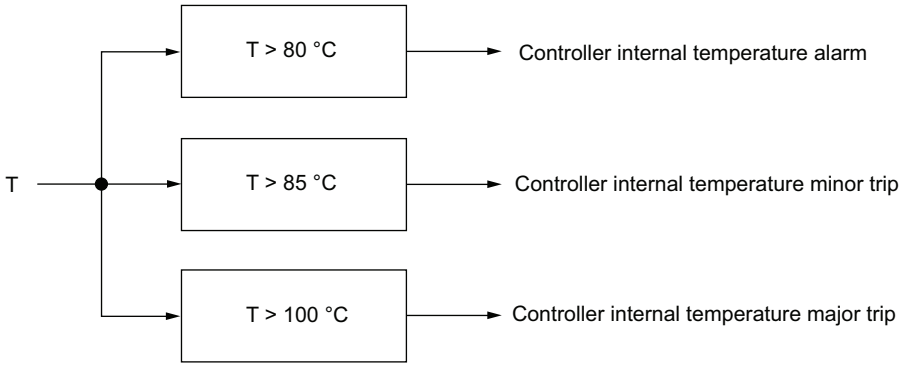
The Controller Internal Temperature function includes the following fixed alarm and trip thresholds:

Condition	Fixed Threshold Value	Sets Parameter
Internal temperature alarm	80 °C (176 °F)	Controller Internal Temperature Alarm
Internal temperature minor trip	85 °C (185 °F)	Controller Internal Trip
Internal temperature major trip	100 °C (212 °F)	

An alarm condition ceases when LTMR Controller Internal Temperature falls below 80 °C (176 °F).

Block Diagram

Controller internal temperature alarm and trip:



T Temperature

T > 80 °C (176 °F) Fixed alarm threshold

T > 85 °C (185 °F) Fixed minor trip threshold

T > 100 °C (212 °F) Fixed major trip threshold

Maximum Internal Controller Temperature

The Controller Internal Temperature Max parameter contains the highest internal temperature, expressed in °C, detected by the LTMR controller's internal temperature sensor. The LTMR controller updates this value whenever it detects an internal temperature greater than the current value.

The maximum internal temperature value is not cleared when factory settings are restored using the Clear All Command, or when statistics are reset using a Clear Statistics Command.

Control Command Trip Diagnostic

Description

The LTMR controller performs diagnostic tests that detect and monitor the proper functionality of control commands.

There are four control command diagnostic functions:

- Start Command Check
- Run Check
- Stop Command Check
- Stop Check

Parameter Settings

All four diagnostic functions are enabled and disabled as a group. The configurable parameter settings are:

Parameters	Setting Range	Factory Setting
Diagnostic Trip Enable	Yes/No	Yes
Diagnostic Alarm Enable	Yes/No	Yes

Start Command Check

The Start Command Check begins after a Start command, and causes the LTMR controller to monitor the main circuit to ensure that current is flowing.

- The Start Command Check reports a Start Command trip or alarm if current is not detected after a delay of 1 second.
- The Start Command Check condition ends if the motor is in Start or Run state (Iavg > 20% FLC) at the one second delay point, then begins the Run Check.

Run Check

The Run Check causes the LTMR controller to continuously monitor the main circuit to ensure current is flowing.

- The Run Check reports a trip or alarm if average phase current is not detected for longer than 0.5 seconds without a Stop command.
- The Run Check ends when a Stop command executes.

Stop Command Check

The Stop Command Check begins after a Stop command, and causes the LTMR controller to monitor the main circuit and ensure that no current is flowing.

- The Stop Command Check reports a trip or alarm if current is detected after a delay of 1 second.
- The Stop Command Check ends if the LTMR controller detects that the current is equal or less than 5% of FLCmin.

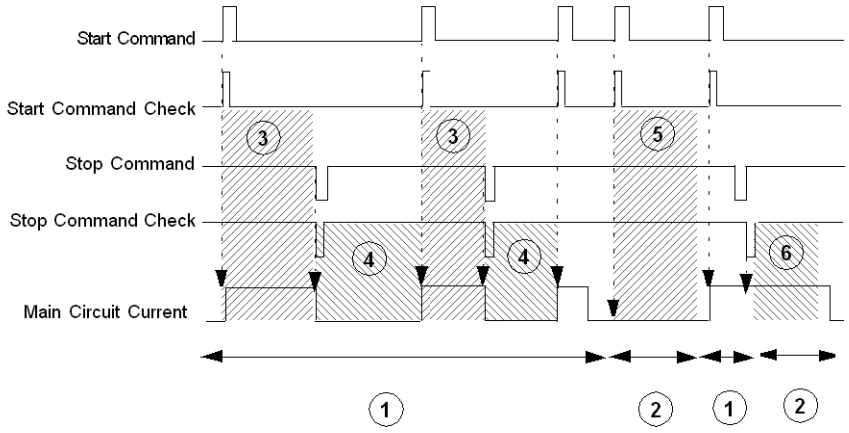
Stop Check

The Stop Check causes the LTMR controller to continuously monitor the main circuit to ensure that no current is flowing.

- The Stop Check reports a Stop Check trip or alarm if average phase current is detected for longer than 0.5 seconds after a Stop command.
- The Stop Check condition ends when a Run command executes.

Timing Sequence

The following diagram is an example of the timing sequence for the Start Command Check and Stop Command Check:



1 Normal operation

2 Trip or alarm condition

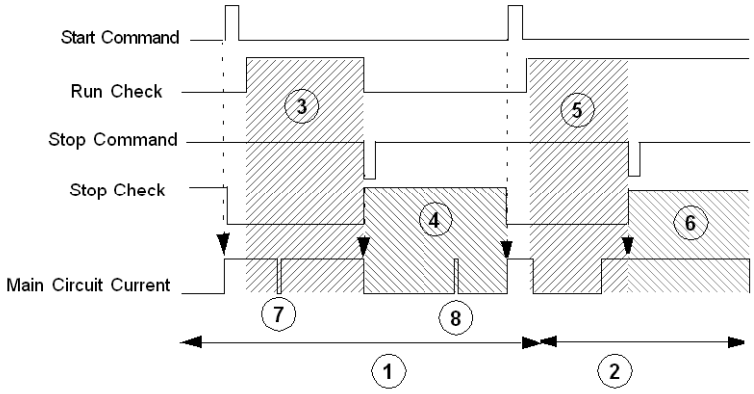
3 The LTMR controller monitors the main circuit to detect current

4 The LTMR controller monitors the main circuit to detect no current

5 The LTMR controller reports a Start Command Check trip and/or alarm if current is not detected after 1 second

6 The LTMR controller reports a Stop Command Check trip and or alarm if current is detected after 1 second

The following diagram is an example of the timing sequence for the Run Check and Stop Check:



1 Normal operation

2 Trip or alarm condition

3 After the motor enters the run state, the LTMR controller continuously monitors the main circuit to detect current until a Stop command is given or the function is disabled

4 The LTMR controller continuously monitors the main circuit to detect no current until a Start command is given or the function is disabled

5 The LTMR controller reports a Run Check trip and/or alarm if the current is not detected for longer than 0.5 seconds without a Stop command

6 The LTMR controller reports a Stop Check trip or alarm if the current is detected for longer than 0.5 seconds without a Start command

7 No current flowing for less than 0.5 seconds

8 Current flowing for less than 0.5 seconds

Wiring Trips

Description

The LTMR controller checks external wiring connections and reports a trip when it detects incorrect or conflicting external wiring. The LTMR controller can detect four wiring errors:

- CT Reversal Detected Error
- Phase Configuration Detected Error
- Motor Temperature Sensor Wiring Detected Errors (short-circuit or open-circuit)

If LTMR controller is connected on the left port of LTME expansion module, the frequency measurement will be wrong. Hence, it is advised to use the LTMCC004 connecting jumper to avoid trips.

Enabling Trip Detection

Wiring diagnostics are enabled using the following parameters:

Protection	Enabling Parameters	Setting Range	Factory Setting
CT Reversal	Wiring Trip Enable	• Yes • No	Yes
Phase Configuration	Motor Phases, if set to single-phase	• Single-phase • three-phase	three phase
Motor Temperature Sensor Wiring	Motor Temperature Sensor Type, if set to a sensor type, and not to **None**	• None • PTC binary • PT100 • PTC analog • NTC analog	None

CT Reversal Detected Error

When individual external load CTs are used, they must all be installed in the same direction. The LTMR controller checks the CT wiring and reports a detected error if it detects one of the current transformers is wired backwards when compared to the others.

This function can be enabled and disabled.

Phase Configuration Detected Error

The LTMR controller checks all three motor phases for On Level current, then checks the Motor Phases parameter setting. The LTMR controller reports a detected error if it detects current in phase 2 if the LTMR controller is configured for single-phase operation.

This function is enabled when the LTMR controller is configured for single-phase operation. It has no configurable parameters.

Motor Temperature Sensor Detected Errors

When the LTMR controller is configured for motor temperature sensor protection, the LTMR controller provides short-circuit and open-circuit detection for the temperature sensing element.

The LTMR controller signals a detected error when calculated resistance at the T1 and T2 terminals:

- Falls below the fixed short-circuit detection threshold (trip code = 34), or
- Exceeds the fixed open-circuit detection threshold (trip code = 35).

The trip must be reset according to the configured Reset Mode: manual, automatic, or remote.

Short-circuit and open-circuit detection thresholds have no trip time delay. There are no alarms associated with the short-circuit and the open-circuit detection.

Short-circuit and open-circuit detection of the motor temperature sensing element is available for all operating states.

This protection is enabled when a temperature sensor is employed and configured, and cannot be disabled.

The motor temperature sensor function has the following characteristics:

Characteristic	Value
Unit	Ω
Normal operating range	15…6500 W
Accuracy	at 15 Ω: +/– 10% at 6500 Ω: +/– 5%
Resolution	0.1 Ω
Refresh interval	100 ms

The fixed thresholds for the open-circuit and short-circuit detection functions are:

Detection Function		Fixed Results For PTC Binary, or PT100, or PTC/ NTC Analog	Accuracy
Short-circuit detection	threshold	15 Ω	+/– 10%
	re-closing	20 Ω	+/– 10%
Open-circuit detection	threshold	6500 Ω	+/– 5%
	re-closing	6000 Ω	+/– 5%

Configuration Checksum

Description

The LTMR controller calculates a checksum of parameters based on all configuration registers. The EEPROM detected error code (64) is reported.

Communication Loss

Description

The LTMR controller monitors communication through:

- The network port
- The HMI port

Network Port Parameter Settings

The LTMR controller monitors network communication creates both a trip and an alarm report when the network communications are lost.

- On LTMR Ethernet controllers configured with EtherNet/IP or Modbus/TCP communication protocol, the communication loss is detected if no communication exchanges occurred with the Primary IP for a time period equal to, or longer than, the network port communication loss timeout. Primary IP must be configured to allow detection of the communication loss.
- On LTMR Modbus controllers, the communication loss is detected if no communication exchanges occurred for a time period equal to, or longer than, the network port comm loss timeout.
- On LTMR PROFIBUS DP, CANopen, or DeviceNet controllers, the communication loss is detected as part of the protocol management, without specific adjustable parameters.

The network port communications have the following configurable settings:

Parameter	Setting Range	Factory Setting
Network port trip enable	Enable/Disable	Disable
Network port alarm enable	Enable/Disable	Disable
Network port comm loss timeout (for Ethernet and Modbus controller)	0.01...99.99 s In increments of 0.01 s	2 s
Network port fallback setting[3(1)]	• Hold • Run • O.1, O.2 off • O.1, O.2 on • O.1 off • O.2 off	O.1, O.2 off
Primary IP address (for Ethernet controller only)	0.0.0.0 to 255.255.255.255	0.0.0.0

HMI Port Parameter Settings

The LTMR controller monitors HMI port communications and reports both an alarm and a trip if no valid communication has been received by the HMI port for longer than 7 seconds.

The HMI port communication has the following fixed and configurable settings:

Parameter	Setting Range	Factory Setting
HMI port trip enable	Enable/Disable	Disable
HMI port alarm enable	Enable/Disable	Disable
HMI port fallback setting[3]	• Hold • Run • O.1, O.2 off • O.1, O.2 on • O.1 off • O.2 off	O.1, O.2 off

Fallback Condition

When the communication between the LTMR controller and either the network or the HMI is lost, the LTMR controller is in a fallback condition. When the communication recovers, the fallback condition is no longer applied by the LTMR controller.

The behavior of logic outputs O.1 and O.2 when the LTMR controller is in fallback condition is determined by:

- The operating mode (refer to Operating Modes, page 145).
- The Network Port Fallback Setting and HMI Port Fallback Setting parameters.

Fallback setting selection can include:

Port Fallback Setting	Description
Hold (O.1, O.2)	Directs the LTMR controller to hold the state of logic outputs O.1 and O.2 as of the time of the communication loss.
Run	Directs the LTMR controller to perform a Run command for a 2-step control sequence on the communication loss.
O.1, O.2 Off	Directs the LTMR controller to turn off both logic outputs O.1 and O.2 following a communication loss.

3. The operating mode affects the configurable parameters for the network port fallback settings.

Port Fallback Setting	Description
O.1, O.2 On	Directs the LTMR controller to turn on both logic outputs O.1 and O.2 following a communication loss.
O.1 On	Directs the LTMR controller to turn on only logic output O.1 following a communication loss.
O.2 On	Directs the LTMR controller to turn on only logic output O.2 following a communication loss.

The following table indicates which fallback options are available for each operating mode:

Port Fallback Setting	Operating Mode					
	Overload	Independent	Reverser	2-step	2-speed	Custom
Hold (O.1, O.2)	Yes	Yes	Yes	Yes	Yes	Yes
Run	No	No	No	Yes	No	No
O.1, O.2 Off	Yes	Yes	Yes	Yes	Yes	Yes
O.1, O.2 On	Yes	Yes	No	No	No	Yes
O.1 On	Yes	Yes	Yes	No	Yes	Yes
O.2 On	Yes	Yes	Yes	No	Yes	Yes

NOTE: When you select a network or HMI fallback setting, your selection must identify an active control source.

Time to Trip

Description

When a thermal overload condition exists, the LTMR controller reports the time to trip before the trip occurs in the Time To Trip parameter.

When the LTMR controller is not in a thermal overload condition, to avoid the appearance of being in a trip state, the LTMR controller reports the time to trip as 9999.

If the motor has an auxiliary fan and the Motor Aux Fan Cooled parameter has been set, the cooling period is four times shorter.

Characteristics

The time to trip function has the following characteristics:

Characteristic	Value
Unit	s
Accuracy	+/– 10%
Resolution	1 s
Refresh interval	100 ms

LTMR Configuration Trip

Description

The LTMR controller checks the Load CT parameters set in configuration mode.

An LTMR configuration trip is detected when the Load CT Primary, Load CT Secondary, and Load CT Multiple Passes parameters are not valid, and generates a System and Device Monitoring Trip. The trip condition is cleared once the parameters are correct. The LTMR controller remains in configuration mode as long as the parameters are not valid.

LTME Configuration Trip and Alarm

Description

The LTMR controller checks the presence of the LTME expansion module. Its absence generates a System and Device Monitoring Trip.

LTME Configuration Trip

LTME configuration trip:

- If LTME based protection trips are enabled but no LTME expansion module is present, this will cause an LTME configuration trip.
- It does not have any delay setting.
- The trip condition clears when no protection trip requiring an LTME is enabled, or when the LTMR has been power-cycled with an appropriate LTME being present.

LTME Configuration Alarm

LTME configuration alarm:

- If LTME based protection alarms are enabled but no LTME expansion module is present, this will cause an LTME configuration alarm.
- The alarm clears when no protection alarm requiring an LTME is enabled, or when the LTMR has been power-cycled with an appropriate LTME being present.

External Trip

Description

The LTMR controller has an external trip feature, which detects if an error happened on an external system linked to it.

An external trip is triggered by setting a bit in the custom logic command register 1 (see following table). This external trip sets the controller into a trip state based on different parameters in the system.

An external trip can be reset only by clearing the external trip bit in the register.

External Trip Parameter Settings

Parameter	Description
Custom logic external trip command	The value is written
External system trip	Reads Custom logic external trip command parameter
Trip code	Number is 16: External trip set by program customized with custom logic editor

Trip and Alarm Counters

Overview

The LTMR controller counts and records the number of trips and alarms that occur. In addition, it counts the number of auto-reset attempts. This information can be accessed to assist with system performance and maintenance.

Trip and alarm counters can be accessed via:

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

Introducing Trip and Alarm Counters

Detecting Alarms

If an alarm detection function is enabled, the LTMR controller detects an alarm immediately when the monitored value rises above, or falls below, a threshold setting.

Detecting Trips

Before the LTMR controller detects a trip, certain preconditions must exist. These conditions can include

- The trip detecting function must be enabled,
- A monitored value (for example, current, voltage, or thermal resistance) must rise above, or fall below, a threshold setting,
- The monitored value must remain above or below the threshold setting for a specified time duration.

Counters

When a trip is detected, the LTMR controller increments at least two counters:

- A counter for the specific trip, and
- A counter for all trips.

When an alarm is detected, the LTMR controller increments a single counter for all alarms. However, when the LTMR controller detects a thermal overload alarm, it also increments the thermal overload alarms counter.

A counter contains a value from 0 to 65,535 and increments by a value of 1 when a trip, alarm, or reset event is detected. A counter stops incrementing when it reaches a value of 65,535.

When a trip is automatically reset, the LTMR controller increments only the auto-resets counter. Counters are saved on power loss.

Clearing Counters

All trip and alarm counters are reset to 0 by executing the Clear Statistics Command or Clear All Command.

All Trips Counter

Description

The Trips Count parameter contains the number of trips that have occurred since the Clear All Statistics Command last executed.

The Trips Count parameter increments by a value of 1 when the LTMR controller detects any trip.

All Alarms Counter

Description

The Alarms Count parameter contains the number of alarms that have occurred since the Clear All Statistics Command last executed.

The Alarms Count parameter increments by a value of 1 when the LTMR controller detects any alarm.

Auto-Reset Counter

Description

The Auto-Reset Count parameter contains the number of times the LTMR controller unsuccessfully attempted to auto-reset a trip. This parameter is used for the three auto-reset trip groups.

If an auto-reset attempt is successful (defined as the same trip not recurring within 60 s), this counter is reset to zero. If a trip is reset either manually or remotely, the counter is not incremented.

For information on trip management, refer to Trip Management and Clear Commands, page 169.

Protection Trips and Alarms Counters

Protection Trip Counts

Protection trip counters include:

- Current Phase Imbalance Trips Count
- Current Phase Loss Trips Count
- Current Phase Reversal Trips Count
- Ground Current Trips Count
- Jam Trips Count
- Long Start Trips Count
- Motor Temp Sensor Trips Count
- Over Power Factor Trips Count
- Overcurrent Trips Count
- Overpower Trips Count
- Overvoltage Trips Count
- Thermal Overload Trips Count
- Under Power Factor Trips Count
- Undercurrent Trips Count
- Underpower Trips Count
- Undervoltage Trips Count
- Voltage Phase Imbalance Trips Count
- Voltage Phase Loss Trips Count
- Voltage Phase Reversal Trips Count

Protection Alarm Counts

The Thermal Overload Alarms Count parameter contains the total number of alarms for the thermal overload protection function.

When any alarm occurs, including a thermal overload alarm, the LTMR controller increments the Alarms Count parameter.

Control Command Trip Counter

Description

A Diagnostic Trip occurs when the LTMR controller detects any of the following control command detected errors:

- Start Command Check detected errors
- Stop Command Check detected errors
- Stop Check detected errors
- Run Check detected errors

For information on these control command functions, refer to Control Command Trip Diagnostic, page 51.

Wiring Trips Counter

Description

The Wiring Trips Count parameter contains the total number of the following wiring trips that have occurred since the Clear Statistics Command last executed:

- Wiring Trip, which is triggered by a:
  - CT Reversal Detected Error
  - Phase Configuration Detected Error
  - Motor Temperature Sensor Wiring Detected Error
- Voltage Phase Reversal Trip
- Current Phase Reversal Trip

The LTMR controller increments the Wiring Trips Count parameter by a value of 1 each time any one of the above three trips occurs. For information on detected connection errors and related trips, refer to Wiring Trips, page 54.

Communication Loss Counters

Description

Trips detected for the following communication functions:

Counter	Contains
HMI Port Trips Count	The number of times communications via the HMI port was lost.
Network Port Internal Trips Count	The number of internal trips experienced by the network module, reported by the network module to the LTMR controller.
Network Port Config Trips Count	The number of major trips experienced by the network module, exclusive of network module internal trips, reported by the network module to the LTMR controller.
Network Port Trips Count	The number of times communications via the network port was lost.

Internal Trip Counters

Description

Trips detected for the following internal trips:

Counter	Contains
Controller Internal Trips Count	The number of major and minor internal trips. For information on internal trips, refer to Controller Internal Trip, page 49.
Internal Port Trips Count	The number of LTMR controller internal communication trips, plus the number of unsuccessful attempts to identify the network communication module.

Trip History

Trip History

The LTMR controller stores a history of LTMR controller data that was recorded at the time of the last five trips. Trip n-0 contains the most recent trip record, and trip n-4 contains the oldest retained trip record.

Each trip record includes:

- Trip Code
- Date and Time

- Value of Settings
  - Motor Full Load Current Ratio (% of FLCmax)
- Value of Measurements
  - Thermal Capacity Level
  - Average Current Ratio
  - L1, L2, L3 Current Ratio
  - Ground Current Ratio
  - Full Load Current Max
  - Current Phase Imbalance
  - Voltage Phase Imbalance
  - Power Factor
  - Frequency
  - Motor Temp Sensor
  - Average Voltage
  - L3-L1 Voltage, L1-L2 Voltage, L2-L3 Voltage
  - Active Power

Motor History

Overview

The LTMR controller tracks and saves motor operating statistics.

Motor statistics can be accessed using:

- A PC running SoMove with the TeSys T DTM
- An HMI device
- A PLC via the network port.

Motor Starts Counters

Description

The LTMR controller tracks motor starts and records the data as a statistic that can be retrieved for operational analysis. The following statistics are tracked:

- Motor Starts Count
- Motor LO1 Closings Count (logic output O.1 starts)
- Motor LO2 Closings Count (logic output O.2 starts)

The Clear Statistics Command resets the Motor Starts Count parameter to 0.

NOTE: The Motor LO1 Closings Count and Motor LO2 Closings Count parameters cannot be reset to 0 because these parameters together indicate the usage of the relay outputs over time.

Motor Starts Per Hour Counter

Description

The LTMR controller tracks the number of motor starts during the past hour and records this figure in the Motor Starts Per Hour Count parameter.

The LTMR controller sums start in 5 minutes intervals with an accuracy of 1 interval (+ 0/– 5 minutes), which means that the parameter will contain the total number of starts within either the previous 60 minutes or the previous 55 minutes.

This function is used as a maintenance function to avoid thermal strain on the motor.

Characteristics

The motor starts per hour function has the following characteristics:

Characteristic	Value
Accuracy	5 minutes (+ 0/– 5 minutes)
Resolution	5 minutes
Refresh interval	100 ms

Load Sheddings Counter

Description

The Load Sheddings Count parameter contains the number of times the load sheddings protection function has been activated since the last Clear Statistics Command.

For information on the Load Sheddings protection function, refer to Load Shedding, page 120.

Auto Restart Counters

Description

There are three types of counting statistics:

- Auto restart immediate count
- Auto restart delayed count
- Auto restart manual count

For information on the Auto restart protection function, refer to Automatic Restart, page 122.

Motor Last Start Current Ratio

Description

The LTMR controller measures the maximum current level reached during the last start of the motor and reports the value in the Motor Last Start Current Ratio parameter for analysis of the system for maintenance purposes.

This value may also be used to help configure the long start threshold setting in the long start protection function.

The value is not stored in the non-volatile memory: it is lost at a power cycle.

Characteristics

The motor last start current ratio function has the following characteristics:

Characteristic	Value
Unit	% of FLC
Accuracy	• +/– 1% for 8 A and 27 A models • +/– 2% for 100 A models
Resolution	1% FLC
Refresh interval	100 ms

Motor Last Start Duration

Description

The LTMR controller tracks the duration of the last motor start and reports the value in the Motor Last Start Duration parameter for analysis of the system for maintenance purposes.

This value may also be useful in setting the long start delay timeout used in the long start and definite trip overload protection functions.

The value is not stored in the non-volatile memory: it is lost at a power cycle.

Characteristics

The motor last start duration function has the following characteristics:

Characteristic	Value
Unit	s
Accuracy	+/– 1%
Resolution	1 s
Refresh interval	1 s

Operating Time

Description

The LTMR controller tracks motor operating time and records the value in the Operating Time parameter. Use this information to help schedule motor maintenance, such as lubrication, inspection, and replacement.

System Operating Status

Overview

The LTMR controller monitors the motor operating state and the minimum time to wait to restart the motor.

The Motor states can be accessed via:

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

Motor State

Description

The LTMR controller tracks the motor state and reports the following states by setting the corresponding boolean parameters:

Motor state	Parameter
Run	Motor Running
Ready	System Ready
Start	Motor Starting

NOTE: The status of the System Ready bit (455.0) does not prevent the system from energizing outputs. System Ready bit is only used to provide feedback to the PLC.

Minimum Wait Time

Description

The LTMR controller tracks the time remaining to restart the motor according to one of the following events:

- Automatic reset, page 173
- Thermal overload, page 73
- Rapid cycle lockout, page 89
- Load shedding, page 120
- Automatic restart, page 122

- Transition time

If more than one timer is active, the parameter displays the maximum timer, which is the minimum wait for the trip response or the control function to reset.

NOTE: Even with an LTMR powered off, time is tracked down for at least 30 min.

Characteristics

The Minimum Wait Time function has the following characteristics:

Characteristic	Value
Unit	s
Accuracy	±1%
Resolution	1 s
Refresh interval	1 s

Motor Protection Functions

Overview

This chapter describes the motor protection functions provided by the LTMR controller.

Motor Protection Functions Introduction

Overview

This section introduces you to the motor protection functions provided by the LTMR controller, including protection parameters and characteristics.

Definitions

Defined Functions and Data

The LTMR controller monitors current, ground-current and motor temperature sensor parameters. When the LTMR controller is connected to an expansion module, it also monitors voltage and power parameters. The LTMR controller uses these parameters in protection functions to detect trip and alarm conditions. The LTMR controller's response to trip and alarm conditions is fixed for the predefined operating modes. Logic output O.4 activates on a trip, and logic output O.3 activates on an alarm. For more information about predefined operating modes, refer to Operating Modes, page 145.

You can configure these motor protection functions to detect the existence of undesirable operating conditions that, if not resolved, can cause motor and equipment damage.

All motor protection functions include trip detection, and most protection functions also include alarm detection.

Customized Functions and Data

In addition to using the protection functions and parameters included in a predefined operating mode, you can use the Custom Logic Editor in the TeSys T DTM to create a new, customized operating mode. To create a custom operating mode, select any predefined operating mode, then edit its code to meet the needs of your application.

Using the Custom Logic Editor, you can create a customized operating mode by:

- Modifying the LTMR controller's responses to protection trips or alarms
- Adding new functions, based on either predefined or newly created parameters

Trips

A trip is a serious undesirable operating condition. Trip-related parameters can be configured for most protection functions.

The response of the LTMR controller to a trip include the following:

- Output O.4 contacts:
  - Contact 95-96 is open
  - Contact 97-98 is closed
- On LTMR Ethernet controllers: Alarm/MS LED is On
  - Minor trip if blinking red once per second (EtherNet/IP only)
  - Minor trip if steady red (Modbus/TCP only)
  - Major trip if steady red
- On other LTMR controllers: Alarm LED is On (steady red)
- Trip status bits are set in a trip parameter
- A text message is displayed in an HMI screen (if an HMI is attached)
- A trip status indicator is displayed in the TeSys T DTM, if connected

The LTMR controller counts and records the number of trips for each protection function.

After a trip has occurred, merely resolving the underlying condition does not clear the trip. To clear the trip, the LTMR controller must be reset. For more information, refer to Trip Management - Introduction, page 169.

Alarms

An alarm is a less-serious, though still undesirable, operating condition. An alarm indicates corrective action may be required to address the undesirable condition. If left unresolved, an alarm may lead to a trip condition. Alarm-related parameters can be configured for most protection functions.

The response of the LTMR controller to an alarm include the following:

- Output O.3 is closed
- On LTMR Ethernet controllers: Alarm/MS LED flashes (Modbus/TCP only)
- On other LTMR controllers: Alarm LED flashes red twice per second
- Alarm status bits are set in an alarm parameter
- A text message is displayed in an HMI screen (if attached)
- An alarm status indicator is displayed in the TeSys T DTM

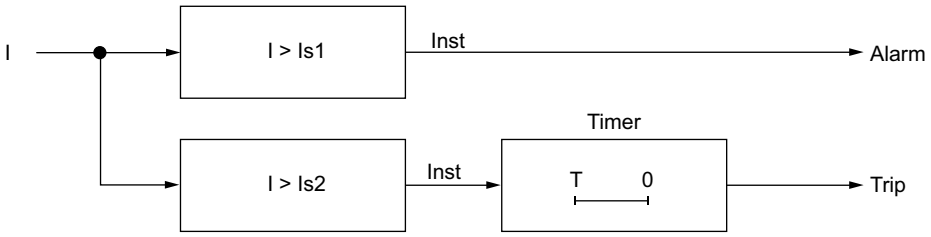
  NOTE: For some protection functions, alarm detection shares the same threshold as a trip. For other protection functions, alarm has a separate threshold.

The LTMR controller clears the alarm whenever the measured value no longer exceeds the alarm threshold-plus or minus a 5% hysteresis band.

Motor Protection Characteristics

Operation

The following diagram describes the operation of a typical motor protection function. This diagram, and the following diagrams, are expressed in terms of current. However, the same principles apply to voltage.



I Measurement of the monitored parameter

Is1 Alarm threshold setting

Is2 Trip threshold setting

T Trip timeout setting

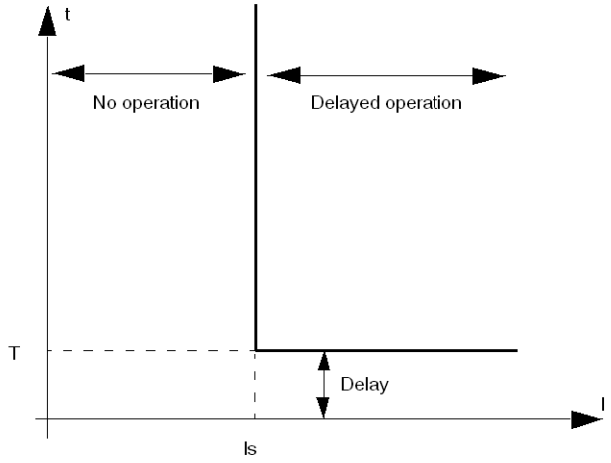
Inst Instantaneous alarm/trip detection

Settings

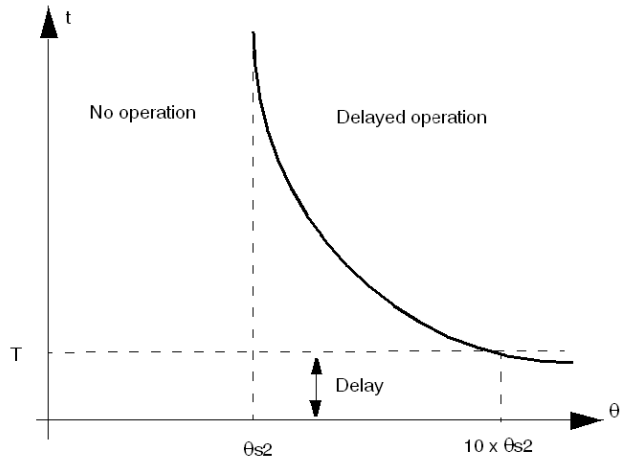
Some protection functions include configurable settings, including:

- Trip threshold: A limit setting for the monitored parameter that triggers a protection function trip.
- Alarm threshold: A limit setting for the monitored parameter that triggers a protection function alarm.
- Trip timeout: A time delay that must expire before the protection function trip is triggered. The behavior of a timeout depends on its trip current characteristic profile.
- Trip curve characteristic (TCC): The LTMR controller includes a definite trip characteristic for all protection functions, except the Thermal Overload Inverse Thermal protection function, which has both an inverse trip and definite trip curve characteristic, as described in the following diagram.

Definite TCC: The duration of the trip timeout remains a constant regardless of changes in the value of the measured quantity (current), as described in the following diagram:



Inverse TCC: The duration of the time delay varies inversely with the value of the measured quantity (here, thermal capacity). As the measured quantity increases, the potential for harm also increases, thereby causing the duration of the time delay to decrease, as described in the following diagram:

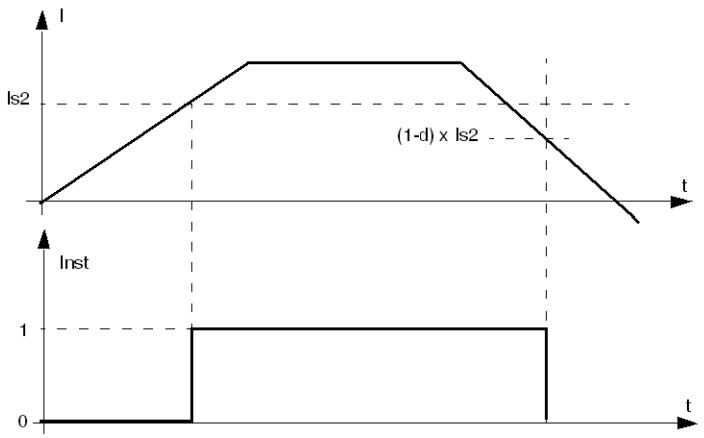


Hysteresis

To improve stability, motor protection functions apply a hysteresis value that is added to or subtracted from limit threshold settings before a trip or alarm response is reset. The hysteresis value is calculated as a percentage, typically 5%, of the limit threshold and is

- Subtracted from the threshold value for upper limit thresholds,
- Added to the threshold value for lower limit thresholds.

The following diagram describes the logic result of measurement processing (Inst) when hysteresis is applied to an upper limit threshold:



d Hysteresis percentage

Thermal Motor Protection Functions

Overview

This section describes the thermal motor protection functions of the LTMR controller.

Thermal Overload

Overview

The LTMR controller can be configured to provide thermal protection, by selecting one of the following settings:

- Inverse Thermal, page 74 (factory setting)
- Definite Time, page 78

Each setting represents a Trip Curve Characteristic. The LTMR controller stores the selected setting in its Thermal Overload Mode parameter. Only one setting can be activated at a time. See the topics that immediately follow, for information on the operation and configuration of each setting.

Parameter Settings

The Thermal Overload function has the following configurable parameter settings, which apply to every trip current characteristic:

Parameters	Setting Range	Factory Setting
Mode	• Inverse thermal • Definite time	Inverse thermal
Trip enable	Enable/Disable	Enable
Alarm enable	Enable/Disable	Enable
Motor auxiliary fan cooled	Enable/Disable	Disable

Thermal Overload - Inverse Thermal

Description

When you set the Thermal Overload Mode parameter to **Inverse Thermal** and select a motor trip class, the LTMR controller monitors the motor's utilized thermal capacity and signals

- An alarm when utilized thermal capacity exceeds a configured alarm threshold,
- A trip when utilized thermal capacity is greater than 100%.

⚠CAUTION

RISK OF MOTOR OVERHEATING

The Motor Trip Class parameter must be set to the thermal heating characteristics of the motor. Refer to the motor manufacturer's instructions before setting this parameter.

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

There is no time delay for the thermal overload alarm.

The LTMR controller calculates the Thermal Capacity Level in all operating states. When power to the LTMR controller is lost, the LTMR controller retains the last measurements of the motor's thermal state for 30 minutes, allowing it to estimate the motor's thermal state when power is reapplied.

Trip and alarm monitoring can be separately enabled and disabled.

- The thermal overload alarm is cleared by the LTMR controller when the utilized thermal capacity falls 5% below the alarm threshold.
- The thermal overload trip can be reset when the utilized thermal capacity falls below the trip reset threshold and after the trip reset timeout is elapsed.

Reset for Emergency Restart

You can use the Clear Thermal Capacity Level Command, issued from the PLC or an HMI, to restart an overloaded motor in an emergency situation. This command resets the thermal capacity utilization value to 0 and bypasses the cooling period required by the thermal model before the motor can be restarted.

This command also resets the Rapid Cycle Lockout Timeout to allow an immediate restart without lock.

The Clear All Command does not perform a Clear Thermal Capacity Level.

⚠WARNING

LOSS OF MOTOR PROTECTION

Clearing the thermal capacity level inhibits thermal protection and can cause equipment overheating and fire. Continued operation with inhibited thermal protection should be limited to applications where immediate restart is vital.

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

The Clear Thermal Capacity Level Command will not reset the trip response. Instead

- Only an action external to the LTMR controller (for example, a reduction in the motor load) can clear the trip condition,

- Only a reset command, from the valid reset means configured in the Trip Reset Mode parameter, will reset the trip response.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- A reset command may restart the motor if the LTMR controller is used in a 2-wire control circuit.
- Equipment operation must conform to local and national safety regulations and codes.

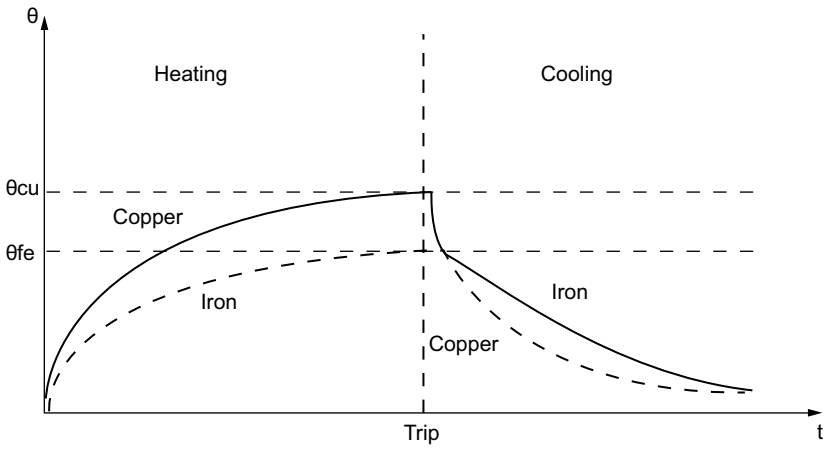
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Operation

The thermal overload inverse thermal protection function is based on a thermal model of the motor that combines two thermal images:

- A copper-based image representing the thermal state of the stator and rotor windings, and
- An iron-based image representing the thermal state of the motor frame.

Using measured current and the input motor trip class setting, the LTMR controller considers only the highest thermal state, iron, or copper, when calculating thermal capacity utilized by the motor, as described in the following diagram:



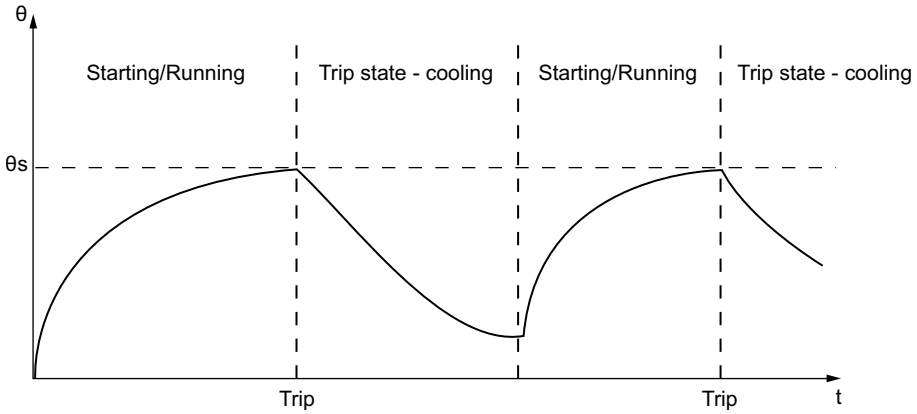
θ Thermal value

θfe Iron tripping threshold

θcu Copper tripping threshold

t Time

When inverse thermal trip mode is selected, the Thermal Capacity Level parameter, indicating utilized thermal capacity due to load current, is incremented during both start and run states. When the LTMR controller detects that the thermal capacity level (θ) exceeds the trip threshold (θ s), it triggers a thermal overload trip, as described in the following diagram:



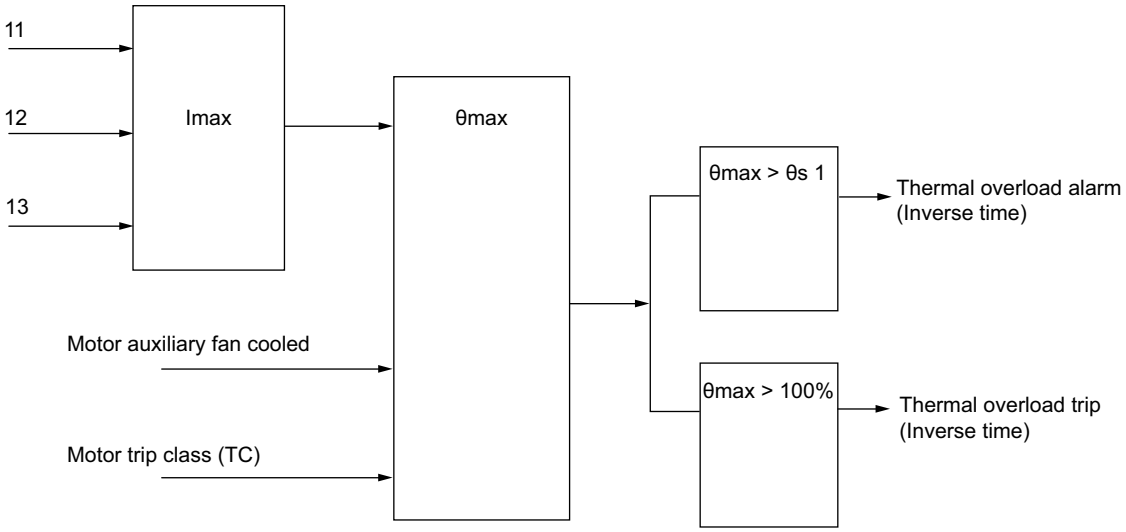
Functional Characteristics

The Thermal Overload inverse thermal functions include the following features:

- One motor trip class setting:
  - Motor Trip Class
- Four configurable thresholds:
  - Motor Full Load Current Ratio (FLC1)
  - Motor High-Speed Full Load Current Ratio (FLC2)
  - Thermal Overload Alarm Threshold
  - Thermal Overload Trip Reset Threshold
- One time delay:
  - Trip Reset Timeout
- Two function outputs:
  - Thermal Overload Trip
  - Thermal Overload Trip
- Two counting statistics:
  - Thermal Overload Trips Count
  - Thermal Overload Alarms Count
- One setting for an external auxiliary motor cooling fan:
  - Motor Aux Fan Cooled
- One measure of utilized thermal capacity:
  - Thermal Capacity Level

NOTE: For LTMR controllers configured for 2-speed predefined operating mode, 2 trip thresholds are used: FLC1 and FLC2.

Block Diagram



Imax Maximum current

θmax Thermal capacity level

θs1 Thermal overload alarm threshold

Parameter Settings

The thermal overload inverse thermal functions have the following configurable parameter settings:

Parameters	Setting Range	Factory Setting
FLC1, FLC2	• 0.4...8.0 A in increments of 0.08 A for LTMR08 • 1.35...27.0 A in increments of 0.27 A for LTMR27 • 5...100 A in increments of 1 A for LTMR100	• 0.4 A for LTMR08 • 1.35 A for LTMR27 • 5 A for LTMR100
Alarm threshold	10...100 % of thermal capacity	85 % of thermal capacity
Motor trip class	5...30 in increments of 5	5
Trip reset timeout	50...9999 in 1 s increments	480 s
Trip reset threshold	35...95 % of thermal capacity	75% of thermal capacity

The thermal overload inverse thermal functions have the following non-configurable parameter settings:

Parameter	Fixed Setting
Thermal overload trip threshold	100% of thermal capacity

Technical Characteristics

The thermal overload inverse thermal functions have the following characteristics:

Characteristics	Value
Hysteresis	–5 % of thermal overload alarm threshold
Trip time accuracy	+/– 0.1 s

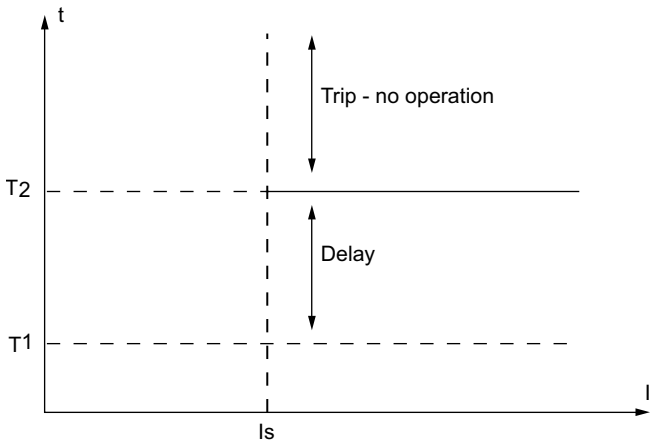
Thermal Overload - Definite Time

Description

When you set the Thermal Overload Mode parameter to **Definite Time**, the LTMR controller signals:

- An alarm when measured maximum phase current exceeds a configurable threshold (OC1 or OC2).
- A trip when the maximum phase current continuously exceeds the same threshold (OC1 or OC2) for a set time delay.

The thermal overload definite time trip includes a time delay of constant magnitude, following a start command, before the protection is active and a trip timeout duration, as described in the following diagram:



IsTrip and alarm threshold (OC1 or OC2)

T1 Start command

T2 Elapsed time delay

There is no time delay for the thermal overload definite time alarm.

Trip and alarm monitoring can be separately enabled and disabled.

The definite time protection function is disabled following a start by a delay defined by the Long Start Trip Timeout setting. The LTMR controller, when configured for overload predefined operating mode, uses the change in state from off to on level current to begin the Start state. This delay allows the motor to draw current on startup required to overcome the inertia of the motor at rest.

NOTE: Configuration of this protection function requires configuration of the Long Start protection function, including the Long Start Trip Timeout parameter.

Functional Characteristics

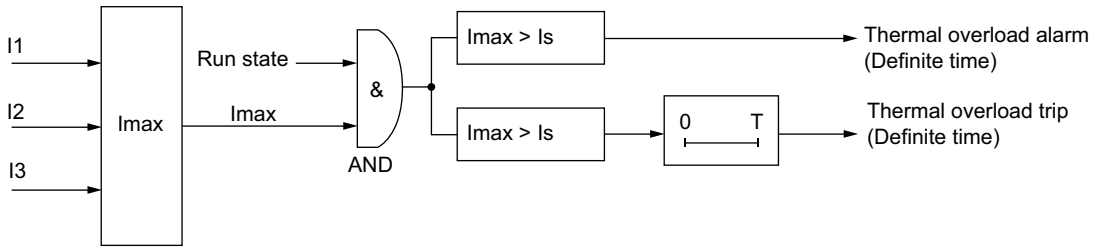
The thermal overload definite time function includes the following features:

- Two configurable threshold settings; one setting (OC1) is used for single speed motors, both settings are required for two-speed motors:
  - OC1(Motor Full Load Current Ratio) or
  - OC2 (Motor High-Speed Full Load Current Ratio)
- One time delay:
  - Overcurrent Time (O-Time, set by the Thermal Overload Trip Definite Timeout parameter)

- Two function outputs:
  - Thermal Overload Alarm
  - Thermal Overload Trip
- Two counting statistics:
  - Thermal Overload Trips Count
  - Thermal Overload Alarms Count

Block Diagram

Thermal overload alarm and trip:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

Is Trip and alarm threshold (OC1 or OC2)

T Trip timeout

Parameter Settings

The definite time thermal overload function has the following configurable parameter settings:

Parameters	Setting Range	Factory Setting
Trip threshold: • Motor full load current ratio (OC1) - or - • Motor high-speed full load current ratio (OC2)	5...100% of FLCmax, in 1% increments. Note: OC1 and OC2 settings can be set directly (in Amperes) in the **Settings** menu of an HMI, or in the **Parameters** tab of the TeSys T DTM.	5% FLCmax
Thermal overload trip definite timeout (O-time or over-current time)	1...300 s in 1 s increments	10 s
Thermal overload alarm threshold	20...800% of OC in 1% increments	80% of OC
Long start trip timeout[4] (D-time)	1...200 s in 1 s increments	10 s

Technical Characteristics

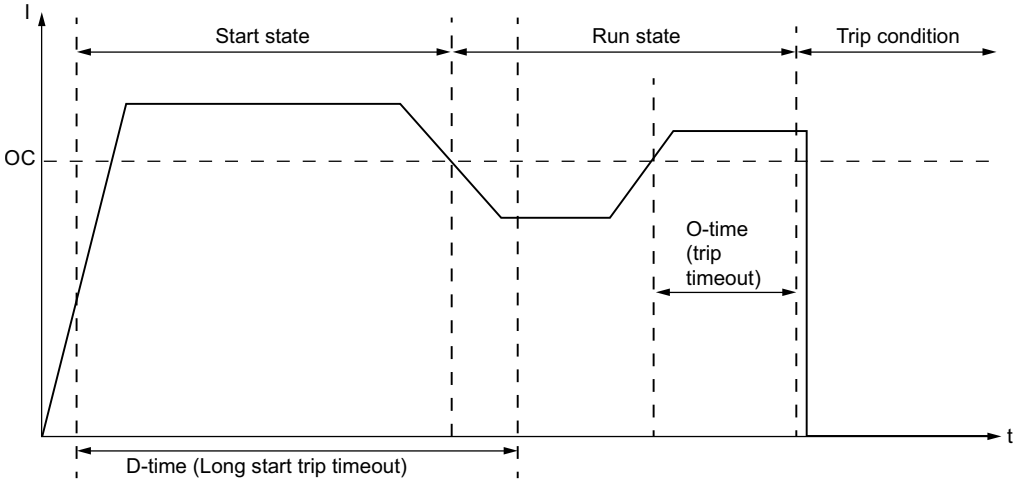
The definite time thermal overload function has the following characteristics:

4. The definite time thermal overload function requires the simultaneous use of the Long start motor protection function, both of which employ the Long start trip timeout setting.

Characteristics	Value
Hysteresis	–5% of alarm and trip thresholds
Trip time accuracy	+/– 0.1 s

Example

The following diagram describes a definite time thermal overload trip:



OC Trip threshold (OC1 or OC2)

Motor Temperature Sensor

Overview

The LTMR controller has two terminals, T1 and T2 that can be connected to a motor temperature sensing element to provide protection for motor windings by detecting high temperature conditions that could lead to damage or degradation.

These protections are activated when the Motor Temp Sensor Type parameter is set to one of the following settings:

- PTC Binary, page 81
- PT100, page 83
- PTC Analog, page 85
- NTC Analog, page 87

Only one of these motor protection sensing elements can be enabled at a time.

NOTE: Motor temperature sensor protection is based in ohms. PTC Binary protection thresholds are pre-set to IEC standards and are non-configurable. PTC Analog and NTC Analog protection functions may require that you scale the resistance value to the corresponding threshold level in degrees, based on the properties of the selected sensing element.

When a sensor type is changed, the LTMR controller's motor temperature sensing configuration settings revert to their factory settings. If a sensor type is replaced with another sensor of the same type, the setting values are retained.

Parameter Settings

The motor temperature sensor function has the following configurable parameter settings, which apply to the selected motor temp sensor type:

Parameters	Setting Range	Factory Setting
Sensor type	• None • PTC Binary • PT100 • PTC Analog • NTC Analog	None
Trip enable	Enable/Disable	Disable
Alarm enable	Enable/Disable	Disable

Motor Temperature Sensor - PTC Binary

Description

The PTC Binary motor temperature sensing function is enabled when the Motor Temp Sensor Type parameter is set to **PTC Binary** and the LTMR controller is connected to a binary positive temperature coefficient thermistor embedded in the motor.

The LTMR controller monitors the state of the temperature sensing element and signals:

- A motor temperature sensor alarm when the measured resistance exceeds a fixed threshold.
- A motor temperature sensor trip when the measured resistance exceeds the same fixed threshold.

The trip and alarm conditions continue until measured resistance falls below a separate fixed motor temperature sensor reclosing threshold.

Motor temperature sensing trip thresholds are factory pre-set and are not configurable. Trip monitoring can be enabled or disabled.

The function is available for all operating states.

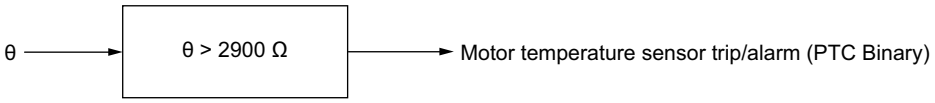
Functional Characteristics

The PTC Binary motor temperature sensor function includes the following features:

- Two function output:
  - Motor Temp Sensor Alarm
  - Motor Temp Sensor Trip
- One counting statistic:
  - Motor Temp Sensor Trips Count

Block Diagram

Motor temperature sensor trip/alarm:



θ Temperature sensing element resistance

Parameter Settings

The PTC binary motor temperature sensor function has the following non-configurable parameter settings:

Parameter	Fixed settings	Accuracy
Trip/Alarm threshold	2900 Ω	+/– 2%
Trip/Alarm reclosing threshold	1575 Ω	+/– 2%

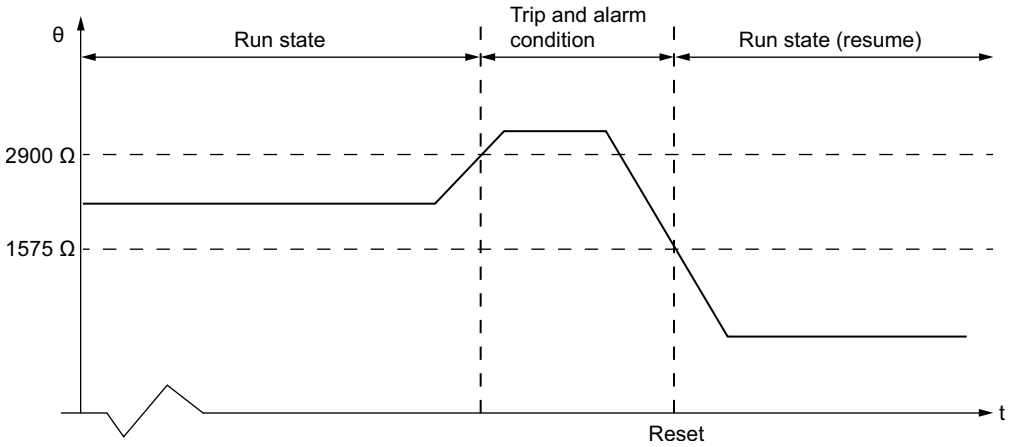
Technical Characteristics

The PTC binary motor temperature sensor function has the following characteristics:

Characteristic	Value
Detection time	0.5...0.6 s
Detection time accuracy	+/– 0.1 s

Example

The following diagram describes the occurrence of a PTC binary motor temp sensor trip with an automatic reset:



2900 Ω Trip threshold

1575 Ω Trip reclosing threshold

Reset This marks the time after which a reset can be executed. A start command is required before run state can be resumed. In this example, auto-reset has been enabled.

Motor Temperature Sensor - PT100

Description

The PT100 motor temperature sensing function is enabled when the Motor Temperature Sensor Type parameter is set to **PT100** and the LTMR controller is connected to a PT100 sensor embedded in the motor.

The LTMR controller monitors the state of the temperature sensing element and signals:

- A motor temperature sensor alarm when the measured temperature exceeds a configurable alarm threshold.
- A motor temperature sensor trip when the measured temperature exceeds a separately set trip threshold.

The LTMR directly measures the temperature with a PT100 sensor. The temperature measured by the PT100 sensor, either in °C (factory setting) or in °F, is displayed on the HMI or the TeSys T DTM, according to the Motor Temperature Sensor Display Degree CF parameter:

The trip or alarm condition continues until the measured temperature falls below 95% of the trip or alarm threshold.

There is a fixed detection time of 0.5 s to 0.6 s to the motor temperature sensor trip or alarm.

Trip and alarm monitoring can be separately enabled and disabled.

The function is available for all operating states.

NOTE:

The temperature is derived from the following equation: **T = 2.6042 * R - 260.42**,

Where **R** = resistance Ω).

NOTE: To connect a 3-wire PT100 sensor to an LTMR controller, simply do not wire the compensation pin of the 3-wire PT100 sensor.

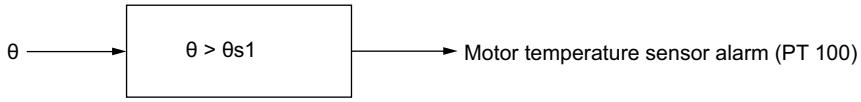
Functional Characteristics

The PT100 motor temperature sensor function includes the following features:

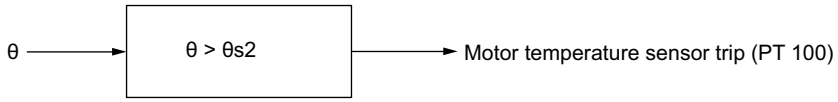
- Two configurable thresholds:
  - Motor Temperature Sensor Alarm Threshold Degree
  - Motor Temperature Sensor Trip Threshold Degree
- Two function outputs:
  - Motor Temperature Sensor Alarm
  - Motor Temperature Sensor Trip
- One counting statistic:
  - Motor Temperature Sensor Trips Count
- One display configuration:
  - Motor Temperature Sensor Display Degree CF

Block Diagram

Motor temperature sensor alarm:



Motor temperature sensor trip:



θ Temperature measured by the PT100 sensor

θs1 Motor temperature sensor alarm threshold

θs2 Motor temperature sensor trip threshold

Parameter Settings

The PT100 motor temperature sensor function has the following configurable parameter settings:

Parameters	Setting Range	Factory Setting
Trip threshold degree	0...200 °C in 1 °C increments	0 °C
Alarm threshold degree	0...200 °C in 1 °C increments	0 °C
Motor temperature sensor display degree CF	°C (0) °F (1)	°C

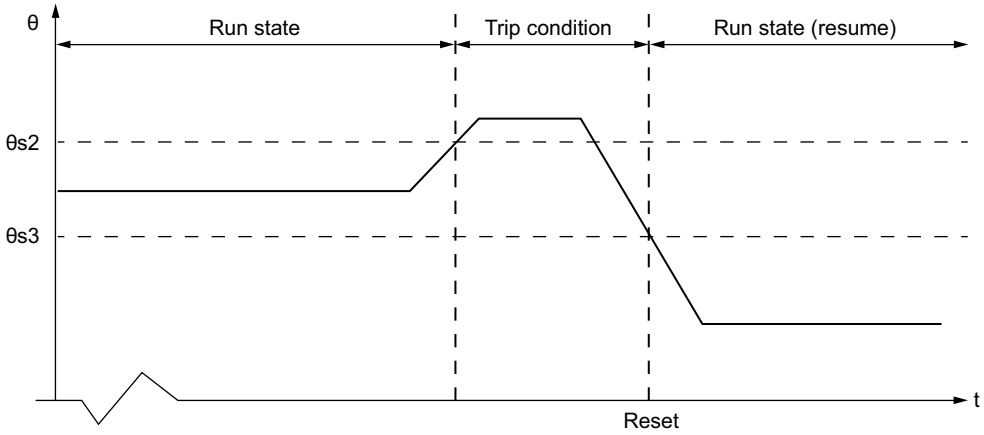
Technical Characteristics

The PT100 motor temperature sensor function has the following characteristics:

Characteristic	Value
Hysteresis	–5% of Alarm threshold and Trip threshold
Detection time	0.5...0.6 s
Trip time accuracy	+/– 0.1 s

Example

The following diagram describes a Motor temperature sensor PT100 trip with automatic reset and an active Run command:



θs2 Trip threshold

θs3 Trip reclosing threshold (95% of trip threshold)

Motor Temperature Sensor - PTC Analog

Description

The PTC Analog motor temperature sensing function is enabled when the Motor Temp Sensor Type parameter is set to **PTC Analog** and the LTMR controller is connected to an analog PTC thermistor embedded in the motor.

The LTMR controller monitors the state of the temperature sensing element and signals:

- A motor temperature sensor alarm when the measured resistance exceeds a configurable alarm threshold.
- A motor temperature sensor trip when the measured resistance exceeds a separately set trip threshold.

The trip or alarm condition continues until the measured resistance falls below 95% of the trip or alarm threshold.

Trip and alarm monitoring can be separately enabled and disabled.

The function is available for all operating states.

Functional Characteristics

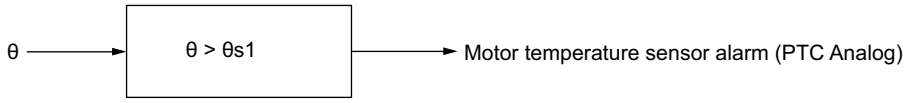
The PTC Analog motor temperature sensor function includes the following features:

- Two configurable thresholds:
  - Motor Temp Sensor Alarm Threshold
  - Motor Temp Sensor Trip Threshold
- Two function outputs:
  - Motor Temp Sensor Alarm
  - Motor Temp Sensor Trip

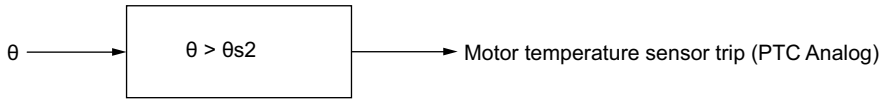
- One counting statistic:
  - Motor Temp Sensor Trips Count

Block Diagram

Motor temperature sensor alarm:



Motor temperature sensor trip:



θ Temperature sensing element resistance

θs1 Motor temperature sensor alarm threshold

θs2 Motor temperature sensor trip threshold

Parameter Settings

The PTC analog motor temperature sensor function has the following configurable parameter settings:

Parameters	Setting Range	Factory Setting
Trip threshold	20...6500 Ω in 0.1 Ω increments	20 Ω
Alarm threshold	20...6500 Ω in 0.1 Ω increments	20 Ω

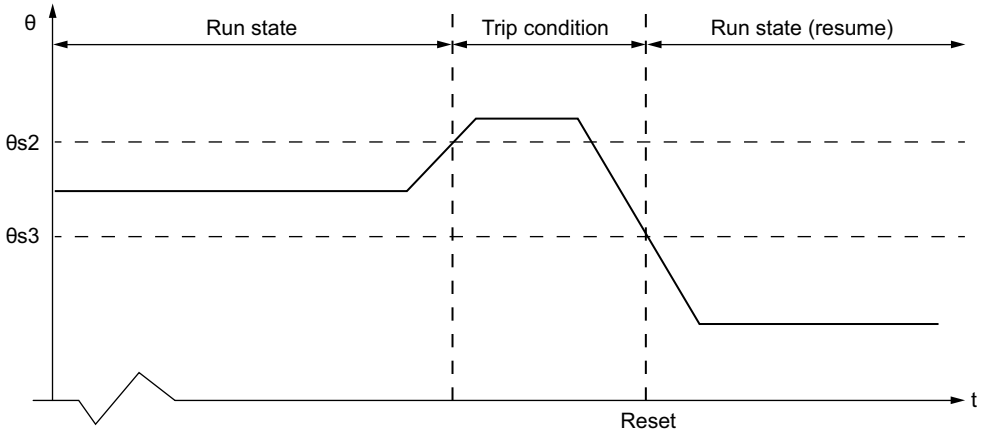
Technical Characteristics

The PTC analog motor temperature sensor function has the following characteristics:

Characteristic	Value
Hysteresis	– 5% of Alarm threshold and Trip threshold
Detection time	0.5...0.6 s
Detection time accuracy	+/– 0.1 s

Example

The following diagram describes a Motor temperature sensor PTC analog trip with automatic reset and an active Run command:



θs2 Trip threshold

θs3 Trip reclosing threshold (95% of trip threshold)

Motor Temperature Sensor - NTC Analog

Description

The NTC Analog motor temperature sensing function is enabled when the Motor Temp Sensor Type parameter is set to **NTC Analog** and the LTMR controller is connected to an analog NTC thermistor embedded in the motor.

The LTMR controller monitors the state of the temperature sensing element and signals:

- A motor temperature sensor alarm when the measured resistance falls below a configurable alarm threshold.
- A motor temperature sensor trip when the measured resistance falls below a separately set trip threshold.

The trip or alarm condition continues until the measured resistance exceeds 105% of the trip or alarm threshold.

Trip and alarm monitoring can be separately enabled and disabled.

The function is available for all operating states.

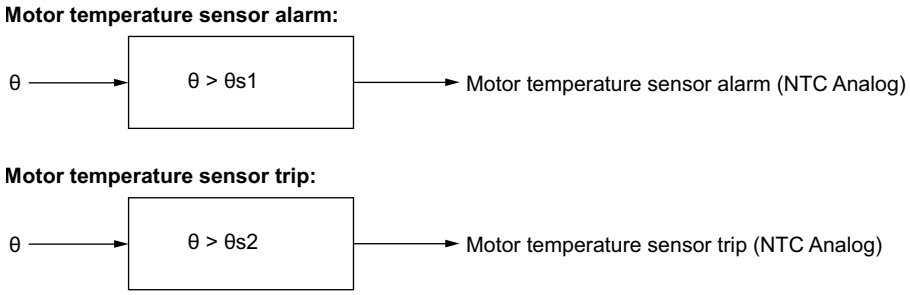
Functional Characteristics

The NTC Analog motor temperature sensor function includes the following features:

- Two configurable thresholds:
  - Alarm Threshold
  - Trip Threshold
- Two function outputs:
  - Motor Temp Sensor Alarm
  - Motor Temp Sensor Trip

- One counting statistic:
  - Motor Temp Sensor Trips Count

Block Diagram



θ Temperature sensing element resistance

θs1 Motor temperature sensor alarm threshold

θs2 Motor temperature sensor trip threshold

Parameter Settings

The NTC analog motor temperature sensor function has the following configurable parameter settings:

Parameters	Setting Range	Factory Setting
Trip threshold	20...6500 Ω in 0.1 Ω increments	20 Ω
Alarm threshold	20...6500 Ω in 0.1 Ω increments	20 Ω

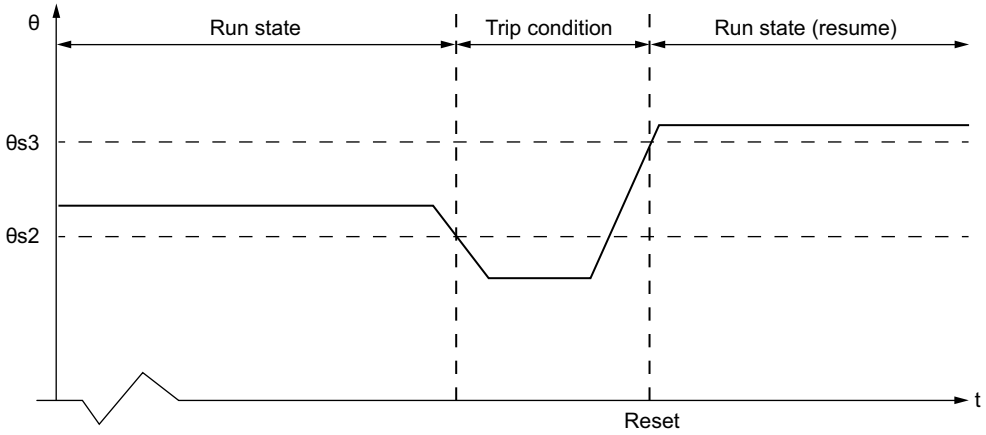
Technical Characteristics

The NTC analog motor temperature sensor function has the following characteristics:

Characteristics	Value
Hysteresis	+ 5% of Alarm threshold and Trip thresholds
Detection time	0.5...0.6 s
Detection time accuracy	+/– 0.1 s

Example

The following diagram describes a Motor temperature sensor NTC analog trip with automatic reset:



θr2 Trip threshold

θr3 Trip reclosing threshold (105% of trip threshold)

Rapid Cycle Lockout

Description

The rapid cycle lockout function prevents potential harm to the motor caused by repetitive, successive inrush currents resulting from too little time between starts.

The rapid cycle lockout function provides a configurable timer, which begins its count when the LTMR controller detects On Level Current–defined as 20% of FLC. At the same time, the Rapid Cycle Lockout bit is set.

If the LTMR controller detects a Run command before the rapid cycle lockout has elapsed, the:

- Rapid Cycle Lockout bit remains set
- LTMR controller ignores the Run command. It prevents the motor from restarting
- HMI device (if attached) displays "WAIT"
- LTMR controller Alarm LED flashes red 5 times per second, indicating the LTMR controller has disabled motor outputs thereby preventing an undesirable condition caused by starting the motor
- LTMR controller monitors the wait time-if more than one timer is active, the LTMR controller reports the minimum wait time before the longest timer elapses

On power loss, the LTMR controller stores the state of the lockout timer in non-volatile memory. When the LTMR controller next powers up, the timer restarts its count and again ignores Run commands until the timer completes the timeout.

Setting the Rapid Cycle Lockout Timeout parameter to 0 disables this function.

The Rapid Cycle Lockout Timeout setting can be edited when the LTMR controller is in its normal operating state. If an edit is made while the timer is counting, the edit is effective when the timer finishes counting.

This function has no alarm and no trip.

NOTE: The Rapid Cycle Lockout function is not active when the overload operating mode is selected.

Functional Characteristics

The rapid cycle lockout function includes the following parameters:

- One time delay:
  - Rapid Cycle Lockout Timeout
- One status bit:
  - Rapid Cycle Lockout

In addition, the Rapid Cycle Lockout function:

- Disables motor outputs
- Causes the LTMR Alarm LED to flash 5 times per second

Parameter Settings

The rapid cycle lockout function has the following parameters:

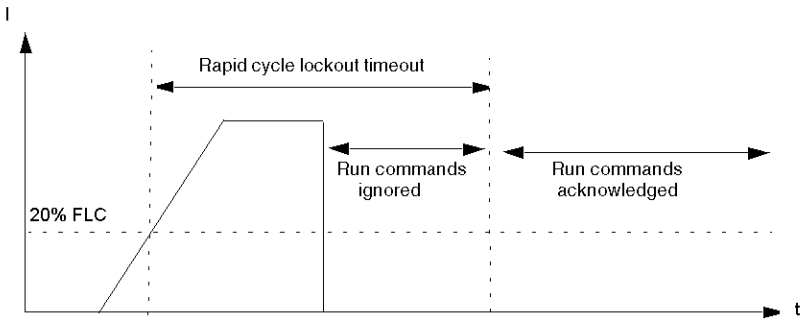
Parameters	Setting Range	Factory Setting
Rapid cycle lockout timeout	0...9999 s in increments of 1 s	0 s

Technical Characteristics

The rapid cycle lockout function has the following characteristics:

Characteristics	Value
Trip time accuracy	+/– 0.1 s or +/– 5%

Example



Current Motor Protection Functions

Overview

This section describes the current motor protection functions of the LTMR controller.

Current Phase Imbalance

Description

The current phase imbalance function signals:

- An alarm when the current in any phase differs by more than a set percentage from the average current in all three phases.
- A trip when the current in any phase differs by more than a separately set percentage from the average current in all three phases for a set period of time.

⚠CAUTION

RISK OF MOTOR OVERHEATING

- The Current Phase Imbalance Trip Threshold must be properly set to protect the wiring and motor equipment from harm caused by motor overheating.
- The setting you input must conform to national and local safety regulations and codes.
- Refer to the motor manufacturer's instructions before setting this parameter.

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

NOTE: Use this function to detect and guard against smaller current phase imbalances. For larger imbalances, in excess of 80% of the average current in all three phases, use the current phase loss motor protection function.

This function has two adjustable trip time delays:

- One applies to current imbalances occurring while the motor is in start state, and
- One applies to current imbalances occurring after startup while the motor is in run state

Both timers begin if the imbalance is detected in start state.

The function identifies the phase causing a current imbalance. If the maximum deviation from the three-phase current average is the same for two phases, the function identifies both phases.

Trip and alarm monitoring can be separately enabled and disabled.

The function applies only to three-phase motors.

Functional Characteristics

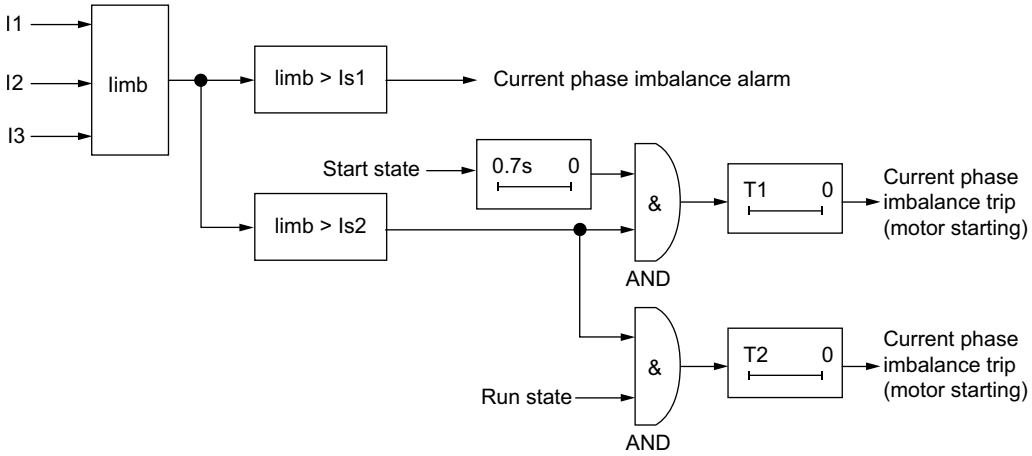
The current phase imbalance function includes the following features:

- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- Two trip time delays:
  - Trip Timeout Starting
  - Trip Timeout Running
- Two function outputs:
  - Current Phase Imbalance Alarm
  - Current Phase Imbalance Trip
- One counting statistic:
  - Current Phase Imbalance Trips Count

- Three indicators identifying the phase or phases with the highest current imbalance:
  - L1 Current Highest Imbalance
  - L2 Current Highest Imbalance
  - L3 Current Highest Imbalance

Block Diagram

Current phase imbalance alarm and trip:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

Iimb Current imbalance ratio for three-phase

Is1 Alarm threshold

Is2 Trip threshold

T1 Trip timeout starting

T2 Trip timeout running

Parameter Settings

The current phase imbalance function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Enable
Trip timeout starting	0.2...20 s in 0.1 s increments	0.7 s
Trip timeout running	0.2...20 s in 0.1 s increments	5 s
Trip threshold	10...70% of the calculated imbalance in 1% increments	10%
Alarm enable	Enable/Disable	Disable
Alarm threshold	10...70% of the calculated imbalance in 1% increments	10%

NOTE: A time of 0.7 second is added to the Trip timeout starting parameter to avoid nuisance tripping during the start phase.

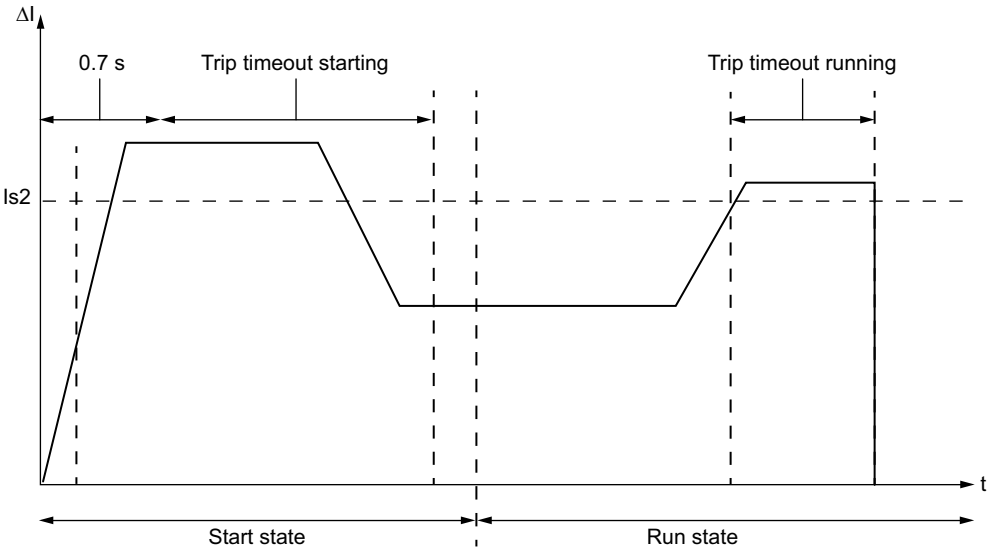
Technical Characteristics

The current phase imbalance function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of trip or alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the detection of a current phase imbalance occurring during run state.



ΔI Percentage difference between current in any phase and the three-phase current average

Is2 Trip threshold

Current Phase Loss

Description

The current phase loss function signals:

- An alarm when the current in any phase differs by more than 80% from the average current in all three phases.
- A trip when the current in any phase differs by more than 80% from the average current in all three phases for a set period of time.

  NOTE: Use this function to detect and guard against large current phase imbalances, in excess of 80% of the average current in all three phases. For smaller current imbalances, use the current phase imbalance motor protection function.

This function has a single adjustable trip time delay, which is applied when the motor is in start state or run state.

The function identifies the phase experiencing a current loss. If the maximum deviation from the three-phase current average is the same for two phases, the function identifies both phases.

Trip and alarm monitoring can be separately enabled and disabled.

The function applies only to three-phase motors.

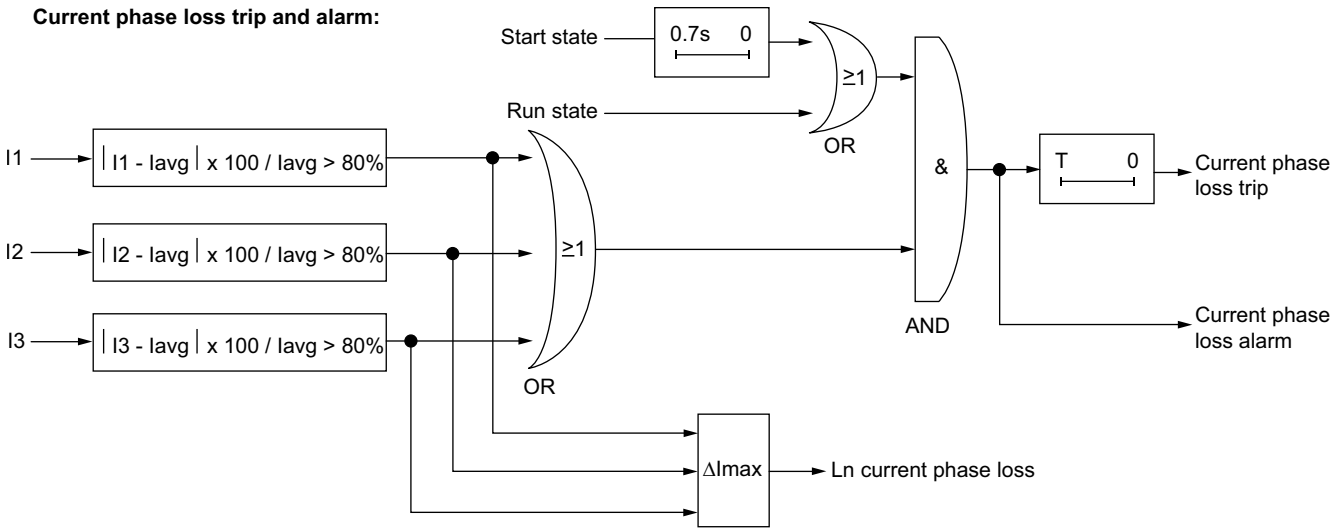
Functional Characteristics

The current phase loss function includes the following features:

- One fixed trip and alarm threshold equal to 80% of the three-phase average current.
- One trip time delay:
  - Current Phase Loss Timeout
- Two function outputs:
  - Current Phase Loss Alarm
  - Current Phase Loss Trip
- One counting statistic:
  - Current Phase Loss Trips Count
- Three indicators identifying the phase or phases experiencing the current loss:
  - L1 Current loss
  - L2 Current loss
  - L3 Current loss

Block Diagram

Current phase loss trip and alarm:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

Ln Line current number or numbers with the greatest deviation from Iavg

Iavg three-phase current average

T Trip timeout

Parameter Settings

The current phase loss function has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Enable
Timeout	0.1...30 s in 0.1 s increments	3 s
Alarm enable	Enable/Disable	Enable

NOTE: A time of 0.7 second is added to the Trip timeout parameter to avoid nuisance tripping during the start phase.

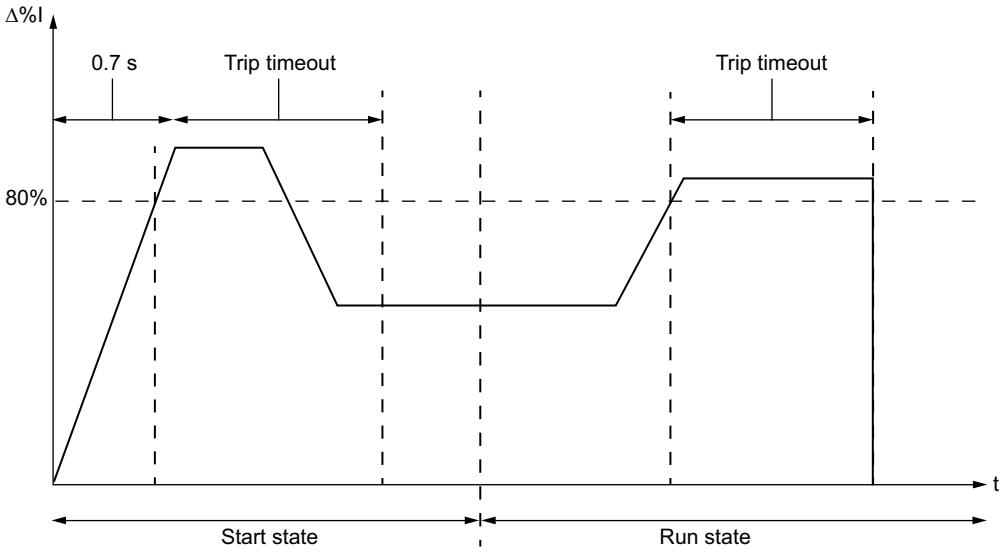
Technical Characteristics

The current phase loss function has the following characteristics:

Characteristics	Value
Hysteresis	75% of the three-phase average current
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of a current phase loss trip of a motor in run state.



Δ%I Percentage difference between current in any phase and the three-phase current average

Current Phase Reversal

Description

The current phase reversal function signals a trip when it detects that the current phases of a three-phase motor are out of sequence with the Motor Phases Sequence parameter, ABC, or ACB.

NOTE: When the LTMR controller is connected to an expansion module, phase reversal protection is based on voltage phase sequence before the motor starts, and on current phase sequence after the motor starts. In case of noisy power systems or loads, it is recommended to use voltage phase reversal protection and disable current phase reversal.

This function:

- Is active when the motor is in start state or run state
- Applies only to three-phase motors
- Has no alarm and no timer.

This function can be enabled or disabled.

Functional Characteristics

The current phase reversal function adds to one counting statistic, Wiring Trips Count.

Parameter Settings

The current phase reversal function has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Phase sequence	• A-B-C • A-C-B	A-B-C

Technical Characteristics

The current phase reversal function has the following characteristics:

Characteristic	Value
Trip time at motor startup	Within 0.2 s of motor startup
Trip time accuracy	+/– 0.1 s or +/– 5%

Long Start

Description

The long start function detects a locked or stalled rotor in start state and signals a trip when current continuously exceeds a separately set threshold for the same period of time.

Each predefined operating mode has its own current profile, representing a successful start cycle for the motor. The LTMR controller detects a long start trip condition whenever the actual current profile, occurring after a start command, varies from the expected profile.

Trip monitoring can be separately enabled and disabled.

This function has no alarm.

Start Cycle

The configurable parameters for the Long Start protection function, Long Start Trip Threshold, and Long Start Trip Timeout, are used by the LTMR controller in defining and detecting the motor's start cycle. For more information, refer to Start Cycle, page 142.

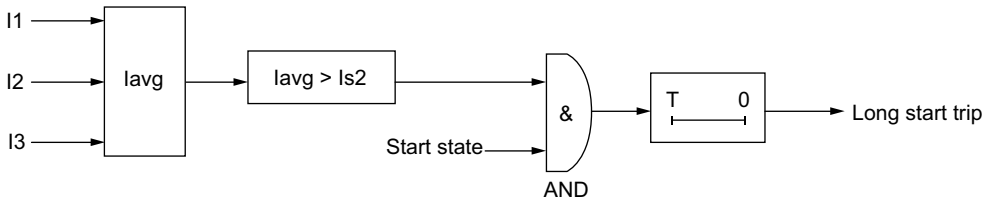
Functional Characteristics

The long start function includes the following features:

- One threshold:
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- One function outputs:
  - Long Start Trip
- One counting statistic:
  - Long Start Trips Count

Block Diagram

Long start trip:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

Is2 Trip threshold

T Trip timeout

Parameter Settings

The long start function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Enable
Trip timeout	1...200 s in 1 s increments	10 s
Trip threshold	100...800% of FLC	100% of FLC

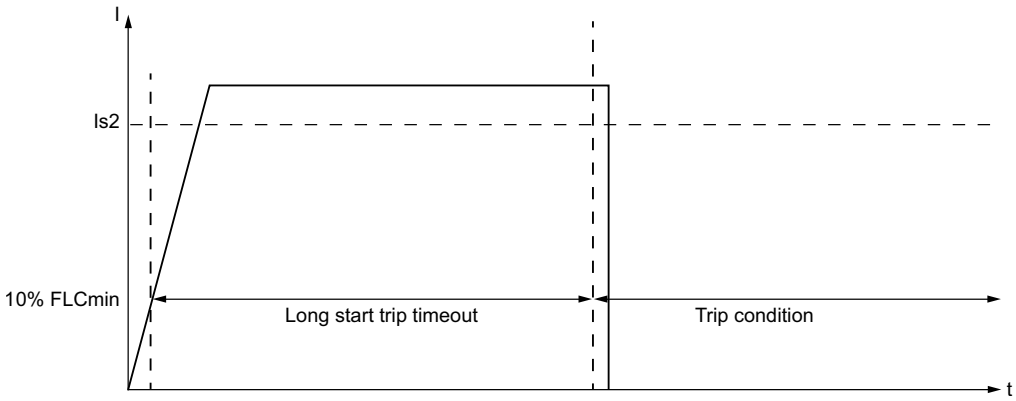
Technical Characteristics

The long start function has the following characteristics:

Characteristic	Value
Hysteresis	– 5% of Trip threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of a single threshold cross long start trip:



Is2 Long start trip threshold

Jam

Description

The jam function detects a locked rotor during run state and signals:

- An alarm when current in any phase exceeds a set threshold after the motor has reached run state.
- A trip when current in any phase continuously exceeds a separately set threshold for a specified period of time after the motor has reached run state.

The jam function is triggered when the motor is jammed during run state and stops, or is suddenly overloaded and draws excessive current.

Trip and alarm monitoring can be separately enabled and disabled.

Functional Characteristics

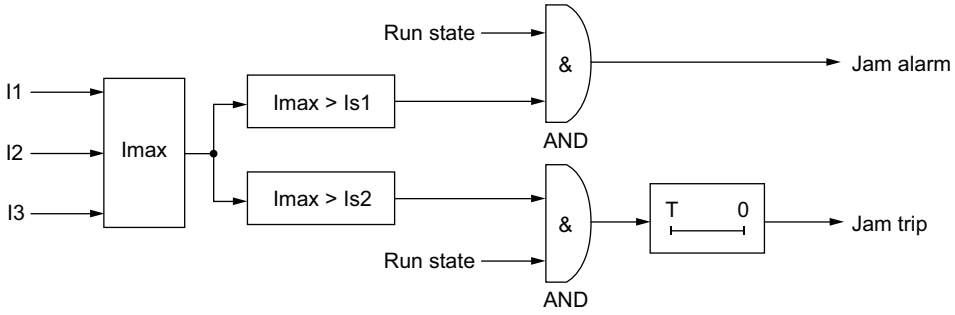
The jam function includes the following features:

- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - Jam Alarm
  - Jam Trip

- One counting statistic:
  - Jam Trips Count

Block Diagram

Jam alarm and trip:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

Is1 Alarm threshold

Is2 Trip threshold

T Trip timeout

Parameter Settings

The jam function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Enable
Trip timeout	1...30 s in 1 s increments	5 s
Trip threshold	100...800% of FLC in 1% increments	200% of FLC
Alarm enable	Enable/Disable	Disable
Alarm threshold	100...800% of FLC in 1% increments	200% of FLC

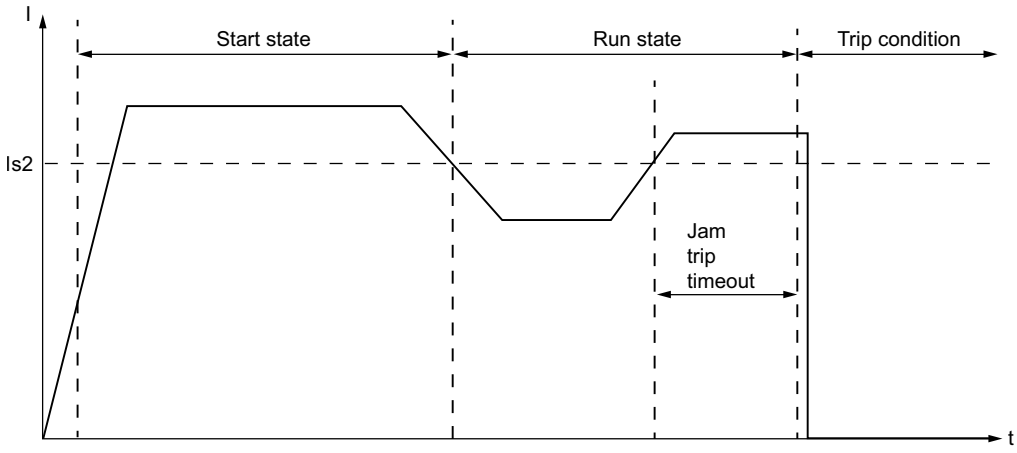
Technical Characteristics

The jam function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of a jam trip.



Is2 Jam trip threshold

Undercurrent

Description

The undercurrent function signals:

- An alarm when the three-phase Average Current falls below a set threshold after the motor has reached run state.
- A trip when the three-phase Average Current falls and remains below a separately set threshold for a set period of time after the motor has reached run state.

The undercurrent function is triggered when the motor current falls below a defined level for the driven load, for example, if a drive belt or shaft has broken, allowing the motor to run free rather than under load. This function has a single trip time delay. Trip and alarm monitoring can be separately enabled and disabled.

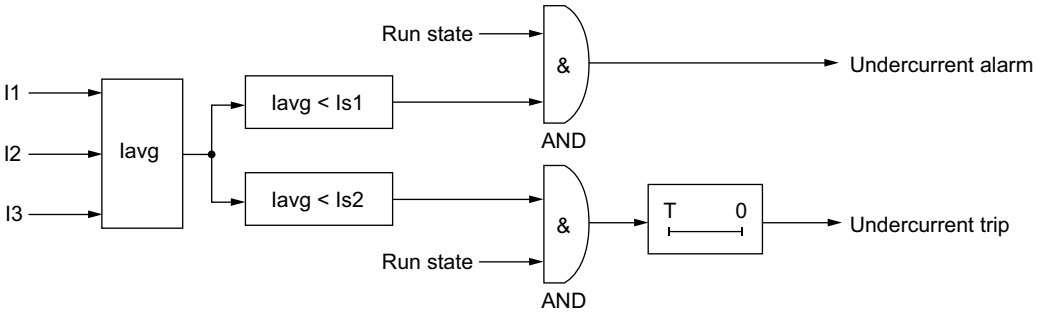
Functional Characteristics

The undercurrent function includes the following features:

- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - Undercurrent Alarm
  - Undercurrent Trip
- One counting statistic:
  - Undercurrent Trips Count

Block Diagram

Undercurrent alarm and trip:



Iavg Average current

Is1 Alarm threshold

Is2 Trip threshold

T Trip timer delay

Parameter Settings

The undercurrent function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	1...200 s in 1 s increments	1 s
Trip threshold	30...100% of FLC in 1% increments	50% of FLC
Alarm enable	Enable/Disable	Disable
Alarm threshold	30...100% of FLC in 1% increments	50% of FLC

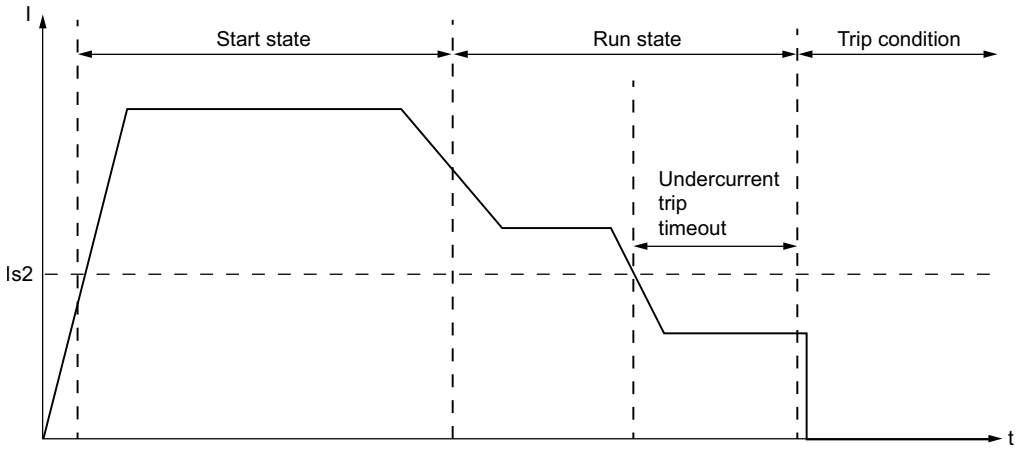
Technical Characteristics

The undercurrent function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an undercurrent trip.



Is2 Undercurrent trip threshold

Overcurrent

Description

The overcurrent function signals:

- An alarm when current in a phase exceeds a set threshold after the motor has reached run state.
- A trip when current in a phase continuously exceeds a separately set threshold for a set period of time after the motor has reached run state.

The overcurrent function can be triggered when the equipment is overloaded or a process condition is detected causing current to increase beyond the set threshold. This function has a single trip time delay. Trip and alarm monitoring can be separately enabled and disabled.

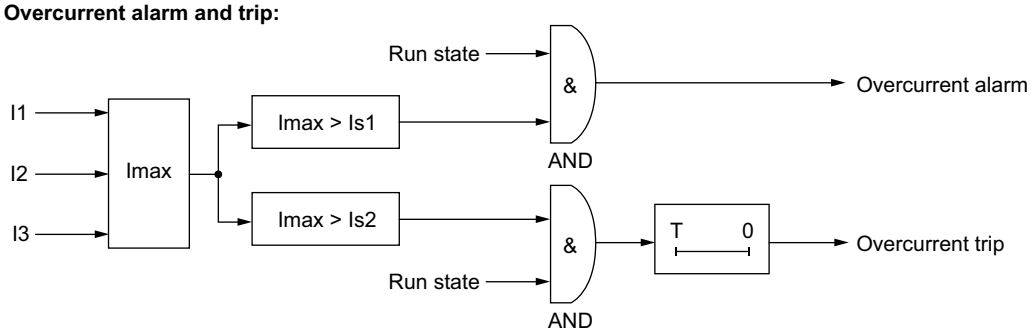
Functional Characteristics

The overcurrent function includes the following features:

- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - Overcurrent Alarm
  - Overcurrent Trip
- One counting statistic:
  - Overcurrent Trips Count

Block Diagram

Overcurrent alarm and trip:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

Is1 Alarm threshold

Is2 Trip threshold

T Trip timeout

Parameter Settings

The overcurrent function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	1...250 s in 1 s increments	10 s
Trip threshold	30...800% of FLC in 1% increments	200% of FLC
Alarm enable	Enable/Disable	Disable
Alarm threshold	30...800% of FLC in 1% increments	200% of FLC

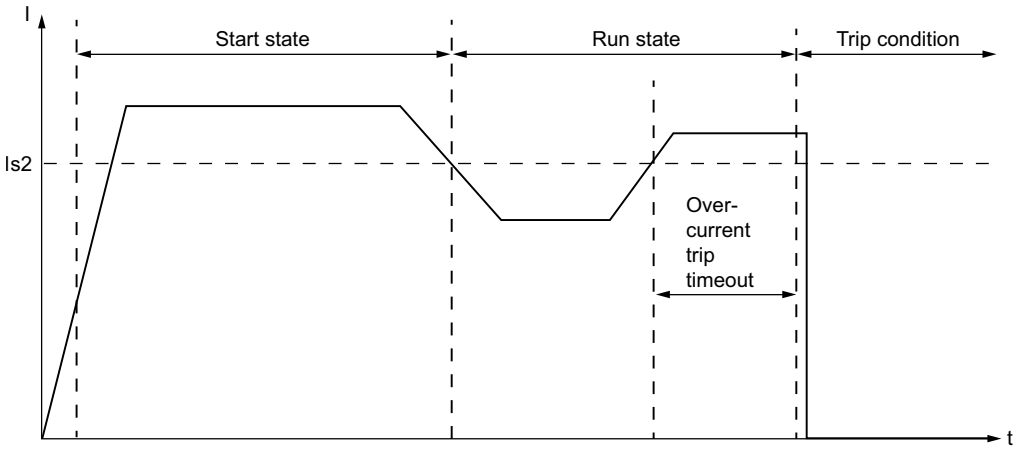
Technical Characteristics

The overcurrent function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an overcurrent trip.



Is2 Overcurrent trip threshold

Ground Current

Overview

The LTMR controller can be configured to detect ground current:

- Internally, by summing the three-phase current signals from the secondary of the internal current transformers, page 105.
- Externally, by measuring the current delivered by the secondary of an external ground current sensor, page 107.

Use the Ground Current Mode parameter to select either internal or external ground current trip protection. Only one of these ground current mode settings can be activated at a time.

Parameter Settings

The ground current protection function has the following configurable parameter settings, which apply to both internal and external ground current protection:

Parameters	Setting Range	Factory Setting
Ground current mode	• Internal • External	Internal
Trip enable	Enable/Disable	Enable
Alarm enable	Enable/Disable	Enable
Ground current trip disabled while starting	Enable/Disable	Enable

Internal Ground Current

Description

The internal ground current function is enabled when the Ground Current Mode parameter is set to **Internal** and disabled when set to **External**.

⚠⚠DANGER

IMPROPER TRIP DETECTION

- Internal ground current function will not protect people from harm caused by ground current.
- Ground current trip thresholds must be set to protect the motor and related equipment.
- Ground current trip settings must conform to national and local safety regulations and codes.

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

The internal ground current function sums the current readings from the secondary of the internal current transformers and signals:

- An alarm when the summed current exceeds a set threshold.
- A trip when the summed current continuously exceeds a separately set threshold for a set period of time.

The internal ground current function has a single trip time delay.

The internal ground current function can be enabled when the motor is in ready state, start state, or run state. This function can be configured so that it is disabled during start state, and enabled only during ready state and run state.

Trip and alarm monitoring can be separately enabled and disabled.

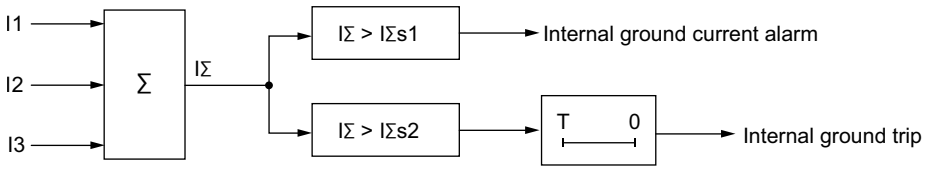
Functional Characteristics

The internal ground current function includes the following features:

- One measure of ground current in amperes:
  - Ground Current
- One measure of ground current as a % of FLCmin:
  - Ground Current Ratio
- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - Internal Ground Current Alarm
  - Internal Ground Current Trip
- One counting statistic:
  - Ground Current Trips Count

Block Diagram

Internal ground current alarm and trip:



I1 Phase 1 current

I2 Phase 2 current

I3 Phase 3 current

IΣ Summed current

IΣs1 Alarm threshold

IΣs2 Trip threshold

T Trip timeout

Parameter Settings

The internal ground current function has the following parameters:

Parameters	Setting Range	Factory Setting
Internal ground current trip timeout	0.5...25 s in 0.1 s increments	1 s
Internal ground current trip threshold	50...500% of FLCmin in 1% increments	50% of FLCmin
Internal ground current alarm threshold	50...500% of FLCmin in 1% increments	50% of FLCmin

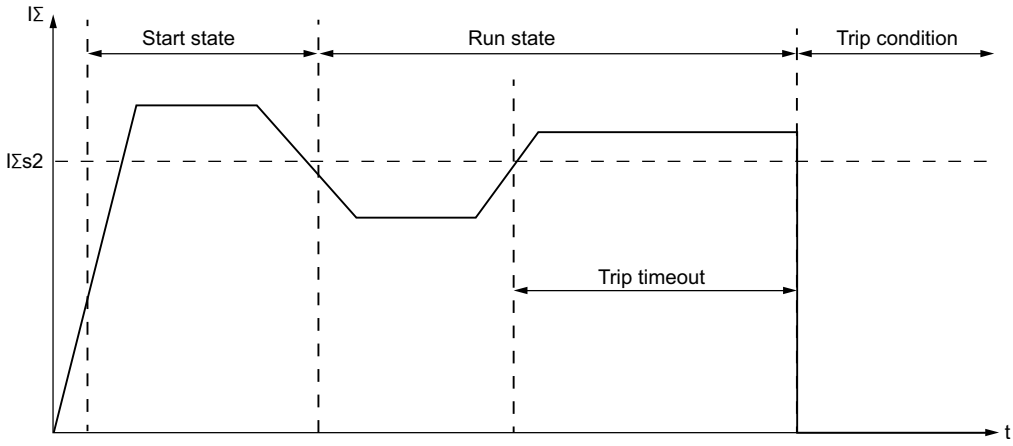
Technical Characteristics

The internal ground current function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an internal ground current trip occurring during run state.



IΣs2 Internal ground current trip threshold

External Ground Current

Description

The external ground current function is enabled when:

- The Ground Current Mode parameter is set to **External**, and
- A current transformation ratio is set.

When Ground Current Mode is set to **Internal**, the external ground current function is disabled.

⚠⚠DANGER

IMPROPER TRIP DETECTION

- External ground current function will not protect people from harm caused by ground current.
- Ground current trip thresholds must be set to protect the motor and related equipment.
- Ground current trip settings must conform to national and local safety regulations and codes.

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

The LTMR controller has two terminals-Z1 and Z2-that can be connected to an external ground current sensor. The external ground current function measures ground current delivered by the secondary of the external current transformer and signals:

- An alarm when the delivered current exceeds a set threshold.
- A trip when the delivered current continuously exceeds a separately set threshold for a set period of time.

The external ground current function has a single trip time delay.

The external ground current function can be enabled when the motor is in ready state, start state, or run state. This function can be configured so that it is disabled only during start state, and enabled during ready state and run state.

Trip and alarm monitoring can be separately enabled and disabled.

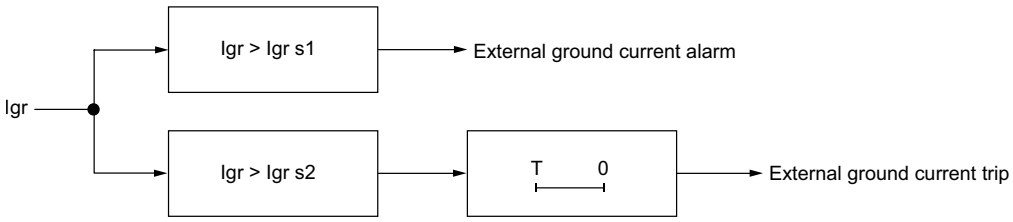
Functional Characteristics

The external ground current function includes the following features:

- One measure of ground current in amperes:
  - Ground Current
- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - External Ground Current Alarm
  - External Ground Current Trip
- One counting statistic:
  - Ground Current Trips Count

Block Diagram

External ground current alarm and trip:



Igr Ground current from external ground CT

Igr s1 Alarm threshold

Igr s2 Trip threshold

T Trip timeout

Parameter Settings

The external ground current function has the following parameters:

Parameters	Setting Range	Factory Setting
External ground current trip timeout	0.1...25 s in 0.01 s increments	0.5 s
External ground current trip threshold	0.02...20 A in 0.01 A increments	1 A
External ground current alarm threshold	0.02...20 A in 0.01 A increments	1 A

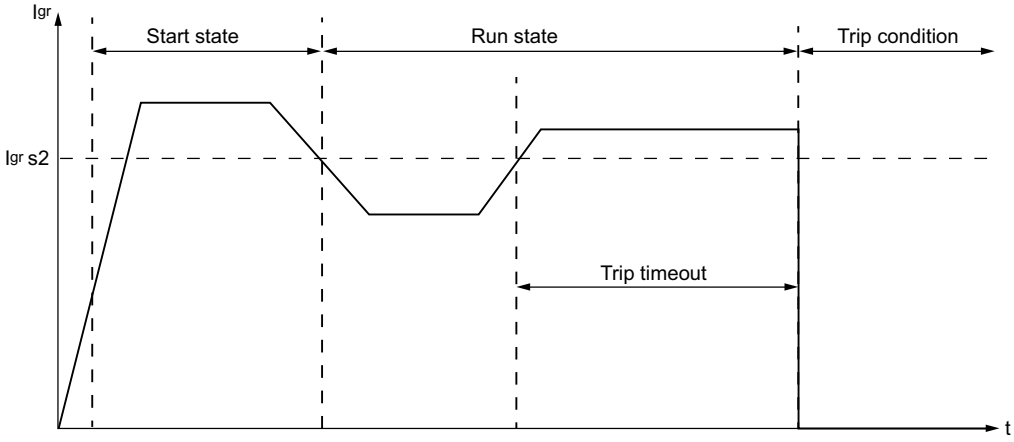
Technical Characteristics

The external ground current function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an external ground current trip occurring during run state.



Igr s2 External ground current trip threshold

Voltage Motor Protection Functions

Overview

This section describes the voltage motor protection functions provided by the LTMR controller.

Voltage Phase Imbalance

Description

The voltage phase imbalance function signals:

- An alarm when the voltage in any composed phase differs by more than a set percentage from the average voltage in all three phases
- A trip when the voltage in any composed phase differs by more than a separately set percentage from the average voltage in all three phases for a set period of time

  NOTE: A composed phase is the combined measure of two phases: L1 + L2, L2 + L3, or L3 + L1.

This function:

- Is active when the LTMR controller is connected to an expansion module
- Is active when the average voltage is between 50% and 120% of the nominal voltage
- Is available when the motor is in ready state, start state, and run state

- Applies only to three-phase motors

This function has two adjustable trip time delays:

- One applies to voltage imbalances occurring while the motor is in start state, and
- One applies to voltage imbalances occurring while the motor is in run state, or when the long start time duration expires

Both timers begin if the imbalance is detected in start state.

NOTE: Use this function to detect and guard against smaller voltage phase imbalances. For larger imbalances, in excess of 40% of the average voltage in all three phases, use the voltage phase loss motor protection function.

Trip and alarm monitoring can be separately enabled and disabled.

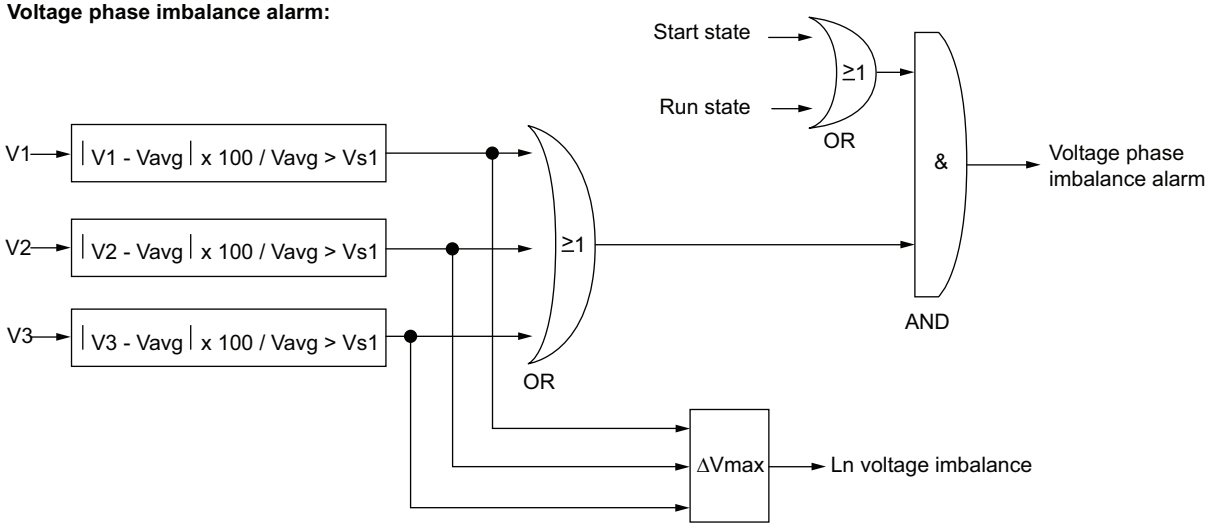
Functional Characteristics

The voltage phase imbalance function includes the following features:

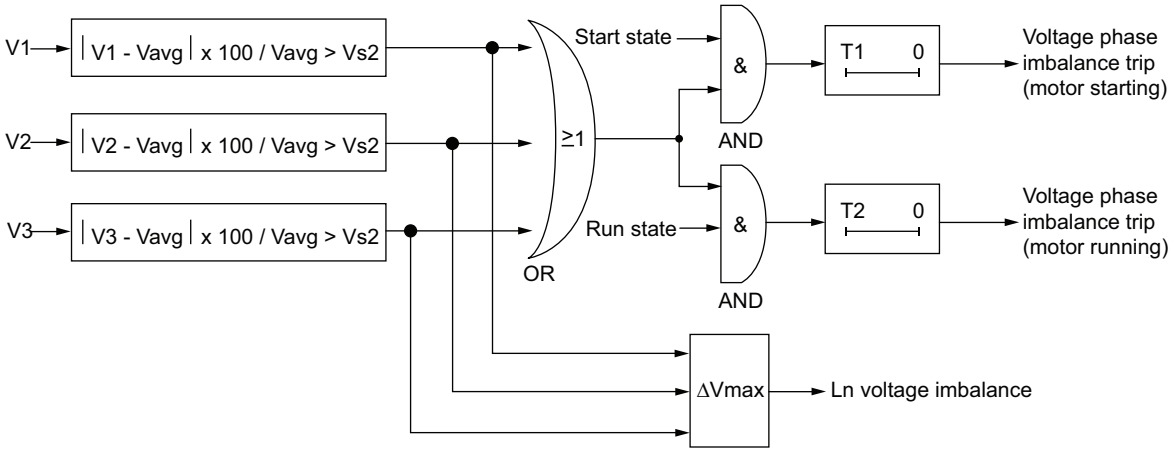
- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- Two trip time delays:
  - Trip Timeout Starting
  - Trip Timeout Running
- Two function outputs:
  - Voltage Phase Imbalance Alarm
  - Voltage Phase Imbalance Trip
- One counting statistic:
  - Voltage Phase Imbalance Trips Count
- Three indicators identifying the phase with the highest voltage imbalance:
  - L1-L2 Highest Imbalance
  - L2-L3 Highest Imbalance
  - L3-L1 Highest Imbalance

Block Diagram

Voltage phase imbalance alarm:



Voltage phase imbalance trip:



V1 L1-L2 voltage

V2 L2-L3 voltage

V3 L3-L1 voltage

Ln Line number or numbers with greatest deviation from Vavg

Vs1 Alarm threshold

Vs2 Trip threshold

Vavg Three-phase voltage average

T1 Trip timeout starting

T2 Trip timeout running

Parameter Settings

The voltage phase imbalance function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout starting	0.2...20 s in 0.1 s increments	0.7 s
Trip timeout running	0.2...20 s in 0.1 s increments	2 s
Trip threshold	3...15% of the calculated imbalance in 1% increments	10%
Alarm enable	Enable/Disable	Disable
Alarm threshold	3...15% of the calculated imbalance in 1% increments	10%

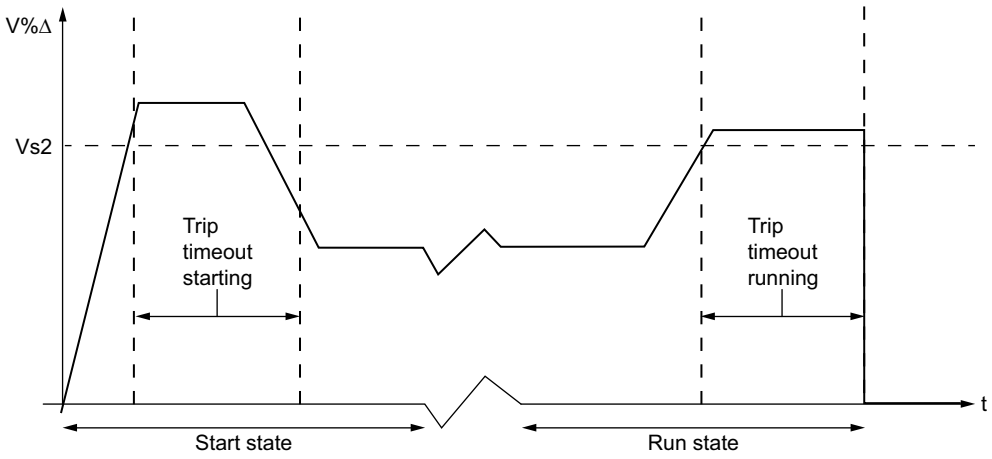
Technical Characteristics

The voltage phase imbalance function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of a voltage phase imbalance:



V%Δ Percentage difference between voltage in any phase and the three-phase average voltage

Vs2 Trip threshold

Voltage Phase Loss

Description

The voltage phase loss function is based on the Voltage Phase Imbalance function and signals:

- An alarm when the voltage in any phase differs by more than 32% from the average voltage in all three phases.

- A trip when the voltage in any phase differs by more than 32% from the average voltage in all three phases for a set period of time.

This function:

- Is active when the LTMR controller is connected to an expansion module
- Is active when the average voltage is between 50% and 120% of the nominal voltage
- Is available when the motor is in ready state or start state
- Applies only to three-phase motors

This function has a single adjustable trip time delay.

NOTE: Use this function to detect and guard against large voltage phase imbalances, in excess of 40% of the average voltage in all three phases. For smaller voltage imbalances, use the voltage phase imbalance motor protection function.

The function identifies the phase experiencing a voltage loss. If the maximum deviation from the three-phase voltage average is the same for two phases, the function identifies both phases.

Trip and alarm monitoring can be separately enabled and disabled.

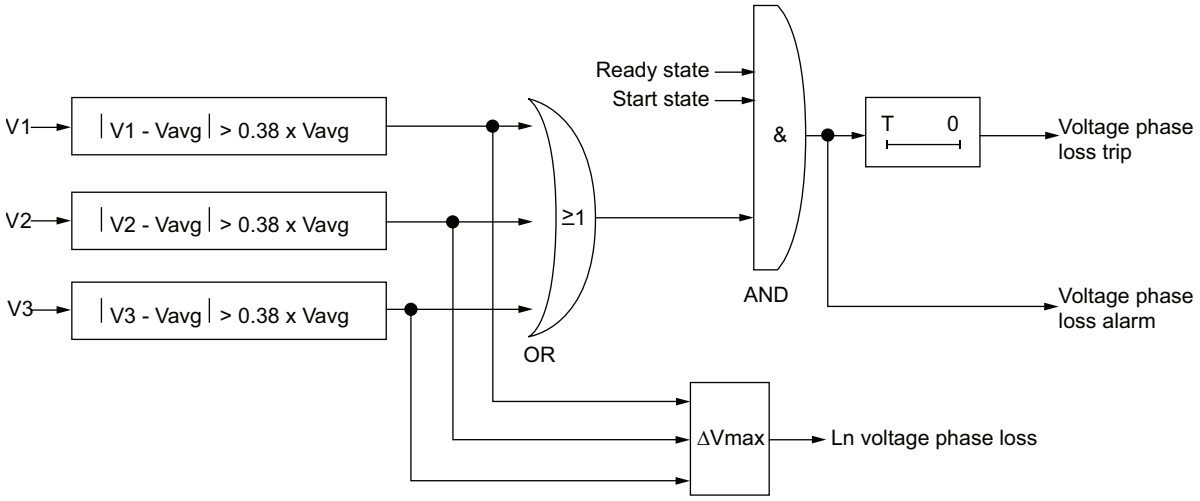
Functional Characteristics

The voltage phase loss function includes the following features:

- A fixed trip and alarm threshold equal to 32% of the three-phase average voltage.
- A single, adjustable trip time delay:
  - Voltage Phase Loss Timeout
- Two function outputs:
  - Voltage Phase Loss Alarm
  - Voltage Phase Loss Trip
- One counting statistic:
  - Voltage Phase Loss Trips Count
- Three indicators identifying the phase experiencing the voltage loss:
  - L1-L2 Voltage loss
  - L2-L3 Voltage loss
  - L3-L1 Voltage loss

Block Diagram

Voltage phase loss trip and alarm:



V1 L1-L2 voltage

V2 L2-L3 voltage

V3 L3-L1 voltage

Ln Line voltage number or numbers with the greatest deviation from Vavg

Vavg Three-phase average voltage

T Trip timeout

Parameter Settings

The voltage phase loss function has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Enable
Trip timeout	0.1...30 s in 0.1 s increments	3 s
Alarm enable	Enable/Disable	Enable

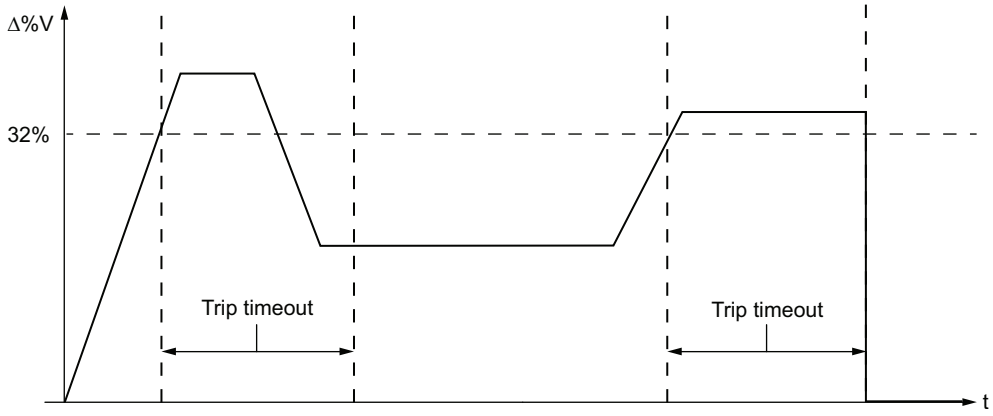
Technical Characteristics

The voltage phase loss function has the following characteristics:

Characteristics	Value
Hysteresis	45% of the three-phase average voltage
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of a voltage phase loss trip of a motor in start state:



ΔV% Percentage difference between voltage in any phase and the three-phase average voltage

Voltage Phase Reversal

Description

The voltage phase reversal function signals a trip when it detects that the voltage phases of a three-phase motor are out of sequence, usually indicating a detected wiring error. Use the Motor Phases Sequence parameter to configure the direction, ABC or ACB, in which the motor will turn.

This function:

- Is available when the LTMR controller is connected to an expansion module
- Is active when the average voltage is between 50% and 120% of the nominal voltage
- Is available when the motor is in ready state, start state and run state
- Applies only to three-phase motors
- Has no alarm and no timer

This function can be enabled or disabled.

Functional Characteristics

The voltage phase reversal function adds one counting statistic, Wiring Trips Count.

Parameter Settings

The voltage phase reversal function has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Motor phases sequence	• A-B-C • A-C-B	A-B-C

Technical Characteristics

The voltage phase reversal function has the following characteristics:

Characteristics	Value
Trip time	Within 0.2 s
Trip time accuracy	+/– 0.1 s

Undervoltage

Description

The undervoltage function signals:

- An alarm when voltage in a phase falls below a set threshold.
- A trip when voltage in a phase falls and remains below a separately set threshold for a set period of time.

This function has a single trip time delay. Both the trip and alarm thresholds are defined as a percentage of the Motor Nominal Voltage (Vnom) parameter setting.

The undervoltage function is available only in ready state and run state when the LTMR controller is connected to an expansion module.

Trip and alarm monitoring can be separately enabled and disabled.

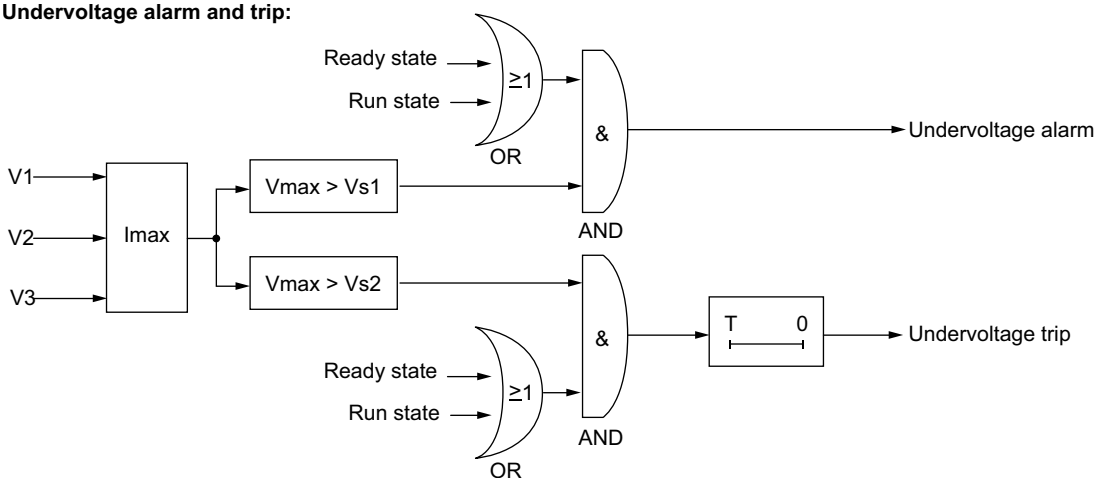
Functional Characteristics

The undervoltage function includes the following features:

- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - Undervoltage Alarm
  - Undervoltage Trip
- One counting statistic:
  - Undervoltage Trips Count

Block Diagram

Undervoltage alarm and trip:



V1 L1-L2 voltage

V2 L2-L3 voltage

V3 L3-L1 voltage

Vs1 Alarm threshold

Vs2 Trip threshold

T Trip timeout

Parameter Settings

The undervoltage function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	0.2...25 s in 0.1 s increments	3 s
Trip threshold	70...99% of Motor nominal voltage in 1% increments	85%
Alarm enable	Enable/Disable	Disable
Alarm threshold	70...99% of Motor nominal voltage in 1% increments	85%

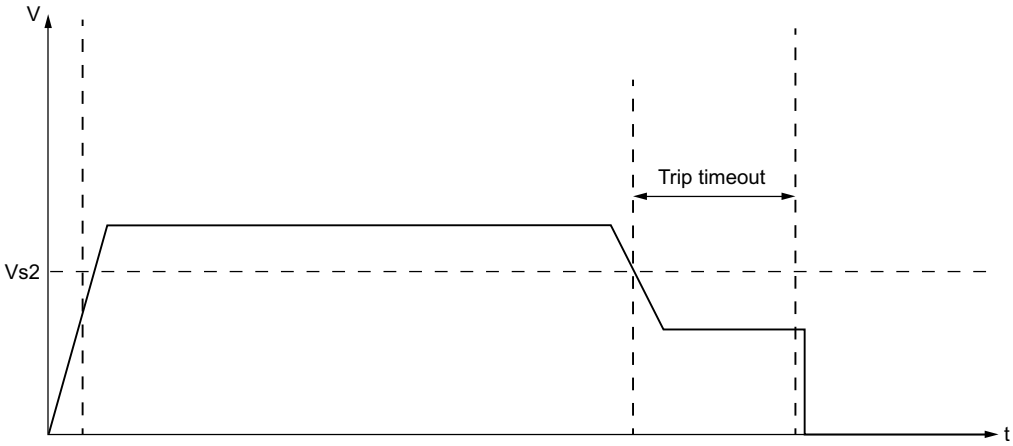
Technical Characteristics

The undervoltage function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an undervoltage trip.



Vs2 Undervoltage trip threshold

Overvoltage

Description

The overvoltage function signals:

- An alarm when voltage in a phase exceeds a set threshold.
- A trip when voltage in a phase continuously exceeds a separately set threshold for a specified period of time.

This function has a single trip time delay. Both the trip and alarm thresholds are defined as a percentage of the Motor Nominal Voltage (Vnom) parameter setting.

The overvoltage function is available in ready state and run state when the LTMR controller is connected to an expansion module.

Trip and alarm monitoring can be separately enabled and disabled.

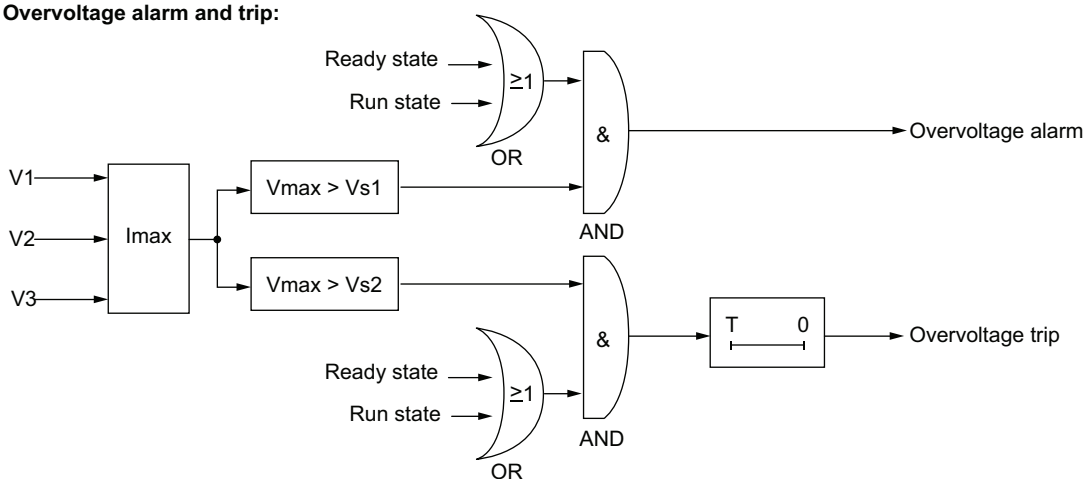
Functional Characteristics

The overvoltage function includes the following features:

- Two thresholds:
  - Alarm Threshold
  - Trip Threshold
- One trip time delay:
  - Trip Timeout
- Two function outputs:
  - Overvoltage Alarm
  - Overvoltage Trip
- One counting statistic:
  - Overvoltage Trips Count

Block Diagram

Overvoltage alarm and trip:



V1 L1-L2 voltage

V2 L2-L3 voltage

V3 L3-L1 voltage

Vs1 Alarm threshold

Vs2 Trip threshold

T Trip timeout

Parameter Settings

The overvoltage function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	0.2...25 s in 0.1 s increments	3 s
Trip threshold	101...115% of Motor nominal voltage in 1% increments	110%
Alarm enable	Enable/Disable	Disable
Alarm threshold	101...115% of Motor nominal voltage in 1% increments	110%

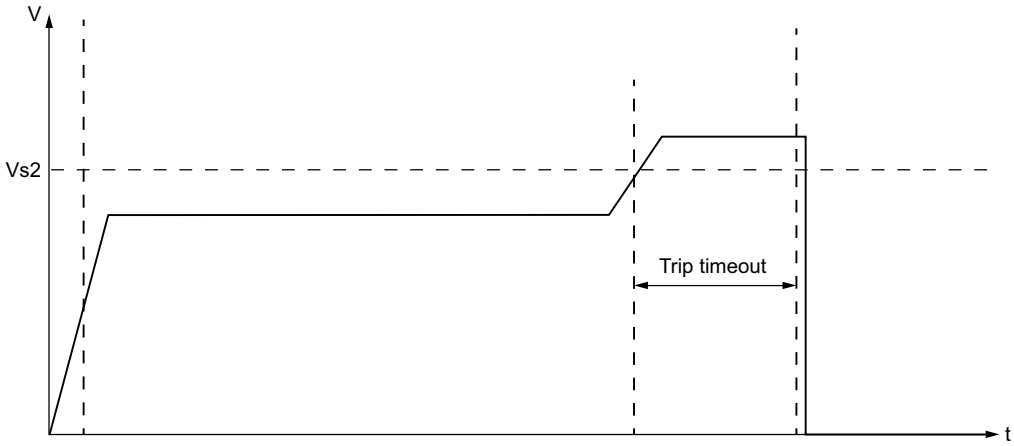
Technical Characteristics

The overvoltage function has the following characteristics:

Characteristics	Value
Hysteresis	–5% of Trip threshold or Alarm threshold
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an overvoltage trip.



Vs2 Overvoltage trip threshold

Voltage Dip Management

Overview

When a voltage dip is detected, the LTMR can perform two different functions to shed and reconnect automatically the load:

- Load shedding, page 120
- Automatic restart, page 122

Selection is done via the Voltage dip mode parameter:

If Voltage Dip Mode is...	Then...
0	Nothing happens
1	Load shedding function is enabled
2	Automatic restart function is enabled

Load Shedding and Automatic Restart functions exclude each other.

Load Shedding

Description

The LTMR controller provides load shedding, which you can use to deactivate non-critical loads if voltage level is substantially reduced. For example, use load shedding when power is transferred from a main utility supply to a backup generator system, where the backup generator system can supply power only to a limited number of critical loads.

The LTMR only monitors load shedding when Load Shedding is selected.

With the load shedding function enabled, the LTMR controller monitors the average phase voltage and:

- Reports a load shedding condition and stops the motor when voltage falls below a configurable Voltage dip threshold and stays below the threshold for the duration of a configurable load shedding timer,
- Clears the load shedding condition when voltage rises above a configurable Voltage dip restart threshold and remains above the threshold for the duration of a configurable Load shedding restart timer.

When the LTMR controller clears the load shedding condition:

- In 2-wire (maintained) configuration, it issues a Run command to restart the motor,
- In 3-wire (impulse) configuration, it does not automatically restart the motor.

In Overload motor operating mode, load shedding conditions do not affect O.1 and O.2 operating states.

In Independent motor operating mode, load shedding conditions do not affect O.2 state.

If your application includes another device that externally provides load shedding, the LTMR controller's load shedding function should not be enabled.

All voltage dip thresholds and timers can be adjusted when the LTMR controller is in its normal operating state. When a load shedding timer is counting at the time it is adjusted, the new duration time does not become effective until the timer expires.

This function is available only when your application includes an LTME expansion module.

Functional Characteristics

The load shedding function includes the following features:

- Two thresholds:
  - Voltage Dip Threshold
  - Voltage Dip Restart Threshold
- Two time delays:
  - Load Shedding Timeout
  - Voltage Dip Restart Timeout
- One status flag
  - Load Shedding
- One counting statistic:
  - Load Sheddings Count

In addition, the load shedding function:

- Disables logic outputs O.1 and O.2
- Causes the alarm LED to flash 5 times per second

Parameter Settings

The load shedding function has the following parameters:

Parameters	Setting Range	Factory Setting
Voltage dip mode	0 = None 1 = Load shedding 2 = Auto restart	0 = None
Load shedding timeout	1...9999 s in increments of 1 s	10 s

Parameters	Setting Range	Factory Setting
Voltage dip threshold	50...115% of Motor nominal voltage	70%
Voltage dip restart timeout	1...9999 s in increments of 1 s	2 s
Voltage dip restart threshold	65...115% of Motor nominal voltage	90%

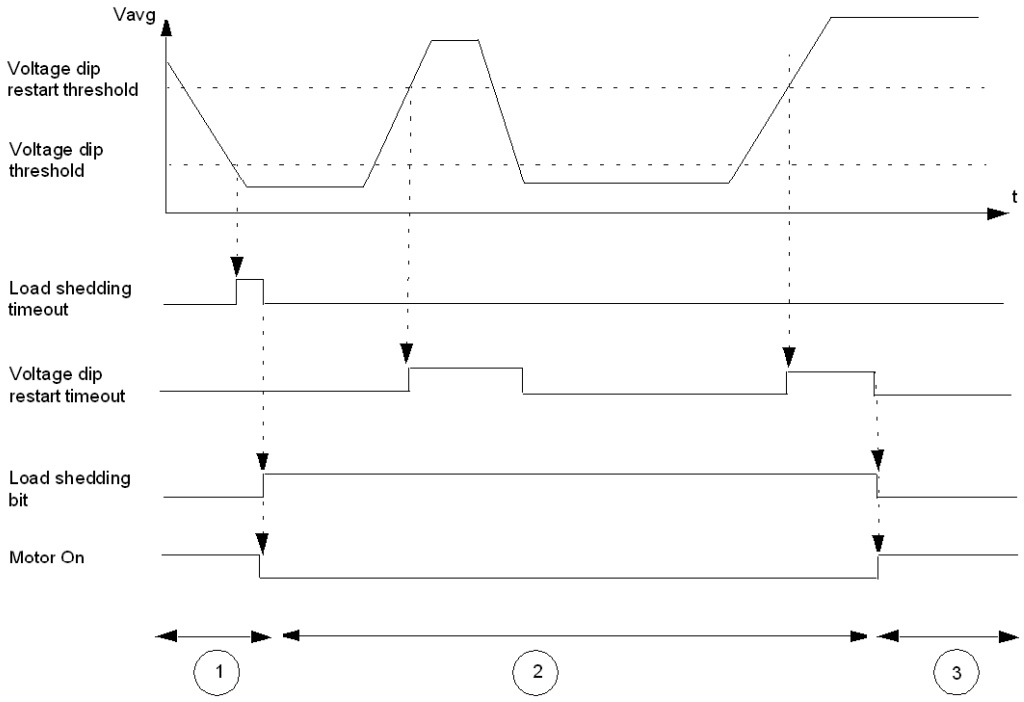
Technical Characteristics

The load shedding function has the following characteristics:

Characteristics	Value
Trip time accuracy	+/– 0.1 s or +/– 5%

Timing Sequence

The following diagram is an example of the timing sequence for the load shedding function, for a 2-wire configuration with automatic restart:



1 Motor running

2 Load shed; motor stopped

3 Load shed cleared; motor auto-restart (2-wire operation)

Automatic Restart

Description

The LTMR controller provides automatic restart.

With the automatic restart function enabled, the LTMR controller monitors the instantaneous phase voltage and detects voltage dip conditions. The voltage dip detection shares some parameters with the Load shedding function.

Three restart sequences are managed by the function according to the duration of the voltage dip:

- Immediate restart: the motor restarts automatically.
- Delayed restart: the motor restarts automatically after a timeout.
- Manual restart: the motor restarts manually. A Run command is necessary.

All automatic restart timers can be adjusted when the LTMR controller is in its normal operating state. When an automatic restart timer is counting at the time it is adjusted, the new duration time does not become effective until the timer expires.

This function is available only when your application includes an LTME expansion module.

Functional Characteristics

The automatic restart function includes the following features:

- Three time delays:
  - Auto Restart Immediate Timeout
  - Auto Restart Delayed Timeout
  - Voltage Dip Restart Timeout
- Five status flags:
  - Voltage Dip Detection: the LTMR is in a dip condition
  - Voltage Dip Occurred: a dip has been detected in the last 4.5 seconds
  - Auto Restart Immediate Condition
  - Auto Restart Delayed Condition
  - Auto Restart Manual Condition
- Three counting statistics:
  - Auto Restart Immediate Count
  - Auto Restart Delayed Count
  - Auto Restart Manual Count

Parameter Settings

The automatic restart function has the following parameters:

Parameters	Setting Range	Factory Setting
Voltage dip mode	0 = None 1 = Load shedding 2 = Auto restart	0 = None
Voltage dip threshold	50...115% of Motor nominal voltage	65%
Voltage dip restart threshold	65...115% of Motor nominal voltage	90%
Auto restart immediate timeout	0...0.4 s in increments of 0. 1 s	0.2 s
Auto restart delayed timeout	• 0...300 s: timeout setting in increments of 1 s • 301 s: timeout infinite	4 s
Voltage dip restart timeout	0...9999 s in increments of 1 s	2 s

Technical Characteristics

The automatic restart function has the following characteristics:

Characteristics	Value
Timing accuracy	+/– 0.1 s or +/– 5%

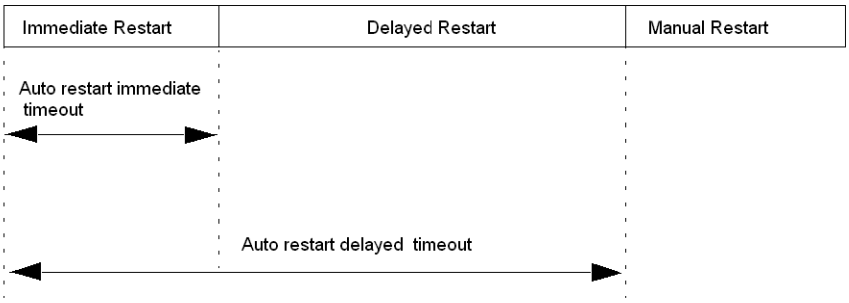
Automatic Restart Behavior

The automatic restart behavior is characterized by the voltage dip duration that is the amount of time passed from the voltage loss until the voltage restoration.

The two possible settings are:

- Immediate restart timeout,
- Delayed restart timeout (with delay defined by Restart Delay Time).

The following diagram shows the automatic restart phases:



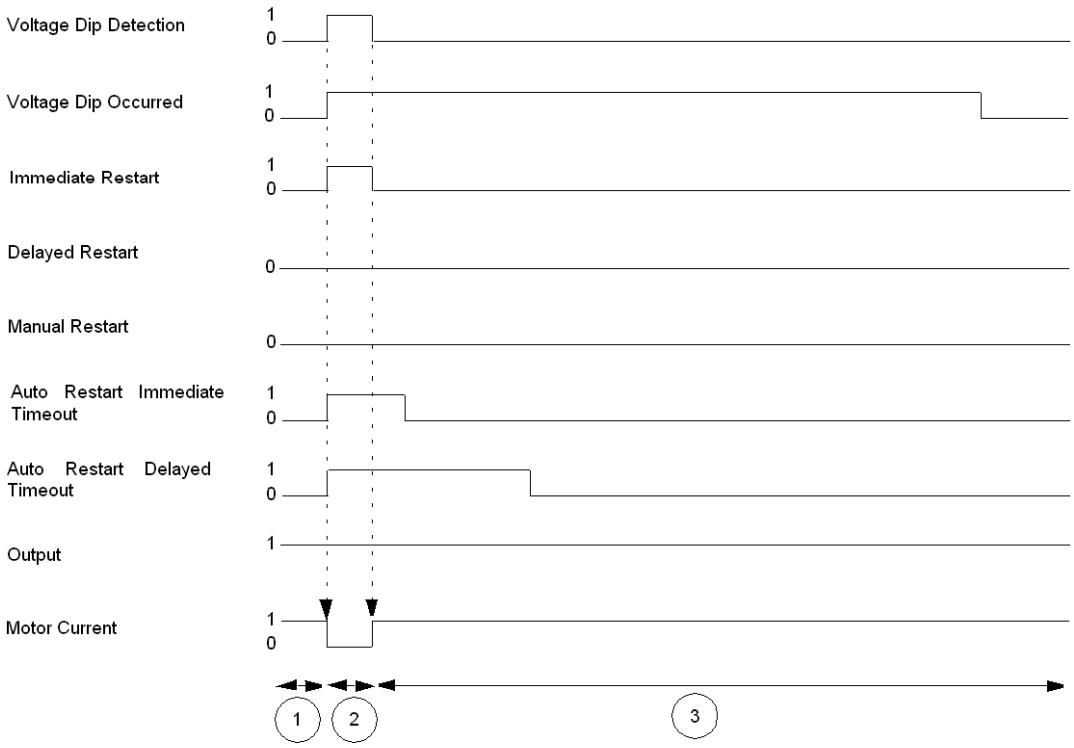
If the voltage dip duration is less than the immediate restart timeout and if the voltage dip is the second one occurring within 1 second, then the motor will require a delayed restart.

When a delayed restart is active (the delay timer is running):

- The timer is paused for the duration of the dip if a voltage dip occurs,
- The delayed restart is canceled if a start or stop command occurs.

Timing Sequence - Immediate Restart

The following diagram is an example of the timing sequence when an immediate restart occurs:



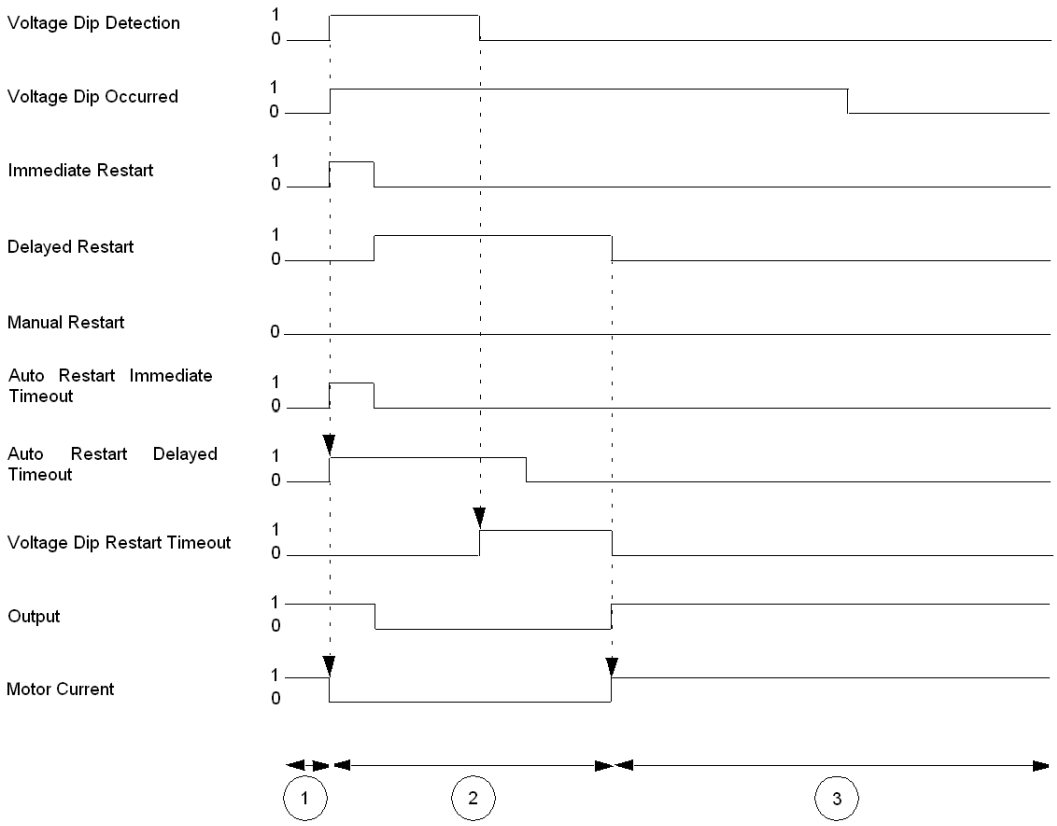
1 Motor running

2 Voltage dip detected, motor stopped

3 Voltage dip cleared, motor automatic restart

Timing Sequence - Delayed Restart

The following diagram is an example of the timing sequence when a delayed restart occurs:



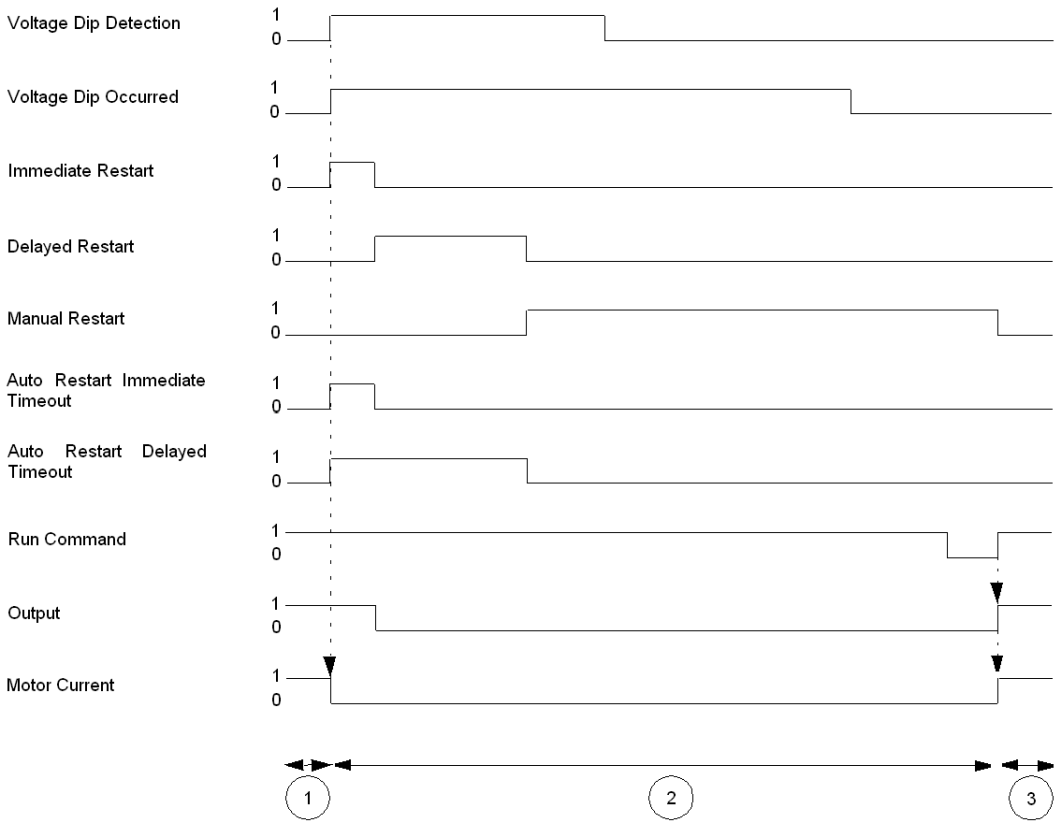
1 Motor running

2 Voltage dip detected, motor stopped

3 Voltage dip cleared, motor automatic restart

Timing Sequence - Manual Restart

The following diagram is an example of the timing sequence when a manual restart occurs:



1 Motor running

2 Voltage dip detected, motor stopped

3 Voltage dip cleared, motor automatic restart

Power Motor Protection Functions

Overview

This section describes the power motor protection functions provided by the LTMR controller.

Underpower

Description

The underpower function signals:

- An alarm when the value of active power falls below a set threshold.
- A trip when the value of active power falls and remains below a separately set threshold for a set period of time.

This function has a single trip time delay. Both the trip and alarm thresholds are defined as a percentage of the Motor Nominal Power parameter setting (Pnom).

The underpower function is available only in run state when the LTMR controller is connected to an expansion module.

Trip and alarm monitoring can be separately enabled and disabled.

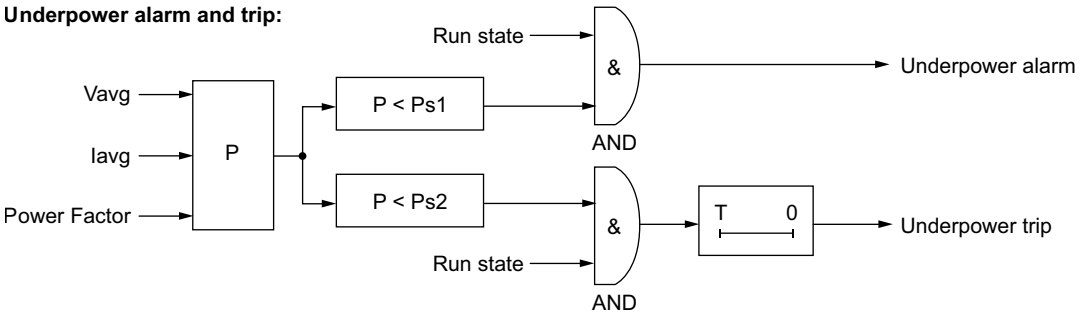
Functional Characteristics

The underpower function includes the following features:

- Two thresholds:
  - Underpower Alarm Threshold
  - Underpower Trip Threshold
- One trip time delay:
  - Underpower Trip Timeout
- Two function outputs:
  - Underpower Alarm
  - Underpower Trip
- One counting statistic:
  - Underpower Trips Count

Block Diagram

Underpower alarm and trip:



Vavg Average rms voltage

Iavg Average rms current

P Power

Ps1 Alarm threshold

Ps2 Trip threshold

T Trip timeout

Parameter Settings

The underpower function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	1...100 s in 1 s increments	60 s

Parameters	Setting Range	Factory Setting
Trip threshold	20...800% of Motor nominal power in 1% increments	20%
Alarm enable	Enable/Disable	Disable
Alarm threshold	20...800% of Motor nominal power in 1% increments	30%

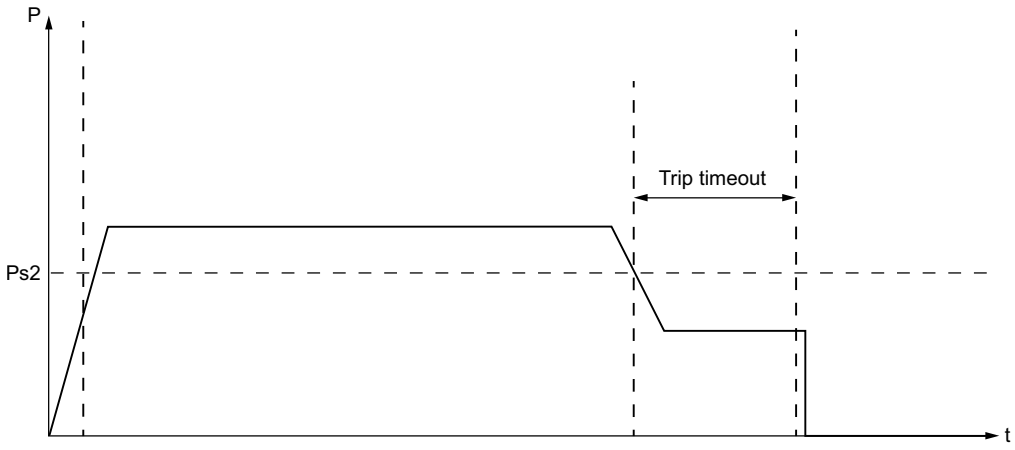
Technical Characteristics

The underpower function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Accuracy	+/– 5%

Example

The following diagram describes the occurrence of an underpower trip.



Ps2 Underpower trip threshold

Overpower

Description

The overpower function signals:

- An alarm when the value of active power exceeds a set threshold.
- A trip when the value of active power exceeds a separately set threshold and remains above that threshold for a set period of time.

This function has a single trip time delay. Both the trip and alarm thresholds are defined as a percentage of the Motor Nominal Power parameter setting (Pnom).

The overpower function is available only in run state when the LTMR controller is connected to an expansion module.

Trip and alarm monitoring can be separately enabled and disabled.

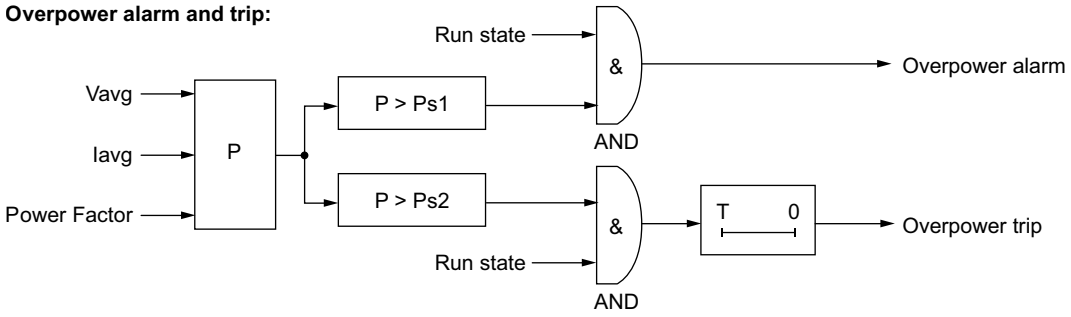
Functional Characteristics

The overpower function includes the following features:

- Two thresholds:
  - Overpower Alarm Threshold
  - Overpower Trip Threshold
- One trip time delay:
  - Overpower Trip Timeout
- Two function outputs:
  - Overpower Alarm
  - Overpower Trip
- One counting statistic:
  - Overpower Trips Count

Block Diagram

Overpower alarm and trip:



Vavg Average rms voltage

Iavg Average rms current

P Power

Ps1 Alarm threshold

Ps2 Trip threshold

T Trip timeout

Parameter Settings

The overpower function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	1...100 s in 1 s increments	60 s
Trip threshold	20...800% of Motor nominal power in 1% increments	150%
Alarm enable	Enable/Disable	Disable
Alarm threshold	20...800% of Motor nominal power in 1% increments	150%

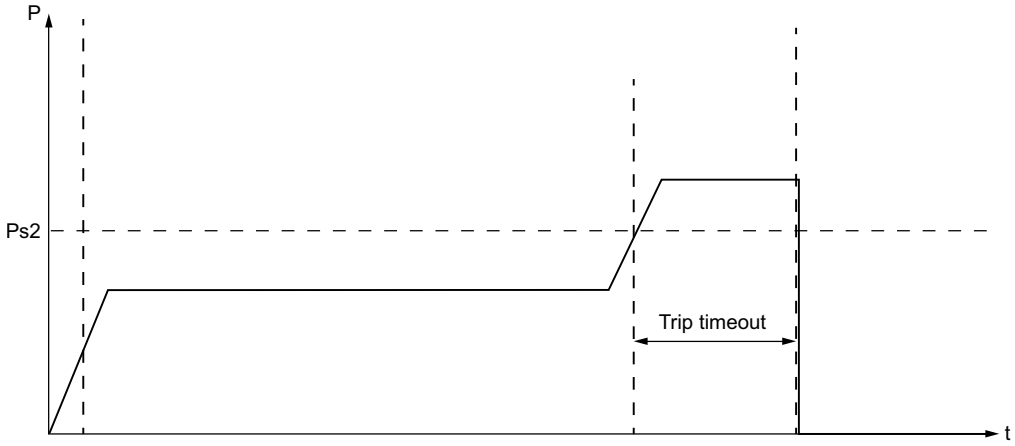
Technical Characteristics

The overpower function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Accuracy	+/– 5%

Example

The following diagram describes the occurrence of an overpower trip.



Ps2 Overpower trip threshold

Under Power Factor

Description

The under power factor protection function monitors the value of the power factor and signals:

- An alarm when the value of the power factor falls below a set threshold.
- A trip when the value of the power factor falls below a separately set threshold and remains below that threshold for a set period of time.

This function has a single trip time delay.

The under power factor protection function is available only in run state when the LTMR controller is connected to an expansion module.

Trip and alarm monitoring can be separately enabled and disabled.

Functional Characteristics

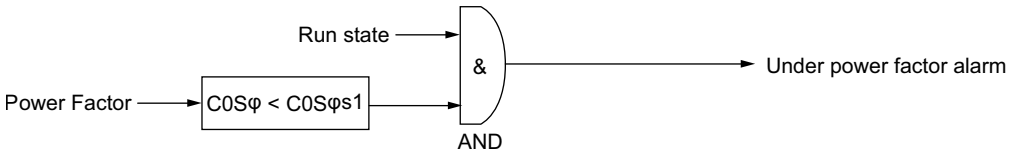
The under power factor function includes the following features:

- Two thresholds:
  - Under Power Factor Alarm Threshold
  - Under Power Factor Trip Threshold

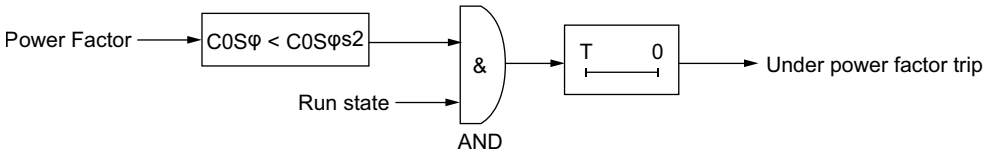
- One trip time delay:
  - Under Power Factor Trip Timeout
- Two function outputs:
  - Under Power Factor Alarm
  - Under Power Factor Trip
- One counting statistic:
  - Under Power Factor Trips Count

Block Diagram

Under power factor alarm:



Under power factor trip:



cosϕs1 Under power factor alarm threshold

cosϕs2 Under power factor trip threshold

T Under power factor trip timeout

Parameter Settings

The under power factor function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	1...25 s in 0.1 s increments	10 s
Trip threshold	0...1 x Power factor in 0.01 increments	0.60
Alarm enable	Enable/Disable	Disable
Alarm threshold	0...1 x Power factor in 0.01 increments	0.60

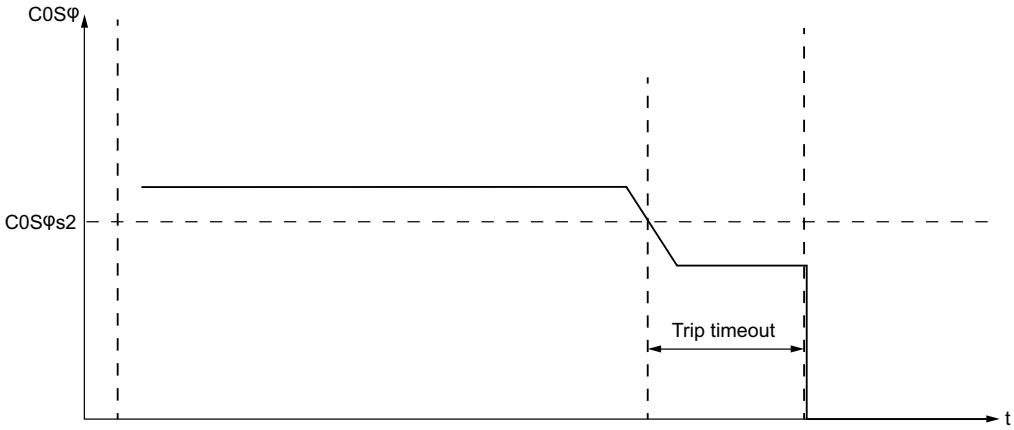
Technical Characteristics

The under power factor function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Accuracy	+/– 3° or +/– 10% (for cos ϕ ≥ 0.6)
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an under power factor trip.



cosϕs2 Under power factor trip threshold

Over Power Factor

Description

The over power factor protection function monitors the value of the power factor and signals:

- An alarm when the value of the power factor exceeds a set threshold.
- A trip when the value of the power factor exceeds a separately set threshold and remains above that threshold for a set period of time.

This function has a single trip time delay.

The over power factor protection function is available only in run state, when the LTMR controller is connected to an expansion module.

Trip and alarm monitoring can be separately enabled and disabled.

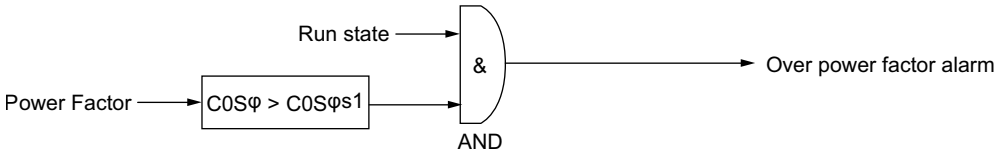
Functional Characteristics

The over power factor function includes the following features:

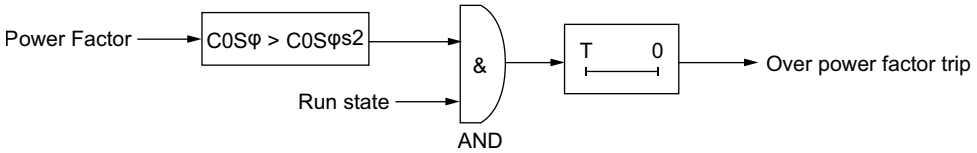
- Two thresholds:
  - Over Power Factor Alarm Threshold
  - Over Power Factor Trip Threshold
- One trip time delay:
  - Over Power Factor Trip Timeout
- Two function outputs:
  - Over Power Factor Alarm
  - Over Power Factor Trip
- One counting statistic:
  - Over Power Factor Trips Count

Block Diagram

Over power factor alarm:



Over power factor trip:



cosϕs1 Over power factor alarm threshold

cosϕs2 Over power factor trip threshold

T Over power factor trip timeout

Parameter Settings

The over power factor function has the following parameters:

Parameters	Setting Range	Factory Setting
Trip enable	Enable/Disable	Disable
Trip timeout	1...25 s in 0.1 s increments	10 s
Trip threshold	0...1 x Power factor in 0.01 increments	0.90
Alarm enable	Enable/Disable	Disable
Alarm threshold	0...1 x Power factor in 0.01 increments	0.90

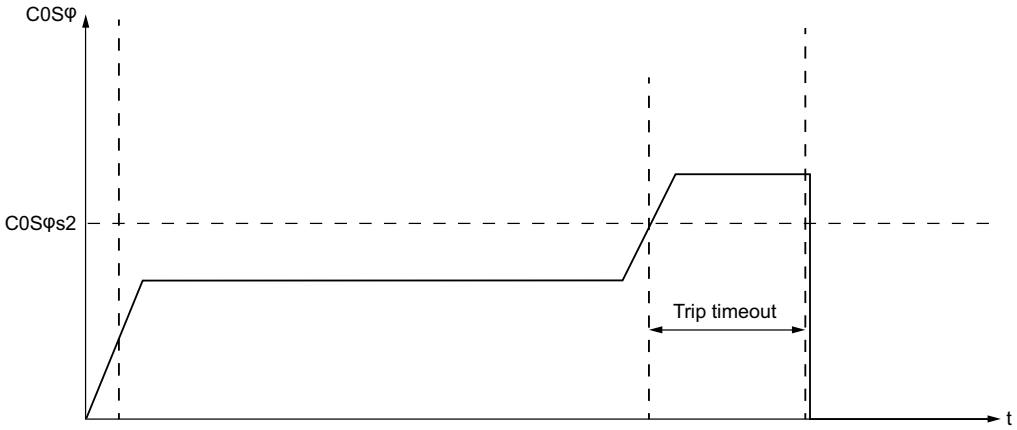
Technical Characteristics

The over power factor function has the following characteristics:

Characteristics	Value
Hysteresis	– 5% of Trip threshold or Alarm threshold
Accuracy	+/– 3° or +/– 10% (for cos ϕ ≥ 0.6)
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of an over power factor trip.



cosϕs2 Over power factor trip threshold

Motor Control Functions

Overview

The topics in this chapter describe the LTMR controller's operating states which determine the operating modes, and the trip reset mode (manual, remote, automatic).

This chapter also introduces custom operating mode, which you can use to customize a predefined control program.

Control Channels and Operating States

Overview

This section describes:

- How to configure control of the LTMR controller outputs, and
- The LTMR controller's operating states, including:
  - How the LTMR controller transitions between operating states during startup, and
  - The motor protection functions provided by the LTMR controller in each operating state

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter and apply this product. Follow all local and national safety codes and standards.

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

Control Channels

Overview

The LTMR can be configured for 1 control channel out of 3:

- Terminal strip: Input devices wired to the input terminals on the front face of the LTMR controller.
- HMI: An HMI device connected to the LTMR controller's HMI port.
- Network: A network PLC connected to the controller network port.

Control Channel Selection

You can easily select between two control channels, assigning one channel to be the local control source and the second channel to be the remote control source.

The possible channel assignments are:

Control Channel	Local	Remote
Terminal strip (factory setting)	Yes	Only with an LTMCU present
HMI	Yes	Only with an LTMCU present
Network	No	Yes

In local control, the control channel selection (Terminal strip or HMI) is determined by setting the Control local channel setting in the Control setting register.

In remote control, the control channel selection is always Network, unless an LTMCU is present. In this case, the control channel selection is determined by setting the Control remote channel setting in the Control setting register.

If an LTMCU is present, the logic input I.6 and the local/remote button on the LTMCU are used together to select between local and remote control source:

Logic Input I.6	LTMCU Local/Remote Status	Active Control Source
Inactive	-	Local
Active	Local	Local
	Remote (or not present)	Remote

NOTE:

- The Network control channel is always considered as 2-wire control, regardless of the operating mode selected.
- In 3-wire mode, Stop commands can be disabled in the Control setting register.
- In 2-wire mode, Stop commands given by the non-controlling channel shall always be ignored.
- Run commands from a channel other than the selected control channel shall be ignored.

For a predefined operating mode, only one control source may be enabled to direct the outputs. You can use the custom logic editor to add one or more additional control sources.

Terminal Strip

In Terminal Strip control, the LTMR controller commands its outputs according to the state of its inputs. This is the control channel factory setting when logic input I.6 is inactive.

The following conditions apply to Terminal Strip control channel:

- Any terminal inputs assigned to start and stop commands control the outputs according to the motor operating mode.
- HMI and network start commands are ignored.

When using LTMCU, the parameter Stop Terminal Strip Disable is set in the Control Setting register.

HMI

In HMI control, the LTMR controller commands its outputs in response to start and stop commands received from an HMI device connected to the HMI port.

The following conditions apply to HMI control channel:

- Any HMI start and stop commands control the outputs according to the motor operating mode.

- Network start commands and terminal strip start commands are ignored.

When using LTMCU, the parameter Stop HMI Disable is set in the Control Setting register.

Network

In Network control, a remote PLC sends commands to the LTMR controller through the network communication port.

The following conditions apply to Network control channel:

- Any network start and stop commands control the outputs according to the motor operating mode.
- The HMI unit can read (but not write) the LTMR controller parameters.

Control Transfer Mode

Select the Control Transfer Mode parameter to enable bumpless transfer when changing the control channel; clear this parameter to enable bump transfer. The configuration setting for this parameter determines the behavior of logic outputs O.1 and O.2, as follows:

Control Transfer Mode Setting	LTMR Controller Behavior When Changing Control Channel
Bump	Logic outputs O.1 and O.2 open (if closed) or remain open (if already open) until the next valid signal occurs. The motor stops. Note: In overload predefined operating mode, logic outputs O.1 and O.2 are user-defined and therefore may not be affected by a Bump transfer.
Bumpless	Logic outputs O.1 and O.2 are not affected and remain in their original position until the next valid signal occurs. The motor does not stop.

When you start the motor in Remote control mode with the PLC, the LTMR controller changes to Local control mode (I.6 = 1 to I.6 = 0) and the status of the motor changes depending on the control transfer mode, as follows:

If the LTMR Controller Configuration is...	Then the Control Mode Changes From Remote to Local and the Motor…
3-Wire Bumpless	keeps running
2-Wire Bumpless	keeps running if the logic inputs I.1 or I.2 are activated
3-Wire Bump	stops
2-Wire Bump	

When the LTMR controller changes from Local to Remote control mode (I.6 = 0 to I.6 = 1), the status of the motor in Local control mode, whether running or stopped, remains unchanged. The control transfer mode selected does not affect the status of the motor as the LTMR controller only takes account of the last control command (logic outputs O.1 or O.2) sent by the PLC.

⚠CAUTION

FAILURE TO STOP AND RISK OF UNINTENDED OPERATION

LTMR controller operation cannot be stopped from the terminals when the control channel is changed to Terminal Strip control channel if the LTMR controller is operating under all of the following conditions:

- Operating in Overload operating mode
- Configured in Bumpless
- Operated over a network using Network control channel
- Operating in Run state
- Configured for 3-wire (impulse) control

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

Whenever control channel is changed to Terminal Strip control channel, operation of the LTMR controller cannot be stopped from the terminals because no terminal input is assigned to a STOP command.

If this behavior is not intended, the control channel must be changed to either Network control channel or HMI control channel to command a STOP. To implement this change, take one of the following steps:

- The commissioner should configure the LTMR controller for either bump transfer of control channel or 2-wire control.
- The installer should provide the LTMR controller with a means of interrupting current to the contactor coil - for example, a push button station wired in series with the LTMR controller outputs.
- The controls engineer should assign a terminal input to disable the Run command using Custom Configuration Mode assignments.

Fallback Transitions

The LTMR controller enters a fallback state when communication with the control source is lost, and exits the fallback state when communication is restored. The transition into and out of the fallback state is as follows:

Transition	Control Source Transfer
Entering the fallback state	Bumpless, when the Control Direct Transition bit is on
Exiting the fallback state	Determined by the settings for Control Transfer Mode (bump or bumpless) and Control Direct Transition (on or off)

For information on how to configure communications fallback parameters, refer to Fallback Condition, page 57.

When using LTMCU, the parameters Control Transfer Mode and Control Direct Transition parameters are set in the Control Setting register.

Operating States

Introduction

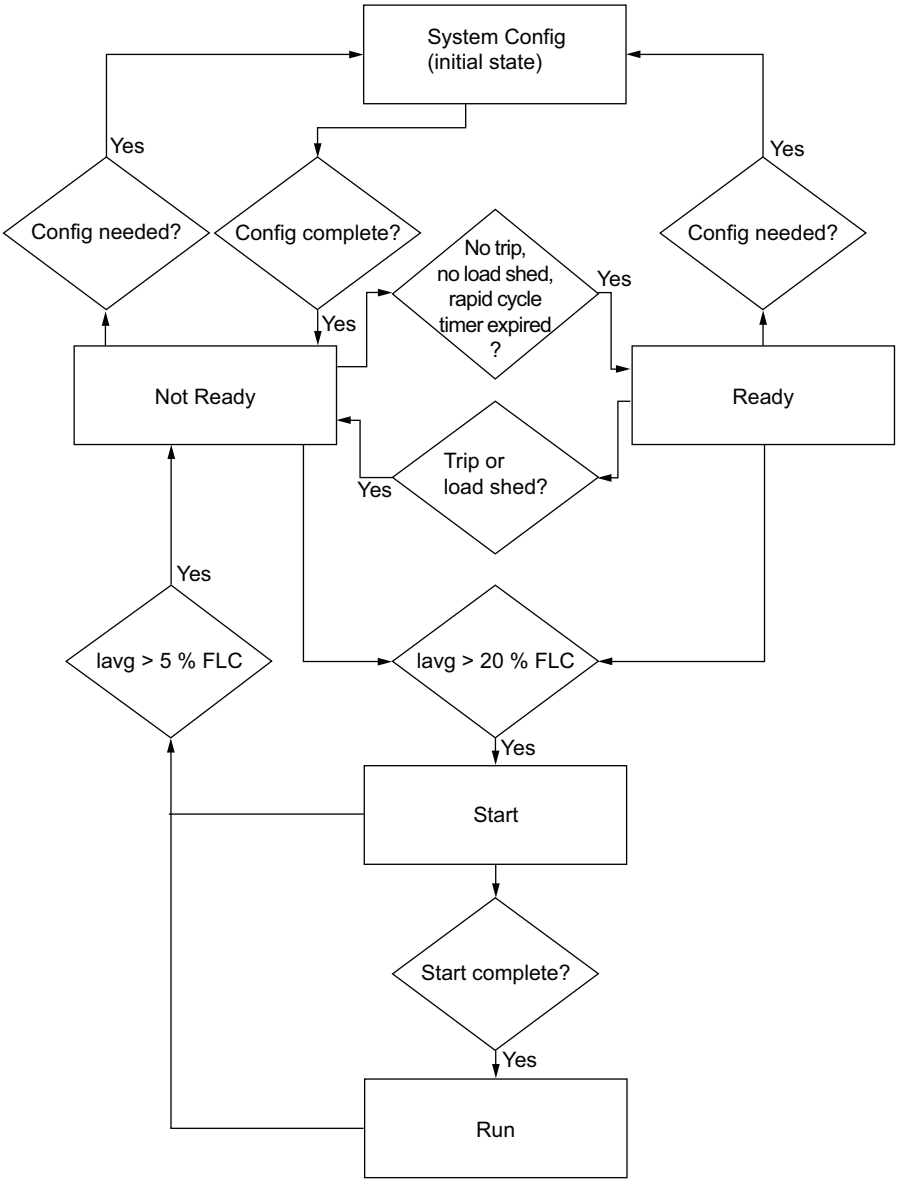
The LTMR controller responds to the state of the motor and provides control, monitoring and protection functions appropriate to each of the motor's operating states. A motor can have many operating states. Some operating states are persistent while others are transitional.

A motor's primary operating states are:

Operating State	Description
Ready	• The motor is stopped. • The LTMR controller: ◦ Detects no trip ◦ Is not performing load shedding ◦ Is not counting down the rapid cycle timer ◦ Is ready to start
Not Ready	• The motor is stopped. • The LTMR controller: ◦ Detects a trip ◦ Is performing load shedding ◦ Is counting down the rapid cycle timer
Start	• The motor starts. • The LTMR controller: ◦ Detects that current has reached the On Level Current threshold ◦ Detects that current has not both crossed and re-crossed the long start trip threshold ◦ Continues to count down the long start trip timer.
Run	• The motor is running. • The LTMR controller detects that current has both crossed and re-crossed the long start trip threshold before the LTMR controller fully counted down the long start trip timer.

Operating State Chart

The operating states of the LTMR controller firmware, as the motor progresses from Off to Run state, are described below. The LTMR controller verifies current in each operating state. The LTMR controller can transition to an internal trip condition from any operating state.



Protection Monitoring by Operating States

The motor operating states, and the trip and alarm protections provided by the LTMR controller while the motor is in each operating state (denoted with an X), are described below. It can transition to an internal trip condition from any operating state.

Protection Category	Monitored Trip/Alarm	Operating States				
		Sys Config	Ready	Not Ready	Start	Run
Diagnostic	Run Command Check	–	X	–	–	–
	Stop Command Check	–	–	X	X	X
	Run Check	–	–	–	X	X
	Stop Check	–	–	–	X	X
Wiring / configuration detected errors	PTC connection	–	X	X	X	X
	CT Reversal	–	–	–	X	–
	Voltage Phase Loss	–	X	X	–	–
	Phase Configuration	–	–	–	X	–
Internal trips	Minor	X	X	X	X	X
	Major	X	X	X	X	X
Motor temp sensor	PTC Binary	–	X	X	X	X
	PT100	–	X	X	X	X
	PTC Analog	–	X	X	X	X
	NTC Analog	–	X	X	X	X
Thermal overload	Definite	–	–	–	–	X
	Inverse Thermal	–	X	X	X	X
Current	Long Start	–	–	–	X	–
	Jam	–	–	–	–	X
	Current Phase Imbalance	–	–	–	X	X
	Current Phase Loss	–	–	–	X	X
	Overcurrent	–	–	–	–	X
	Undercurrent	–	–	–	–	X
	Ground Current Trip (Internal)	–	–	–	X	X
	Ground Current Trip (External)	–	–	–	X	X
Voltage	Overvoltage Level	–	X	X	–	X
	Undervoltage Level	–	X	X	–	X
	Voltage Phase Imbalance	–	–	–	X	X
Power/ Power Factor	Over Power Factor Level	–	–	–	–	X
	Under Power Factor Level	–	–	–	–	X
	Overpower Level	–	–	–	–	X
	Underpower Level	–	–	–	–	X

X Monitored

– Not monitored

Start Cycle

Description

The start cycle is the time period allowed for the motor to reach its normal FLC level. The LTMR controller measures the start cycle in seconds, beginning when it detects On Level Current, defined as maximum phase current equal to 20% of FLC.

During the start cycle, the LTMR controller compares:

- Detected current against the configurable Long Start Trip Threshold parameter, and
- Elapsed start cycle time against the configurable Long Start Trip Timeout parameter.

There are three start cycle scenarios, each based on the number of times (0,1, or 2) maximum phase current crosses the Long Start Trip Threshold. A description of each scenario is described below.

For information on the statistics the LTMR controller retains describing motor starts, refer to Motor Starts Counters, page 64. For information about the long start protection function, refer to Long Start, page 96.

Start Cycle Operating States

During the start cycle, the LTMR controller transitions through the motor's operating states as follows:

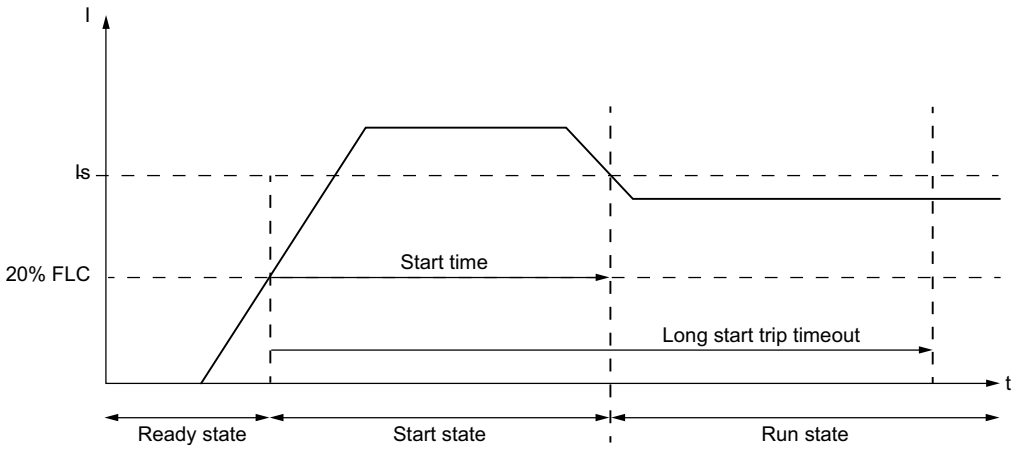
Step	Event	Operating State
1	LTMR controller receives a start command input signal.	Ready
2	The LTMR controller confirms that all startup preconditions exist (for example: no trips, load shedding, or rapid cycle timer).	Ready
3	The LTMR controller closes the appropriate output contacts designated as terminals 13-14 or 23-24, thereby closing the control circuit of the motor starting contactors.	Ready
4	The LTMR controller detects that maximum phase current exceeds the On Level Current threshold.	Start
5	The LTMR controller detects that current rises above and then falls below the Long Start Trip Threshold before the Long Start Trip Timeout timer expires.	Run

2 Threshold Crosses

In this start cycle scenario, the start cycle executes successfully:

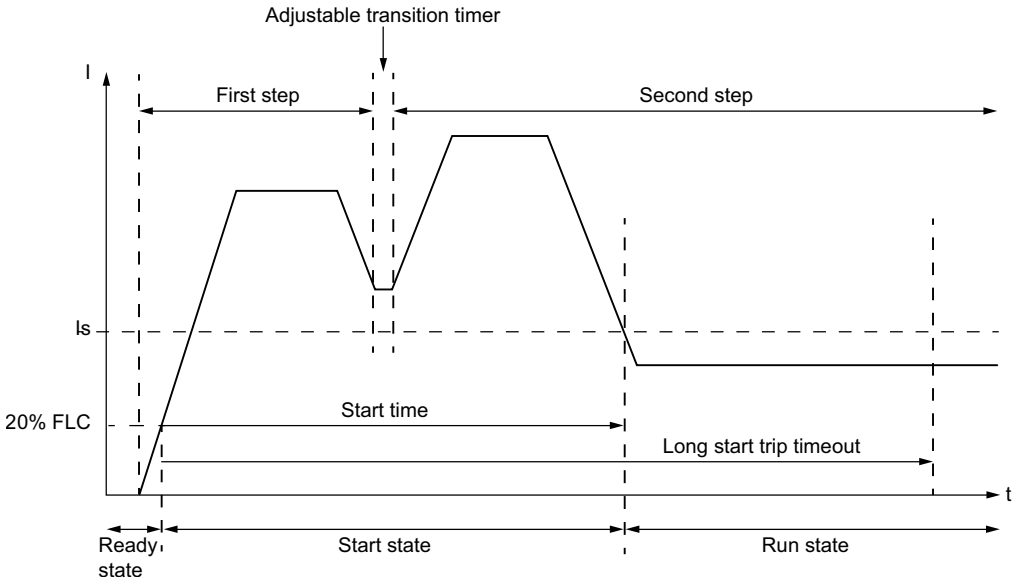
- Current rises above, then drops below, the trip threshold.
- The LTMR controller reports the actual start cycle time, that is, the time elapsed from detection of On Level Current until the maximum phase current drops below the trip threshold.

Start cycle with 2 threshold crosses, single step:



Is Long start trip threshold

Start cycle with 2 threshold crosses, two steps:

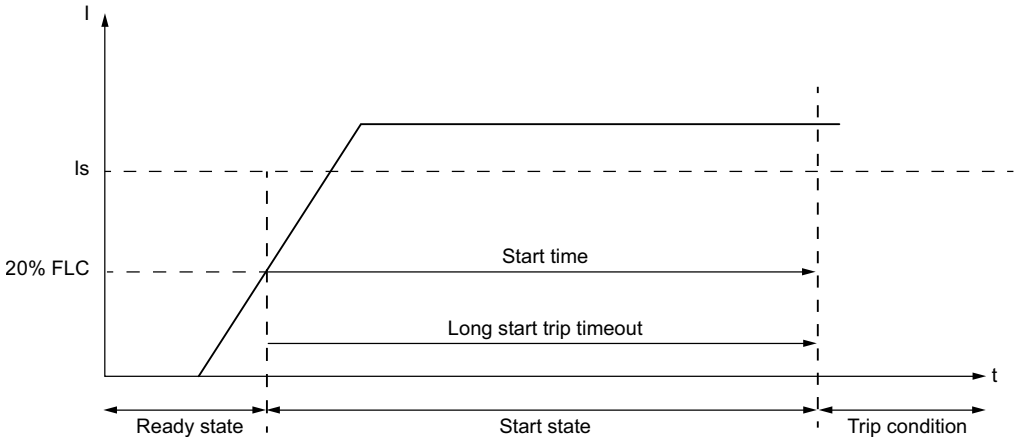


1 Threshold Cross

In this start cycle scenario, the start cycle does not execute:

- Current rises above, but does not drop below, the Long Start Trip Threshold.
- If Long Start protection is enabled, the LTMR controller signals a trip when the Long Start Trip Timeout is reached
- If Long Start protection is disabled, the LTMR controller does not signal a trip and the run cycle begins after the Long Start Trip Timeout has expired.
- Other motor protection functions begin their respective duration times after the Long Start Trip Timeout.
- The LTMR controller reports start cycle time as 9999, indicating that current exceeded and remained above the trip threshold.
- The LTMR controller reports the maximum current detected during the start cycle.

Start cycle with 1 threshold cross:



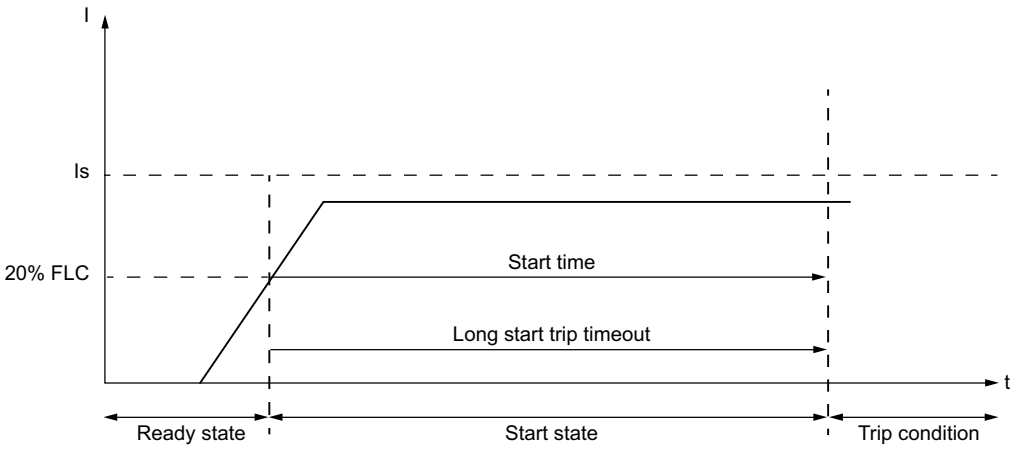
0 Threshold Cross

In this start cycle scenario, the start cycle does not execute:

- Current never rises above the trip threshold.

- If Long Start protection is enabled, the LTMR controller signals a trip when the Long Start Trip Timeout is reached
- If Long Start protection is disabled, the LTMR controller does not signal a trip and the run cycle begins after the Long Start Trip Timeout has expired.
- Other motor protection functions begin their respective duration times after the Long Start Trip Timeout.
- The LTMR controller reports both the start cycle time and the maximum current detected during start cycle as 0000, indicating current never reached the trip threshold.

Start cycle with 0 threshold cross:



Is Long start trip threshold

Operating Modes

Overview

The LTMR controller can be configured to 1 of 10 predefined operating modes. Selecting custom operating mode allows you to select one of the 10 predefined operating modes and customize it to your specific application.

The selection of a predefined operating mode determines the behavior of all LTMR controller inputs and outputs.

Each predefined operating mode selection includes a control wiring selection:

- 2-wire (maintained), or
- 3-wire (impulse)

Control Principles

Overview

The LTMR controller performs control and monitoring functions for single-phase and three-phase electric motors.

- These functions are predefined and fit the applications most frequently used. They are ready to use and are implemented by simple parameter setting after the LTMR controller has been commissioned.

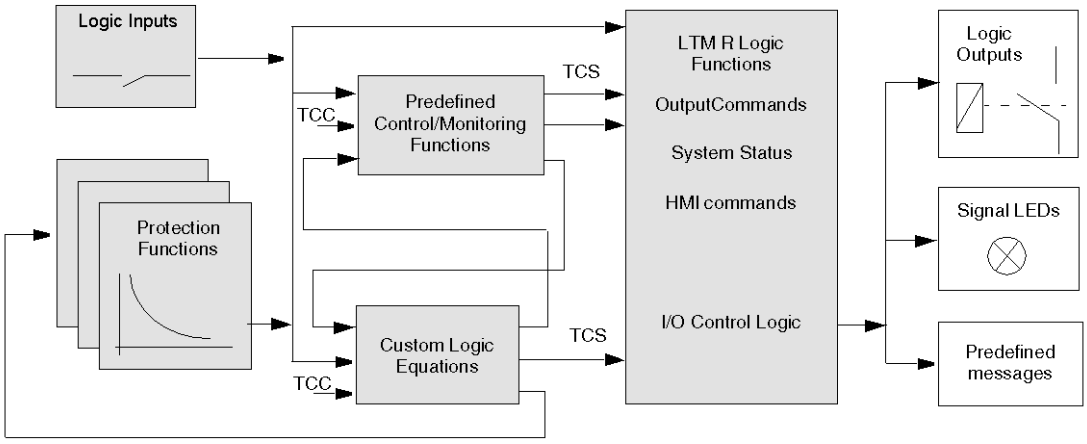
- The predefined control and monitoring functions can be adapted for particular needs using the custom logic editor in the TeSys T DTM to:
  - Customize the use of results of protection functions
  - Change the operation of control and monitoring functions
  - Alter the predefined LTMR controller I/O logic

Operating Principle

The processing of control and monitoring functions has three parts:

- Acquisition of input data:
  - The output of protection function processing
  - External logic data from logic inputs
  - Telecommunication commands (TCC) received from the control source
- Logic processing by the control or monitoring function
- Utilization of the processing results:
  - Activation of logic outputs
  - Display of predefined messages
  - Activation of LEDs
  - Telecommunication signals (TCS) sent via a communications link.

The control and monitoring function process is shown in the following diagram:



Logic Inputs and Outputs

The LTMR controller provides six logic inputs and four logic outputs. By adding an LTME expansion module, you can add four more logic inputs.

Selecting a predefined operating mode automatically assigns the logic inputs to functions and defines the relationship between logic inputs and outputs. Using the custom logic editor, you can change these assignments.

Predefined Operating Modes

Overview

The LTMR controller can be configured in one out of 10 predefined operating modes. Each operating mode is designed to meet the requirements of a common application configuration.

When you select an operating mode, you specify both the:

- Operating mode type, which determines the relationship between logic inputs and logic outputs, and
- Control circuit type, which determines logic input behavior, based on the control wiring design

Operating Mode Types

There are 10 types of operating modes:

Operating Mode Type	Best used for:
Overload, page 150	All motor starter applications in which the user defines assignment of: • Logic inputs I.1, I.2, I.3, and I.4 • Logic outputs O.1 and O.2 • Aux1, Aux2, and Stop commands from the HMI keypad. The I/O can be defined using a control program managed by the primary network controller in remote control, by an HMI tool, or by using custom logic.
Independent, page 152	Direct-on-line (across-the-line) full-voltage non-reversing motor starting applications
Reverser, page 155	Direct-on-line (across-the-line) full-voltage reversing motor starting applications
Two-Step, page 158	Reduced voltage starting motor applications, including: • Wye-Delta • Open Transition Primary Resistor • Open Transition Autotransformer
Two-Speed, page 163	Two-speed motor applications for motor types, including: • Dahlander (consequent pole) • Pole Changer

Logic Input Behavior

When you select an operating mode, you also specify that logic inputs are wired for either 2-wire (maintained) or 3-wire (impulse) control. Your selection determines the valid start and stop commands from the various control sources, and sets the behavior of the input command following the return of power after an outage:

Control Circuit Type	Behavior of Logic Inputs I.1 and I.2
2-wire (maintained)	The LTMR controller after detecting the rising edge on the input assigned to start the motor, issues a run command. The run command remains active only while the input is active. The signal is not latched.
3-wire (impulse)	The LTMR controller: • After detecting the rising edge on the input assigned to start the motor, latch the run command, and • After a stop command, disables the run command to disable the output relay wired in series with the coil of the contactor that turns the motor on or off • Following a stop, must detect a rising edge on the input to latch the run command.

Control logic assignments for logic inputs I.1, I.2, I.3, and I.4 are described in each of the predefined motor operating modes.

NOTE: In Network control channel, network commands behave as 2-wire control commands, regardless of the control circuit type of the selected operating mode. For information on Control Channels, refer to Control Channels, page 136.

In each predefined operating mode, logic inputs I.3, I.4, I.5, and I.6 behave as follows:

Logic Input	Behavior
I.3	• When it is configured to be used as the external system ready input (Logic Input 3 External Ready Enable = 1), this input provides a feedback on the system state (Ready or not): ◦ If I.3 = 0, the external system is not ready. System Ready bit (455.0) is set to 0. ◦ If I.3 = 1, the external system is ready. System Ready bit (455.0) can be set to 1 depending on other conditions on the system. • When it is not configured to be used as the external system ready input (Logic Input 3 External Ready Enable = 0), this input is user-defined and only sets a bit in a register. **NOTE:** The status of the System Ready bit (455.0) does not prevent the system from energizing outputs.
I.4	• In 3-wire (impulse) control: a Stop command. Note that this stop command can be disabled in terminal strip control by setting the parameter Stop terminal strip disable in the Control setting register. • In 2-wire (maintained) control: a user-defined input that can be configured to send information to a PLC address over the network. Note: In Overload operating mode, logic input I.4 is not used and can be user-defined.
I.5	A Trip Reset command is recognized when this input receives the rising edge of a signal. **Note:** this input must first become inactive, and then receive the rising edge of a subsequent signal, for another reset to occur.
I.6	Local/Remote control of the LTMR controller's outputs: • Active: Remote control (can be associated to any Control channel). • Inactive: Local control through either the terminal strip or the HMI port, as determined by the Control Local Channel Setting parameter.

⚠WARNING

LOSS OF MOTOR PROTECTION IN HMI CONTROL

If the terminal strip Stop is disabled, the trip output (terminal NC 95-96) must be wired in series with the contactor coil.

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

Logic Output Behavior

The behavior of logic outputs O.1 and O.2 is determined by the selected operating mode. See the topics that follow for a description of the 10 predefined operating mode types and the behavior of logic outputs O.1 and O.2.

When the LTMR controller has lost communication with either the network or the HMI, the LTMR controller enters a fallback condition. When it receives a stop command in a fallback condition, logic outputs O.1 and O.2 behave as follows:

Control Circuit Type	Response of Logic Outputs O.1 and O.2 to a Stop Command
2-wire (maintained)	A stop command overrides the fallback condition and turns off logic outputs O.1 and O.2 while the stop command is active. After the stop command is no longer active, logic outputs O.1 and O.2 return to their programmed fallback state.
3-wire (impulse)	A stop command overrides the fallback condition and turns off logic outputs O.1 and O.2. The outputs remain off after the stop command is removed and do not return to their programmed fallback state.

For more information about configuring fallback parameters, refer to Fallback Condition, page 57.

In all operating mode types, the following logic outputs behave as described in the following table:

Logic Output	Behavior
O.3	Activated by any enabled protection alarm: • Terminals NO 33-34
O.4	Activated by any enabled protection trip: • Terminals NC 95-96 • Terminals NO 97-98 **Note:** When control voltage is too low or off: • NC 95-96 open • NO 97-98 close

Control Wiring and Trip Management

Overview

When Overload predefined operating mode is selected, the LTMR controller does not manage logic output O.1, O.2, and O.3.

For all other predefined operating modes (Independent, Reverser, 2-Step, and 2-Speed) the predefined control logic in the LTMR controller is designed to meet the objectives of many common motor starting applications. This includes managing motor behavior in response to:

- Start and stop actions, and
- Trip and reset actions

Because the LTMR controller can be used in special applications, such as fire pumps that require the motor to run despite a known external trip condition, the predefined control logic is designed so that the control circuit, and not the predefined control logic, determines how the LTMR controller interrupts current flow to the contactor coil.

Control Logic Action on Starts and Stops

Predefined control logic acts upon start and stop commands as follows:

- For all 3-wire (impulse) control wiring diagrams, when input 4 is configured as a stop command, the LTMR controller must detect input current at logic input I.4 in order to act on a start command.
- If logic input I.4 is active and a user start action initiates current at logic inputs I.1 or I.2, the LTMR controller detects the rising edge of the current and sets an internal (firmware) latch command that directs the appropriate relay output to close and remain closed until the latch command is disabled.
- A stop action that interrupts current at logic input I.4, causes the LTMR controller to disable the latch command. Disabling the firmware latch causes the output to open-and remain open-until the next valid start condition.
- For all 2-wire (maintained) control wiring diagrams, the LTMR controller detects the presence of current at logic inputs I.1 or I.2 as start commands, and the absence of current disables the start command.

Control Logic Action on Trips and Resets

Predefined control logic manages trips and reset commands as follows:

- Logic output O.4 opens in response to a trip condition.
- Logic output O.4 closes in response to a reset command.

Control Logic and Control Wiring Together Managing Trips

The control circuits, shown in the wiring diagrams in this chapter and in the Appendix, indicate how the LTMR controller's control logic and the control circuit combine to stop a motor in response to a trip:

- For 3-wire (impulse) control circuits, the control strategy links the state of logic output O.4 to the state of the current at logic input I.4:
  - Control logic opens logic output O.4 in response to a trip.
  - Logic output O.4 opening interrupts current at logic input I.4, disabling the control logic latch command on logic output O.1.
  - Logic output O.1 opens, due to control logic described above, and stops the flow of current to the contactor coil.

  In order to restart the motor, the trip must be reset and a new start command must be issued.
- For 2-wire (maintained) control circuits, the control strategy links the state of logic output O.4 directly with the logic inputs I.1 or I.2.
  - Control logic opens logic output O.4 in response to a trip.
  - Logic output O.4 opening interrupts current to the logic inputs I.1 or I.2
  - Control logic disables the start commands opening logic outputs O.1 or O.2.

  In order to restart the motor, the trip must be reset and the state of Start/Stop operators determines the state of logic inputs I.1 or I.2.

The control circuits needed to run a motor, during a motor protection trip, are not shown in the wiring diagrams that follow. However, the control strategy is to not link the state of logic output O.4 to the state of the input commands. In this way, trip conditions may be annunciated while control logic continues to manage Start and Stop commands.

Overload Operating Mode

Description

Use Overload operating mode when motor load monitoring is required and motor load control (start/stop) is performed by a mechanism other than the LTMR controller.

Functional Characteristics

The Overload operating mode includes the following features:

- The LTMR controller overload operating mode does not manage logic outputs O.1, O.2, and O.3. The logic output O.1 and O.2 commands are accessible in Network control channel.
- Logic output O.4 opens in response to a detected diagnostic error.

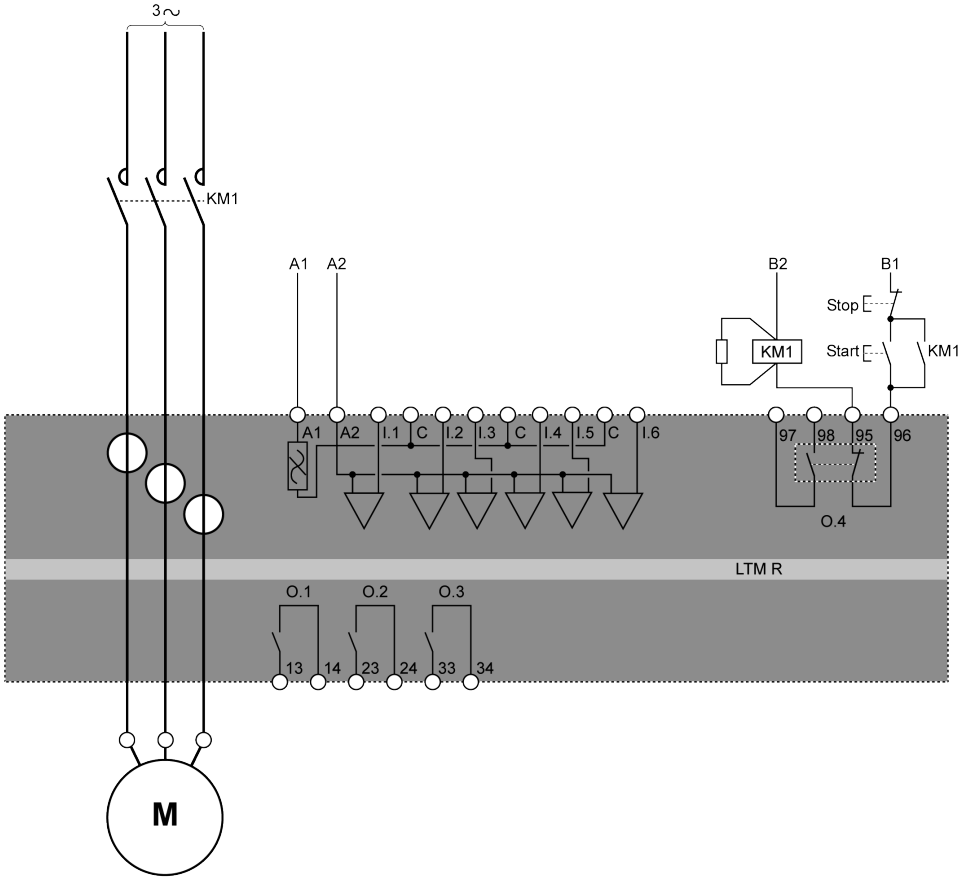
  NOTE: In Overload operating mode, detected diagnostic error is disabled by default. You can enable it, if needed.

- The LTMR controller sets a bit in a status word when it detects an active signal:
  - On logic inputs I.1, I.2, I.3, or I.4, or
  - From the Aux 1, Aux 2, or Stop buttons on the HMI keypad.

NOTE: When a bit is set in the input status word, it can be read by a PLC which can write a bit to the LTMR controller's command word. When the LTMR controller detects a bit in its command word, it can turn on the respective output (or outputs).

Overload Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a 3-wire (impulse) terminal strip control overload application.



For additional examples of overload operating mode IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of overload operating mode NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

I/O Assignment

Overload operating mode provides the following logic inputs:

Logic Inputs	Assignment
I.1	Free
I.2	Free
I.3	Free
I.4	Free

Logic Inputs	Assignment
I.5	Reset
I.6	Local (0) or Remote (1)

Overload operating mode provides the following logic outputs:

Logic Outputs	Assignment
O.1 (13 and 14)	Responds to network control commands
O.2 (23 and 24)	Responds to network control commands
O.3 (33 and 34)	Alarm signal
O.4 (95, 96, 97, and 98)	Trip signal

Overload operating mode uses the following HMI keys:

HMI Keys	Assignment
Aux 1	Free
Aux 2	Free
Stop	Free

Parameters

Overload operating mode requires no associated parameter settings.

Independent Operating Mode

Description

Use Independent operating mode in single direct-on-line (across-the-line) full-voltage, non-reversing motor starting applications.

Functional Characteristics

This function includes the following features:

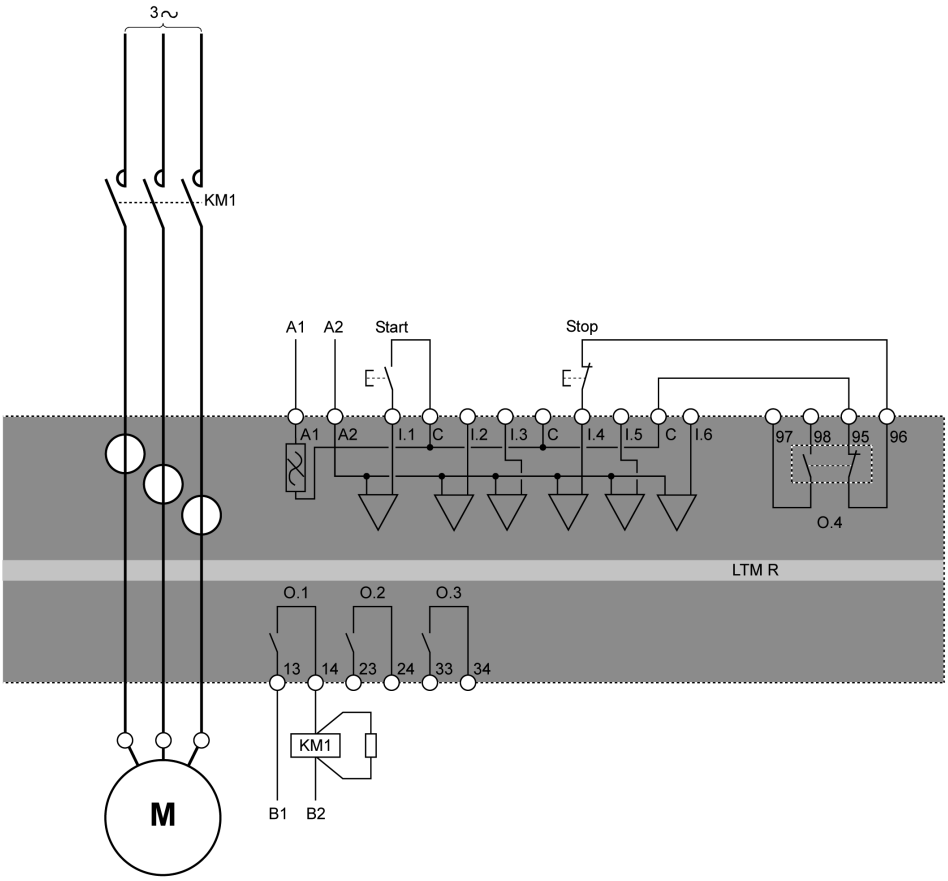
- Accessible in three control channels: Terminal Strip, HMI, and Network.
- The LTMR controller does not manage the relationship between logic outputs O.1 and O.2.
- In terminal strip control channel, logic input I.1 controls logic output O.1, and logic input I.2 controls logic output O.2.
- In network or HMI control channels, the Motor Run Forward Command parameter controls logic output O.1 and the Motor Run Reverse Command parameter controls logic output O.2.
- Logic input I.3 is not used in the control circuit, but can be configured to set a bit in memory.
- Logic outputs O.1 and O.2 deactivate (and the motor stops) when control voltage becomes too low.
- Logic outputs O.1 and O.4 deactivate (and the motor stops) in response to a detected diagnostic error.

NOTE: Refer to Control Wiring and Trip Management, page 149 for information about the interaction between

- The LTMR controller's predefined control logic, and
- The control wiring, an example of which appears in the following diagram.

Independent Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a 3-wire (impulse) terminal strip control independent application.



For additional examples of independent operating mode IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of independent operating mode NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

I/O Assignment

Independent operating mode provides the following logic inputs:

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.1	Start/Stop motor	Start motor
I.2	Open/Close O.2	Close O.2
I.3	Free	Free
I.4	Free	Stop motor and open O.1 and O.2

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.5	Reset	Reset
I.6	Local (0) or Remote (1)	Local (0) or Remote (1)

Independent operating mode provides the following logic outputs:

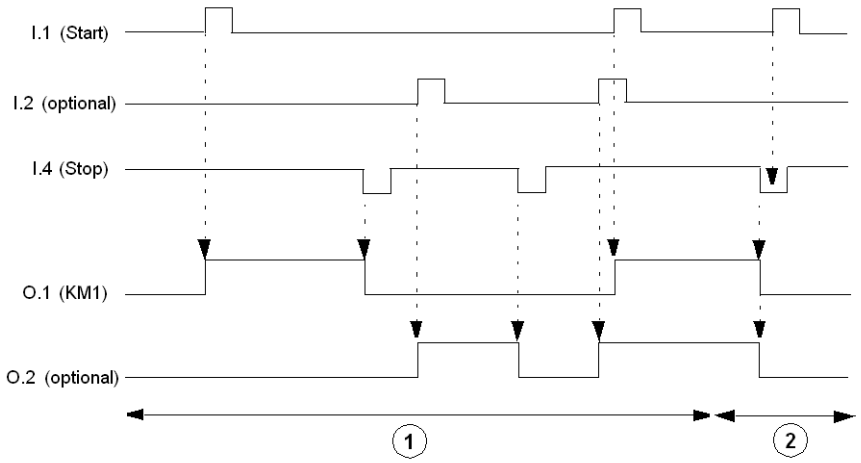
Logic Outputs	Assignment
O.1 (13 and 14)	KM1 contactor control
O.2 (23 and 24)	Controlled by I.2
O.3 (33 and 34)	Alarm signal
O.4 (95, 96, 97, and 98)	Trip signal

Independent operating mode uses the following HMI keys:

HMI Keys	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
Aux 1	Control motor	Start motor
Aux 2	Control O.2	Close O.2
Stop	Stop motor and open O.2 while pressed	Stop motor and open O.2

Timing Sequence

The following diagram is an example of the timing sequence for the Independent operating mode that shows the inputs and outputs for a 3-wire (impulse) configuration:



1 Normal operation

2 Start command ignored: stop command active

Parameters

Independent operating mode requires no associated parameters.

Reverser Operating Mode

Description

Use Reverser operating mode in direct-on-line (across-the-line) full-voltage, reversing motor starting applications.

Functional Characteristics

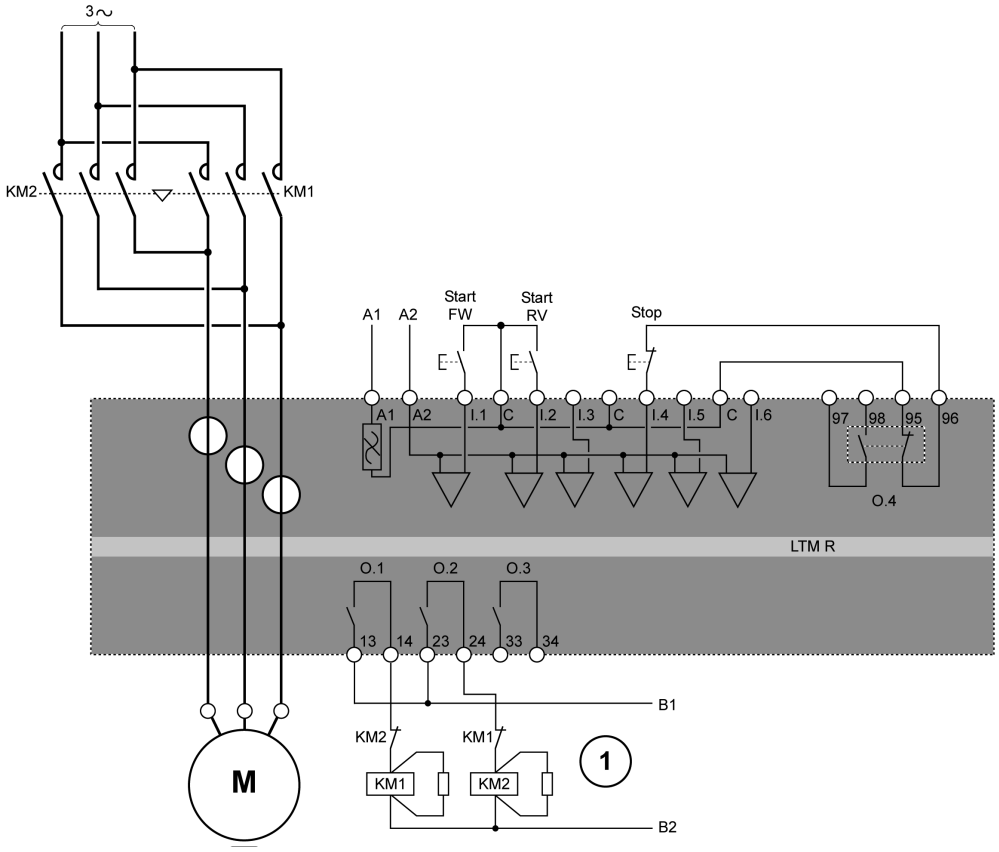
This function includes the following features:

- Accessible in three control channels: Terminal Strip, HMI, and Network.
- Firmware interlocking prevents simultaneous activation of the O.1 (forward) and O.2 (reverse) logic outputs: in case of simultaneous forward and reverse commands, only the logic output O.1 (forward) is activated.
- The LTMR controller can change direction from forward to reverse and reverse to forward in one of two modes:
  - Standard Transition mode: The Control Direct Transition bit is Off. This mode requires a Stop command followed by count-down of the adjustable Motor Transition Timeout (anti-backspin) timer.
  - Direct Transition mode: The Control Direct Transition bit is On. This mode automatically transitions after the count-down of the adjustable Motor Transition Timeout (anti-backspin) timer.
- In terminal strip control channel, logic input I.1 controls logic output O.1, and logic input I.2 controls logic output O.2.
- In Network or HMI control channels, the Motor Run Forward Command parameter controls logic output O.1 and the Motor Run Reverse Command controls logic output O.2.
- Logic input I.3 is not used in the control circuit, but can be configured to set a bit in memory.
- Logic outputs O.1 and O.2 deactivate (and the motor stops) when control voltage becomes too low.
- Logic outputs O.1, O.2, and O.4 deactivate (and the motor stops) in response to a detected diagnostic error.

  NOTE: Refer to Control Wiring and Trip Management, page 149 for information about the interaction between
  - The LTMR controller's predefined control logic, and
  - The control wiring, an example of which appears in the following diagram.

Reverser Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a 3-wire (impulse) terminal strip control reverser application.



Start FW Start forward

Start RV Start reverse

1 The N.C. interlock contacts KM1 and KM2 are not mandatory because the LTMR controller firmware interlocks O.1 and O.2.

For additional examples of reverser operating mode IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of reverser operating mode NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

I/O Assignment

Reverser operating mode provides the following logic inputs:

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.1	Forward run	Start motor forward
I.2	Reverse run	Start motor reverse
I.3	Free	Free
I.4	Free	Stop motor
I.5	Reset	Reset
I.6	Local (0) or Remote (1)	Local (0) or Remote (1)

Reverser operating mode provides the following logic outputs:

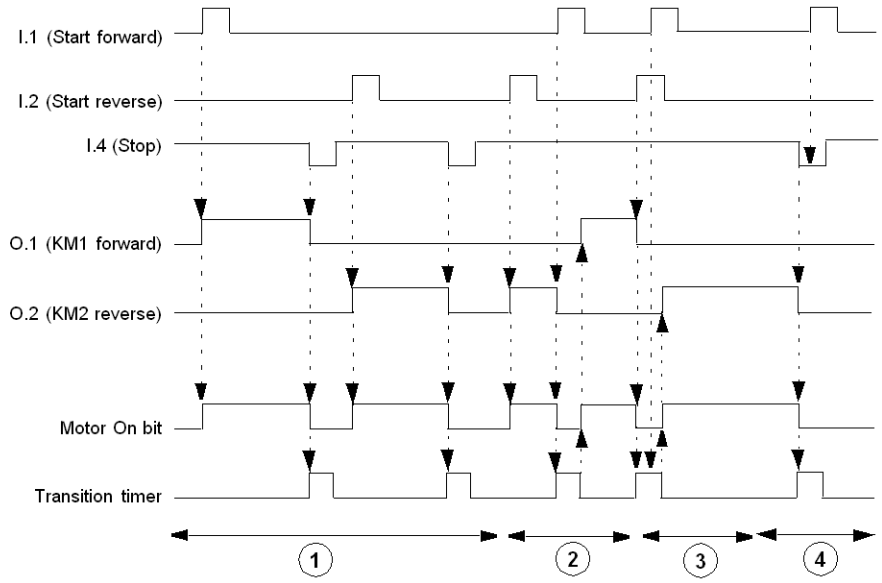
Logic Outputs	Assignment
O.1 (13 and 14)	KM1 contactor control Forward
O.2 (23 and 24)	KM2 contactor control Reverse
O.3 (33 and 34)	Alarm signal
O.4 (95, 96, 97, and 98)	Trip signal

Reverser operating mode uses the following HMI keys:

HMI Keys	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
Aux 1	Forward run	Start motor forward
Aux 2	Reverse run	Start motor reverse
Stop	Stop while pressed	Stop

Timing Sequence

The following diagram is an example of the timing sequence for the Reverser operating mode that shows the inputs and outputs for a 3-wire (impulse) configuration when the control direct transition bit is On:



1 Normal operation with stop command

2 Normal operation without stop command

3 Forward run command ignored: transition timer active

4 Forward run command ignored: stop command active

Parameters

Reverser operating mode has the following parameters:

Parameters	Setting Range	Factory Setting
Motor transition timeout	0…999.9 s	0.1 s
Control direct transition	On/Off	Off

Two-Step Operating Mode

Description

Use Two-Step operating mode in reduced voltage starting motor applications such as:

- Wye-Delta
- Open Transition Primary Resistor
- Open Transition Autotransformer

Functional Characteristics

This function includes the following features:

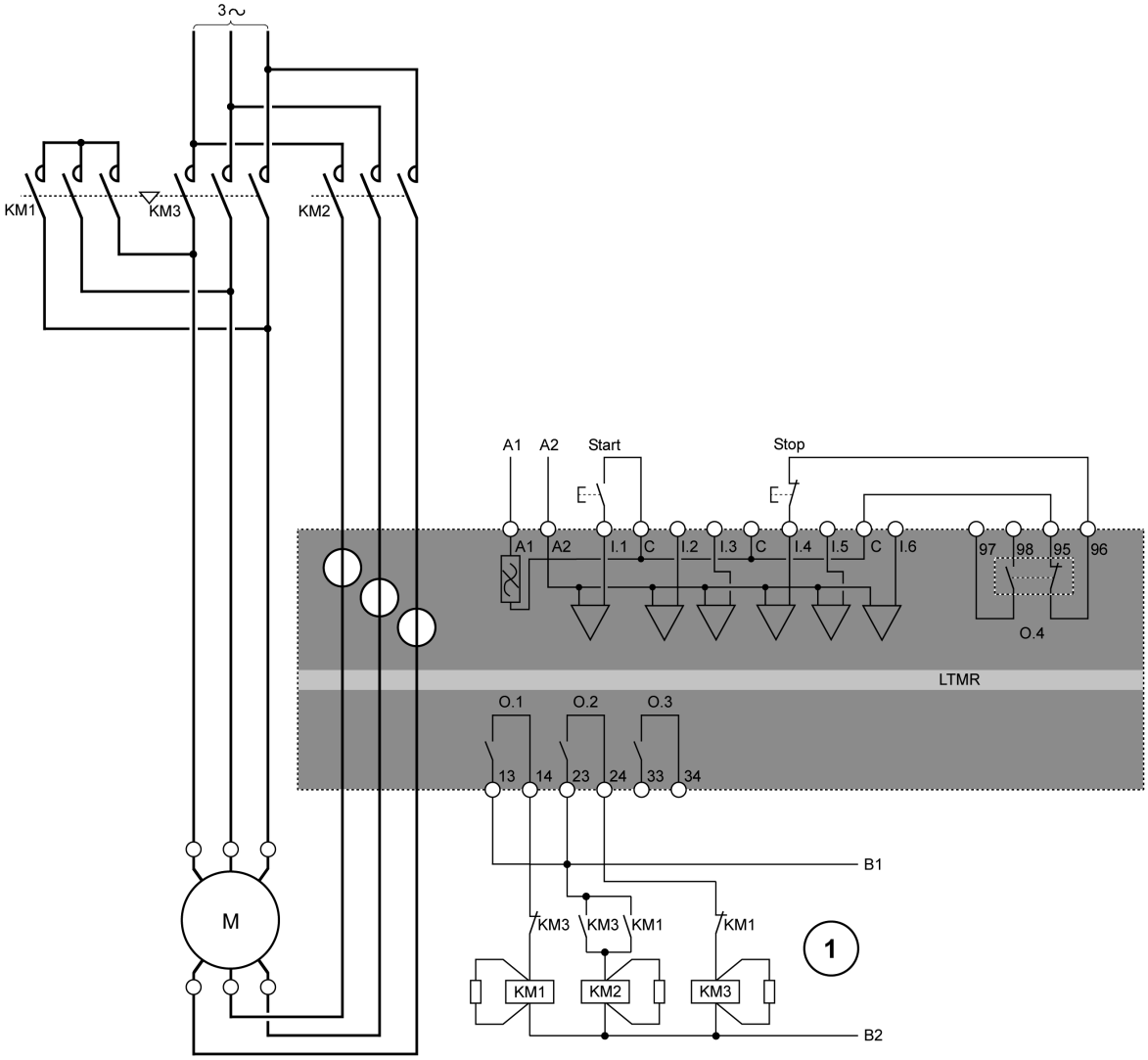
- Accessible in three control channels: Terminal Strip, HMI, and Network.
- Two-Step operation settings include:
  - A Motor Step 1 To 2 Timeout that starts when current reaches 10% of FLC min.
  - A Motor Step 1 To 2 Threshold setting.
  - A Motor Transition Timeout setting that starts upon the earlier of the following events: expiration of the Motor Step 1 To 2 Timeout, or current falling below the Motor Step 1 To 2 Threshold.
- Firmware interlocking prevents simultaneous activation of O.1 (step 1) and O.2 (step 2) logic outputs.
- In terminal strip control channel, logic input I.1 controls logic outputs O.1 and O.2.
- In Network or HMI control channels, the Motor Run Forward Command parameter controls logic outputs O.1 and O.2. The Motor Run Reverse Command parameter is ignored.
- Logic outputs O.1 and O.2 deactivate, and the motor stops when control voltage becomes too low.
- Logic outputs O.1, O.2 and O.4 deactivate, and the motor stops, in response to a detected diagnostic error.

  NOTE: Refer to Control Wiring and Trip Management, page 149 for information about the interaction between:

  - The LTMR controller's predefined control logic, and
  - The control wiring, an example of which appears in the following diagrams.

Two-Step Wye-Delta Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a two-step 3-wire (impulse) terminal strip control wye-delta application.



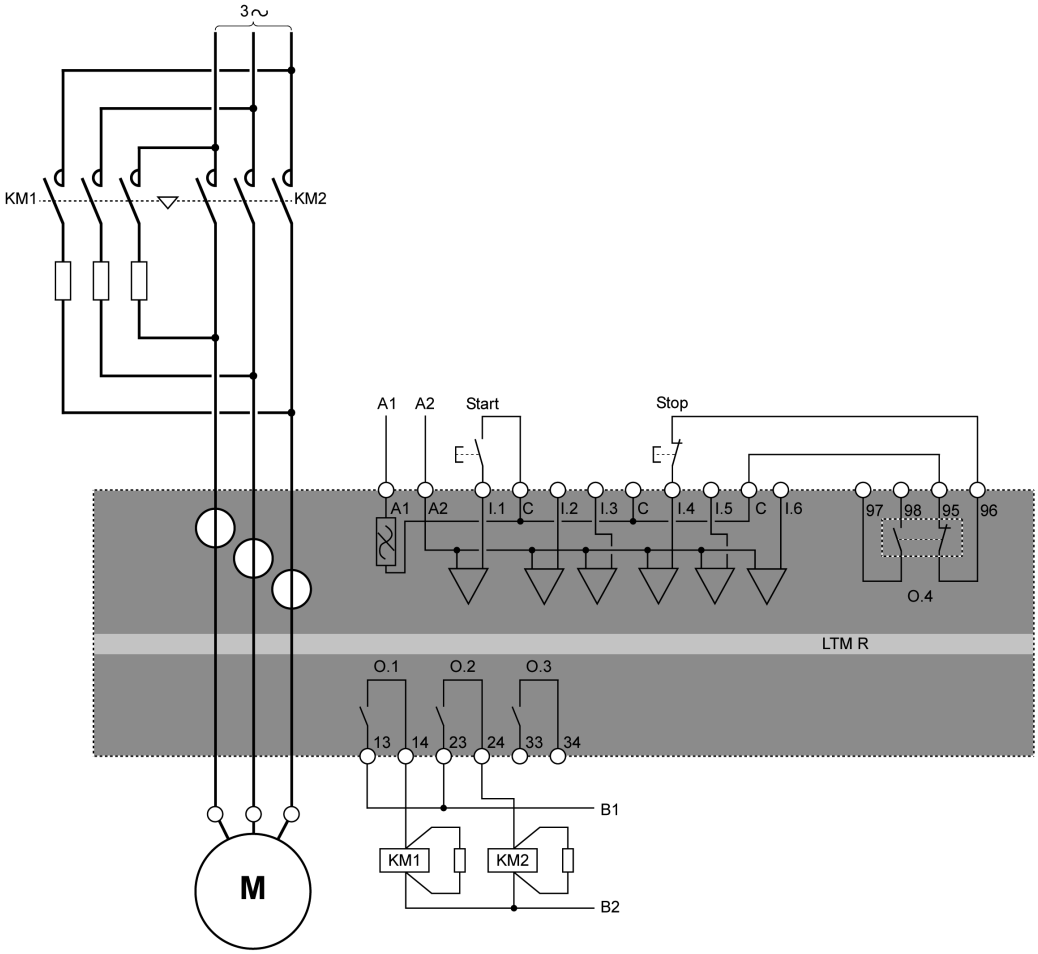
1 The N.C. interlock contacts KM1 and KM3 are not mandatory because the LTMR controller electronically interlocks O.1 and O.2.

For additional examples of two-step Wye-Delta IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of two-step Wye-Delta NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

Two-Step Primary Resistor Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a two-step 3-wire (impulse) terminal strip control primary resistance application.

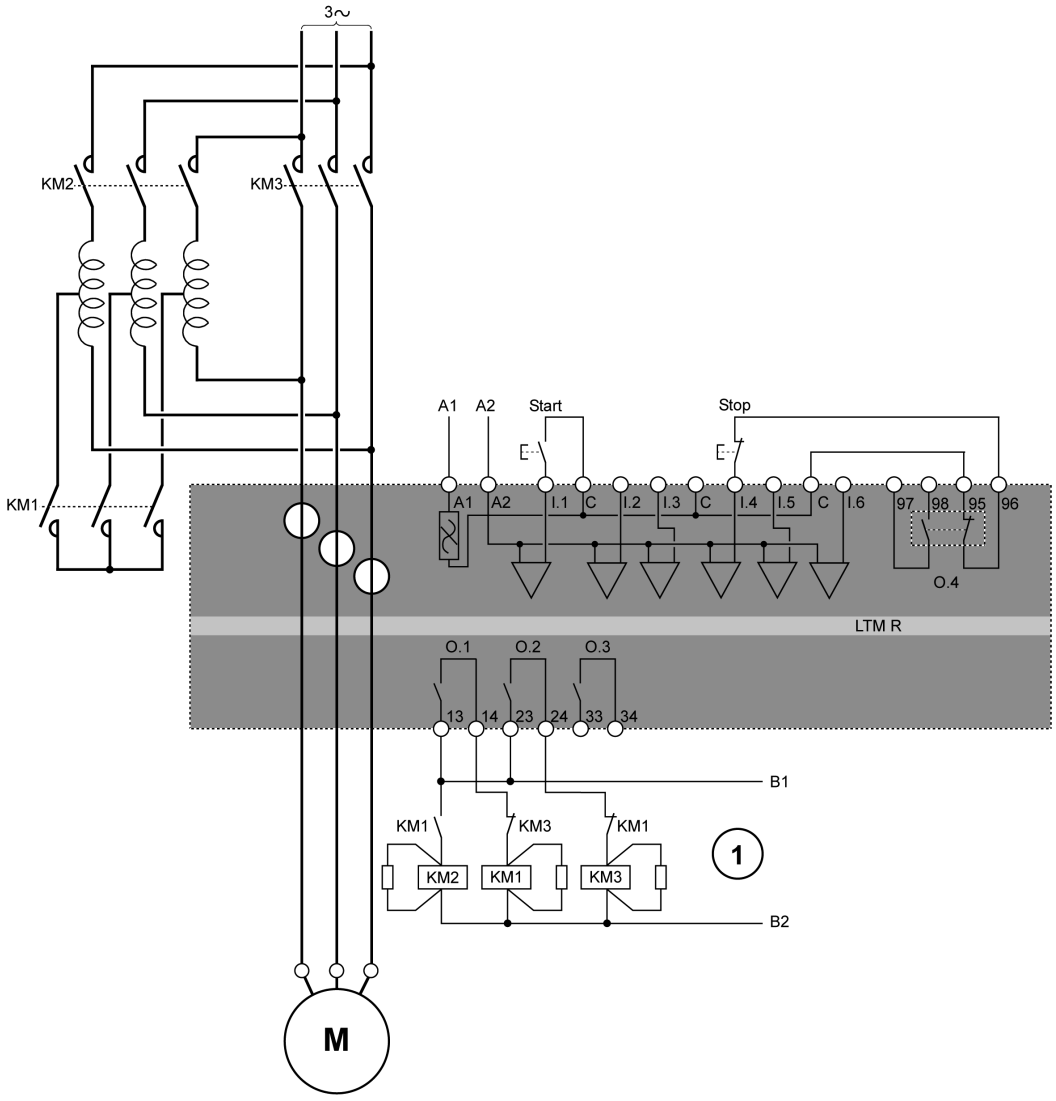


For additional examples of two-step primary resistor IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of two-step primary resistor NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

Two-Step Autotransformer Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a two-step 3-wire (impulse) terminal strip control autotransformer application.



1 The N.C. interlock contacts KM1 and KM3 are not mandatory because the LTMR controller electronically interlocks O.1 and O.2.

For additional examples of two-step autotransformer IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of two-step autotransformer NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

I/O assignment

Two-step operating mode provides the following logic inputs:

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.1	Control motor	Start motor
I.2	Free	Free
I.3	Free	Free
I.4	Free	Stop motor

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.5	Reset	Reset
I.6	Local (0) or Remote (1)	Local (0) or Remote (1)

Two-step operating mode provides the following logic outputs:

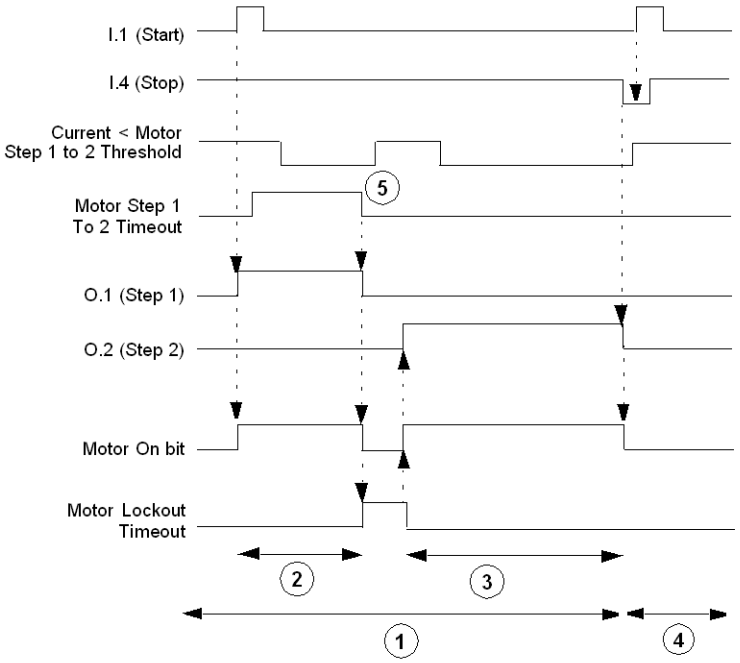
Logic Outputs	Assignment
O.1 (13 and 14)	Step 1 contactor control
O.2 (23 and 24)	Step 2 contactor control
O.3 (33 and 34)	Alarm signal
O.4 (95, 96, 97, and 98)	Trip signal

Two-step operating mode uses the following HMI keys:

HMI Keys	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
Aux 1	Control motor	Start motor
Aux 2	Free	Free
Stop	Stop motor while pressed	Stop motor

Timing Sequence

The following diagram is an example of the timing sequence for the Two-Step operating mode that shows the inputs and outputs for a 3-wire (impulse) configuration:



1 Normal operation

2 Step 1 start

3 Step 2 start

4 Start command ignored: Stop command active

5 Current falling below the Motor Step 1 To 2 Threshold ignored: preceded by expiration of the Motor Step 1 To 2 Timeout.

Parameters

Two-step operating mode has the following parameters:

Parameter	Setting Range	Factory Setting
Motor step 1 to 2 timeout	0.1…999.9 s	5 s
Motor transition timeout	0…999.9 s	100 ms
Motor step 1 to 2 threshold	20-800% FLC in 1% increments	150% FLC

Two-Speed Operating Mode

Description

Use Two-Speed operating mode in two-speed motor applications for motor types such as:

- Dahlander (consequent pole)

- Pole Changer

Functional Characteristics

This function includes the following features:

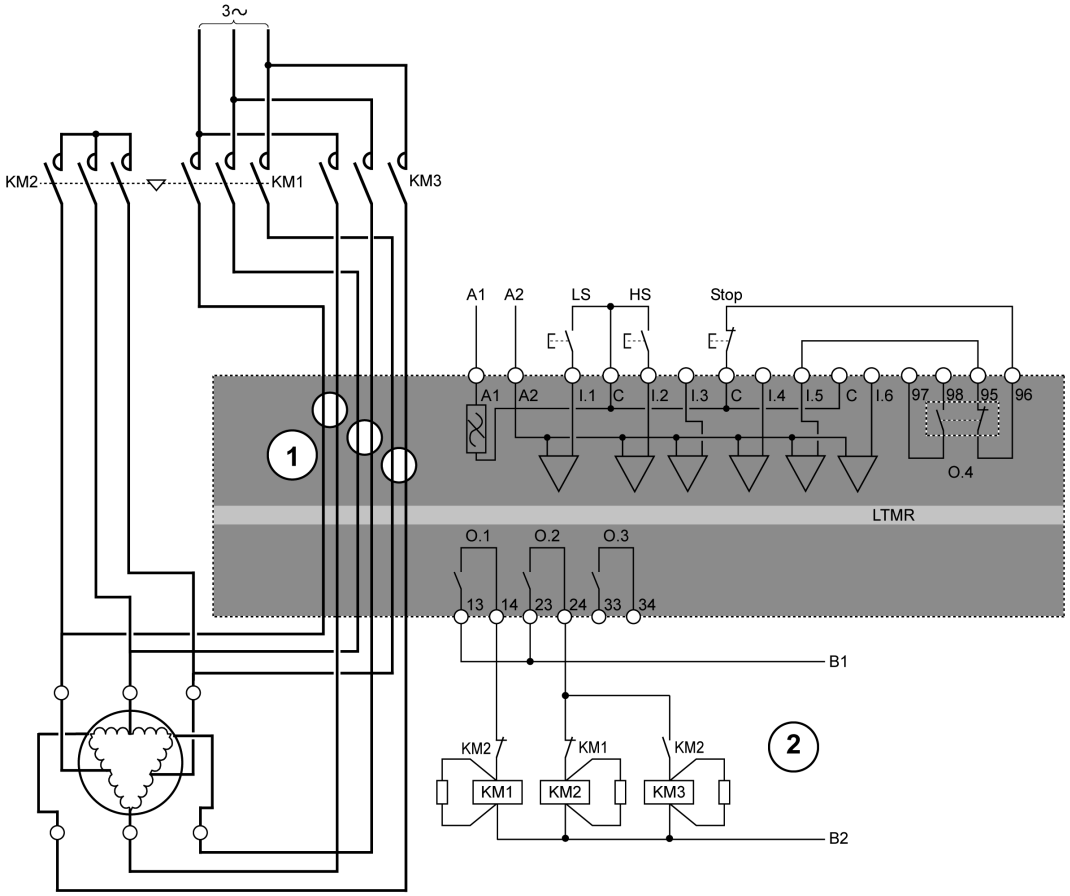
- Accessible in three control channels: Terminal Strip, HMI, and Network.
- Firmware interlocking prevents simultaneous activation of O.1 (low speed) and O.2 (high speed) logic outputs.
- Two measures of FLC:
  - FLC1 (Motor Full Load Current Ratio) at low speed
  - FLC2 (Motor High-Speed Full Load Current Ratio) at high speed
- The LTMR controller can change speed in two scenarios:
  - The Control Direct Transition bit is Off: requires a Stop command followed by expiration of the Motor Transition Timeout.
  - The Control Direct Transition bit is On: automatically transitions from high speed to low speed after a time-out of the adjustable Motor Transition Timeout.
- In terminal strip control channel, logic input I.1 controls logic output O.1, and logic input I.2 controls logic output O.2.
- In Network or HMI control channels, when the Motor Run Forward Command parameter is set to 1 and:
  - Motor Low Speed Command is set to 1, logic output O.1 is enabled.
  - Motor Low Speed Command is set to 0, logic output O.2 is enabled.
- Logic input I.3 is not used in the control circuit, but can be configured to set a bit in memory.
- Logic outputs O.1 and O.2 deactivate (and the motor stops) when control voltage becomes too low.
- Logic outputs O.1, O.2, and O.4 deactivate (and the motor stops) in response to a detected diagnostic error.

  NOTE: Refer to Control Wiring and Trip Management, page 149 for information about the interaction between:

  - The LTMR controller's predefined control logic, and
  - The control wiring, an example of which appears in the following diagrams

Two-Speed Dahlander Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a two-speed 3-wire (impulse) terminal strip control Dahlander consequent pole application.



LS Low speed

HS High speed

1 A Dahlander application requires two sets of wires passing through the CT windows. The LTMR controller can also be placed upstream of the contactors. If this is the case, and if the Dahlander motor is used in variable torque mode, all the wires downstream of the contactors must be the same size.

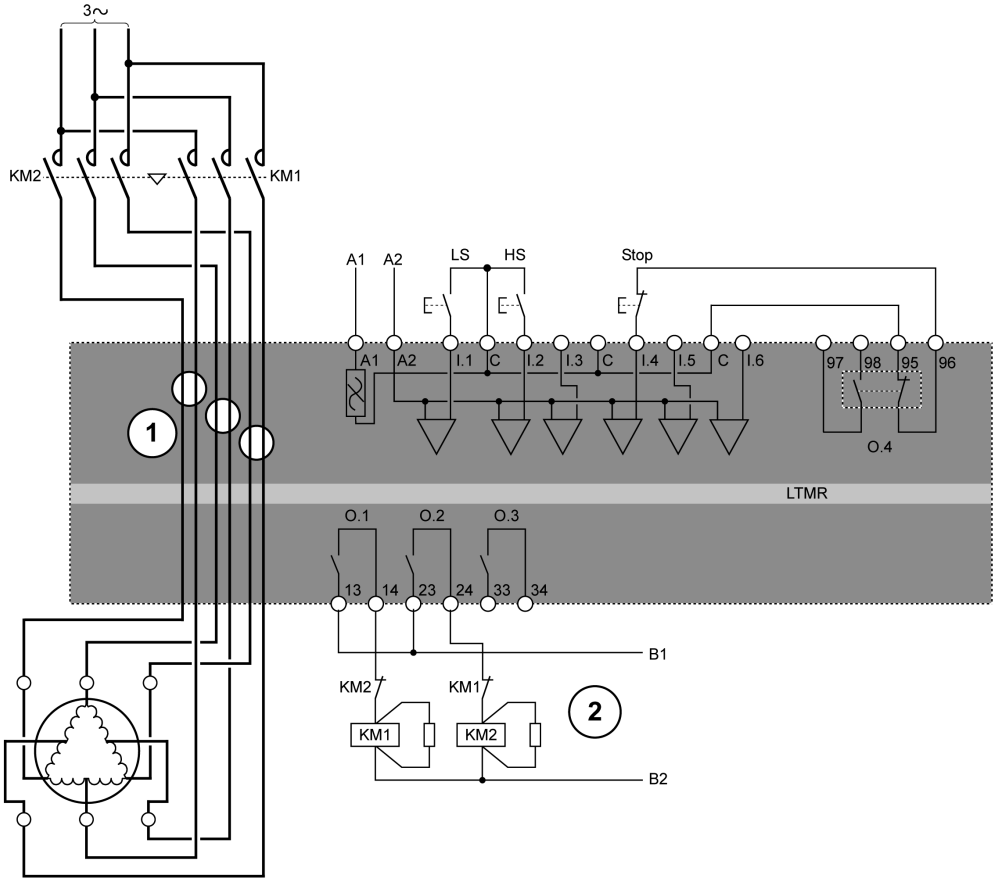
2 The N.C. interlock contacts KM1 and KM2 are not mandatory because the LTMR controller firmware interlocks O.1 and O.2.

For additional examples of two-speed Dahlander IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of two-speed Dahlander NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

Two-Speed Pole-Changing Application Diagram

The following wiring diagram represents a simplified example of the LTMR controller in a two-speed 3-wire (impulse) terminal strip control pole-changing application.



LS Low speed

HS High speed

1 A pole-changing application requires two sets of wires passing through the CT windows. The LTMR controller can also be placed upstream of the contactors. If this is the case, all the wires downstream of the contactors must be the same size.

2 The N.C. interlock contacts KM1 and KM2 are not mandatory because the LTMR controller firmware interlocks O.1 and O.2.

For additional examples of pole-changing IEC diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

For examples of pole-changing NEMA diagrams, refer to relevant diagrams in the *TeSys T LTMR Motor Management Controller Installation Guide*.

I/O Assignment

Two-Speed operating mode provides the following logic inputs:

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.1	Low speed command	Low speed start
I.2	High-speed command	High-speed start
I.3	Free	Free

Logic Inputs	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
I.4	Free	Stop
I.5	Reset	Reset
I.6	Local (0) or Remote (1)	Local (0) or Remote (1)

Two-Speed operating mode provides the following logic outputs:

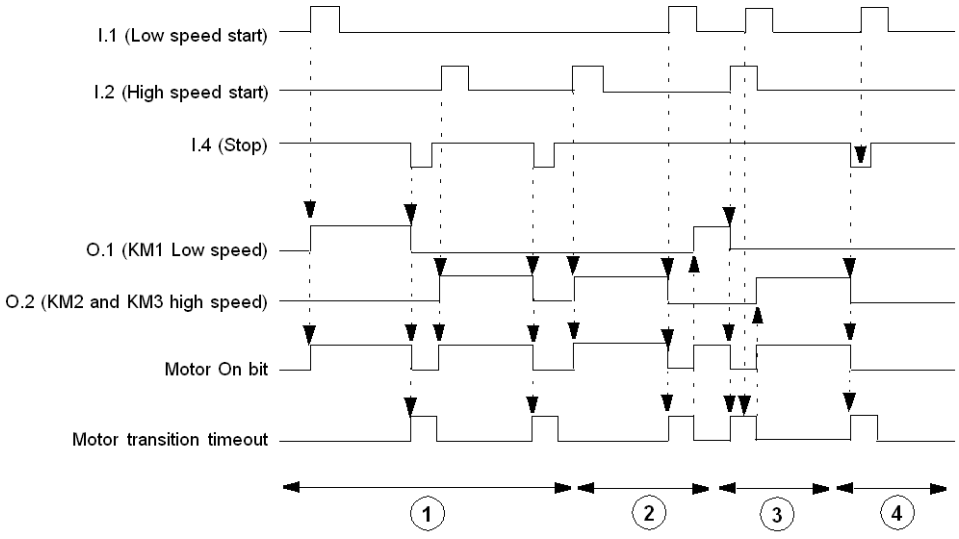
Logic Outputs	Assignment
O.1 (13 and 14)	Low speed control
O.2 (23 and 24)	High-speed control
O.3 (33 and 34)	Alarm signal
O.4 (95, 96, 97, and 98)	Trip signal

Two-speed operating mode uses the following HMI keys:

HMI Keys	2-Wire (Maintained) Assignment	3-Wire (Impulse) Assignment
Aux 1	Low speed control	Low speed start
Aux 2	High-speed control	High-speed start
Stop	Stop the motor	Stop the motor

Timing Sequence

The following diagram is an example of the timing sequence for the two-speed operating mode that shows the inputs and outputs for a 3-wire (impulse) configuration when the Control Direct Transition bit is On:



1 Normal operation with stop command

2 Normal operation without stop command

3 Low-speed start command ignored: motor transition timeout active

4 Low-speed start command ignored: stop command active

Parameters

The following table lists the parameters associated with the Two-Speed operating mode.

Parameters	Setting Range	Factory Setting
Motor transition timeout (high speed to low speed)	0…999.9 s	100 ms
Control direct transition	On/Off	Off

NOTE: The low speed to high-speed timer is fixed at 100 ms.

Custom Operating Mode

Overview

The predefined control and monitoring functions can be adapted for particular needs using the custom logic editor in the TeSys T DTM to:

- Customize the use of results of protection functions
- Change the operation of control and monitoring functions
- Alter the predefined LTMR controller I/O logic.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

The application of custom logic requires expertise in the designing and programming of control systems. Only persons with such expertise must be allowed to program, install, alter, and apply this product. Follow all local and national safety codes and standards.

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

Possible Functions with Custom Logic

With custom logic, it is possible to customize the motor operating mode to:

- Control the motor through two channels at the same time
- Enable/disable protection functions or change the protection level
- Customize external trips: circuit breaker trip, wrong drawer position
- Create a commissioning or testing mode and activate all outputs without motor current
- Switch to local or remote based on a bit activated by network
- Limit the number of starts per hour
- Use TeSys T for motors over 1000 A, and return correct calculation of power

Configuration Files

The configuration of the LTMR controller consists of two files:

- A configuration file that contains parameter configuration settings

- A logic file that contains a series of logic commands that manage LTMR controller behavior, including:
  - Motor start and stop commands
  - Motor transitions between steps, speeds, and directions
  - The valid control source and transitions between control sources
  - Trip and alarm logic for relay outputs 1 and 2, and the HMI
  - Terminal strip reset functions
  - PLC and HMI communication loss and fallback
  - Load shed
  - Rapid cycle
  - Starting and stopping LTMR controller diagnostics.

When a predefined operating mode is selected, the LTMR controller applies a predefined logic file that permanently resides in the LTMR controller.

When custom operating mode is selected, the LTMR controller uses a customized logic file created in the custom logic editor and downloaded to the LTMR controller from the TeSys T DTM.

Trip Management and Clear Commands

Overview

This section describes how the LTMR controller manages the trip handling process, and explains:

- How to select a trip reset mode, and
- Controller behavior for each trip reset mode selection.

Trip Management - Introduction

Overview

When the LTMR controller detects a trip condition and activates the appropriate response, the trip becomes latched. Once a trip becomes latched, it remains latched, even if the underlying trip condition is eliminated, until cleared by a reset command.

The setting of the Trip Reset Mode parameter determines how the LTMR controller manages trips. The trip reset mode selections, listed below, are described in the topics that follow:

- Manual, page 172 (Factory setting)
- Automatic, page 173
- Remote, page 177

The trip reset mode cannot be changed while a trip remains active. All trips must be reset before the trip reset mode can be changed.

Trip Reset Methods

A Reset command can be issued using any of the following means:

- Cycling power

- Reset button on the LTMR controller
- Reset button on the HMI keypad
- Reset command from the HMI engineering tool
- Logic input I.5
- A network command
- Automatic reset

⚠WARNING

RISK OF UNINTENDED OPERATION

When the LTMR controller is operating in 2-wire control with an active Run command, a Reset command will immediately restart the motor.

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

Trip Specific Reset Behaviors

The LTMR controller's response to trips depends on the nature of the trip that has occurred and how the related protection function is configured. For example:

- Thermal trips can be reset after the Trip Reset Timeout counts down and the utilized thermal capacity falls below the Trip Reset Threshold level.
- If the trip includes a reset timeout setting, the timeout must fully count down before a reset command executes.
- Internal device trips can be reset only by cycling power.
- LTMR controller memory does not retain diagnostic and wiring trips after a power loss, but does retain all other trips after a power loss.
- Internal, diagnostic, and wiring trips cannot be automatically reset.
- All wiring and diagnostic trips can be manually reset by local reset methods.
- For diagnostic trips, network reset commands are valid only in remote (network) control channel.
- For wiring trips, network reset commands are not valid in any control channel.

Trip Characteristics

The LTMR controller trip monitoring functions save the status of communications monitoring and motor protection trips on a power loss so that these trips must be acknowledged and reset as part of an overall motor maintenance strategy.

Protection Category	Monitored Trip	LTMR Controller	LTMR with LTME	Saved On Power Loss
Diagnostic	Run Command Check	X	X	–
	Stop Command Check	X	X	–
	Run Check	X	X	–
	Stop Check	X	X	–
Wiring / configuration detected errors	PTC connection	X	X	–
	CT Reversal	X	X	–
	Voltage Phase Reversal	–	X	–
	Current Phase Reversal	X	X	–
	Voltage Phase Loss	–	X	–
	Phase Configuration	X	X	–
Internal trips	Stack Overflow	X	X	–
	Watchdog	X	X	–
	ROM Checksum	X	X	–
	EEROM	X	X	–
	CPU	X	X	–
	Internal Temperature	X	X	–
Motor temp sensor	PTC Binary	X	X	X
	PT100	X	X	X
	PTC Analog	X	X	X
	NTC Analog	X	X	X
Thermal overload	Definite	X	X	X
	Inverse Thermal	X	X	X
Current	Long Start	X	X	X
	Jam	X	X	X
	Current Phase Imbalance	X	X	X
	Current Phase Loss	X	X	X
	Overcurrent	X	X	X
	Undercurrent	X	X	X
	Internal Ground Current	X	X	X
	External Ground Current	X	X	X
Voltage	Overvoltage	–	X	X
	Undervoltage	–	X	X
	Voltage Phase Imbalance	–	X	X
Power	Underpower	–	X	X
	Overpower	–	X	X
	Under Power Factor	–	X	X
	Over Power Factor	–	X	X
Communication loss	PLC to LTMR	X	X	X
	HMI to LTMR	X	X	X

X Monitored

– Not monitored

Manual Reset

Introduction

When the Trip Reset Mode parameter is set to **Manual**, the LTMR controller allows resets-usually performed by a person-via a power cycle of the control power or by using a local reset means, including:

- Terminal Strip (logic input I.5)
- Reset button on the LTMR controller
- Reset commands from the HMI

A manual reset provides on-site personnel the opportunity to inspect the equipment and wiring before performing the reset.

NOTE: A manual reset blocks all reset commands from the LTMR controller's network port-even when the Control Channel is set to **Network**.

Manual Reset Methods

The LTMR controller provides the following manual reset methods:

Protection Category	Monitored Trip	Control Channel		
		Terminal Strip	HMI	Network[5]
Diagnostic	Run Command Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Stop Command Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Run Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Stop Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
Wiring/configuration detected errors	PTC connection	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	CT Reversal	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Voltage Phase Reversal	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Current Phase Reversal	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Voltage Phase Loss	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Phase Configuration	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
Internal trips	Stack Overflow	PC	PC	PC
	Watchdog	PC	PC	PC
	ROM Checksum	PC	PC	PC
	EEROM	PC	PC	PC
	CPU	PC	PC	PC
	Internal Temperature	PC	PC	PC
Motor temp sensor	PTC Binary	RB, I.5	RB, I.5	RB, I.5
	PT100	RB, I.5	RB, I.5	RB, I.5
	PTC Analog	RB, I.5	RB, I.5	RB, I.5
	NTC Analog	RB, I.5	RB, I.5	RB, I.5
Thermal overload	Definite	RB, I.5	RB, I.5	RB, I.5
	Inverse Thermal	RB, I.5	RB, I.5	RB, I.5

5. Remote network reset commands are not allowed even when the LTMR controller is configured for network control channel.

Protection Category	Monitored Trip	Control Channel		
		Terminal Strip	HMI	Network[6]
Current	Long Start	RB, I.5	RB, I.5	RB, I.5
	Jam	RB, I.5	RB, I.5	RB, I.5
	Current Phase Imbalance	RB, I.5	RB, I.5	RB, I.5
	Current Phase Loss	RB, I.5	RB, I.5	RB, I.5
	Undercurrent	RB, I.5	RB, I.5	RB, I.5
	Overcurrent	RB, I.5	RB, I.5	RB, I.5
	External Ground Current	RB, I.5	RB, I.5	RB, I.5
	Internal Ground Current	RB, I.5	RB, I.5	RB, I.5
Voltage	Undervoltage	RB, I.5	RB, I.5	RB, I.5
	Overvoltage	RB, I.5	RB, I.5	RB, I.5
	Voltage Phase Imbalance	RB, I.5	RB, I.5	RB, I.5
Power	Underpower	RB, I.5	RB, I.5	RB, I.5
	Overpower	RB, I.5	RB, I.5	RB, I.5
	Under Power Factor	RB, I.5	RB, I.5	RB, I.5
	Over Power Factor	RB, I.5	RB, I.5	RB, I.5
Communication loss	PLC to LTMR	RB, I.5	RB, I.5	RB, I.5
	LTME to LTMR	RB, I.5	RB, I.5	RB, I.5

RB Test/Reset button on the LTMR controller front face or an HMI

PC Power cycle on the LTMR controller

I.5 Set I.5 logic input on the LTMR controller

Automatic Reset

Introduction

Setting the Trip Reset Mode parameter to **Automatic** lets you:

- Configure the LTMR controller to attempt to reset motor protection and communications trips without the intervention of either a human operator or the remote PLC, for example:
  - For a non-networked LTMR controller installed at a location that is physically remote, or locally hard to access
- Configure trip handling for each protection trip group in a manner that is appropriate to the trips in that group:
  - Set a different timeout delay
  - Permit a different number of reset attempts
  - Disable automatic trip resetting

The Trip Reset Mode parameter selection determines the available reset methods.

Each protection trip is included in one of three auto-reset trip groups, based on the characteristics of that trip, as described below. Each trip group has two configurable parameters:

- A timeout: the Auto-Reset Group (number 1, 2, or 3) Timeout parameter, and

6. Remote network reset commands are not allowed even when the LTMR controller is configured for network control channel.

- A maximum number of permissible trip resets: the Auto-Reset Attempts Group (number 1, 2, or 3) Setting parameter

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

An auto-reset command may restart the motor if the LTMR controller is used in a 2-wire control circuit.

Equipment operation must conform to local and national safety regulations and codes.

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

Reset Behavior

After power is cycled, the LTMR controller clears and sets to 0 the values of the following parameters:

- Auto-Reset Group (number 1, 2, or 3) Timeout and
- Auto Reset Group (number 1, 2, or 3) Setting.

On a successful reset, the Number of Resets counts is cleared and set to 0. A reset is successful if, after reset, the motor runs for 1 minute without a trip of a type in the designated group.

If the maximum number of automatic resets has been reached and if the last reset was unsuccessful, the reset mode turns to Manual. When the motor restarts, the automatic mode parameters are set to 0.

Emergency Restart

Use the Clear Thermal Capacity Level Command, in applications where it is necessary, to clear the Thermal Capacity Level parameter following a Thermal Overload inverse thermal trip. This command permits an emergency restart before the motor has actually cooled.

⚠WARNING

LOSS OF MOTOR PROTECTION

Clearing the thermal capacity level inhibits thermal protection and can cause equipment overheating and fire. Continued operation with inhibited thermal protection must be limited to applications where immediate restart is vital.

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

Number of Resets

Each protection group can be set to manual, 1, 2, 3, 4, or 5.

Select "0" to disable automatic reset of protection trip groups-and require a manual reset-even though the Trip Reset Mode parameter is configured for automatic reset.

Select "5" to enable unlimited auto-reset attempts. After the time delay has expired the LTMR controller continually attempts to reset every trip in that reset group.

Auto-Reset Group 1 (AU-G1)

Group 1 trips require a predefined cooling time after the monitored parameter returns to and falls below a predefined threshold. Group 1 trips include Thermal Overload and Motor Temp Sensor trips. The cooling time delay is non-configurable. However, you can:

- Add to the cooling time delay by setting the Auto-Reset Group 1 Timeout parameter to a value greater than 0, or
- Disable auto-reset by setting the Auto-Reset Group 1 Timeout parameter to 0

Auto-reset group 1 has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Auto-Reset Attempts Group 1 Setting	0 = manual, 1, 2, 3, 4, 5 = unlimited number of reset attempts	5
Auto-Reset Group 1 Timeout	0...9999 s	480 s

Auto-Reset Group 2 (AU-G2)

Group 2 trips generally do not include a predefined cooling time delay before a reset can be executed, but can be reset as soon as the trip condition clears. Many group 2 trips can result in some motor overheating, depending upon the severity and duration of the trip condition, which in turn depends upon the protection function configuration.

You can add a cooling time delay, if appropriate, by setting the Auto-Reset Group 2 Timeout parameter to a value greater than 0. You may also want to limit the number of reset attempts to prevent premature wear or inoperable equipment.

Auto-reset group 2 has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Auto-Reset Attempts Group 2 Setting	0 = manual, 1, 2, 3, 4, 5 = unlimited number of reset attempts	0
Auto-Reset Group 2 Timeout	0...9999 s	1,200 s

Auto-Reset Group 3 (AU-G3)

Group 3 trips often apply to equipment monitoring and generally do not require a motor cooling period. These trips can be used to detect equipment conditions-for example, an undercurrent trip that detects the loss of a belt, or an overpower trip that detects an increased loading condition in a mixer. You may want to configure group 3 trips in a way that differs significantly from groups 1 or 2, for example, by setting the number of resets to 0, thereby requiring a manual reset after the inoperable condition of the equipment has been discovered and corrected.

Auto-reset group 3 has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Auto-Reset Attempts Group 3 Setting	0 = manual, 1, 2, 3, 4, 5 = unlimited number of reset attempts	0
Auto-Reset Group 3 Timeout	0..9999 s	60 s

Auto-Reset Methods

The LTMR controller allows the following auto-reset methods:

- RB:Test/Reset button on the LTMR or the HMI

- PC: Power cycle on the LTMR controller
- I.5: Set I.5 logic input on the LTMR
- NC: Network command
- Automatic with conditions configured for the protection function group (where AU-GX = AU-G1, AU-G2, or AU-G3)

The following table lists the possible auto-reset methods for each monitored trip:

Protection Category	Monitored Trip	Control Channel		
		Terminal Strip	HMI	Network
Diagnostic	Run Command Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC
	Stop Command Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC
	Run Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC
	Stop Check	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC
Wiring / configuration detected errors	PTC connection	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	CT Reversal	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Voltage Phase Reversal	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Current Phase Reversal	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Voltage Phase Loss	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Phase Configuration	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC
Internal trips	Stack Overflow	PC	PC	PC
	Watchdog	PC	PC	PC
	ROM Checksum	PC	PC	PC
	EEROM	PC	PC	PC
	CPU	PC	PC	PC
	Internal Temperature	PC	PC	PC
Motor temp sensor	PTC Binary	AU-G1	AU-G1	AU-G1
	PT100	AU-G1	AU-G1	AU-G1
	PTC Analog	AU-G1	AU-G1	AU-G1
	NTC Analog	AU-G1	AU-G1	AU-G1
Thermal overload	Definite	AU-G1	AU-G1	AU-G1
	Inverse Thermal	AU-G1	AU-G1	AU-G1
Current	Long Start	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Jam	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Current Phase Imbalance	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Current Phase Loss	RB, I.5	RB, I.5	RB, I.5, NC
	Undercurrent	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3
	Overcurrent	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3
	External Ground Current	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Internal Ground Current	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
Voltage	Undervoltage	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Overvoltage	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Voltage Phase Imbalance	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2

Protection Category	Monitored Trip	Control Channel		
		Terminal Strip	HMI	Network
Power	Underpower	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3
	Overpower	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3
	Under Power Factor	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
	Over Power Factor	RB, I.5, AU-G2	RB, I.5, AU-G2	RB, I.5, NC, AU-G2
Communication Loss	PLC to LTMR	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3
	LTME to LTMR	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3

Remote Reset

Introduction

Setting the Trip Reset Mode parameter to **Remote** adds resetting trips from the PLC over the LTMR network port. This provides centralized monitoring and control of equipment installations. The Control channel parameter selection determines the available reset methods.

Both manual reset methods and remote reset methods reset a trip.

Remote Reset Methods

The LTMR controller provides the following remote reset methods:

Protection Category	Monitored Trip	Control Channel		
		Terminal Strip	HMI	Network
Diagnostic	Run Command Check	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Stop Command Check	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Run Check	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Stop Check	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
Wiring/configuration detected errors	PTC connection	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	CT Reversal	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Voltage Phase Reversal	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Current Phase Reversal	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Voltage Phase Loss	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Phase Configuration	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
Internal trips	Stack Overflow	PC	PC	PC
	Watchdog	PC	PC	PC
	ROM Checksum	PC	PC	PC
	EEROM	PC	PC	PC
	CPU	PC	PC	PC
	Internal Temperature	PC	PC	PC

Protection Category	Monitored Trip	Control Channel		
		Terminal Strip	HMI	Network
Motor temp sensor	PTC Binary	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	PT100	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	PTC Analog	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	NTC Analog	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
Thermal overload	Definite	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Inverse Thermal	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
Current	Long Start	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Jam	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Current Phase Imbalance	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Current Phase Loss	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Undercurrent	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Overcurrent	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	External Ground Current	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Internal Ground Current	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
Voltage	Undervoltage	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Overvoltage	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Voltage Phase Imbalance	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
Power	Underpower	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Overpower	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Under Power Factor	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	Over Power Factor	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
Communication Loss	PLC to LTMR	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	LTME to LTMR	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC

RB Test/Reset button on the LTMR controller front face or the HMI

PC Power cycle on the LTMR controller

I.5 Set I.5 logic input on the LTMR controller

NC Network command

Trip and Alarm Codes

Trip Codes

Each trip is identified by a numerical trip code.

Trip Code	Description
0	No detected error
3	Ground current
4	Thermal overload
5	Long start
6	Jam

Trip Code	Description
7	Current phase imbalance
8	Undercurrent
10	Self test
12	HMI port communication loss
13	Network port internal detected error
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 detected error
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)
60	L2 current or voltage detected in single-phase mode
64	Non-volatile memory detected error
65	Expansion module communication detected error
66	Stuck reset button
67	Logic function detected error
109	Network port comm detected error

Trip Code	Description
111	Fast device replacement detected error
555	Network port configuration detected error

Alarm Codes

Each alarm is identified by a numerical alarm code.

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
34	Temperature sensor short circuit
35	Temperature sensor open circuit
36	CT reversal
31	Under power factor
32	Over power factor
33	LTME configuration
46	Start command check
47	Run check
48	Stop command check
49	Stop check
109	Network port comm loss
555	Network port configuration

LTMR Controller Clear Commands

Overview

Clear commands allow you to clear specific categories of LTMR controller parameters:

- Clear all parameters
- Clear the statistics
- Clear the thermal capacity level
- Clear the controller settings
- Clear the network port settings

The Clear commands can be executed from:

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

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.

The Clear All Command 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

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

The Clear Thermal Capacity Level Command clears the following parameters:

- Thermal Capacity Level
- Rapid Cycle Lockout Timeout

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

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

For more information about the Clear Thermal Capacity Level Command, refer to Reset for Emergency Restart, page 74.

Clear Controller Settings Command

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

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 LTMR controller network port factory settings (address, and so on).

Network port settings are cleared without the controller being forced into configuration mode. Static characteristics are preserved. Only the network communication becomes ineffective.

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

Use

Overview

This chapter describes:

- The user interface devices and the hardware configurations you can use to operate the LTMR controller
- How to set parameters with each user interface
- How to perform monitoring, trip handling, and control functions with each user interface.

Using the LTMR Controller Stand-Alone

Overview

This section describes how to use the LTMR controller, either by itself or connected to an LTME expansion module, in a stand-alone configuration without a user interface device.

Hardware Configurations

Overview

The LTMR controller, either alone or connected to an LTME expansion module, can be operated with or without a user interface device.

In any configuration, the LTMR controller can be configured to perform monitoring, trip management, motor protection and control functions.

Communications

User interface devices and their communications interfaces include:

User Interface Device	Communicates Via the
PC running SoMove with the TeSys T DTM	HMI port via the local RJ45 connector on the LTMR controller or LTME expansion module.
PLC connected to an Ethernet network	Network port on the LTMR Ethernet controller via the network RJ45 connector.
PLC connected to a Modbus network	Network port on the LTMR Modbus controller via the network RJ45 connector or terminal wiring
PLC connected to a PROFIBUS DP network	Network port on the LTMR PROFIBUS DP controller via the network 9-pin sub-D socket connector or terminal wiring
PLC connected to a CANopen network	Network port on the LTMR CANopen controller via the network 9-pin sub-D plug connector or terminal wiring
PLC connected to a DeviceNet network	Network port on the LTMR DeviceNet controller via terminal wiring

NOTE: The use of the RJ45 or 9-pin sub-D plug connector is recommended instead of the terminal wiring to connect the LTMR controller to Modbus, PROFIBUS DP, and CANopen communication network.

LTMR Ethernet Controller Stand-Alone Configuration

Overview

Before the LTMR controller can operate in a stand-alone configuration, parameters must be set via an HMI device or SoMove software with the TeSys T DTM.

NOTE: Only SoMove with the TeSys T DTM can configure all of the controller's Ethernet network communication parameters.

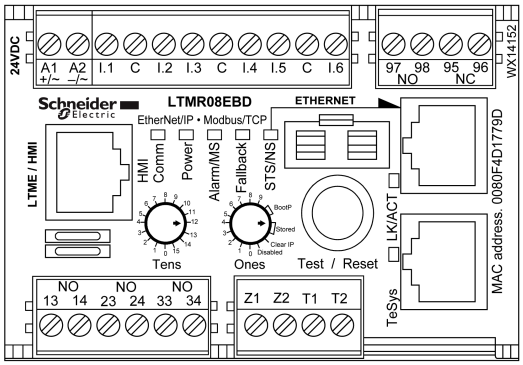
When parameters are set, the device can be detached and you can use the following controls to operate the LTMR controller:

Use this Control	To
• LEDs: ◦ 7 LTMR controller LEDs ◦ 5 LTME expansion module LEDs	Monitor the state of the LTMR controller and LTME expansion module
• LTMR controller Test/Reset button	Self test, manage trips, reset to factory settings
• Programmed operating parameters • Logic inputs: ◦ 6 LTMR controller inputs ◦ 4 LTME expansion module inputs	Control the: • LTMR controller • LTME expansion module • Motor • Power and control wiring • Any connected sensors, including ◦ Motor temp sensors ◦ External ground current trip CTs
• Programmed protection parameters	Protect the: • LTMR controller • LTME expansion module • Motor • Equipment

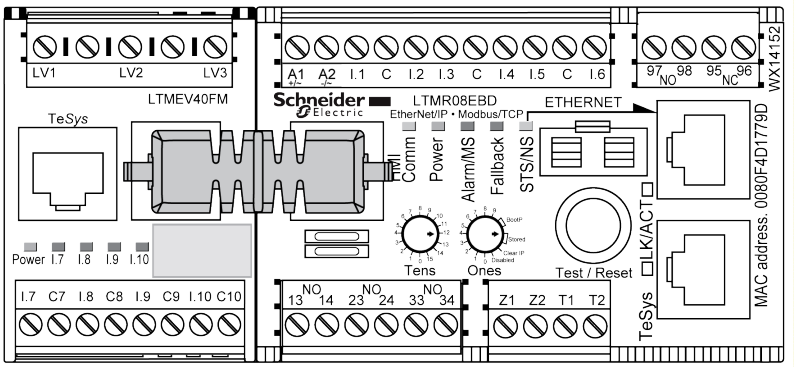
Configurations

The stand-alone physical configurations of the LTMR controller (with and without a connected LTME expansion module) are depicted below:

The LTMR controller alone



The LTMR controller and LTME expansion module



EtherNet/IP LTMR Controller LEDs

Use the 7 LEDs on the face of the EtherNet/IP LTMR controller to monitor its state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTMR controller and HMI device, PC, or LTME expansion module	• Flashing yellow = communication • Off = no communication
Power	Yellow or green	LTMR controller power or internal trip condition	• Solid yellow = power-on, no internal trips, and motor off • Flashing yellow = power-on, no internal trips, and motor on • Blinking yellow and green = power-up, self test • Off = power-off, or internal trips exist
Alarm/MS	Green or red	Protection trip or alarm, or internal trip condition	• Solid green = no trip (when power is on) • Flashing green (1 x per s) = device in standby state
			• Solid red = device goes into major trip (not recoverable) • Flashing red (1 x per s) = minor trip (recoverable) • Flashing red (2 x per s) = alarm • Flashing red (5 x per s) = load shed or rapid cycle condition
			• Blinking green and red = power-up testing, self test mode • Off = no trips, alarms, load shed, or rapid cycle (when power is On)
Fallback	Red	Indicates communication loss between the LTMR controller and network or HMI control source	• Solid red = in fallback • Off = not in fallback (no power)

LED	Color	Describes	Indicates
STS/NS	Green or red	Indicates the network status	• Blinking green = trip present during network start-up • Solid green = CIP connection established and not timeout • Flashing green (1 x per s) = no CIP connection established
			• Solid red = duplicate IP address • Flashing red (1 x per s) = connection timeout
			• Blinking green and red = power-up testing, self test, webpage discover test • Off = no IP address (when power is On)
LK/ACT	Green or yellow	Ethernet link status Ethernet communication activity status	• Blinking green = speed is 100 Mbits/s • Blinking yellow = speed is 10 Mbits/s • Off = no connection established

NOTE: LK/ACT LEDs color may be different under the condition of EtherNet/IP hardware cooperated with network firmware equal or lower than 2.2.000.

NOTE: For a description of STS/NS LED behavior during startup, refer to the *TeSys T LTMR Ethernet Communication Guide.*

Modbus/TCP LTMR Controller LEDs

Use the 7 LEDs on the face of the Modbus/TCP LTMR controller to monitor its state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTMR controller and LTME expansion module	• On = communication • Off = no communication
Power	Green or yellow	LTMR controller power or internal trip condition	• Solid green = power-on, no internal trips, and motor off • Flashing green = power-on, no internal trips, and motor on • Blinking yellow and green = power-up, self test • Off = power-off, or internal trips exist
Alarm/MS	Red or green	Protection trip or alarm, or internal trip condition	• Solid red = internal or protection trip • Flashing red (2 x per s) = alarm • Flashing red (5 x per s) = load shed or rapid cycle condition • Blinking red and green = power-up, self test • Off = no trips, alarms, load shed, or rapid cycle (when power is On)
Fallback	Red	Communication connection between LTMR controller and network module	• Solid red = in fallback • Off = not in fallback (no power)

LED	Color	Describes	Indicates
STS/NS	Green or red	Ethernet link status Ethernet communication activity status	• On = communication established • Off = communication is not established • 2 blinks green = no MAC address • 3 blinks green = no link • 4 blinks green = duplicate IP condition • 5 blinks green = waiting for served IP configuration • 6 blinks green = using the default IP configuration • 7 blinks green = firmware upgrade in progress • 8 blinks green = critical detected error • 10 blinks green = no FDR server available • Blinking green or red = power-up, self test, webpage discover test
LK/ACT	Green or yellow	Indicates the connection speed	• Blinking green = speed is 100Mbits/s • Blinking yellow = speed is 10Mbits/s • Off = no connection established

NOTE: LK/ACT LEDs color may be different under the condition of EtherNet/IP hardware cooperated with network firmware equal or lower than 2.2.000.

NOTE: For a description of STS/NS LED behavior during startup, refer to the *TeSys T LTMR Ethernet Communication Guide.*

LTME Expansion Module LEDs

Use the 5 LEDs on the face of the LTME expansion module to monitor its operating and communications state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
Power	Green or red	Module power or internal trip condition	• Solid green = power-on with no internal trips • Solid red = power-on with internal trips • Off = power-off
Logic inputs I.7, I.8, I.9, and I.10	Yellow	State of input	• On = input activated • Off = input not activated

Test/Reset

Use the Test/Reset button to perform the following LTMR controller's functions:

Function	Description	Procedure
Trip reset	Resets all trips that can be reset. For more information about resetting trips Trip Management - Introduction, page 169.	Press the button and release within 3 s.
Self test	Performs a self test if: • No trips exist • Self-test function is enabled.	Press and hold the button for more than 3 s up to and including 15 s.

Function	Description	Procedure
Local return to factory setting	Returns the LTMR controller to factory settings if the product is in one of the following states: Ready, Not ready or System configuration. If the product is in Start or Run state, the return to factory setting is ignored. When the reset button is pressed during more than 15 s, the Alarm LED blinks at 2 Hz. If the reset button is released, the product executes a reset to factory setting.	Press and hold the button down for more than 15 s not exceeding 20 s.
Induce a trip	Put the LTMR controller into internal trip condition.	Press and hold the button down for more than 20 s.

LED Behavior on Power-Up

This table describes the LED sequence behavior on a LTMR controller with EtherNet/IP protocol on power-up.

LED Order of Sequence	Description of Sequence
	All LEDs are OFF.
Alarm/MS	MS indicator lights green for 0.25 seconds.
Alarm/MS	MS indicator changes color to red and lights for 0.25 seconds.
Alarm/MS	MS indicator remains lights green.
STS/NS	NS indicator lights up green for 0.25 seconds.
STS/NS	NS indicator changes color to red for 0.25 seconds.
STS/NS	NS indicator lights off.
HMI Comm	HMI indicator lights up yellow for 0.5 seconds.
HMI Comm	HMI indicator lights off.
Power	Power indicator lights green for 0.25 seconds.
Power	Power indicator changes color to yellow and lights up for 0.25 seconds.
Power	Power indicator lights off.
Fallback	Fallback indicator lights red for 0.25 seconds.
Fallback	Fallback indicator lights off.

LTMR Modbus Controller Stand-Alone Configuration

Overview

Before the LTMR controller can operate in a stand-alone configuration, parameters must be set via an HMI device or SoMove with the TeSys T DTM.

When parameters are set, the device can be detached and you can use the following controls to operate the LTMR controller:

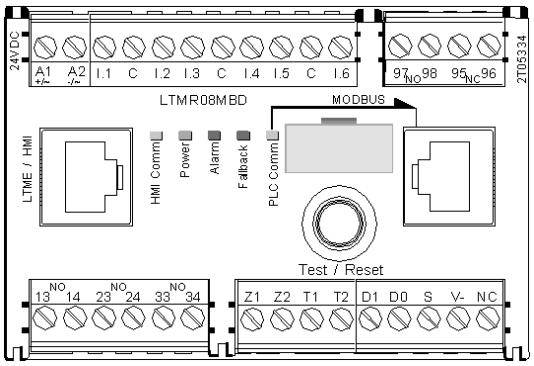
Use this Control	To
• LEDs: ◦ 7 LTMR controller LEDs ◦ 5 LTME expansion module LEDs	Monitor the state of the LTMR controller and LTME expansion module
• LTMR controller Test/Reset button	Self test, manage trips, reset to factory settings

Use this Control	To
• Programmed operating parameters • Logic inputs: ◦ 6 LTMR controller inputs ◦ 4 LTME expansion module inputs	Control the: • LTMR controller • LTME expansion module • Motor • Power and control wiring • Any connected sensors, including ◦ Motor temp sensors ◦ External ground current trip CTs
• Programmed protection parameters	Protect the: • LTMR controller • LTME expansion module • Motor • Equipment

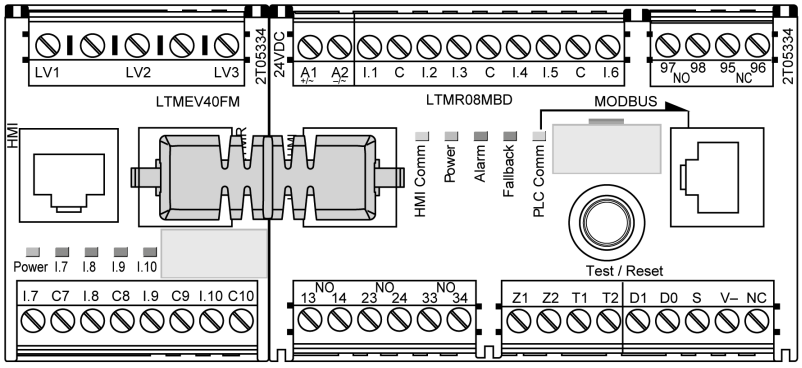
Configurations

The stand-alone physical configurations of the LTMR controller (with and without a connected LTME expansion module) are depicted below:

The LTMR controller alone



The LTMR controller and LTME expansion module



LTMR Controller LEDs

Use the 5 LEDs on the face of the LTMR controller to monitor its state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.

- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTMR controller and LTME expansion module	• Flashing yellow = communication • Off = no communication
Power	Green	LTMR controller power or internal trip condition	• Solid green = power-on, no internal trips, and motor off • Flashing green = power-on, no internal trips, and motor on • Off = power-off, or internal trips exist
Alarm/MS	Red	Protection trip or alarm, or internal trip condition	• Solid red = internal or protection trip • Flashing red (2 x per s) = alarm • Flashing red (5 x per s) = load shed or rapid cycle condition • Off = no trips, alarms, load shed, or rapid cycle (when power is On)
Fallback	Red	Communication connection between LTMR controller and network module	• Solid red = in fallback • Off = not in fallback (no power)
PLC Comm	Yellow	Communication activity on the network bus	• Flashing yellow (0.2 s on,1.0 s off) = network bus communication • Off = no network bus communication

LTME Expansion Module LEDs

Use the 5 LEDs on the face of the LTME expansion module to monitor its operating and communications state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
Power	Green or red	Module power or internal trip condition	• Solid green = power-on with no internal trips • Solid red = power-on with internal trips • Off = power-off
Logic inputs I.7, I.8, I.9, and I.10	Yellow	State of input	• On = input activated • Off = input not activated

Test/Reset

Use the Test/Reset button to perform the following LTMR controller's functions:

Function	Description	Procedure
Trip reset	Resets all trips that can be reset. For more information about resetting trips, refer to Trip Management - Introduction, page 169.	Press the button and release within 3 s.
Self test	Performs a self test if: • No trips exist • Self-test function is enabled.	Press and hold the button for more than 3 s up to and including 15 s.

Function	Description	Procedure
Local return to factory setting	Returns the LTMR controller to factory settings if the product is in one of the following states: Ready, Not ready or System configuration. If the product is in Start or Run state, the return to factory setting is ignored. When the reset button is pressed during more than 15 s, the Alarm LED blinks at 2 Hz. If the reset button is released, the product executes a reset to factory setting.	Press and hold the button down for more than 15 s not exceeding 20 s.
Induce a trip	Put the LTMR controller into internal trip condition.	Press and hold the button down for more than 20 s.

LTMR PROFIBUS DP Controller Stand-Alone Configuration

Overview

Before the LTMR controller can operate in a stand-alone configuration, parameters must be set via an HMI device or SoMove with the TeSys T DTM.

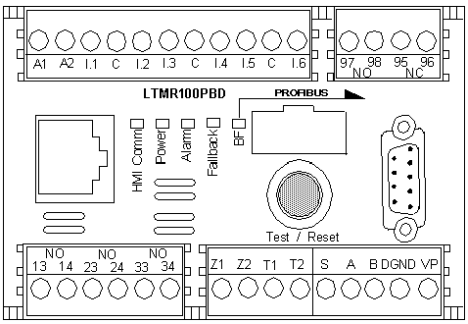
When parameters are set, the device can be detached and you can use the following controls to operate the LTMR controller:

Use this Control	To
• LEDs: ◦ 7 LTMR controller LEDs ◦ 5 LTME expansion module LEDs	Monitor the state of the LTMR controller and LTME expansion module
• LTMR controller Test/Reset button	Self test, manage trips, reset to factory settings
• Programmed operating parameters • Logic inputs: ◦ 6 LTMR controller inputs ◦ 4 LTME expansion module inputs	Control the: • LTMR controller • LTME expansion module • Motor • Power and control wiring • Any connected sensors, including ◦ Motor temp sensors ◦ External ground current trip CTs
• Programmed protection parameters	Protect the: • LTMR controller • LTME expansion module • Motor • Equipment

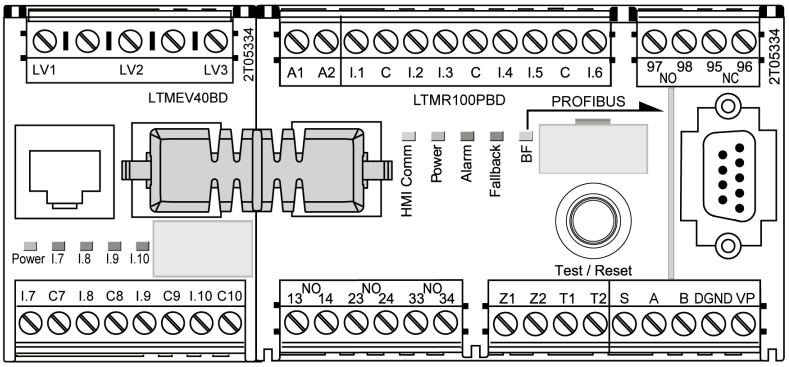
Configurations

The stand-alone physical configurations of the LTMR controller (with and without a connected LTME expansion module) are depicted below:

The LTMR controller alone



The LTMR controller and LTME expansion module



LTMR Controller LEDs

Use the 5 LEDs on the face of the LTMR controller to monitor its state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTMR controller and LTME expansion module	• On = communication • Off = no communication
Power	Green	LTMR controller power or internal trip condition	• Solid green = power-on, no internal trips, and motor off • Flashing green = power-on, no internal trips, and motor on • Off = power-off, or internal trips exist
Alarm/MS	Red	Protection trip or alarm, or internal trip condition	• Solid red = internal or protection trip • Flashing red (2 x per s) = alarm • Flashing red (5 x per s) = load shed or rapid cycle condition • Off = no trips, alarms, load shed, or rapid cycle (when power is On)
Fallback	Red	Communication connection between LTMR controller and network module	• Solid red = in fallback • Off = not in fallback (no power)
BF	Red	Communication activity between LTMR controller and network module	• Off = communication • Red = no communication

LTME Expansion Module LEDs

Use the 5 LEDs on the face of the LTME expansion module to monitor its operating and communications state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
Power	Green or red	Module power or internal trip condition	• Solid green = power-on with no internal trips • Solid red = power-on with internal trips • Off = power-off
Logic inputs I.7, I.8, I.9, and I.10	Yellow	State of input	• On = input activated • Off = input not activated

Test/Reset

Use the Test/Reset button to perform the following LTMR controller's functions:

Function	Description	Procedure
Trip reset	Resets all trips that can be reset. For more information about resetting trips, refer to Trip Management - Introduction, page 169.	Press the button and release within 3 s.
Self test	Performs a self test if: • No trips exist • Self-test function is enabled.	Press and hold the button for more than 3 s up to and including 15 s.
Local return to factory setting	Returns the LTMR controller to factory settings if the product is in one of the following states: Ready, Not ready or System configuration. If the product is in Start or Run state, the return to factory setting is ignored. When the reset button is pressed during more than 15 s, the Alarm LED blinks at 2 Hz. If the reset button is released, the product executes a reset to factory setting.	Press and hold the button down for more than 15 s not exceeding 20 s.
Induce a trip	Put the LTMR controller into internal trip condition.	Press and hold the button down for more than 20 s.

LTMR CANopen Controller Stand-Alone Configuration

Overview

Before the LTMR controller can operate in a stand-alone configuration, parameters must be set via an HMI device or SoMove software with the TeSys T DTM.

When parameters are set, the device can be detached and you can use the following controls to operate the LTMR controller:

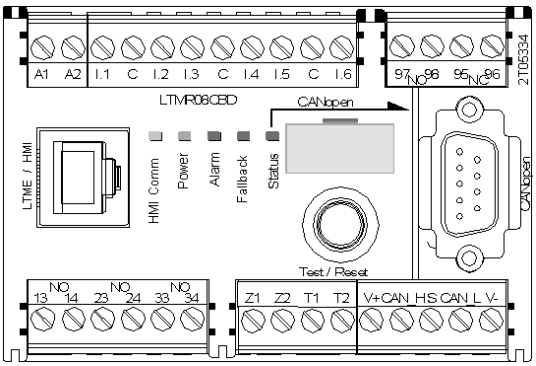
Use this Control	To
• LEDs: ◦ 7 LTMR controller LEDs ◦ 5 LTME expansion module LEDs	Monitor the state of the LTMR controller and LTME expansion module
• LTMR controller Test/Reset button	Self test, manage trips, reset to factory settings

Use this Control	To
• Programmed operating parameters • Logic inputs: ◦ 6 LTMR controller inputs ◦ 4 LTME expansion module inputs	Control the: • LTMR controller • LTME expansion module • Motor • Power and control wiring • Any connected sensors, including ◦ Motor temp sensors ◦ External ground current trip CTs
• Programmed protection parameters	Protect the: • LTMR controller • LTME expansion module • Motor • Equipment

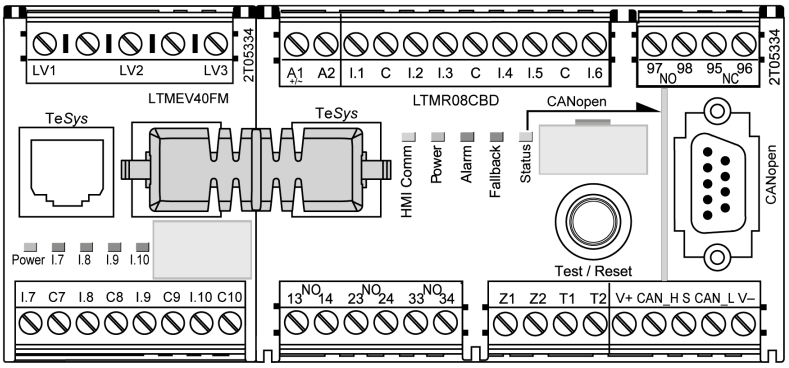
Configurations

The stand-alone physical configurations of the LTMR controller (with and without a connected LTME expansion module) are depicted below:

The LTMR controller alone



The LTMR controller and LTME expansion module



LTMR Controller LEDs

Use the 5LEDs on the face of the LTMR controller to monitor its state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.

- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTMR controller and LTME expansion module	• On = communication • Off = no communication
Power	Green	LTMR controller power or internal trip condition	• Solid green = power-on, no internal trips, and motor off • Flashing green = power-on, no internal trips, and motor on • Off = power-off, or internal trips exist
Alarm/MS	Red	Protection trip or alarm, or internal trip condition	• Solid red = internal or protection trip • Flashing red (2 x per s) = alarm • Flashing red (5 x per s) = load shed or rapid cycle condition • Off = no trips, alarms, load shed, or rapid cycle (when power is On)
Fallback	Red	Communication connection between LTMR controller and network module	• Solid red = in fallback • Off = not in fallback (no power)
Status	Red/green	Communication activity between LTMR controller and network module	• Green = communication • Red = no communication

LTME Expansion Module LEDs

Use the 5 LEDs on the face of the LTME expansion module to monitor its operating and communications state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
Power	Green or red	Module power or internal trip condition	• Solid green = power-on with no internal trips • Solid red = power-on with internal trips • Off = power-off
Logic inputs I.7, I.8, I.9, and I.10	Yellow	State of input	• On = input activated • Off = input not activated

Test/Reset

Use the Test/Reset button to perform the following LTMR controller's functions:

Function	Description	Procedure
Trip reset	Resets all trips that can be reset. For more information about resetting trips, refer to Trip Management - Introduction, page 169.	Press the button and release within 3 s.
Self test	Performs a self test if: • No trips exist • Self-test function is enabled.	Press and hold the button for more than 3 s up to and including 15 s.

Function	Description	Procedure
Local return to factory setting	Returns the LTMR controller to factory settings if the product is in one of the following states: Ready, Not ready or System configuration. If the product is in Start or Run state, the return to factory setting is ignored. When the reset button is pressed during more than 15 s, the Alarm LED blinks at 2 Hz. If the reset button is released, the product executes a reset to factory setting.	Press and hold the button down for more than 15 s not exceeding 20 s.
Induce a trip	Put the LTMR controller into internal trip condition.	Press and hold the button down for more than 20 s.

LTMR DeviceNet Controller Stand-Alone Configuration

Overview

Before the LTMR controller can operate in a stand-alone configuration, parameters must be set via an HMI device or SoMove software with the TeSys T DTM.

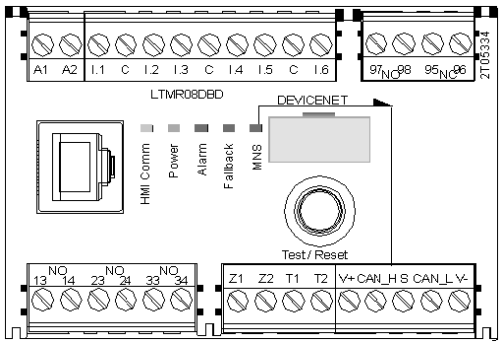
When parameters are set, the device can be detached and you can use the following controls to operate the LTMR controller:

Use this control	To
• LEDs: ◦ 7 LTMR controller LEDs ◦ 5 LTME expansion module LEDs	Monitor the state of the LTMR controller and LTME expansion module
• LTMR controller Test/Reset button	Self test, manage trips, reset to factory settings
• Programmed operating parameters • Logic inputs: ◦ 6 LTMR controller inputs ◦ 4 LTME expansion module inputs	Control the: • LTMR controller • LTME expansion module • Motor • Power and control wiring • Any connected sensors, including ◦ Motor temp sensors ◦ External ground current trip CTs
• Programmed protection parameters	Protect the: • LTMR controller • LTME expansion module • Motor • Equipment

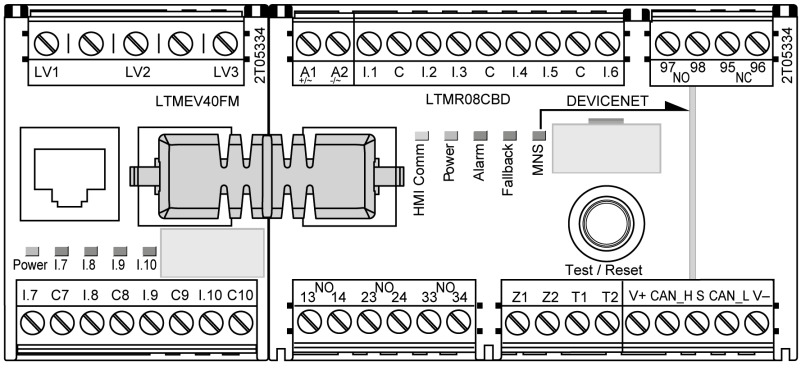
Configurations

The stand-alone physical configurations of the LTMR controller (with and without a connected LTME expansion module) are depicted below:

The LTMR controller alone



The LTMR controller and LTME expansion module



LTMR Controller LEDs

Use the 5 LEDs on the face of the LTMR controller to monitor its state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTMR controller and LTME expansion module	• On = communication • Off = no communication
Power	Green	LTMR controller power or internal trip condition	• Solid green = power-on, no internal trips, and motor off • Flashing green = power-on, no internal trips, and motor on • Off = power-off, or internal trips exist
Alarm/MS	Red	Protection trip or alarm, or internal trip condition	• Solid red = internal or protection trip • Flashing red (2 x per s) = alarm • Flashing red (5 x per s) = load shed or rapid cycle condition • Off = no trips, alarms, load shed, or rapid cycle (when power is On)

LED	Color	Describes	Indicates
Fallback	Red	Communication connection between LTMR controller and network module	• Solid red = in fallback • Off = not in fallback (no power)
MNS	Red/green	Communication activity between LTMR controller and network module	• Green/Red Alternating: Startup self-test • Green Flashing: Communication starting • Green Solid: Communication established • Red Flashing: Communication loss / timeout • Red Solid: Unable to start network due to addressing/baud rate issue

LTME Expansion Module LEDs

Use the 5 LEDs on the face of the LTME expansion module to monitor its operating and communications state, as follows. Note the following definitions:

- Flashing: when the LED is lit up to 250 ms whatever the time cycle is.
- Blinking: when the LED is lit 50% of the time in the time cycle.

LED	Color	Describes	Indicates
Power	Green or red	Module power or internal trip condition	• Solid green = power-on with no internal trips • Solid red = power-on with internal trips • Off = power-off
Logic inputs I.7, I.8, I.9, and I.10	Yellow	State of input	• On = input activated • Off = input not activated

Test/Reset

Use the Test/Reset button to perform the following LTMR controller's functions:

Function	Description	Procedure
Trip reset	Resets all trips that can be reset. For more information about resetting trips, refer to Trip Management - Introduction, page 169.	Press the button and release within 3 s.
Self test	Performs a self test if: • No trips exist • Self-test function is enabled.	Press and hold the button for more than 3 s up to and including 15 s.
Local return to factory setting	Returns the LTMR controller to factory settings if the product is in one of the following states: Ready, Not ready or System configuration. If the product is in Start or Run state, the return to factory setting is ignored. When the reset button is pressed during more than 15 s, the Alarm LED blinks at 2 Hz. If the reset button is released, the product executes a reset to factory setting.	Press and hold the button down for more than 15 s not exceeding 20 s.
Induce a trip	Put the LTMR controller into internal trip condition.	Press and hold the button down for more than 20 s.

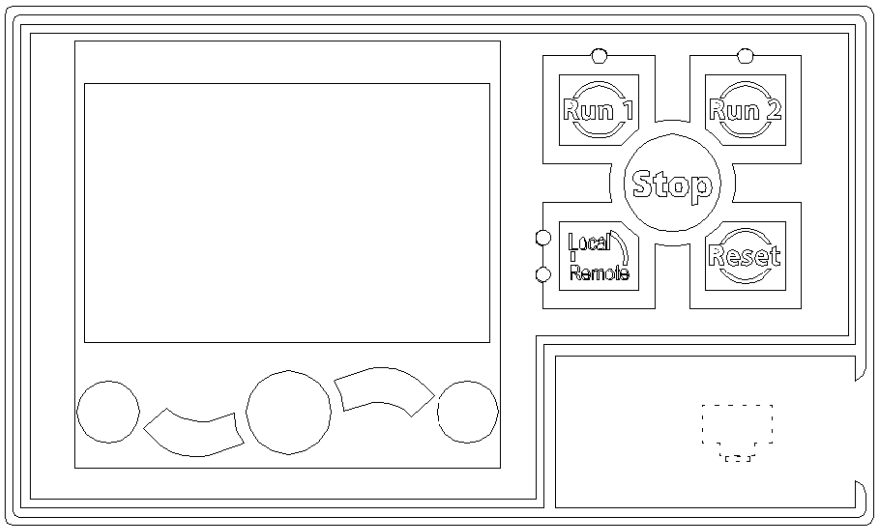
Using the LTMCU Control Operator Unit

Presentation of the LTMCU Control Operator Unit

Aim of the Product

The LTMCU Control Operator Unit is a remote operator terminal that enables the configuration, monitoring and control of the LTMR controller, as part of the TeSys T motor management system. The LTMCU has been specially developed to act as the Human Machine Interface (HMI) of the LTMR controller, and is internally powered by the LTMR controller.

The diagram below shows the LTMCU front face:



LTMCU Functions

The LTMCU HMI device can be used to:

- Configure parameters for the LTMR controller,
- Display information about the LTMR controller configuration and operation,
- Monitor trips and alarms detected by the controller,
- Control the motor locally using the local control interface.

LTMCUF Functions

The LTMCUF HMI device is similar to LTMCU HMI device with the FDR (Fast Device Replacement) service and can be used to:

- Backup or restore the configuration and custom logic of LTMR controller.
- Facilitate the operator task when replacing a drawer in an environment of high continuity of service without using any computer.

For More Information

Refer to the *TeSys T LTMCU Control Operator Unit User's Manual*.

Configuration of the HMI Port

HMI Port

The HMI port is the RJ45 port on the LTMR controller, or on the LTME expansion module used to connect the LTMR controller to an HMI device, such as a Magelis XBT or a TeSys T LTMCU, or to a PC running SoMove with the TeSys T DTM.

Communication Parameters

Use the TeSys T DTM or the HMI to modify the HMI port communication parameters:

- HMI port address setting
- HMI port baud rate setting
- HMI port parity setting
- HMI port endian setting

HMI Port Address Setting

The HMI port address can be set between 1 and 247.

Factory setting is 1.

HMI Port Baud Rate Setting

Possible transmission rates are:

- 4800 Baud
- 9600 Baud
- 19,200 Baud (Factory setting)

HMI Port Parity Setting

The parity can be selected from:

- Even (Factory setting)
- None

Parity and stop bit behavior is linked:

If the Parity is...	Then the Number of Stop Bts is...
Even	1
None	2

HMI Port Endian Setting

The HMI 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)

HMI Port Fallback Setting

Fallback Condition, page 57 is used to adjust the fallback mode in case of a loss of communication with the PLC.

Configuring the Magelis XBTN410

Overview

The Magelis XBTN410 HMI can be used to operate up to eight LTMR controllers, in a 1 HMI to many LTMR controllers (1-to-many) physical configuration.

The HMI presents a unique user interface, including both LCD display and keypad and requires the use of:

- A software application file, and
- A keypad label

This section shows you how to obtain and install a software application in the Magelis XBTN410 for a 1-to-many configuration.

Refer to the XBT-N Instruction Sheet that ships with the Magelis XBTN410 HMI for instructions on selecting and installing the keypad label that is appropriate for your configuration.

After connecting the HMI port, refer to instructions about configuring the HMI port, page 200.

Installing Magelis XBTL1000 Programming Software

Overview

The LTMR controller comes with a copy of Magelis XBTL1000 programming software. You need to:

- Install the Magelis XBTL1000 programming software on your PC, and
- Use it to transfer a 1-to-many software application to the Magelis XBTN410 HMI.

NOTE: Magelis XBTL1000 programming software is a powerful programming tool. This document describes only its utility in opening and transferring pre-programmed software applications to the Magelis XBTN410 HMI. For more information about the Magelis XBTL1000 programming software, consult its help file and printed documentation.

For instructions on how to download 1-to-many software applications, refer to Download 1-to-many Software Application Files, page 202.

For instructions on how to transfer 1-to-many software applications from your PC to the Magelis XBTN410 HM, refer to Transferring Application Software Files to Magelis XBTN410 HMI, page 202.

Installation Steps

To install the Magelis XBTL1000 programming software on your PC:

Step	Action
1	Place the installation disk into your PC's disk drive. The installation program should begin.
2	If the installation program does not begin, use Microsoft Windows® Explorer to navigate to and click the file **Setup.exe**.
3	If any screens appear that do not require action, click **Next**.
4	In the language screen, select a language and click **OK**.
5	In the name and company screen, type your name and your company name (or accept the factory settings) and click **Next**.
6	If a screen appears alerting you that protocols will be uninstalled, click **Yes** to continue.
7	In the Protocols Choices screen, be sure that **Modbus** is selected, then click **Next**.
8	In the Select Components screen, make no selections then click **Next**.
9	In the Choose Destination Location screen, either accept proposed path or use the Browse button to navigate to a new one, then click **Next**.
10	In the Start Copying Files screen, review your selections, and then click: • **Back** to return to earlier screens and make changes • **Next** to proceed to the final screen.
11	In the Finish screen, click **Finish**. The Magelis XBTL1000 programming software is installed.

Download 1-to-many Software Application Files

Overview

You must download the software application file required by your installation of the Magelis XBTN410 HMI from the www.se.com website.

From the www.se.com website, you can freely obtain the software application file LTM_1T8_(language)_(version).dop.

For instructions on installing the Magelis XBTL1000 programming software, refer to Installing Magelis XBTL1000 Programming Software, page 201.

For instructions on transferring application files from the Magelis XBTL1000 programming software on your PC to the Magelis XBTN410 HMI, refer to Transferring Application Software Files to Magelis XBTN410 HMI, page 202.

Transferring Application Software Files to Magelis XBTN410 HMI

Overview

After you have installed the Magelis XBT L1000 programming software on your PC and downloaded the required 1-to-many application software file, you are ready to transfer the application software file to the Magelis XBTN410 HMI.

For instructions on downloading software application files, refer to Download 1-to-many Software Application Files, page 202.

Transfer Steps

To transfer a software application file from Magelis XBT L1000 programming software on your PC to the Magelis XBTN410 HMI:

Step	Action
1	Supply power to the Magelis XBTN410 HMI.
2	Connect the PC 9-PIN Com1 port to the 25-pin data port on the HMI using an XBT Z915 programming cable. The HMI LCD reads: "FIRMWARE VX.X WAITING FOR TRANSFER"
3	Start up the Magelis XBT_L1000 programming software.
4	Close all child windows in the programming software.
5	In the File menu, select **Open**. The Open dialog is displayed.
6	In the Open dialog, navigate to the 1-to-many software application file (with a .dop extension) and click **Open**. The programming software displays the selected file.
7	In the Transfers menu, select **Export**.
8	When notified that the Export command will destroy the existing application, click **OK** to continue the export. The HMI LCD indicates: "DOWNLOAD IN PROGRESS" and then "DOWNLOAD COMPLETED"
9	Click **OK** when the programming software reports "Transfer accomplished successfully".

Using the Magelis XBTN410 HMI (1-to-many)

Overview

This section describes how to use the Magelis XBTN410 HMI to operate up to eight LTMR controllers, in a 1 HMI to many LTMR controllers (1-to-many) physical configuration.

The 1-to-many physical configuration presents a unique:

- User interface (LCD display and keypad)
- Menu structure

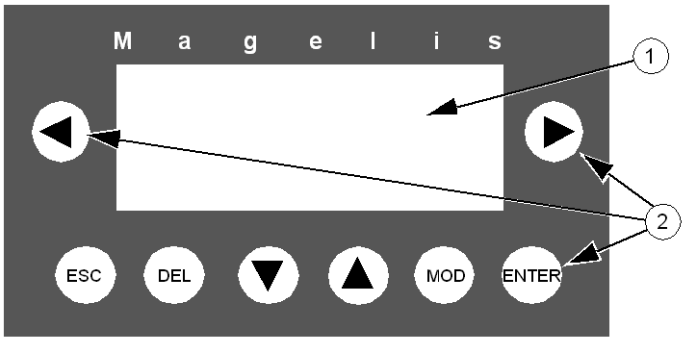
  NOTE: The Magelis XBTN410 HMI can operate up to eight LTMR controllers that have previously been commissioned. To commission an individual LTMR controller, use either:

  - An LTMCU control operator unit, or
  - SoMove with the TeSys T DTM.

Physical Description (1-to-many)

1-to-many Interface

When a Magelis XBTN410 is used in a 1-to-many physical configuration, the face of the HMI looks like this:



1 LCD display

2 Eight button keypad

1-to-many Keypad

The 1-to-many configuration requires a customized keypad label. Using a blank keypad label, add the names of the six bottom buttons to the label. For instructions on creating and installing a customized keypad label, refer to the XBT-N Instruction Sheet that ships with the Magelis XBTN410 HMI.

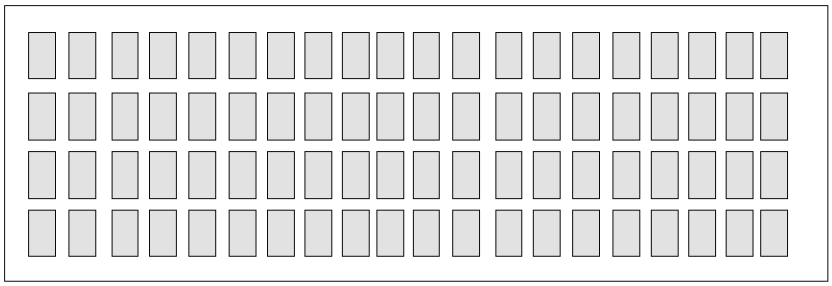
In a 1-to-many configuration, the keypad buttons perform the following functions:

Keys	Use this Key to
	• Enter the menu structure for a selected LTMR controller at address 1-4 • Move to the adjacent left character within a numerical setting value • Execute remote reset commands for a selected LTMR controller at address 1-4 • Reset statistics to factory settings for a selected LTMR controller • Display the description of another trip when the LCD displays trip messages
	• Enter the menu structure for a selected LTMR controller at address 5-8 • Move to a lower level in an LTMR controller menu structure • Move to the adjacent right character within a numerical setting value • Toggle between alternate values for Boolean settings • Execute remote reset commands for a selected LTMR controller at address 5-8 • Reset settings to factory settings for a selected LTMR controller • Display the description of another trip when the LCD displays trip messages
	• Scroll down through a page • Decrement by 1 the value of the selected digit or setting
	• Scroll up through a page • Increment by 1 the value of the selected digit or setting
	• Select a numeric setting for editing **Note:** After a setting is selected, you can increment or decrement either: ◦ The entire value - or - ◦ A selected digit within the setting.

Keys	Use this Key to
ESC	• Exit the present level in the HMI menu structure and move up to the next level • Exit the selected setting without saving changes.
ENTER	• Save changes and exit the selected setting
DEL	• Delete the value of the selected setting **Note:** After deleting a setting value, you can either: ◦ Use the arrow keys to input a new value, and then click ENTER to save it - or - ◦ Click ESC to restore the deleted value.

1-to-Many LCD

In a 1-to-many configuration, the Magelis XBTN410 HMI presents a flexible LCD that can display up to four rows of 20 characters, as follows:



In some cases, the LCD displays only three text lines because one line-containing a trip message or page header-is twice the height of normal text.

Pages

The LCD displays pages of text. There are two types of pages:

Page Type	Contains	Displayed
Menu structure page	• Page header that is twice the height of ordinary LCD text • Links to other pages • Read-only parameter values • Editable parameter settings • Function commands	By navigating through the HMI menu structure to the specific page
Trip message page	• A flashing trip message • The number of active trips	• Automatically when a trip occurs • By selecting trips in the Home page

Pages often contain more than four lines of text. For instructions on how to navigate within and between pages, refer to Navigating the Menu Structure (1-to-many), page 207.

Page Examples

The Home page:

The top four lines of the Home page	TeSys T Vx.x IMPORTANT ▶ Controller Currents ▶
Use the ▼ button to scroll down and reveal more of this page. **Note:** Click on a flashing ▶ to navigate to that page.	Controller Status ▶ Trips ▶ Remote Reset ▶ Reset to Defaults ▶

Trip message pages:

The opening trip message page. **Note:** The trip name "THERMAL OVERLOAD" and the LTMR controller address "Controller 1" both flash when displayed.	1/ 2 THERMAL OVERLOAD Controller 1
Click the ▶ button to display additional trip message pages.	2/ 2 GROUND CURRENT Controller 2
Click the ▼ button to scroll down and reveal more of the Ground Current trip message.	Controller 2 CORRECT ORIGIN OF THE GROUND CURRENT TRIP BEFORE RESET

Command Lines (1-to-many)

Overview

Use the HMI keypad ◀ and ▶ keys to execute text line commands. A command line is identified by a:

- ▶ At the right end of the text line, or

-  At the left end of the text line

A command can be executed only when its text line has focus. A text line has focus when the  or  at either end of the text line-plus any additional command character-is blinking.

Command Lines

The 1-to-many menu structure presents four different kinds of command lines, depending upon the command character-if any-next to the command-line arrow, as follows:

Command-Line Characters		Description
Left	**Right**	
		Links to a page. With no character next to the blinking arrow, click the: •  Keypad button to move to the page indicated by the left arrow •  Keypad button to move to the page indicated by the right arrow.
N/A	0  - or - 1 	Toggle bit commands. With a 0 or a 1 next to the blinking arrow, click the  keypad button to toggle the boolean setting value.
 v	v 	Value write commands. With a v next to the blinking arrow, click the: •  Keypad button to execute the command indicated by the left arrow •  Keypad button to execute the command indicated by the right arrow. For example: • Reset to Defaults: Statistics • Reset to Defaults: Settings • Self-Test
 ?	? 	Command cannot execute. There is no connection between the HMI and the indicated LTMR controller.

Navigating the Menu Structure (1-to-many)

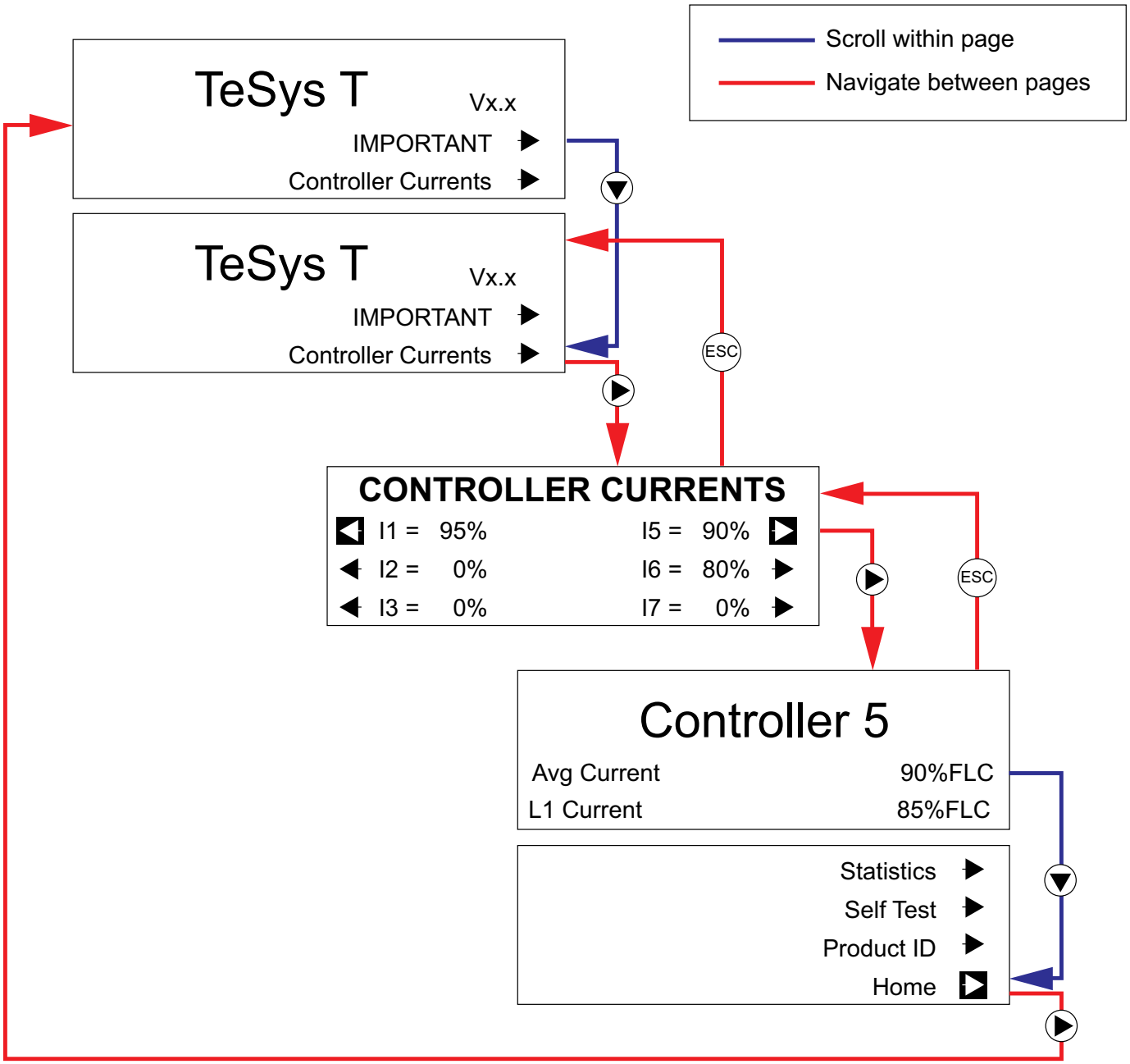
Overview

Use the HMI keypad  ,  ,  ,  , and  buttons to:

- Scroll within a page
- Link to a page in the next, lower level in the menu structure
- Return to a page in the next, higher level in the menu structure
- Jump to the Home page

Example

The following navigation example begins and ends at the Home page:



Editing Values (1-to-many)

Overview

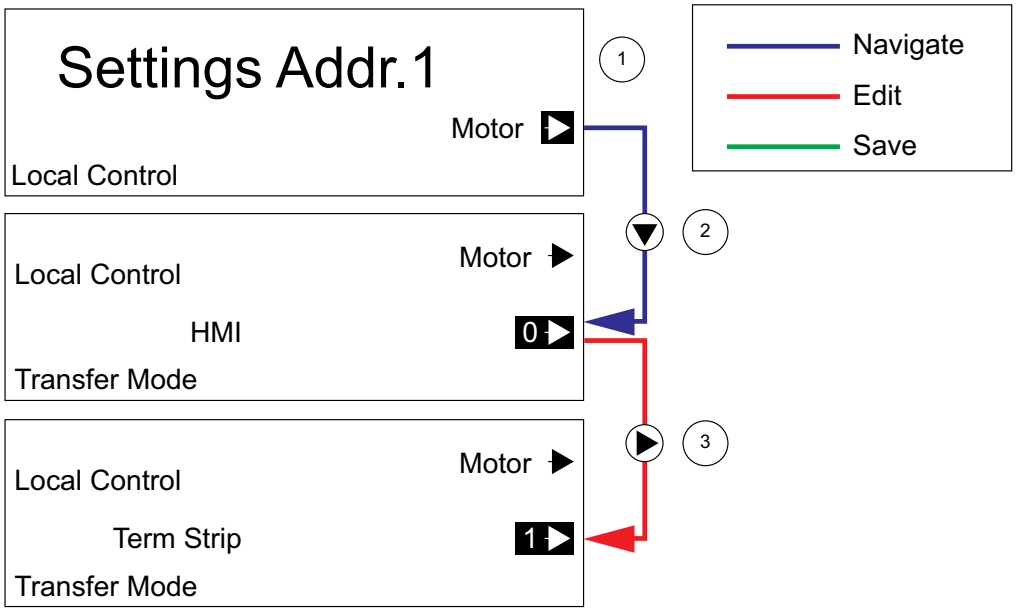
Use the HMI keypad , , , , , and buttons to edit setting values. There are three kinds of editable settings:

- Boolean
- Numeric
- Value list

Only settings that are displayed in the LCD can be edited. To display a setting, navigate to the page that contains the setting. With the correct page opened, you may need to scroll down to display the setting.

Boolean Settings

A boolean value setting includes a 0 or a 1 next to the ▶ at the right end of the text line. The following example shows you how to select and then edit a boolean value:



1 The Settings page opens with focus at the top line.

2 Click the **DOWN** button to scroll down to the Local Control setting (HMI). The boolean value (0) and command-line arrow blink, indicating focus.

3 Click the **RIGHT** arrow to toggle the Local Control setting to Term Strip and the boolean value to 1.

NOTE: An edited boolean value is saved when its value changes.

Numeric Settings

Numeric value settings are incremented or decremented, and can be edited in two ways:

- By selecting the entire setting and then incrementing or decrementing its value
- By selecting individual characters within the setting and then incrementing or decrementing the value of each digit.

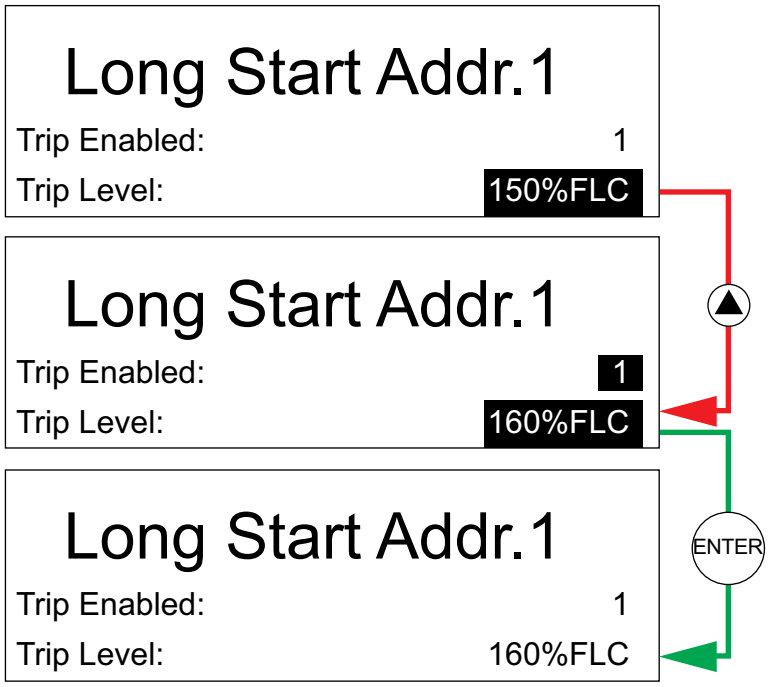
Use the MOD button to select the value to be edited, as follows:

1 The Long Start page opens with no setting selected for editing.

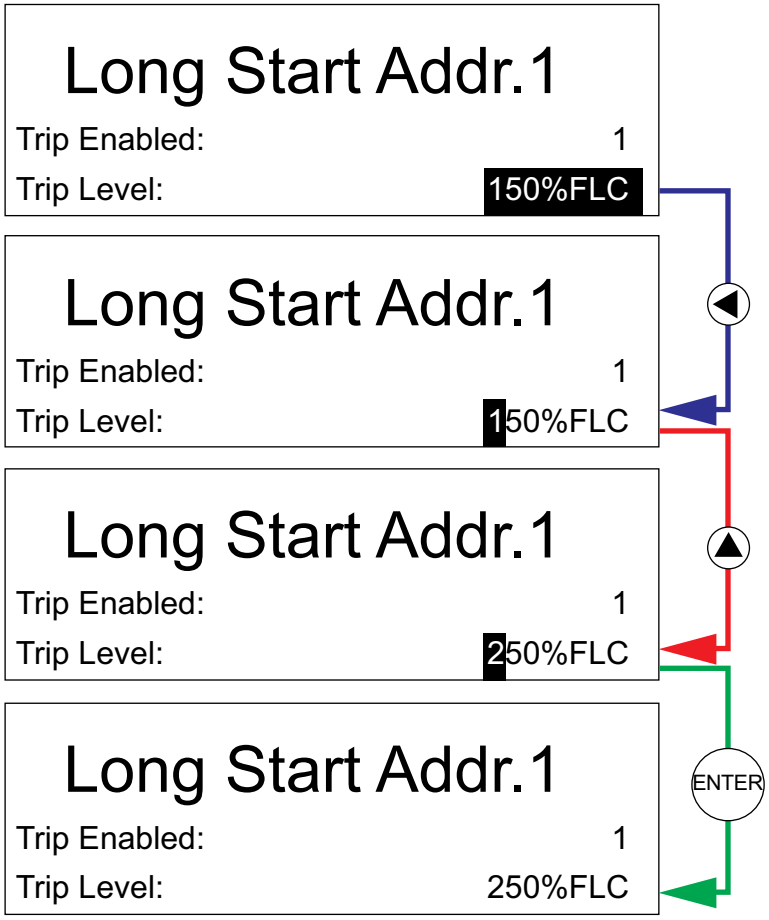
2 Click the **MOD** button once to select the first displayed numerical field for editing.

3 Click the **MOD** button a second time to select the next displayed numerical field for editing.

After a setting is selected for editing, you can use the ▲ and ▼ buttons to increment or decrement the entire value, then use the ENTER button to save the edit:

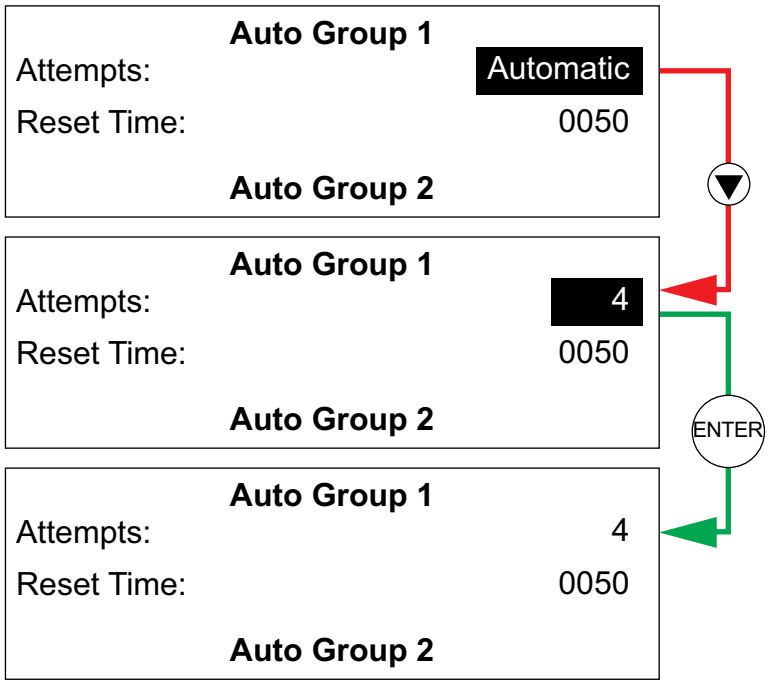


Alternatively after a setting is highlighted you can use the and buttons to select only a single character within a field and edit that character, as follows:



Value List Settings

In a few cases, a setting presents a list of value selections. Selecting a value from the list is very much like incrementing or decrementing the entire value of a numerical setting, as shown in the following figure:



Executing a Value Write Command (1-to-many)

Overview

The Magelis XBTN410 HMI, in 1-to-many configuration provides executable value write commands. A value write command immediately executes a task. The value write command line is identified by either a:

- ◀ v (at the left end of a command line, or)
- v ▶ (at the right end of a command line

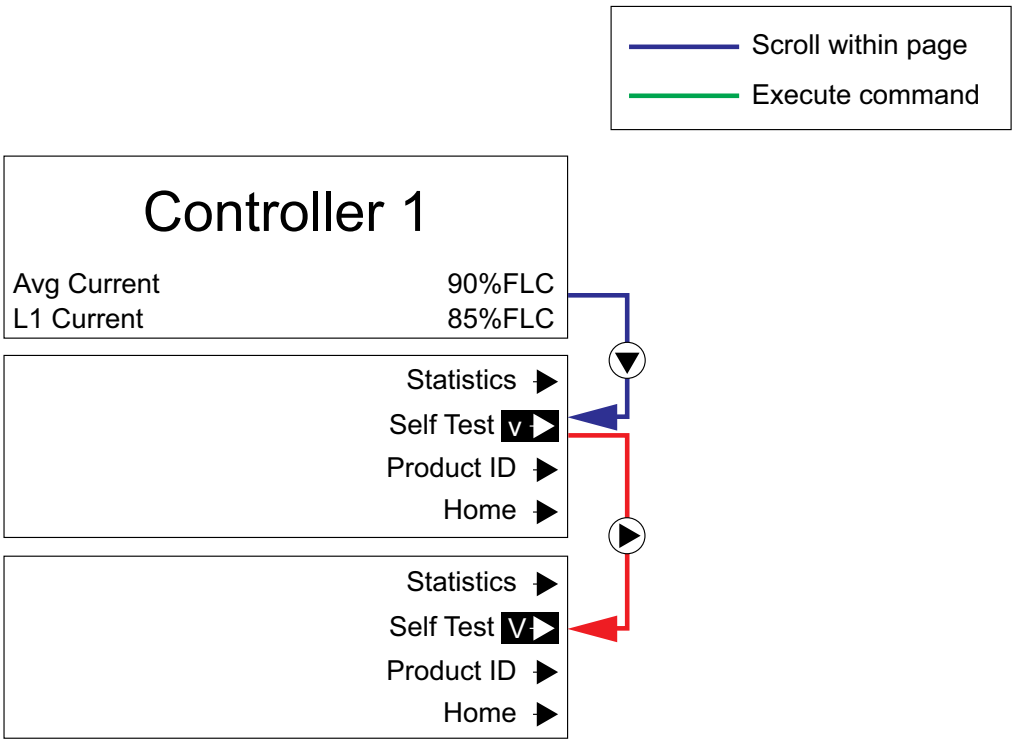
If a value write command is unsuccessful, the HMI displays a detected error message.

Value write commands include:

Value Write Command	Task	Location
Clear Settings	Clears settings and restores factory settings.	Reset to Defaults page
Clear Statistics	Clears statistics and restores factory settings.	
Self Test	Performs a self-test.	Controller page
Reset-Manual	Enables manual resetting of trips	Reset page
Reset-Remote	Enables remote resetting of trips	
Reset-Automatic	Enables automatic resetting of trips	

Example

Use the  or the  arrow key to execute a value write command. When a value write command executes, the lower case "v" next to the arrow becomes an upper case "V", as shown in the following figure, then quickly returns to a lower case "v" after the command executes:



Menu Structure (1-to-many)

Overview

The Magelis XBTN410 HMI 1-to-many menu structure is hierarchical in its design and consists of six levels of individual pages. The upper menu structure levels provide information and commands for the HMI itself and for all LTMR controllers connected to the HMI. The lower menu structure levels provide settings, statistics, and commands for a selected LTMR controller.

Menu Structure Outline

The Magelis XBTN410 HMI 1-to-many menu structure presents the following outline of levels and pages:

Level	Pages	Description
1	Home page	The starting page – navigation to all other pages begins here. Opens on start-up when no trips exist.
2	Controller currents page	• Displays average current as a percent of FLC for every LTMR controller. • Provides a link to each LTMR controller's menu structure.
	Controller status page	• Displays operating status (On, Off, Trip) for every LTMR controller. • Provides a link to each LTMR controller's menu structure.
	Trip pages	Displays a series of pages, each page describing an active trip. Opens automatically when a trip exists.
	Remote reset page	Executable commands for the remote reset of each LTMR controller.
	Reset to defaults page	Executable commands to reset statistics or settings for each LTMR controller.
	XBTN reference page	Describes communication settings, application program file, programming software version, and HMI firmware version.
3	Controller page	For a selected LTMR controller: • Displays dynamically changing parameter values • Self Test command • Links to its settings, statistics, and Product ID information.
4, 5, 6	Settings page and sub-pages	Contains configurable settings for a selected LTMR controller
	Statistics page and sub-pages	Presents statistics for a selected LTMR controller, including trip n-0 and trip n-1 history.
	Product ID page	LTMR controller and LTME expansion module part and firmware identification.

Menu Structure - Home Page (1-to-many)

Overview

The Home Page opens on HMI start-up when the Magelis XBTN410 is connected to 1 or more LTMR controllers-all of which are running without trips or alarms.

The Home page is the only page located in level 1 of the Magelis XBTN410 1-to-many menu structure. It is the starting place for navigation to all other levels and pages in the menu structure.

Home Page

The Home page contains the following menu items:

Menu Item	Description
TeSys T VX.X	Page header with LTMR controller firmware version.
IMPORTANT →	Links to a page with the following CAUTION message: 'Set HMI Port Endianess to LEndian to ensure that all values are correctly displayed'.
Controller currents →	Links to a page that displays average current and provides links to data and commands for each LTMR controller.
Controller status →	Links to a page that displays status (On, Off, Trip) and provides links to data and commands for each LTMR controller.
Trips →	Displays a series of trip messages.
Remote Reset →	Links to a page that displays the status of each LTMR controller; and provides a reset command for each LTMR controller.

Menu Item	Description
Reset to defaults →	Links to a page with commands that reset to factory settings each LTMR controller's statistics or settings.
XBTN Reference →	Links to a page that describes communication speed and parity, programming software, and LTMR controller firmware.

Menu Structure - All LTMR Controllers and the HMI (1-to-many)

Overview

Pages located in level 2 of the menu structure contain:

- Information and commands for up to eight connected LTMR controllers, or
- Trip information for all LTMR controllers, or
- Information about the Magelis XBTN410 HMI

All level 2 menu structure pages are accessible from the Home page.

Controller Currents Page

Use the Controller Currents page to monitor the Average Current Ratio for all connected LTMR controllers, and to navigate to other pages as described in the following table:

Level 2	Description
Controller Currents	–
← I1=XXXX% I5=XXXX% →	Opens the Controller page for the selected LTMR controller (1-8).
← I2=XXXX% I6=XXXX% →	
← I3=XXXX% I7=XXXX% →	
← I4=XXXX% I8=XXXX% →	
Controller status →	Opens the Controller Status page.
Remote reset →	Opens the Remote Reset page.
Home →	Returns to the Home page.

Controller Status Page

Use the Controller Status page to monitor the System On and System Trip status of all connected LTMR controllers, and to navigate to other pages as described in the following table:

Level 2	Description
Controller Status	–
← 1:Off 5:OffFLT →	Opens the Controller page for the selected controller (1-8).
← 2:Off 6:On →	
← 3:On FLT 7:Off →	
← 4:Off 8:Off →	

Level 2	Description
Controller currents →	Opens the Controller Currents page.
Remote reset →	Opens the Remote Reset page.
Home →	Returns to the Home page.

Trips Display

The Magelis XBTN410 HMI displays active trips in a series of pages-1 trip to a page-when:

- A trip occurs, and the display of active trips automatically opens
- You select Trips in the Home page and manually open the display of active trips.

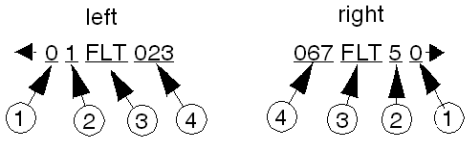
For information about trip management, including the trips display pages, refer to Trip Management (1-to-many), page 230.

Remote Reset Page

Use the Remote Reset page to remotely execute a Trip Reset Command for a tripped LTMR controller–for controller with Trip Reset Mode set to Remote, and to navigate to other pages:

Level 2	Description
Remote Reset	–
← 01FLT023 067FLT50 →	Executes a Trip Reset Command for the selected LTMR controller (1-8) if remote trip reset is enabled for that controller.
← 02FLT034 078FLT60 →	
← 03FLT045 089FLT70 →	
← 04FLT056 090FLT80 →	
Controller currents →	Opens the Controller Currents page.
Controller status →	Opens the Controller Status page.
Home →	Returns to the Home page.

Each of the first four lines of this page provides the following trip reset information at the indicated locations:



1 Trip reset bit (not significant)

2 LTMR controller number (1-8)

3 Trip status (ON, OFF, FLT)

4 Time to reset (seconds)

Reset to Defaults Page

The Reset to Defaults page provides the Clear Statistics Command and the Clear Controller Settings Command for each LTMR controller, as displayed in the following table:

Level 2	Description
Reset to defaults	–
◄ Stats 1 Settings ►	Clears statistics (left arrows) or settings (right arrows) for the selected LTMR controller (1-8), and restores factory settings.
◄ Stats 2 Settings ►	
◄ Stats 3 Settings ►	
◄ Stats 4 Settings ►	
◄ Stats 5 Settings ►	
◄ Stats 6 Settings ►	
◄ Stats 7 Settings ►	
◄ Stats 8 Settings ►	

XBTN Reference Page

The XBTN Reference page provides information about the HMI. The following is an example of information displayed in this page:

Level 2	Parameter Name/Description
XBTN Reference	–
MB Speed= 19200	HMI Port Baud Rate Setting
MB Parity= Even	HMI Port Parity Setting
LTM_1T8_E_Vx.xx.DOP	File name for the HMI application program
XX/XX/200X xx:xx:xx	Date of the HMI application program file
XBT-L1000= V 4.42	Version of the XBT 1000 software
Firmware= V 3.1	Version of the HMI firmware

Controller Page (1-to-many)

Overview

The Controller page presents information and commands for the LTMR controller that was selected in either the Controller Currents page or the Controller Status page. For more information, refer to Controller Currents Page, page 215.

The Controller page is the only page located in level 3 of the menu structure.

Use the Controller page to:

- Monitor dynamically changing current, voltage, and power values for a single, selected LTMR controller
- Navigate to editable parameter settings for an LTMR controller
- Navigate to read-only statistics and product information for an LTMR controller

- Execute the Self Test command for an LTMR controller

Controller Page

The Controller page displays dynamically changing parameter values, and contains the command lines, as follows:

Level 3	Parameter Name/Description
Controller 1-8	Page header indicating LTMR controller address (1-8).
Avg Current= xxxx%FLC	Average Current Ratio
L1 Current= xxxx%FLC	L1 Current Ratio
L2 Current= xxxx%FLC	L2 Current Ratio
L3 Current= xxxx%FLC	L3 Current Ratio
GRCurr= xxxx.x%FLCmin	Ground Current Ratio
Curr Ph Imb= xxx%Imb	Current Phase Imbalance
Th Capacity= xxxxx%	Thermal Capacity Level
Time To Trip= xxxxSec	Time To Trip
Avg Voltage= xxxx%FLCmin	Average Voltage
L1-L2 Volts= xxxxxV	L1-L2 Voltage
L2-L3 Volts= xxxxxV	L2-L3 Voltage
L3-L1 Volts= xxxxxV	L3-L1 Voltage
Volt Ph Imb= xxx%Imb	Voltage Phase Imbalance
Power Factor= xx.xx	Power Factor
Active Pwr= xxxx.xkW	Active Power
React Pwr= xxxx.xkVAR	Reactive Power
Temp Sensor= xxxx.xΩ	Motor Temp Sensor
Settings →	Links to editable settings for the LTMR controller.
Statistics →	Links to read-only statistics for the LTMR controller.
Self Test v →	Executes the Self Test command.
Product ID →	Links to product reference numbers and firmware versions for the LTMR controller and expansion module.
Home →	Returns to the Home page.

Settings (1-to-many)

Overview

The Magelis XBTN410 HMI provides several pages of editable parameter settings, nested in levels 4, 5, and 6 of the menu structure. The settings page is your starting place for locating and editing settings, including:

- Motor
- Local control
- Transfer mode

- Reset (trip)
- Current
- Voltage
- Power
- Load shed
- Rapid cycle lockouts
- Communication loss

The settings page is located in level 4 of the menu structure. To navigate to the settings page, use one of the following paths:

Level	From this Page...	Select...
1	Home page	Controller currents, or Controller status
2	Controller Currents page, or Controller Status page	LTMR controller number
3	Controller page	Settings

Motor, Control, and Transfer Settings

Use the settings page to navigate to and edit the following motor, local control and transfer mode settings:

Level 4	Level 5	Parameter Name
Settings Addr. 1-8		–
Motor	Nom Voltage	Motor Nominal Voltage
	Nom Power (kW)	Motor Nominal Power (expressed in kW)
	Nom Power (hp)	Motor Nominal Power (expressed in hp)
	DirTrans	Control Direct Transition
	TransTime	Motor Transition Timeout
	2-step Level	Motor Step 1 to 2 Threshold
	2-step Time	Motor Step 1 to 2 Timeout
	Aux Fan	Motor Auxiliary Fan Cooled
	TEMP SENSOR	–
	Trip	Motor Temp Sensor Trip Enable
	Trip Level	Motor Temp Sensor Trip Threshold
	Warn	Motor Temp Sensor Alarm Enable
	Warn Level	Motor Temp Sensor Alarm Threshold
Local Control		Control Local Channel Setting
Transfer Mode		Control Transfer Mode

Trip Reset Settings

Use the settings page to navigate to and edit the following trip reset settings:

Level 4	Level 5	Parameter Name
Settings Addr.1-8		–
Reset	Manual	Trip Reset Mode
	Remote	
	Automatic	
	Net Port	Network Port Endian Setting
	AUTO GROUP 1	–
	Attempts	Auto-Reset Attempts Group 1 Setting
	Reset Time	Auto-Reset Group 1 Timeout
	AUTO GROUP 2	–
	Attempts	Auto-Reset Attempts Group 2 Setting
	Reset Time	Auto-Reset Group 2 Timeout
	AUTO GROUP 3	–
	Attempts	Auto-Reset Attempts Group 3 Setting
	Reset Time	Auto-Reset Group 3 Timeout

Current Settings

From the settings page, you can navigate to and edit the following current settings:

Level 4	Level 5	Level 6	Parameter Name
Settings Addr.1-8			**–**
Current	Th Overload	Trip	Thermal Overload Trip Enable
		FLC1-OC1	Motor Full Load Current Ratio
		FLC2-OC2	Motor High-Speed Full Load Current Ratio
		Trip Class	Motor Trip Class
		Reset Level	Thermal Overload Trip Reset Threshold
		Def O-Time	Thermal Overload Trip Definite Timeout (O-Time)
		Def D-Time	Long Start Trip Timeout (D-Time)
		Warn	Thermal Overload Alarm Enable
		Warn Level	Thermal Overload Alarm Threshold
	Phase Imb/Loss/Rev	CURR PH IMB	–
		Trip	Current Phase Imbalance Trip Enable
		Trip Level	Current Phase Imbalance Trip Threshold
		FltTimeStrt	Current Phase Imbalance Trip Timeout Starting
		FltTimeRun	Current Phase Imbalance Trip Timeout Running
		Warn	Current Phase Imbalance Alarm Enable
		Warn Level	Current Phase Imbalance Alarm Threshold
		CURR PH LOSS	–
		Trip	Current Phase Loss Trip Enable
		Trip Time	Current Phase Loss Timeout
		Warn	Current Phase Loss Alarm Enable
		CURR PH REV	–
		Trip	Current Phase Reversal Trip Enable
	Long Start	Trip	Long Start Trip Enable
		Trip Level	Long Start Trip Threshold
		Trip Time	Long Start Trip Timeout
	Jam	Trip	Jam Trip Enable
		Trip Level	Jam Trip Threshold
		Trip Time	Jam Trip Timeout
		Warn	Jam Alarm Enable
		Warn Level	Jam Alarm Threshold

Level 4	Level 5	Level 6	Parameter Name
Settings Addr.1-8			**–**
Current (continued)	Under/Over Curr	UNDER CURR	–
		Trip	Undercurrent Trip Enable
		Trip Level	Undercurrent Trip Threshold
		Trip Time	Undercurrent Trip Timeout
		Warn	Undercurrent Alarm Enable
		Warn Level	Undercurrent Alarm Threshold
		OVER CURR	–
		Trip	Overcurrent Trip Enable
		Trip Level	Overcurrent Trip Threshold
		Trip Time	Overcurrent Trip Timeout
		Warn	Overcurrent Alarm Enable
		Warn Level	Overcurrent Alarm Threshold
	Ground Current	Trip	Ground Current Mode
		IntFltLvl	Internal Ground Current Trip Threshold
		IntFltTime	Internal Ground Current Trip Timeout
		ExtFltLvl	External Ground Current Trip Threshold
		ExtFltTime	External Ground Current Trip Timeout
		Warn	Ground Current Alarm Enable
		IntWarnLvl	Internal Ground Current Alarm Threshold
		ExtWarnLvl	External Ground Current Alarm Threshold

Voltage Settings

From the settings page, you can navigate to and edit the following voltage settings:

Level 4	Level 5	Level 6	Parameter Name
Settings Addr.1-8			**–**
Voltage	Phase Imb/Loss/Rev	VOLT PH IMB	–
		Trip	Voltage Phase Imbalance Trip Enable
		Trip Level	Voltage Phase Imbalance Trip Threshold
		FltTimeStart	Voltage Phase Imbalance Trip Timeout Starting
		FltTimeRun	Voltage Phase Imbalance Trip Timeout Running
		Warn	Voltage Phase Imbalance Alarm Enable
		Warn Level	Voltage Phase Imbalance Alarm Threshold
		VOLT PH LOSS	–
		Trip	Voltage Phase Loss Trip Enable
		Trip Time	Voltage Phase Loss Trip Timeout
		Warn	Voltage Phase Loss Alarm Enable
		VOLT PH REV	–
		Trip	Voltage Phase Reversal Trip Enable
	Under/Over Voltage	UNDER VOLT	–
		Trip	Undervoltage Trip Enable
		Trip Level	Undervoltage Trip Threshold
		Trip Time	Undervoltage Trip Timeout
		Warn	Undervoltage Alarm Enable
		Warn Level	Undervoltage Alarm Threshold
		OVER VOLT	–
		Trip	Overvoltage Trip Enable
		Trip Level	Overvoltage Trip Threshold
		Trip Time	Overvoltage Trip Timeout
		Warn	Overvoltage Alarm Enable
		Warn Level	Overvoltage Alarm Threshold

Power Settings

From the settings page, you can navigate to and edit the following power settings:

Level 4	Level 5	Level 6	Parameter Name
Settings Addr.1-8			**–**
Power	Under/Over Power	UNDER POWER	–
		Trip	Underpower Trip Enable
		Trip Level	Underpower Trip Threshold
		Trip Time	Underpower Trip Timeout Starting
		Warn	Underpower Alarm Enable
		Warn Level	Underpower Alarm Threshold
		OVER POWER	–
		Trip	Overpower Trip Enable
		Trip Level	Overpower Trip Threshold
		Trip Time	Overpower Trip Timeout
		Warn	Overpower Alarm Enable
		Warn Level	Overpower Trip Enable
	Under/Over PowFact	UNDER POW FACTOR	–
		Trip	Under Power Factor Trip Enable
		Trip Level	Under Power Factor Trip Threshold
		Trip Time	Under Power Factor Trip Timeout
		Warn	Under Power Factor Alarm Enable
		Warn Level	Under Power Factor Alarm Threshold
		OVER POW FACTOR	–
		Trip	Over Power Factor Trip Enable
		Trip Level	Over Power Factor Trip Threshold
		Trip Time	Over Power Factor Trip Timeout
		Warn	Over Power Factor Alarm Enable
		Warn Level	Over Power Factor Alarm Threshold

Load Shed, Diagnostic, Rapid Cycle Lockouts, Communication Ports Settings

From the settings page, you can navigate to and edit the following load shed, diagnostic, rapid cycle lockout, and communication ports settings:

Level 4	Level 5	Parameter Name
Settings Addr.1-8		**–**
Load Shed	Trip	Load Shedding
	Trip Level	Voltage Dip Threshold
	Trip Time	Load Shedding Timeout
	RestartLvl	Voltage Dip Restart Threshold
	RestartTime	Voltage Dip Restart Timeout
Diagnostic	DIAG TRIP	
	Trip	Diagnostic Trip Enable
	Warn	Diagnostic Alarm Enable
	WIRING CT REVERSAL	
	Trip	Wiring trip enable
Rapid Cycle Lockout Time		Rapid Cycle Lockout Timeout
Comm Ports	Net Port	Network Port Endian Setting
	HMI Port	HMI Port Endian Setting
	NET PORT COMM LOSS	–
	Trip	Network Port Trip Enable
	Trip Time	Network Port Comm Loss Timeout
	Warn	Network Port Alarm Enable
	HMI PORT COMM LOSS	–
	Trip	HMI Port Trip Enable
	Warn	HMI Port Alarm Enable

Statistics (1-to-many)

Overview

The Magelis XBTN410 HMI provides read-only statistics pages–nested in levels 4 and 5 of the menu structure–for a selected LTMR controller.

To navigate to the statistics page, use one of the following paths:

Level	From this Page...	Select...
1	Home page	Controller currents, or Controller status
2	Controller Currents page, or Controller Status page	LTMR controller number
3	Controller page	Statistics

Statistics

From the settings page, you can navigate to and read the following statistics:

Level 4	Level 5	Parameter Name
Statistics Addr. 1-8		**–**
CntrlTempMax		Controller Internal Temperature Max
OperTime		Operating Time
MtrStarts		Motor Starts Count
LastStartDur		Motor Last Start Duration
LastStart		Motor Last Start Current
All Trips		Trips Count
Th Ovld Flt		Thermal Overload Trips Count
Th Ovld Warn		Thermal Overload Alarms Count
Curr Imb Flt		Current Phase Imbalance Trips Count
LongStart Flt		Long Start Trips Count
UnderCurr Flt		Undercurrent Trips Count
Ground Current Trips		Ground Current Trips Count
VoltPhImb Flt		Voltage Phase Imbalance Trips Count
Under Volt Flt		Undervoltage Trips Count
Over Volt Flt		Overvoltage Trips Count
HMI Loss Flt		HMI Port Trips Count
Ntwk Int Flt		Network Port Internal Trips Count
Ntwk Cnfg Flt		Network Port Config Trips Count
Ntwk Port Flt		Network Port Trips Count
Cntrl Int Flt		Controller Internal Trips Count
InterPort Flt		Internal Port Trips Count

Level 4	Level 5	Parameter Name
Statistics Addr. 1-8		**–**
Trip n-0	Trip Code	Trip Code n-0
	Date (MMDDYYYY)	Date And Time n-0
	Time (HHMMSS)	Date And Time n-0
	FLC Ratio	Motor Full Load Current Ratio n-0
	FLC Max	Motor Full Load Current Max n-0
	Avg Current	Average Current n-0
	L1 Current	L1 Current Ratio n-0
	L2 Current	L2 Current Ratio n-0
	L3 Current	L3 Current Ratio n-0
	GRCurr	Ground Current Ratio n-0
	Curr Ph Imb	Current Phase Imbalance n-0
	Th Capacity	Thermal Capacity Level n-0
	Avg Volts	Average Voltage n-0
	L1-L2 Volts	L1-L2 Voltage n-0
	L2-L3 Volts	L2-L3 Voltage n-0
	L3-L1 Volts	L3-L1 Voltage n-0
	Volt Ph Imb	Voltage Phase Imbalance n-0
	Frequency	Frequency n-0
	Active Pwr	Active Power n-0
	Power Factor	Power Factor n-0
	Temp Sensor	Motor Temp Sensor n-0

Level 4	Level 5	Parameter Name
Statistics Addr. 1-8		**–**
Trip n-1	Trip Code	Trip Code n-1
	Date (MMDDYYYY)	Date And Time n-1
	Time (HHMMSS)	Date And Time n-1
	FLC Ratio	Motor Full Load Current Ratio n-1
	FLC Max	Motor Full Load Current Max n-1
	Avg Current	Average Current n-1
	L1 Current	L1 Current Ratio n-1
	L2 Current	L2 Current Ratio n-1
	L3 Current	L3 Current Ratio n-1
	GRCurr	Ground Current Ratio n-1
	Curr Ph Imb	Current Phase Imbalance n-1
	Th Capacity	Thermal Capacity Level n-1
	Avg Volts	Average Voltage n-1
	L1-L2 Volts	L1-L2 Voltage n-1
	L2-L3 Volts	L2-L3 Voltage n-1
	L3-L1 Volts	L3-L1 Voltage n-1
	Volt Ph Imb	Voltage Phase Imbalance n-1
	Frequency	Frequency n-1
	Active Pwr	Active Power n-1
	Power Factor	Power Factor n-1
	Temp Sensor	Motor Temp Sensor n-1

Product ID (1-to-many)

Overview

The Magelis XBTN410 HMI provides a description of the product number and firmware for both the LTMR controller and LTME expansion module.

To navigate to the Product ID page, use one of the following paths:

Level	From this Page...	Select...
1	Home page	Controller currents, or Controller status
2	Controller Currents page, or Controller Status page	LTMR controller number
3	Controller page	Product ID

Product ID

In the Product ID page, you can read the following information about the LTMR controller and LTME expansion module:

Level 4	Parameter Name/Description
Product ID Addr. 1-8	**–**
Controller Catalog Ref	Controller Commercial Reference (product number)
Controller Firmware	Controller Firmware Version
Exp Module Catalog Ref	Expansion Commercial Reference (product number)
Exp Module Firmware	Expansion Firmware Version
Network Type	Network Port ID Code
Network Firmware	Network Port Firmware Version

Monitoring (1-to-many)

Overview

Use the Magelis XBTN410 HMI, in a 1-to-many configuration, to monitor:

- Operating status and average current for multiple LTMR controllers, or
- Current, voltage, and power parameters for a selected LTMR controller.

Monitoring Multiple LTMR Controllers

Navigate to the following pages to simultaneously monitor these dynamically changing values for all LTMR controllers:

Page	Value
Controller currents page	Average current ratio
Controller status page	Operating status (On, Off, Trip)

For more information on both pages, refer to Controller Currents Page, page 215.

Monitoring a Single LTMR Controller

Navigate to the Controller page for a selected LTMR controller to monitor the dynamically changing values of the following parameters:

- Current:
  - Average Current Ratio
  - L1 Current Ratio
  - L2 Current Ratio
  - L3 Current Ratio
  - Ground Current Ratio
  - Current Phase Imbalance
- Thermal
  - Thermal Capacity Level
  - Time To Trip
  - Motor Temp Sensor

- Voltage
  - Average Voltage
  - L1-L2 Voltage
  - L2-L3 Voltage
  - L3-L1 Voltage
  - Voltage Phase Imbalance
- Power
  - Power Factor
  - Active Power
  - Reactive Power

For more information on the Controller page, refer to Controller Page (1-to-many), page 217.

Trip Management (1-to-many)

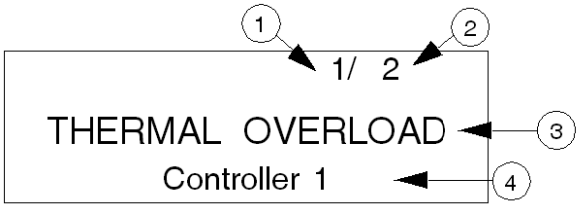
Overview

When a trip occurs, the Magelis XBTN410 HMI automatically opens a trip display, consisting of one page for each active trip. Each page contains the:

- Trip name
- Address of the LTMR controller experiencing the trip
- Total number of unresolved trips

Trip Display Pages

A typical trip display page looks like this:



1 Trip display page number

2 Total number of active trips

3 Trip name (flashing)

4 Address of LTMR controller experiencing the trip (flashing)

If more than one trip is active, use the  and  keypad buttons to move back and forth through the trip display pages.

Because some trip messages contain more than four lines of text, you may need to use the  and  keypad buttons to scroll up and down within a trip display page and display the entire trip message.

Opening/Closing the Trip Display

The 1-to-many HMI automatically opens the trip display whenever a trip occurs. When you remove the cause of a specific trip and execute a trip reset command, that trips no longer appears in the trip display.

You can also close the trip display by clicking the 

keypad button. This does not fix the underlying cause of any trip, nor it does not clear any trip. You can reopen the trip display at any time by navigating to the Home page, scrolling to the Trips command line, then clicking the  keypad button.

If you open the trip display when no trips are active, the HMI displays the message "**No Trips Present**".

Magelis XBT Communication Loss

If a key is pressed while the Magelis XBT HMI device loses communication, the keypad update will not be complete. When the communication with the LTMR is back, the following message displays: "**#203 Cannot connect to controller**". Press any key or power cycle the device.

Service Commands (1-to-many)

Overview

The Magelis XBTN410, in 1-to-many configuration, provides the following service commands:

Command	Description	Location/Reference
Self Test	Performs an internal check of the LTMR controller and LTME expansion module.	Level 3, Controller page. Refer to Controller Page, page 218.
Reset to Defaults: Statistics	Executes the Clear Statistics Command for a selected LTMR controller.	Level 2, Reset to Defaults page. Refer to Reset to Defaults Page, page 217.
Reset to Defaults: Settings	Executes the Clear Controller Settings Command for a selected LTMR controller.	Level 2, Reset to Defaults page. Refer to Reset to Defaults Page, page 217.
Remote Reset	Performs remote trip reset for a selected LTMR controller	Level 2, Remote Reset page. Refer to Remote Reset Page, page 216

Using SoMove with the TeSys T DTM

Overview

The following topics show you how to use the LTMR controller when it is connected to a PC running SoMove with the TeSys T DTM.

Presentation of SoMove with the TeSys T DTM

Aim of the Software

SoMove software is a Microsoft Windows-based application, using the open FDT/DTM technology.

SoMove contains DTMs for different devices. The TeSys T DTM is a specific DTM that enables the configuration, monitoring, control, and customization of the control functions of the LTMR controller, as part of the TeSys T motor management system.

Functions

The TeSys T DTM can be used to:

- Configure parameters for the LTMR controller,
- Display information about the LTMR controller configuration and operation,
- Display the status of trips and alarms in the LTMR controller,
- Control the motor,
- Customize operating modes.

For More Information

Refer to the *TeSys T DTM for SoMove FDT Container Online Help* embedded in the DTM software.

Installing SoMove and the TeSys DTM Library

Overview

The installation of SoMove includes some DTMs such as the TeSys DTM library.

The TeSys DTM library includes:

- TeSys T DTM
- TeSys U DTM

These DTM are automatically installed during the SoMove installation process.

Downloading SoMove

SoMove can be downloaded from the Schneider Electric website (www.se.com) by entering `SoMove Lite` in the **Search** field.

Installing SoMove

Step	Action
1	Unzip the downloaded file: the SoMove file is unzipped in a folder named *SoMove_Lite - V.X.X.X.X* (where X.X.X.X is the version number). Open this folder and double-click **setup.exe**.
2	In the **Choose Setup Language** dialog box, select the installation language.
3	Click **OK**.

Step	Action
4	In the **Welcome to the Installation Wizard for SoMove Lite** dialog box, click the **Next** button.
5	If an **Install Shield Wizard** dialog box appears and informs you that you must install Modbus driver, click the **Install** button. **Result:** Modbus driver is installed automatically.
6	In the **Readme and Release Notes** dialog box, click the **Next** button.
7	In the **Readme** dialog box, click the **Next** button.
8	In the **License Agreement** dialog box: • Read carefully the license agreement. • Select **I accept the terms** in the license agreement option. • Click the **Next** button.
9	In the **Customer Information** dialog box: • Enter the following information in the corresponding fields: ◦ First name ◦ Last name ◦ Company name • Select an installation option: ◦ Either the **Anyone who uses this computer** option if SoMove Lite is used by all users of this computer, or ◦ **Only for me** if SoMove Lite is used only by you. • Click the **Next** button.
10	In the **Destination Folder** dialog box: • If necessary, modify the SoMove Lite destination folder by clicking the **Change** button. • Click the **Next** button.
11	In the **Shortcuts** dialog box: • If you want to create a shortcut on the desktop and/or in the quick launch bar, select the corresponding options. • Click the **Next** button.
12	In the **Ready to Install the Program** dialog box, click the **Install** button. **Result:** The SoMove Lite components are installed automatically: • Modbus communication DTM library which contains the communication protocol • DTM libraries which contain different drive catalogs • SoMove Lite itself
13	In the **Installation Wizard Completed** dialog box, click the **Finish** button. **Result:** SoMove Lite is installed on your computer.

Appendix

This appendix presents technical data related to the LTMR controller and the LTME expansion module.

Technical Specifications of the LTMR Controller

Technical Specifications

The LTMR controller meets the following specifications:

Certification[7]	UL, CSA, IEC, CTIC'K, CCC, NOM, EAC, IACS E10 (BV, DNV-GL, RINA, ABS), ATEX		
Conformity to Standards	IEC/EN 60947-4-1, UL 60947-4-1, CSA C22.2 no. 60947-4-1, IACS E10		
European Community directives	CE marking, satisfies the essential requirements of the low voltage (LV) and electromagnetic compatibility (EMC) directives.		
Rated insulation voltage (Ui)	According to IEC/EN 60947-1	Overvoltage category III, degree of pollution: 3	690 V
	According to UL 60947-4-1, CSA C22.2 no. 60947-4-1		600 V
Rated impulse withstand voltage (Uimp)	According to IEC60947-1 8.3.3.4.1 paragraph 2	220 V power, input, and output circuits	4.8 kV
		24 V power, input, and output circuits	0.91 kV
		Communication circuits	0.91 kV
		PTC and GF circuits	0.91 kV
Withstand to short-circuit	According to IEC60947-4-1		100 kA
Degree of protection	According to IEC60947-1 (protection against direct contact)		IP20
Protective treatment	IEC/EN 60068		"TH"
	IEC/EN 60068-2-30	Cycle humidity	12 cycles
	IEC/EN 60068-2-11	Salt spray	48 h
Ambient air temperature around the device	Storage		-40…+80 °C (-40…176 °F)
	Operation		-20…+60 °C (-4…140 °F)
Maximum operating altitude	Derating accepted		4500 m (14,763 ft)
	Without derating		2000 m (6,561 ft)
Fire resistance	According to UL 94		V2
	According to IEC60695-2-1	(Parts supporting live components)	960 °C (1,760 °F)
		(Other components)	650 °C (1,202 °F)
Half-sine mechanical shock pulse = 11 ms	According to IEC60068-2-27[8]		15 gn
Resistance to vibration	According to IEC60068-2-6[8]	Panel mounted	4 gn
		DIN rail mounted	1 gn
Immunity to electrostatic discharge	According to EN61000-4-2	Through air	8 kV level 3
		Over surface	6 kV level 3

7. Some certifications are in progress.
8. Without modifying the state of the contacts in the least favorable direction.

Immunity to radiated fields	According to EN61000-4-3		10 V/m level 3
Immunity to fast transient bursts	According to EN61000-4-4	On power lines and relay outputs	4 kV level 4
		All other circuits	2 kV level 3
Immunity to radioelectric fields	According to EN61000-4-6[9]		10 V rms level 3
Surge immunity	According to IEC/EN 61000-4-5	Common mode	Differential mode
	Power lines and relay outputs	4 kV (12 Ω/9 F)	2 kV (2 Ω/18 F)
	24 Vdc inputs and power	1 kV (12 Ω/9 F)	0.5 kV (2 Ω/18 F)
	100...240 Vac inputs and power	2 kV (12 Ω/9 F)	1 kV (2 Ω/18 F)
	Communication	2 kV (12 Ω/18 F)	–
	Temperature sensor (IT1/IT2)	1 kV (42 Ω/0.5 F)	0.5 kV (42 Ω/0.5 F)

Control Voltage Characteristics

The LTMR controller has the following control voltage characteristics:

Control Voltage		**24 Vdc**	**100...240 Vac**
Power consumption	According to IEC/EN 60947-1	56...127 mA	8...62.8 mA
Control voltage range	According to IEC/EN 60947-1	20.4...26.4 Vdc	93.5...264 Vac
Overcurrent protection		24 V fuse 0.5 A gG	100...240 V fuse 0.5 A gG
Resistance to Microbreaks		3 ms	3 ms
Resistance to voltage dips	According to IEC/EN 61000-4-11	70% of UC min. for 500 ms	70% of UC min. for 500 ms

Logic Inputs Characteristics

Nominal input values		Voltage	24 Vdc	100...240 Vac
		Current	7 mA	• 3.1 mA at 100 Vac • 7.5 mA at 240 Vac
Input limit values	At state 1	Voltage	15 V minimum	79 V < V < 264 V
		Current	2 mA min to 15 mA max	2 mA min. at 110 Vac to 3 mA min. at 220 Vac
	At state 0	Voltage	5 V maximum	0 V < V < 40 V
		Current	15 mA maximum	15 mA maximum
Response time	Change to state 1		15 ms	25 ms
	Change to state 0		5 ms	25 ms
IEC 61131-1 conformity			Type 1	Type 1
Type of input			Resistive	Capacitive

9. This product has been designed for use in environment A. Use of this product in environment B may cause unwanted electromagnetic disturbance, which may require the implementation of adequate mitigation measures.

Logic Outputs Characteristics

Rated insulation voltage	300 V
AC rated thermal load	250 Vac / 5 A
DC rated thermal load	30 Vdc / 5 A
AC 15 rating	480 VA, 500,000 operations, Ie max = 2 A
DC 13 rating	30 W, 500,000 operations, Ie max = 1.25 A
Associated fuse protection	gG at 4 A
Maximum operating rate	1,800 cycles/h
Maximum frequency	2 Hz (2 cycles/s)
Response time closing	< 10 ms
Response time opening	< 10 ms
Contact rating	B300

Altitude Derating

The following table provides the deratings to apply for dielectric strengths and maximum operating temperature according to altitude.

Corrective Factors for Altitude	**2000 m (6,561.68 ft)**	**3000 m (9,842.52 ft)**	**3500 m (11,482.94 ft)**	**4000 m (13,123.36 ft)**	**4500 m (14,763.78 ft)**
Dielectric Strength Ui	1	0.93	0.87	0.8	0.7
Max Operating Temperature	1	0.93	0.92	0.9	0.88

Technical Specifications of the LTME Expansion Module

Technical Specifications

The LTME expansion module meets the following specifications:

Certifications[10]	UL, CSA, IEC, CTIC'K, CCC, NOM, EAC, IACS E10 (BV, DNV-GL, RINA, ABS), ATEX		
Conformity to Standards	IEC/EN 60947-4-1, UL 60947-4-1, CSA C22.2 no. 60947-4-1, IACS E10		
European Community directives	CE marking. Satisfies the essential requirements of the low voltage (LV) and electromagnetic compatibility (EMC) directives.		
Rated insulation voltage (Ui)	According to IEC/EN 60947-1	Overvoltage category III, degree of pollution: 3	690 V UI on voltage inputs
	According to UL 60947-4-1, CSA C22.2 no. 60947-4-1		600 V UI on voltage inputs
Rated impulse withstand voltage (Uimp)	According to IEC60947-1 8.3.3.4.1 Paragraph 2	220 V inputs circuits	4.8 kV
		24 V inputs circuits	0.91 kV
		Communication circuits	0.91 kV
		Voltage input circuits	7.3 kV
Degree of protection	According to 60947-1 (protection against direct contact)		IP20

10. Some certifications are in progress.

Protective treatment	IEC/EN 60068		"TH"
	IEC/EN 60068-2-30	Cycle humidity	12 cycles
	IEC/EN 60068-2-11	Salt spray	48 h
Ambient air temperature around the device	Storage		-40…+80 °C (-40…176 °F)
	Operation[11]	>40 mm (1.57 inches) spacing	-20…+60 °C (-4…140 °F)
		<40 mm (1.57 inches) but >9 mm (0.35 inches) spacing	-20…+55 °C (-4…131 °F)
		<9 mm (0.35 inches) spacing	-20…+45 °C (-4…113 °F)
Maximum operating altitude	Derating accepted		4500 m (14,763 ft)
	Without derating		2000 m (6,561 ft)
Fire resistance	According to UL 94		V2
	According to IEC60695-2-1	(Parts supporting live components)	960 °C (1,760 °F)
		(Other components)	650 °C (1,202 °F)
Half-sine mechanical shock pulse = 11 ms	According to IEC60068-2-27[12]		30 g three axis and six directions
Resistance to vibration	According to IEC60068-2-6[12]		5 gn
Immunity to electrostatic discharge	According to EN61000-4-2	Through air	8 kV Level 3
		Over surface	6 kV Level 3
Immunity to radiated fields	According to EN61000-4-3		10 V/m Level 3
Immunity to fast transient bursts	According to EN61000-4-4	All circuits	4 kV Level 4 2 kV on all other circuits
Immunity to radioelectric fields	According to EN61000-4-6[13]		10 V rms Level 3
Surge immunity	According to IEC/EN 61000-4-5	Common mode	Differential mode
	100...240 Vac inputs	4 kV (12 Ω)	2 kV (2 Ω)
	24 Vdc inputs	1 kV (12 Ω)	0.5 kV (2 Ω)
	Communication	1 kV (12 Ω)	–

Logic Inputs Characteristics

Control Voltage			**24 Vdc**	**115...230 Vac**
Nominal input values		Voltage	24 Vdc	100...240 Vac
		Current	7 mA	• 3.1 mA at 100 Vac • 7.5 mA at 240 Vac
Input limit values	At state 1	Voltage	15 V maximum	79 V < V < 264 V
		Current	2 mA min to 15 mA max	2 mA min. at 110 Vac to 3 mA min. at 220 Vac
	At state 0	Voltage	5 V maximum	0 V < V < 40 V
		Current	15 mA maximum	15 mA maximum

11. The maximum rated ambient temperature of the LTME expansion module depends on the installation spacing with the LTMR controller.
12. Without modifying the state of the contacts in the least favorable direction.
13. NOTE: This product has been designed for use in environment A. Use of this product in environment B may cause unwanted electromagnetic disturbance, which may require the implementation of adequate mitigation measures.

Control Voltage		24 Vdc	115...230 Vac
Response time	Change to state 1	15 ms (input only)	25 ms (input only)
	Change to state 0	5 ms (input only)	25 ms (input only)
IEC61131-1 conformity		Type 1	Type 1
Type of input		Resistive	Capacitive

Altitude Derating

The following table provides the deratings to apply for dielectric strengths and maximum operating temperature according to altitude.

Corrective Factors for Altitude	2000 m (6,561.68 ft)	3000 m (9,842.52 ft)	3500 m (11,482.94 ft)	4000 m (13,123.36 ft)	4500 m (14,763.78 ft)
Dielectric Strength Ui	1	0.93	0.87	0.8	0.7
Max Operating Temperature	1	0.93	0.92	0.9	0.88

Characteristics of the Metering and Monitoring Functions

Measurement

Parameter	Accuracy[14]	Value Saved on Power Loss
L1 current (A) L2 current (A) L3 current (A) L1 current ratio (% FLC) L2 current ratio (% FLC) L3 current ratio (% FLC)	• +/– 1% for 8 A and 27 A models • +/– 2% for 100 A models	No
Ground current ratio (% FLCmin)	• Internal ground current: +/– 10...20% for ground current greater than: ◦ 0.1 A on 8 A models ◦ 0.2 A on 27 A models ◦ 0.3 A on 100 A models • External ground current: greater of +/– 5% or +/– 0.01 A	No
Average current (A) Average current ratio (% FLCmin)	• +/– 1% for 8 A and 27 A models • +/– 2% for 100 A models	No
Current phase imbalance (% imb)	• +/– 1.5% for 8 A and 27 A models • +/– 3% for 100 A models	No
Thermal capacity level (% trip level)	+/– 1%	No
Time to trip (s)	+/– 10%	No
Minimum wait time (s)	+/– 1%	No
Motor temperature sensor (Ω)	+/– 2%	No

14. The accuracy levels presented in this table are typical accuracy levels. Actual accuracy levels may be lower or greater than these values.

Parameter	Accuracy[15]	Value Saved on Power Loss
Controller internal temperature (°C)	+/– 4%	No
Frequency (Hz)	+/– 2%	No
L1-L2 voltage (V) L2-L3 voltage (V) L3-L1 voltage (V)	+/– 1%	No
Voltage phase imbalance (% imb)	+/– 1.5%	No
Average voltage (V)	+/– 1%	No
Power factor (cos ϕ)	+/– 10%	No
Active power (kW)	+/– 15%	No
Reactive power (kVAR)	+/– 15%	No
Active power consumption (kWh)	+/– 15%	Yes
Reactive power consumption (kVARh)	+/– 15%	Yes

Motor History

Parameter	Accuracy	Value Saved on Power Loss
Motor starts count Motor LO1 closings count Motor LO2 closings count	+/– 1	Yes
Motor starts per hour count	+ 0/– 5 mn	Yes
Load sheddings count	+/– 1	Yes
Motor last start current ratio (% FLC)	• +/– 1% for 8 A and 27 A models • +/– 2% for 100 A models	Yes
Motor last start duration (s)	+/– 1%	No
Operating time (s)		Yes
Controller internal temperature max (°C)	+/– 4 °C	Yes

Recommended Contactors

Recommended Contactors

You can use the following contactor types:

- Schneider Electric IEC-style contactors, from the TeSys D or TeSys F ranges
- Square D NEMA-style contactors, from the S range

15. The accuracy levels presented in this table are typical accuracy levels. Actual accuracy levels may be lower or greater than these values.

TeSys D IEC Contactors

Catalog references and characteristics for TeSys D IEC contactors are listed in the following table. Coil voltages are grouped according to whether an interposing relay is required:

TeSys D Catalog References	Control Circuit Frequency (Hz)	VA or W Maintained (Max)	Coil Voltages	
			Interposing Relay Not Required	Interposing Relay Required
LC1D09...LC1D38	50...60	7.5	AC = 24, 32, 36, 42, 48, 60, 100, 127, 200, 208, 220, 230, 240	AC = 277, 380, 400, 415, 440, 480, 575, 600, 690
		6	DC (std) = 24	DC (std) = 36, 48, 60, 72, 96, 100, 110, 125, 155, 220, 250, 440, 575
		2.4	DC (low consumption) = 24	DC (low consumption) = 48, 72, 96, 110, 220, 250
LC1D40A...LC1D80A		0.5	DC (low consumption) = 24	
LC1D40...LC1D95		26	AC = 24, 32, 42, 48, 110, 115, 120, 127, 208, 220, 220/230, 230, 240	AC = 256, 277, 380, 380/400, 400, 415, 440, 480, 500, 575, 600, 660
		22		DC = 24, 36, 48, 60, 72, 110, 125, 220, 250, 440
LC1D115		18	AC = 24, 32, 42, 48, 110, 115, 120, 127, 208, 220, 230, 240	AC = 277, 380, 400, 415, 440, 480, 500
		22		DC = 24, 48, 60, 72, 110, 125, 220, 250, 440
LC1D150		18	AC = 24, 32, 42, 48, 110, 115, 120, 127, 208, 220, 230, 240	AC = 277, 380, 400, 415, 440, 480, 500
		5		DC = 24, 48, 60, 72, 110, 125, 220, 250, 440

TeSys F IEC Contactors

Catalog references and characteristics for TeSys F IEC contactors are listed in the following table. Coil voltages are grouped according to whether an interposing relay is required:

TeSys F Catalog References	Control Circuit Frequency (Hz)	VA or W Maintained (Max)	Coil Voltages	
			Interposing Relay Not Required	Interposing Relay Required
LC1F115	50	45	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 380/400, 415/440, 500, 660, 1000
	60	45	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 265/277, 380, 415, 460/480, 660, 1000
		5		DC = 24, 48, 110, 125, 220/230, 250, 440/460
LC1F150	50	45	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 380/400, 415/440, 500, 660, 1000
	60	45	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 265/277, 380, 415, 460/480, 660, 1000
		5		DC = 24, 48, 110, 125, 220/230, 250, 440/460

TeSys F Catalog References	Control Circuit Frequency (Hz)	VA or W Maintained (Max)	Coil Voltages	
			Interposing Relay Not Required	Interposing Relay Required
LC1F185[16]	50	55	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 380/400, 415/440, 500, 660, 1000
	60	55	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 265/277, 380, 415, 460/480, 660,1000
		5		DC = 24, 48, 110, 125, 220/230, 250, 440/460
LC1F225(1)	50	55	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 380/400, 415/440, 500, 660, 1000
	60	55	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 265/277, 380, 415, 460/480, 660, 1000
		5		DC = 24, 48, 110, 125, 220/230, 250, 440/460
LC1F265	40...400[17]	10	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 277, 380/415, 480/500, 600/660, 1000
		5	DC = 24	DC = 48, 110, 125, 220/230, 250, 440/460
LC1F330		10	AC = 24, 42, 48, 110/115, 127, 220/230, 240	AC = 277, 380/415, 480/500, 600/660, 1000
		5	DC = 24	DC = 48, 110, 125, 220/230, 250, 440/460
LC1F400		15	AC = 48, 110/120, 125, 127, 200/208, 220/230, 230/240	AC = 265, 277, 380/400, 415/480, 500, 550/600, 1000
		8		DC = 48, 110, 125, 220, 250, 440
LC1F500		18	AC = 48, 110/120, 127, 200/208, 220/230, 230/240	AC = 265, 277, 380/400, 415/480, 500, 550/600, 1000
		8		DC = 48, 110, 125, 220, 250, 440
LC1F630		22	AC = 48, 110/120, 125, 127, 200/208, 220/240	AC = 265/277, 380/400, 415/480, 500, 550/600, 1000
		73		DC = 48, 110, 125, 220, 250, 440
LC1F780(1)		50	AC = 110/120, 127, 200/208, 220/240	AC = 265/277, 380, 415/480, 500
		52		DC = 110, 125, 220, 250, 440
LC1F800		15	AC = 110/127, 220/240	AC = 380/440
		25		DC =110/127, 220/240, 380/440

NEMA Type S Contactors

Catalog references and characteristics for NEMA Type S contactors are listed in the following table. Coil voltages are grouped according to whether an interposing relay is required:

16. Dual-parallel contactors of this size require an interposing relay.
17. Control circuit frequency may be 40...400 Hz; but power to contactors, monitored by CTs, must be 50 Hz or 60 Hz in frequency.

NEMA Size	VA Maintained (Max)	Control Circuit Frequency (Hz)	Coil Voltages	
			Interposing Relay Not Required	Interposing Relay Required
00	33	50/60	24, 115, 120, 208, 220, 240	277, 380, 440, 480, 550, 600
00, 0,1	27			
2	37			
	38			
3	47			
4	89		115, 120, 208, 220, 240	277, 380, 440, 480, 550, 600
5	15		115, 120, 208, 220, 240	277, 380, 440, 480
6	59		115, 120, 208, 220, 240	277, 380, 440, 480, 550, 600
7				

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 (for example, temperature) or outputs (for example, 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 (for example, 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 (for example, 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:

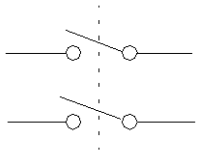
Deutsches Institut für Normung. The European organization that organizes the creation and maintenance of dimensional and engineering standards.

discrete:

Describes inputs (for example, switches) or outputs (for example, coils) that can be only *On* or *Off*. Contrast with analog.

DPST:

double-pole/single-throw. A switch that connects or disconnects two circuit conductors in a single branch circuit. A DPST switch has four terminals, and is the equivalent of two single-pole/single-throw switches controlled by a single mechanism, as shown in the following diagram:



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 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 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 (for example, 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 two-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 (for example, 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.

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.

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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