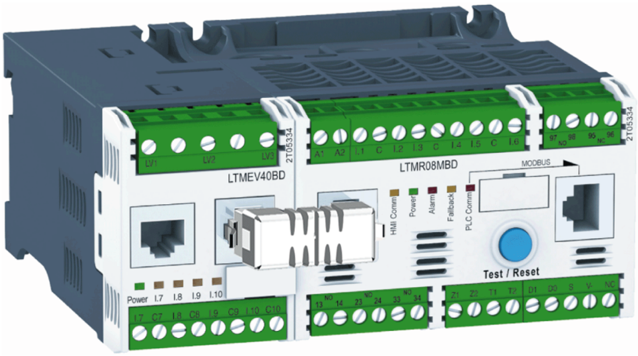
TeSys T LTM R Modbus

Motor Management Controller
User Manual

09/2014



1639501EN-04

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

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

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

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

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

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This manual describes the Modbus® network protocol version of the TeSys® T LTM R motor management controller and LTM E expansion module.

The purpose of this manual is to:
- describe and explain the monitoring, protection, and control functions of the LTM R controller and LTM E expansion module
- provide all the information necessary to implement and support a solution that best meets your application requirements

The manual describes the 4 key parts of a successful system implementation:
- installing the LTM R controller and LTM E expansion module
- commissioning the LTM R controller by setting essential parameter values
- using the LTM R controller and LTM E expansion module, both with and without additional human-machine interface devices
- maintaining the LTM R controller and LTM E expansion module

This manual is intended for:
- design engineers
- system integrators
- system operators
- maintenance engineers

Validity Note

This manual is valid for all LTM R Modbus® controllers. Some functions are available depending on the software version of the controller.

Related Documents

Title of Documentation	Reference Number
TeSys T LTM R••• Instruction Sheet	AAV7709901
TeSys T LTM E••• Instruction Sheet	AAV7950501
TeSys T LTM CU Control Operator Unit User's Manual	1639581
TeSys T LTM CU Instruction Sheet	AAV6665701
TeSys T DTM Online Help	1672614
XBT-N User Manual	1681029
XBT-N Instruction Sheet	1681014
Electrical Installation Guide (Wiki version)	www.electrical-installation.org
Okken Solution Guide	DESY014EN
Blokset Solution Guide	ESBED297701EN

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

Chapter 1
Introducing the TeSys T Motor Management System

Overview

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

What Is in This Chapter?

This chapter contains the following topics:

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 3-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 protections 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 warnings and faults, 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 (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
	
	Other industry
	● tunnel machines
	● cranes

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 2 main hardware components of the system are the LTM R controller and the LTM E expansion module.

The system can be configured and controlled:

- using an HMI (Human Machine Interface) device: Magelis® XBT or TeSys® T LTM CU
- using a PC running SoMove with the TeSys T DTM.
- using a PLC connected to the system via the communication network

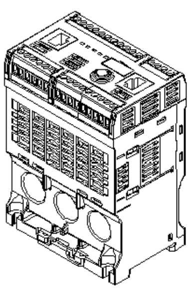
Components such as external motor load current transformers and ground current transformers add additional range to the system.

LTM R Controller

The microprocessor-based LTM R controller is the central component in the system that manages the control, protection, and monitoring functions of single-phase or 3-phase AC induction motors.

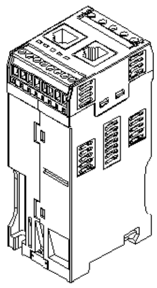
The LTM R controller is designed to work over various fieldbus protocols. This manual focuses only on systems designed to communicate over the Modbus protocol.

The range includes 6 LTM R controller models using Modbus communication protocol.

LTM R Controller	Functional Description	Reference Number
	• current sensing 0.4...100 A • single-phase or 3-phase current inputs • 6 discrete logic inputs • 4 relay outputs: 3 SPST, 1 DPST • connections for a ground current sensor • connection for a motor temperature sensor • connection for network • connection for HMI device or expansion module • current protection, metering and monitoring functions • motor control functions • power indicator and communication protocol selection indicator • fault and warning LED indicators • network communication and alarm indicators • HMI communication LED indicator • test and reset function	LTMR08MBD (24 VDC, 0.4...8 A FLC) LTMR27MBD (24 VDC, 1.35...27 A FLC) LTMR100MBD (24 VDC, 5...100 A FLC) LTMR08MFM (100...240 VAC, 0.4...8 A FLC) LTMR27MFM (100...240 VAC, 1.35...27 A FLC) LTMR100MFM (100...240 VAC, 5...100 A FLC)

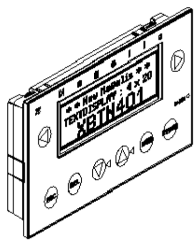
LTM E Expansion Module

There are 2 models of LTM E expansion modules that provide voltage monitoring functionality and 4 additional logic inputs. The LTM E expansion modules are powered by the LTM R controller via a connector cable.

LTM E Expansion Module	Functional Description	Reference Number
	• voltage sensing 110...690 VAC • 3-phase voltage inputs • 4 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: • LTM R controller to LTM E connection cable	LTMEV40BD (24 VDC logic inputs)
		LTMEV40FM (100...240 VAC logic inputs)

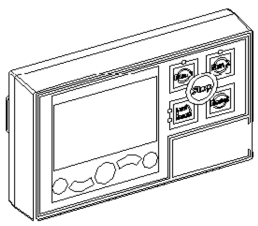
HMI Device: Magelis® XBTN410

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, warnings, and faults Additional components required for an optional HMI device: • separate power source • LTM R/LTM E to HMI communication cable • Magelis XBTL1000 programming software	XBTN410 (HMI)
		XBTZ938 (cable)
		XBTL1000 (software)

HMI Device: LTM CU Control Operator Unit

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

LTM CU Control Operator Unit	Functional Description	Reference Number
	• configures the system through menu entries • displays parameters, warnings, and faults • control the motor Additional components required for an optional HMI device: • LTM R/LTM E to HMI communication cable	LTM CU
		LTM9CU•0 (HMI communication cable)
		TCSMCNAM3M002P (cable kit)
		LTM9KCU Kit for portable LTM CU

SoMove with the TeSys T DTM

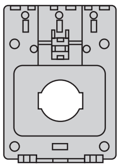
SoMove software is a Microsoft® Windows®-based application, using the open FDT/DTM technology.

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

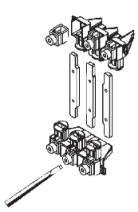
SoMove with the TeSys T DTM	Functional Description	Reference Number
	● configure the system through menu entries ● display parameters, warnings, and faults ● control the motor ● enable customization of operating modes Additional components required for the SoMove FDT container: ● a PC ● separate power source ● LTM R / LTM E / LTM CU 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.

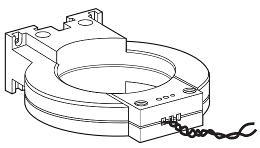
Schneider Electric Load Current Transformers	Primary	Secondary	Inside Diameter		Reference Number
			mm	in.	
	100	1	35	1.38	LT6CT1001
	200	1	35	1.38	LT6CT2001
	400	1	35	1.38	LT6CT4001
	800	1	35	1.38	LT6CT8001
	Note: The following current transformers are also available: Schneider Electric LUTC0301, LUTC0501, LUTC1001, LUTC2001, LUTC4001, and LUTC8001.				

Lug-lug kit provides bus bars and lug terminals that adapt the pass through wiring windows and provide line and load terminations for the power circuit.

Square D Lug-lug Kit	Description	Reference Number
	Square D Lug-lug Kit	MLPL9999

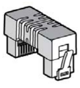
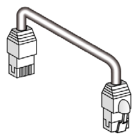
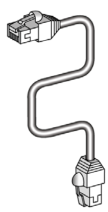
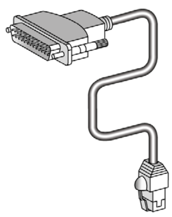
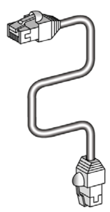
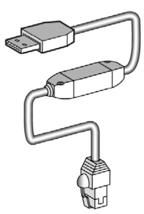
Ground Fault Current Transformers

External ground fault current transformers measure ground fault 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.

Cable	Description	Reference Number
	Connecting jumper 0.04 m (1.57 in.) length, for side by side connection of the LTM R and LTM E	LTMCC004
	LTM R to LTM E RJ45 connector cable 0.3 m (11.81 in.) length	LTM9CEXP03
	LTM R to LTM E RJ45 connector cable 1.0 m (3.28 ft) length	LTM9CEXP10
	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
	LTM R/LTM E to Magelis® HMI device connection cable 2.5 m (8.20 ft) length	XBTZ938
	LTM R/LTM E to LTM CU HMI device connection cable 1.0 m (3.28 ft) length	LTM9CU10
	LTM R/LTM E to LTM CU HMI device connection cable 3.0 m (9.84 ft) length	LTM9CU30
	Cable kit, includes LTM E / LTM R / LTM CU to PC communication cable 2.5 m (8.2 ft) length	TCSMCNAM3M002P

System Selection Guide

Overview

This section describes the LTM R controller with and without the optional LTM E expansion module for metering and monitoring, protection, and control functions.

- **Metering and Monitoring functions**
  - measurement
  - fault and warning counters
  - system and device monitoring faults
  - 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
  - fault management

Metering Functions

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

Function	LTM R Controller	LTM R with LTM E
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
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 Faults		
Controller internal faults	X	X
Controller internal temperature	X	X
Control command error diagnostic	X	X
Wiring fault - Temperature sensor connections	X	X
Wiring fault - Current connections	X	X
Wiring fault - Voltage connections	–	X
Configuration checksum	X	X
Communication loss	X	X
Time to trip	X	X
X The function is available **–** The function is not available		

Function	LTM R Controller	LTM R with LTM E
Fault and warning counters		
Protection fault counts	X	X
Protection warning counts	X	X
Diagnostic fault counts	X	X
Motor control function counts	X	X
Fault 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	LTM R Controller	LTM R with LTM E
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	LTM R Controller	LTM R with LTM E
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
Two-speed	X	X
Custom	X	X
Fault Management		
Manual reset	X	X
Automatic reset	X	X
Remote reset	X	X
X The function is available **–** The function is not available		

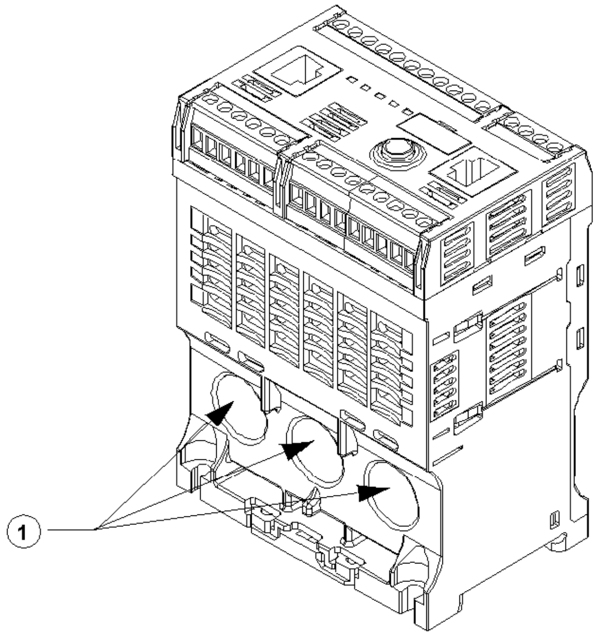
Physical Description of the LTM R Modbus Controller

Overview

The microprocessor-based LTM R controller provides control, protection and monitoring for single-phase and 3-phase AC induction motors.

Phase Current Inputs

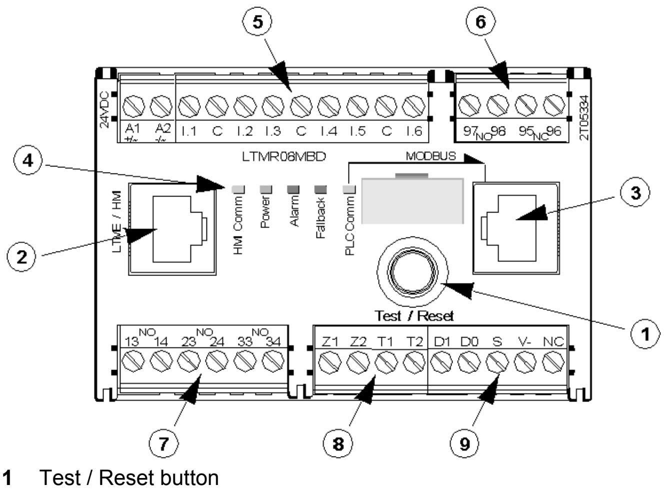
The LTM R controller includes internal current transformers for measuring the motor load phase current directly from the motor load power cables or from secondaries of external current transformers.



1 Windows for phase current measurement

Front Face

The LTM R controller front face includes the following features:



1 Test / Reset button
2 HMI port with RJ45 connector connecting the LTM R controller to an HMI, PC or LTM E expansion module
3 Network port with RJ45 connector connecting the LTM R controller to Modbus network
4 LTM R 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 fault 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 LTM R controller in an internal fault state. For a detailed description of the test/rest button functions, see *Test / Reset, page 245*.

HMI Device/Expansion Module/PC Port

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

- an expansion module
- a PC running SoMove with the TeSys T DTM
- a Magelis® XBTN410 HMI

LTM R status-indicating LEDs

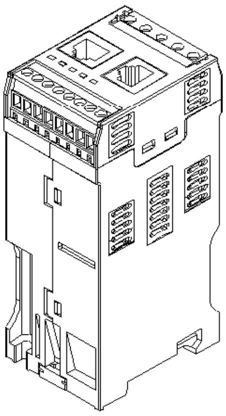
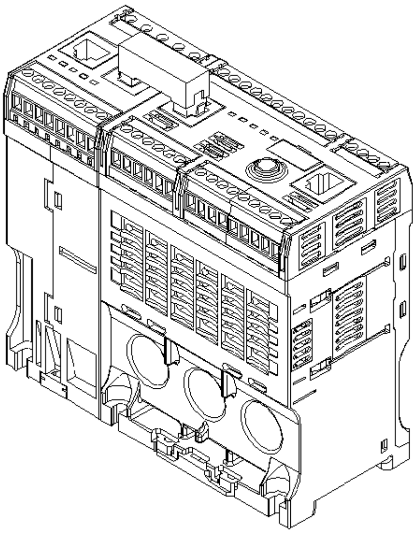
LED name	Description
HMI Comm	Communication between LTM R controller and HMI device, PC, or LTM E expansion module
Power	LTM R controller power or internal fault condition
Alarm	Protection warning or fault, or internal fault
Fallback	Communication loss between the LTM R controller and network or HMI control source
PLC Comm	Network activity

Physical Description of the LTM E Expansion Module

Overview

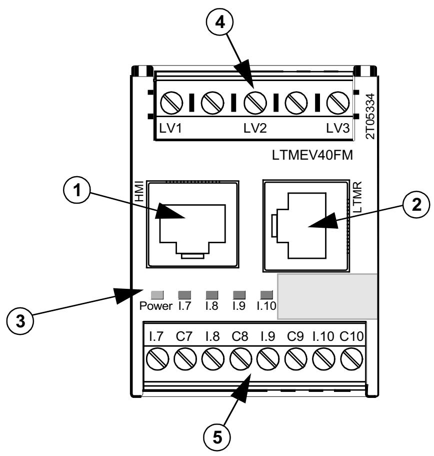
The LTM E expansion module extends the monitoring and control functions of the LTM R controller by providing voltage measurement and additional logic inputs:

- 3 phase voltage inputs
- 4 additional discrete logic inputs

LTM E Expansion module	LTM E Expansion module connected to an LTM R controller
	

Front Face

The LTM E expansion module front face includes the following features:



1 Port with RJ45 connector to HMI or PC
2 Port with RJ45 connector to LTM R 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/Fault status	Green	Power on, no faults
		Red	Power on, faults
		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

Chapter 2
Metering and Monitoring Functions

Overview

The LTM R controller provides measurement, metering, and monitoring in support of the current, temperature, and ground fault protection functions. When connected to an LTM E expansion module, the LTM R controller also provides voltage and power measurement functions.

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
Measurement

Overview

The LTM R 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

What Is in This Section?

This section contains the following topics:

Line Currents

Description

The LTM R 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 3 CT inputs:

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

The LTM R controller performs true rms calculations for line currents up to the 7th 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	See *Line Current Characteristics, page 29*
Resolution	1% FLC
Refresh interval	100 ms

Ground Current

Description

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

- The internal ground current (IgrΣ) is calculated by the LTM R controller from the 3 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 transformer 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 • 2000:1 • Other Ratio	None
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			
LTM R 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)	
LTM R 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)	
LTM R 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
(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

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

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	See Ground Current Characteristics, above
Resolution	0.1 % FLCmin
Refresh interval	100 ms

Average Current

Description

The LTM R 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.

Average Current Formulas

The LTM R 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	See Average Current Characteristics, above
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 phase (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 fault is triggered (see *Time to Trip, page 48*), and
- the time remaining until the fault condition is cleared after a thermal overload fault has been triggered (see *Minimum Wait Time, page 58*).

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 4 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 LTM E 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 7th 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 phase 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 LTM R controller calculates average voltage and provides the value in volts. The average voltage function returns the rms value of the average voltage.

Formulas

The LTM R 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

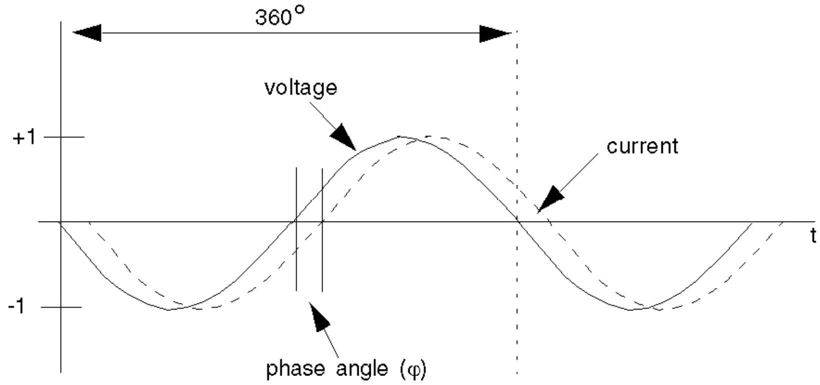
Description

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

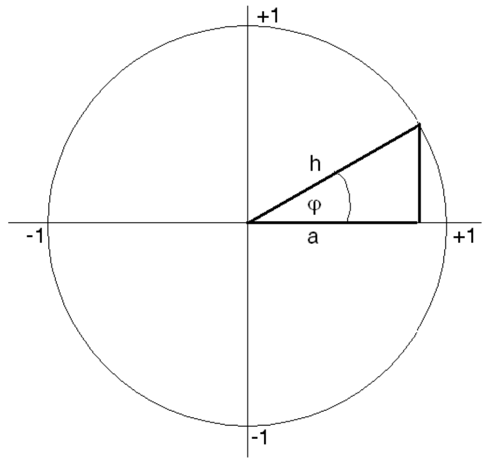
Formula

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 2 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 active power function has the following characteristics:

Characteristic	Value
Accuracy	+/- 10 % for cos $\varphi \geq 0.6$
Resolution	0.01
Refresh interval	30 ms (typical)(1)
(1) 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	√3 x Iavg x Vavg x cosφ
Active power for single-phase motor	Iavg x Vavg x cosφ
Where: ● Iavg = Average rms current ● Vavg = Average rms voltage	

The reactive power measurement is derived from the following formulas:

Calculated Measurement	Formula
Reactive power for three phase motor	√3 x Iavg x Vavg x sinφ
Reactive power for single-phase motor	Iavg x Vavg x sinφ
Where: ● Iavg = Average rms current ● Vavg = 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	0.1 kWh	0.1 kVARh
Refresh interval	100 ms	100 ms

Section 2.2
System and Device Monitoring Faults

Overview

The LTM R controller and the LTM E expansion module detect faults which affect the LTM R controller ability to work properly (internal controller check and check of communications, wiring, and configuration errors).

The system and device monitoring fault records can be accessed via:
- a PC running SoMove with the TeSys T DTM
- an HMI device
- a PLC via the network port

What Is in This Section?

This section contains the following topics:

Controller Internal Fault

Description

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

When an internal fault occurs, the Controller Internal Fault parameter is set.

Major Internal Faults

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

- stack overflow fault
- stack underflow fault
- watchdog time-out
- firmware checksum failure
- CPU failure
- internal temperature fault (at 100 °C / 212 °F)
- RAM test error

Minor Internal Faults

Minor internal faults indicate that the data being provided to the LTM R controller is unreliable and protection could be compromised. During a minor fault, the LTM R controller continues to attempt to monitor status and communications, but does not accept any start commands. During a minor fault condition, the LTM R controller continues to detect and report major faults, but not additional minor faults. Minor internal faults include:

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

Controller Internal Temperature

Description

The LTM R controller monitors its Controller Internal Temperature, and reports warning, minor fault, and major fault conditions. Fault detection cannot be disabled. Warning 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:

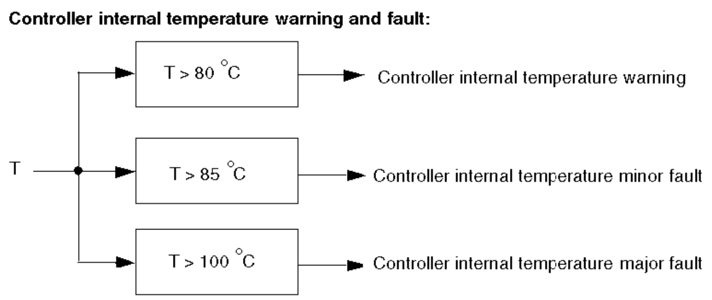
Parameter	Setting Range	Factory Setting
Controller internal temperature warning enable	• Enable • Disable	Enable

The Controller Internal Temperature function includes the following fixed warning and fault thresholds:

Condition	Fixed Threshold Value	Sets Parameter
Internal temperature warning	80 °C (176 °F)	Controller Internal Temperature Warning
Internal temperature minor fault	85 °C (185 °F)	Controller Internal Fault
Internal temperature major fault	100 °C (212 °F)	

A warning condition ceases when LTM R Controller Internal Temperature falls below 80 °C (176 °F).

Block Diagram



T Temperature
T > 80 °C (176 °F) Fixed warning threshold
T > 85 °C (185 °F) Fixed minor fault threshold
T > 100 °C (212 °F) Fixed major fault threshold

Maximum Internal Controller Temperature

The Controller Internal Temperature Max parameter contains the highest internal temperature, expressed in °C, detected by the LTM R controller's internal temperature sensor. The LTM R 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 Error Diagnostic

Description

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

There are 4 control command diagnostic functions:

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

Parameter Settings

All 4 diagnostic functions are enabled and disabled as a group. The configurable parameter settings are:

Parameters	Setting Range	Factory Setting
Diagnostic Fault Enable	Yes/No	Yes
Diagnostic Warning Enable	Yes/No	Yes

Start Command Check

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

- The Start Command Check reports a Start Command fault or warning if current is not detected after a delay of 1 second.
- The Start Command Check conditions ends if the motor is in Run state and the LTM R controller detects that the current is equal or more than 10% of FLCmin.

Run Check Back

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

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

Stop Command Check

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

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

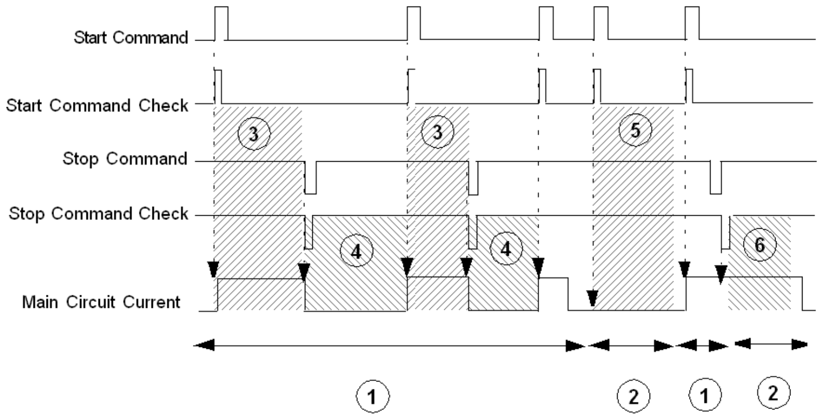
Stop Check Back

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

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

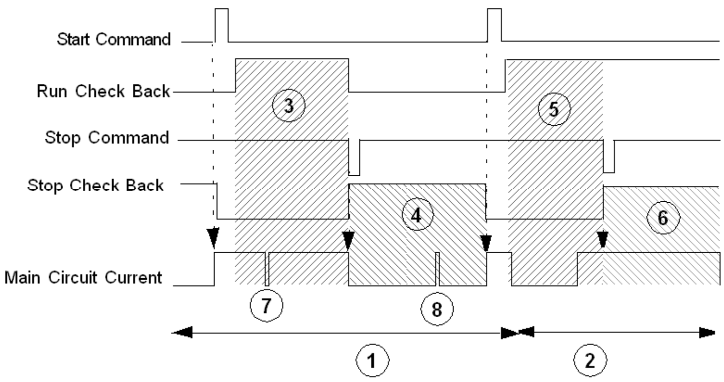
Timing Sequence

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



1 Normal operation
2 Fault or warning condition
3 The LTM R controller monitors the main circuit to detect current
4 The LTM R controller monitors the main circuit to detect no current
5 The LTM R controller reports a Start Command Check fault and/or warning if current is not detected after 1 second
6 The LTM R controller reports a Stop Command Check fault and or warning if current is detected after 1 second

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



1 Normal operation
2 Fault or warning condition
3 After the motor enters the run state, the LTM R controller continuously monitors the main circuit to detect current until a Stop command is given or the function is disabled
4 The LTM R controller continuously monitors the main circuit to detect no current until a Start command is given or the function is disabled
5 The LTM R controller reports a Run Check Back fault and/or warning if the current is not detected for longer than 0.5 seconds without a Stop command
6 The LTM R controller reports a Stop Check Back fault or warning 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 Faults

Description

The LTM R controller checks external wiring connections and reports a fault when it detects incorrect or conflicting external wiring. The LTM R controller can detect 4 wiring errors:

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

Enabling Fault Detection

Wiring diagnostics are enabled using the following parameters:

Protection	Enabling Parameters	Setting Range	Factory Setting
CT Reversal	Wiring Fault 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 Error

When individual external load CTs are used, they must all be installed in the same direction. The LTM R controller checks the CT wiring and reports an 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 Error

The LTM R controller checks all 3 motor phases for On Level current, then checks the Motor Phases parameter setting. The LTM R controller reports an error if it detects current in phase 2 if the LTM R controller is configured for single-phase operation.

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

Motor Temperature Sensor Errors

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

The LTM R controller signals an error when calculated resistance at the T1 and T2 terminals:

- falls below the fixed short-circuit detection threshold, or
- exceeds the fixed open-circuit detection threshold.

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

Short-circuit and open-circuit detection thresholds have no fault time delay. There are no warnings 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 %

Characteristic	Value
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 LTM R controller calculates a checksum of parameters based on all configuration registers. The EEPROM error code (64) is reported.

Communication Loss

Description

The LTM R controller monitors communication through:

- the network port
- the HMI port

Network Port Parameter Settings

The LTM R controller monitors network communication creates both a fault and a warning report when the network communications are lost.

On LTM R Version LTMR••M••, 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.

The network port communications have the following configurable settings:

Parameter	Setting Range	Factory Setting
Network port fault enable	Enable/Disable	Enable
Network port warning enable	Enable/Disable	Enable
Network port comm loss timeout	0...99.99 s In increments of 0.01 s	2 s
Network port fallback setting(1)	• Hold • Run • O.1, O.2 off • O.1, O.2 on • O.1 off • O.2 off	O.1, O.2 off
(1) The operating mode affects the configurable parameters for the network port fallback settings.		

HMI Port Parameter Settings

The LTM R controller monitors HMI port communications and reports both a warning and a fault 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 fault enable	Enable/Disable	Enable
HMI port warning enable	Enable/Disable	Enable
HMI port fallback setting(1)	• Hold • Run • O.1, O.2 off • O.1, O.2 on • O.1 off • O.2 off	O.1, O.2 off
(1) The operating mode affects the configurable parameters for the HMI port fallback settings.		

Fallback Condition

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

The behavior of logic outputs O.1 and O.2 when the LTM R controller is in fallback condition is determined by:
- The operating mode (see *Operating Modes, page 142*).
- 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 LTM R controller to hold the state of logic outputs O.1 and O.2 as of the time of the communication loss.
Run	Directs the LTM R controller to perform a Run command for a 2-step control sequence on the communication loss.
O.1, O.2 Off	Directs the LTM R controller to turn off both logic outputs O.1 and O.2 following a communication loss.
O.1, O.2 On	Directs the LTM R controller to turn on both logic outputs O.1 and O.2 following a communication loss.
O.1 On	Directs the LTM R controller to turn on only logic output O.1 following a communication loss.
O.2 On	Directs the LTM R 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 LTM R controller reports the time to trip before the fault occurs in the Time To Trip parameter.

When the LTM R controller is not in a thermal overload condition, to avoid the appearance of being in a fault state, the LTM R 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 4 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

LTM R Configuration Fault

Description

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

An LTM R configuration fault is detected when the Load CT Primary, Load CT Secondary, and Load CT Multiple Passes parameters are not consistent, and generates a System and Device Monitoring Fault. The fault condition is cleared once the parameters are correct. The LTM R controller remains in configuration mode as long as the parameters are not consistent.

LTM E Configuration Fault and Warning

Description

The LTM R controller checks the presence of the LTM E expansion module. Its absence generates a System and Device Monitoring Fault.

LTM E Configuration Fault

LTM E configuration fault:

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

LTM E Configuration Warning

LTM E configuration warning:

- If LTM E based protection warnings are enabled but no LTM E expansion module is present, this will cause an LTM E configuration warning.
- The warning clears when no protection warning requiring an LTM E is enabled, or when the LTM R has been power-cycled with an appropriate LTM E being present.

External Fault

Description

The LTM R controller has an external fault feature, which detects if an error happened on an external system linked to it.

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

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

External Fault Parameter Settings

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

Section 2.3
Fault and Warning Counters

Overview

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

Fault and warning counters can be accessed via:
- a PC running SoMove with the TeSys T DTM
- an HMI device
- a PLC via the network port

What Is in This Section?

This section contains the following topics:

Introducing Fault and Warning Counters

Detecting Warnings

If a warning detection function is enabled, the LTM R controller detects a warning immediately when the monitored value rises above, or falls below, a threshold setting.

Detecting Faults

Before the LTM R controller detects a fault, certain preconditions must exist. These conditions can include
- the fault 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 fault occurs, the LTM R controller increments at least 2 counters:
- a counter for the specific fault detecting function, and
- a counter for all faults.

When a warning occurs, the LTM R controller increments a single counter for all warnings. However, when the LTM R controller detects a thermal overload warning, it also increments the thermal overload warnings counter.

A counter contains a value from 0 to 65,535 and increments by a value of 1 when a fault, warning, or reset event occurs. A counter stops incrementing when it reaches a value of 65,535.

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

Clearing Counters

All fault and warning counters are reset to 0 by executing the Clear Statistics Command or Clear All Command.

All Faults Counter

Description

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

The Faults Count parameter increments by a value of 1 when the LTM R controller detects any fault.

All Warnings Counter

Description

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

The Warnings Count parameter increments by a value of 1 when the LTM R controller detects any warning.

Auto-Reset Counter

Description

The Auto-Reset Count parameter contains the number of times the LTM R controller attempted, but failed, to auto-reset a fault. This parameter is used for the 3 auto-reset fault groups.

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

For information on fault management, see *Fault Management and Clear Commands, page 164*.

Protection Faults and Warnings Counters

Protection Fault Counts

Protection fault counters include:
- Current Phase Imbalance Faults Count
- Current Phase Loss Faults Count
- Current Phase Reversal Faults Count
- Ground Current Faults Count
- Jam Faults Count
- Long Start Faults Count
- Motor Temp Sensor Faults Count
- Over Power Factor Faults Count
- Overcurrent Faults Count
- Overpower Faults Count
- Overvoltage Faults Count
- Thermal Overload Faults Count
- Under Power Factor Faults Count
- Undercurrent Faults Count
- Underpower Faults Count
- Undervoltage Faults Count
- Voltage Phase Imbalance Faults Count
- Voltage Phase Loss Faults Count
- Voltage Phase Reversal Faults Count

Protection Warning Counts

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

When any warning occurs, including a thermal overload warning, the LTM R controller increments the Warnings Count parameter.

Control Command Errors Counter

Description

A Diagnostic Fault occurs when the LTM R controller detects any of the following control command errors:

- Start Command Check errors
- Stop Command Check errors
- Stop Check Back errors
- Run Check Back errors

For information on these control command functions, see *Control Command Error Diagnostic, page 42*.

Wiring Faults Counter

Description

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

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

The LTM R controller increments the Wiring Faults Count parameter by a value of 1 each time any one of the above 3 faults occurs. For information on connection errors and related faults, see *Wiring Faults, page 44*.

Communication Loss Counters

Description

Faults detected for the following communication functions:

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

Internal Fault Counters

Description

Faults detected for the following internal faults:

Counter	Contains
Controller Internal Faults Count	The number of major and minor internal faults. For information on internal faults, see *Controller Internal Fault, page 40*.
Internal Port Faults Count	The number of LTM R controller internal communication faults, plus the number of failed attempts to identify the network communication module.

Fault History

Fault History

The LTM R controller stores a history of LTM R controller data that was recorded at the time of the last 5 detected faults. Fault n-0 contains the most recent fault record, and fault n-4 contains the oldest retained fault record.

Each fault record includes:

- Fault 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

Section 2.4
Motor History

Overview

The LTM R 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.

What Is in This Section?

This section contains the following topics:

Motor Starts Counters

Description

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

The LTM R controller sums start in 5 minute 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, see *Load Shedding, page 115*.

Auto Restart Counters

Description

There are 3 types of counting statistics:

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

For information on the Auto restart protection function, see *Automatic Restart, page 117*.

Motor Last Start Current Ratio

Description

The LTM R 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 LTM R 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 LTM R 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.

Section 2.5
System Operating Status

Overview

The LTM R 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

What Is in This Section?

This section contains the following topics:

Motor State

Description

The LTM R 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

Minimum Wait Time

Description

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

- automatic reset *(see page 169)*
- thermal overload *(see page 65)*
- rapid cycle lockout *(see page 81)*
- load shedding *(see page 115)*
- automatic restart *(see page 117)*
- transition time.

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

NOTE: Even with an LTM R powered off, time is tracked down for at least 30 mn.

Characteristics

The Minimum Wait Time function has the following characteristics:

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

Chapter 3
Motor Protection Functions

Overview

This chapter describes the motor protection functions provided by the LTM R controller.

What Is in This Chapter?

This chapter contains the following sections:

Section 3.1
Motor Protection Functions Introduction

Overview

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

What Is in This Section?

This section contains the following topics:

Definitions

Defined Functions and Data

The LTM R controller monitors current, ground-current and motor temperature sensor parameters. When the LTM R controller is connected to an expansion module, it also monitors voltage and power parameters. The LTM R controller uses these parameters in protection functions to detect fault and warning conditions.The LTM R controller's response to fault and warning conditions is fixed for the predefined operating modes. Logic output O.4 activates on a fault, and logic output O.3 activates on a warning. For more information about predefined operating modes, see *Operating Modes, page 142*.

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 fault detection, and most protection functions also include warning 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 LTM R controller's responses to protection faults or warnings
- adding new functions, based on either predefined or newly created parameters

Faults

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

The response of the LTM R controller to a fault include the following:

- output O.4 contacts:
  - contact 95-96 is open
  - contact 97-98 is closed
- Alarm LED is On (steady red)
- fault status bits are set in a fault parameter
- a text message is displayed in an HMI screen (if an HMI is attached)
- a fault status indicator is displayed in the TeSys T DTM, if connected

The LTM R controller counts and records the number of faults for each protection function.

After a fault has occurred, merely resolving the underlying condition does not clear the fault. To clear the fault, the LTM R controller must be reset. See *Fault Management - Introduction, page 165*.

Warnings

A warning is a less-serious, though still undesirable, operating condition. A warning indicates corrective action may be required to prevent a problem condition from occurring. If left unresolved, a warning may lead to a fault condition. Warning-related parameters can be configured for most protection functions.

The response of the LTM R controller to a warning include the following:

- output O.3 is closed
- Alarm LED flashes red twice per second
- warning status bits are set in a warning parameter
- a text message is displayed in an HMI screen (if attached)
- a warning status indicator is displayed in the TeSys T DTM

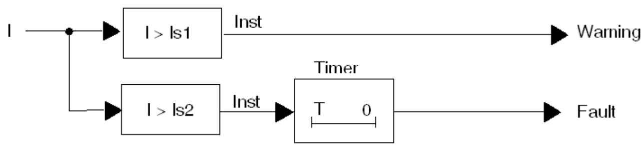
NOTE: For some protection functions, warning detection shares the same threshold as fault detection. For other protection functions, warning detection has a separate warning threshold.

The LTM R controller clears the warning whenever the measured value no longer exceeds the warning 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.



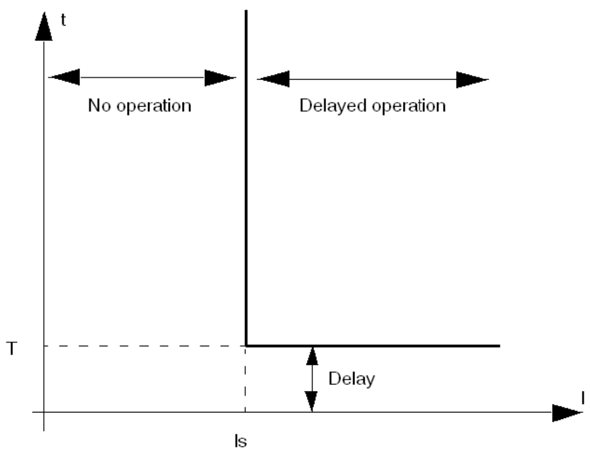
I Measurement of the monitored parameter
Is1 Warning threshold setting
Is2 Fault threshold setting
T Fault timeout setting
Inst Instantaneous warning/fault detection

Settings

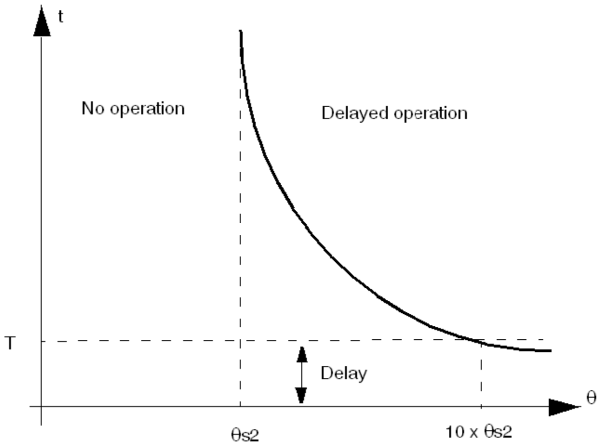
Some protection functions include configurable settings, including:

- Fault threshold: A limit setting for the monitored parameter that triggers a protection function fault.
- Warning threshold: A limit setting for the monitored parameter that triggers a protection function warning.
- Fault timeout: A time delay that must expire before the protection function fault is triggered. The behavior of a timeout depends on its trip current characteristic profile.
- Trip curve characteristic (TCC): The LTM R 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 below.

Definite TCC: The duration of the fault 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:

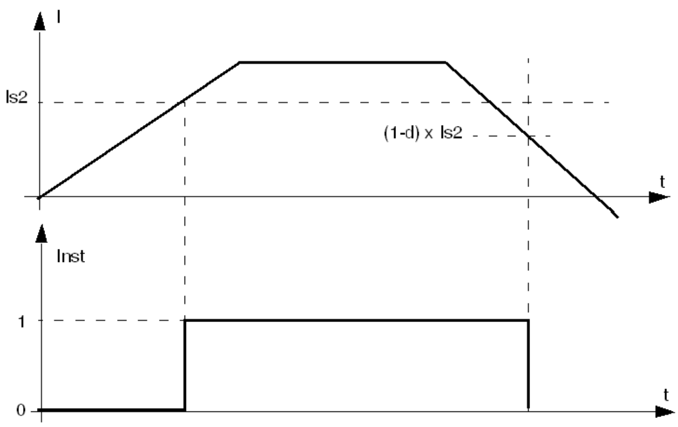


Hysteresis

To improve stability, motor protection functions apply a hysteresis value that is added to or subtracted from limit threshold settings before a fault or warning 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

Section 3.2
Thermal Motor Protection Functions

Overview

This section describes the thermal motor protection functions of the LTM R controller.

What Is in This Section?

This section contains the following topics:

Thermal Overload

Overview

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

- Inverse Thermal *(see page 66)* (factory setting)
- Definite Time *(see page 70)*

Each setting represents a Trip Curve Characteristic. The LTM R 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
Fault enable	Enable/Disable	Enable
Warning 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 LTM R controller monitors the motor's utilized thermal capacity and signals

- a warning when utilized thermal capacity exceeds a configured warning threshold,
- a fault 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 warning.

The LTM R controller calculates the Thermal Capacity Level in all operating states. When power to the LTM R controller is lost, the LTM R controller retains the last measurements of the motor's thermal state for a period of 30 minutes, allowing it to estimate the motor's thermal state when power is re-applied.

Fault and warning monitoring can be separately enabled and disabled.

- The thermal overload warning is cleared by the LTM R controller when the utilized thermal capacity falls 5 % below the warning threshold.
- The thermal overload fault can be reset by the user when the utilized thermal capacity falls below the fault reset threshold and after the fault 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 re-start 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 fault response. Instead

- Only an action external to the LTM R controller (for example, a reduction in the motor load) can clear the fault condition,
- Only a reset command, from the valid reset means configured in the Fault Reset Mode parameter, will reset the fault response.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

A reset command may re-start the motor if the LTM R controller is used in a 2-wire control circuit.

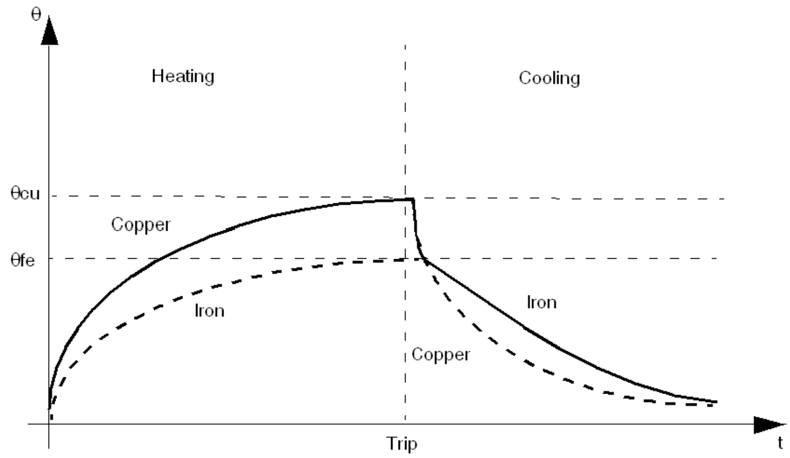
Equipment operation must conform to local and national safety regulations and codes.

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

Operation

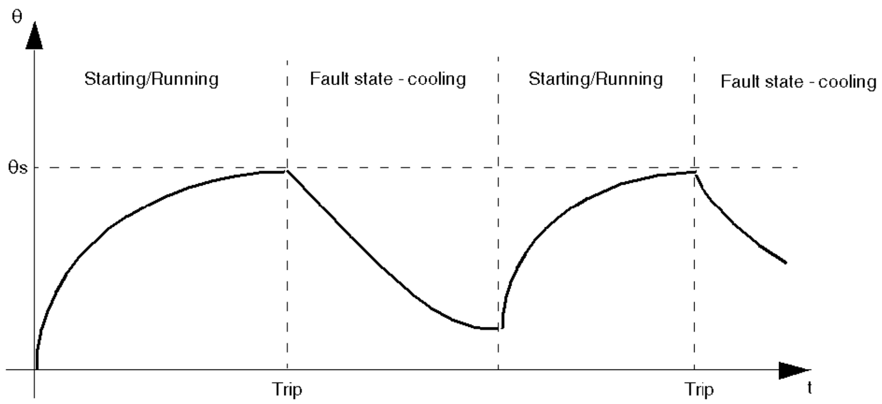
The thermal overload inverse thermal protection function is based on a thermal model of the motor that combines 2 thermal images:
- a copper-based image representing the thermal state of the stator and rotor windings, and
- an iron-based image representing the thermal state of the motor frame.

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



θ Thermal value
θ**fe** Iron tripping threshold
θ**cu** Copper tripping threshold
t Time

When inverse thermal fault 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 LTM R controller detects that the thermal capacity level (θ) exceeds the fault threshold (θ s), it triggers a thermal overload fault, as described below:



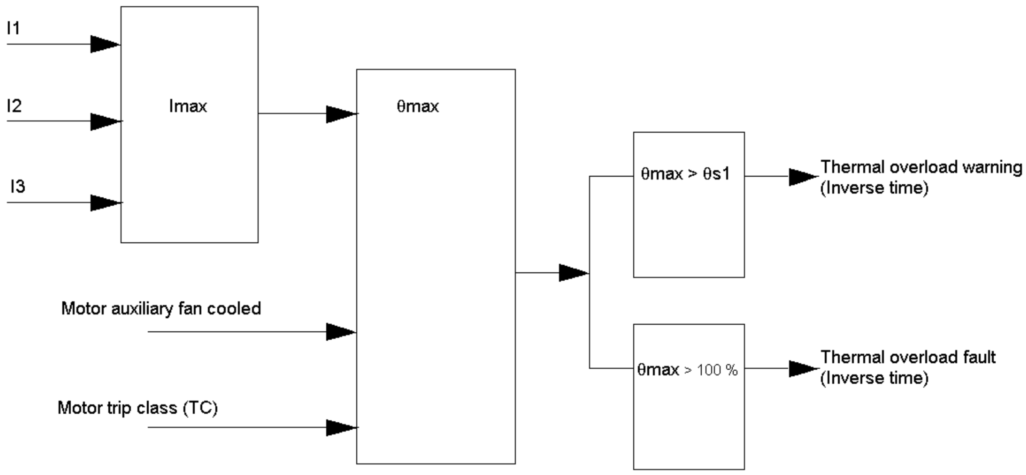
Functional Characteristics

The Thermal Overload inverse thermal functions include the following features:

- 1 motor trip class setting:
  - Motor Trip Class
- 4 configurable thresholds:
  - Motor Full Load Current Ratio (FLC1)
  - Motor High Speed Full Load Current Ratio (FLC2)
  - Thermal Overload Warning Threshold
  - Thermal Overload Fault Reset Threshold
- 1 time delay:
  - Fault Reset Timeout
- 2 function outputs:
  - Thermal Overload Warning
  - Thermal Overload Fault
- 2 counting statistics:
  - Thermal Overload Faults Count
  - Thermal Overload Warnings Count
- 1 setting for an external auxiliary motor cooling fan:
  - Motor Aux Fan Cooled
- 1 measure of utilized thermal capacity:
  - Thermal Capacity Level

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

Block Diagram



Imax Maximum current
θ**max** Thermal capacity level
θ**s1** Thermal overload warning 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
Warning threshold	10...100 % of thermal capacity	85 % of thermal capacity
Motor trip class	5...30 in increments of 5	5
Fault reset timeout	50...999 in 1 s increments	120 s
Fault 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 fault threshold	100 % of thermal capacity

Technical Characteristics

The thermal overload inverse thermal functions have the following characteristics:

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

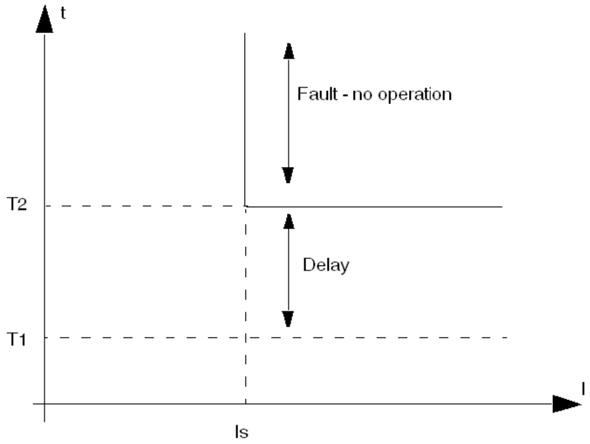
Thermal Overload - Definite Time

Description

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

- a warning when measured maximum phase current exceeds a configurable threshold (OC1 or OC2).
- a fault when the maximum phase current continuously exceeds the same threshold (OC1 or OC2) for a set time delay.

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



Is Fault and warning threshold (OC1 or OC2)
T1 Start command
T2 Elapsed time delay

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

Fault and warning 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 Fault Timeout setting. The LTM R 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 Fault Timeout parameter.

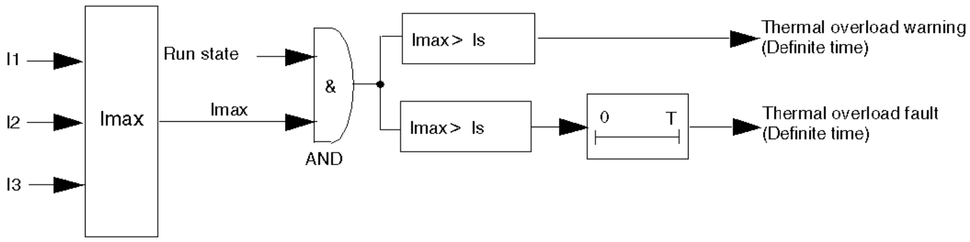
Functional Characteristics

The thermal overload definite time function includes the following features:

- 2 configurable threshold settings; one setting (OC1) is used for single speed motors, both settings are required for 2-speed motors:
  - OC1(Motor Full Load Current Ratio) or
  - OC2 (Motor High Speed Full Load Current Ratio)
- 1 time delay:
  - Overcurrent Time (O-Time, set by the Thermal Overload Fault Definite Timeout parameter)
- 2 function outputs:
  - Thermal Overload Warning
  - Thermal Overload Fault
- 2 counting statistics:
  - Thermal Overload Faults Count
  - Thermal Overload Warnings Count

Block Diagram

Thermal overload warning and fault:



I1 Phase 1 current
I2 Phase 2 current
I3 Phase 3 current
Is Fault and warning threshold (OC1 or OC2)
T Fault timeout

Parameter Settings

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

Parameters	Setting Range	Factory Setting
Fault 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 fault definite timeout (O-time or over-current time)	1...300 s in 1 s increments	10 s
Thermal overload warning threshold	20...800 % of OC in 1 % increments	80 % of OC
Long start fault timeout(1) (D-time)	1...200 s in 1 s increments	10 s
(1) The definite time thermal overload function requires the simultaneous use of the Long start motor protection function, both of which employ the Long start fault timeout setting.		

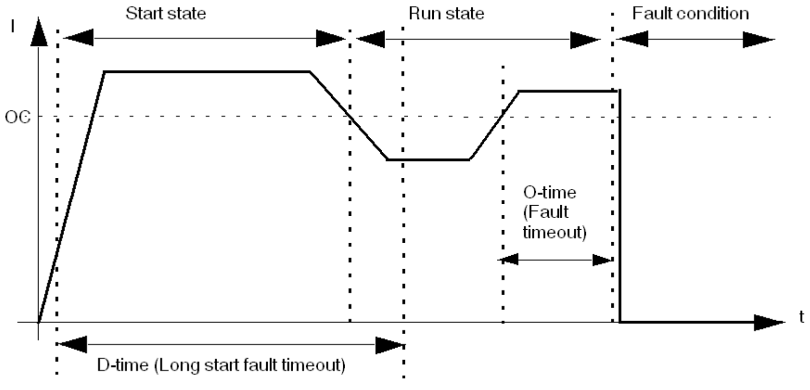
Technical Characteristics

The definite time thermal overload function has the following characteristics:

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

Example

The following diagram describes a definite time thermal overload fault:



OC Fault threshold (OC1 or OC2)

Motor Temperature Sensor

Overview

The LTM R controller has 2 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 *(see page 73)*
- PT100 *(see page 75)*
- PTC Analog *(see page 77)*
- NTC Analog *(see page 79)*

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 LTM R 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
Fault enable	Enable/Disable	Disable
Warning 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 LTM R controller is connected to a binary positive temperature coefficient thermistor embedded in the motor.

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

- a motor temperature sensor warning when the measured resistance exceeds a fixed threshold.
- a motor temperature sensor fault when the measured resistance exceeds the same fixed threshold.

The fault and warning conditions continue until measured resistance falls below a separate fixed motor temperature sensor re-closing threshold.

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

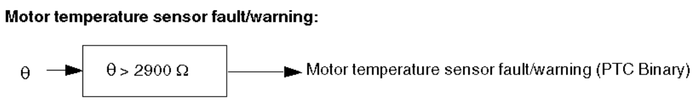
The function is available for all operating states.

Functional Characteristics

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

- 2 function output:
  - Motor Temp Sensor Warning
  - Motor Temp Sensor Fault
- 1 counting statistic:
  - Motor Temp Sensor Faults Count

Block Diagram



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
Fault/Warning threshold	2900 Ω	+/– 2 %
Fault/Warning re-closing threshold	1575 Ω	+/– 2 %

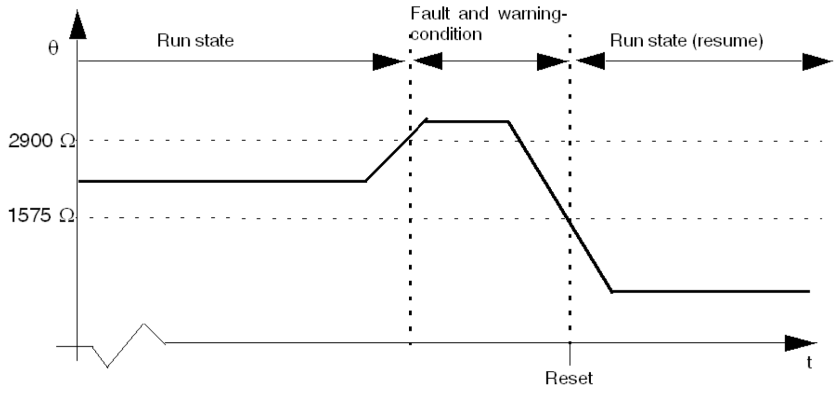
Technical Characteristics

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 fault with an automatic reset:



2900 Ω Fault threshold
1575 Ω Fault re-closing 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 LTM R controller is connected to a PT100 sensor embedded in the motor.

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

- a motor temperature sensor warning when the measured temperature exceeds a configurable warning threshold.
- a motor temperature sensor fault when the measured temperature exceeds a separately set fault threshold.

The LTM R 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 fault or warning condition continues until the measured temperature falls below 95 % of the fault or warning threshold.

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

Fault and warning 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).

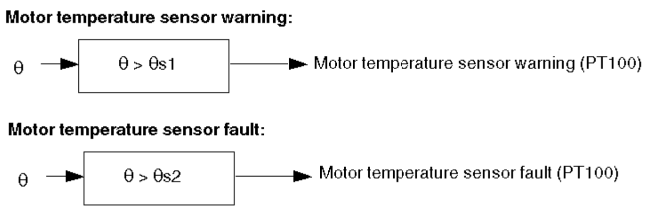
NOTE: To connect a 3-wire PT100 sensor to an LTM R controller, simply do not wire the compensation pin of the 3-wire PT100 sensor.

Functional Characteristics

The PT100 motor temperature sensor function includes the following features:

- 2 configurable thresholds:
  - Motor Temperature Sensor Warning Threshold Degree
  - Motor Temperature Sensor Fault Threshold Degree
- 2 function outputs:
  - Motor Temperature Sensor Warning
  - Motor Temperature Sensor Fault
- 1 counting statistic:
  - Motor Temperature Sensor Faults Count
- 1 display configuration:
  - Motor Temperature Sensor Display Degree CF

Block Diagram



θ Temperature measured by the PT100 sensor
θ**s1** Motor temperature sensor warning threshold
θ**s2** Motor temperature sensor fault threshold

Parameter Settings

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

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

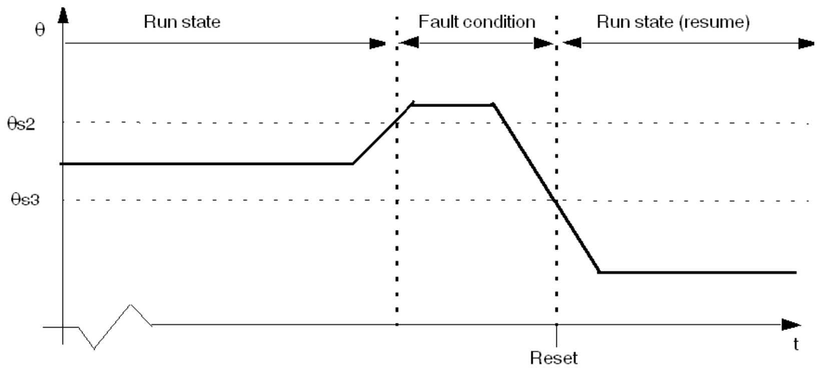
Technical Characteristics

The PT100 motor temperature sensor function has the following characteristics:

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

Example

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



θs2 Fault threshold
θs3 Fault re-closing threshold (95% of fault 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 LTM R controller is connected to an analog PTC thermistor embedded in the motor.

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

- a motor temperature sensor warning when the measured resistance exceeds a configurable warning threshold.
- a motor temperature sensor fault when the measured resistance exceeds a separately set fault threshold.

The fault or warning condition continues until the measured resistance falls below 95 % of the fault or warning threshold.

Fault and warning monitoring can be separately enabled and disabled.

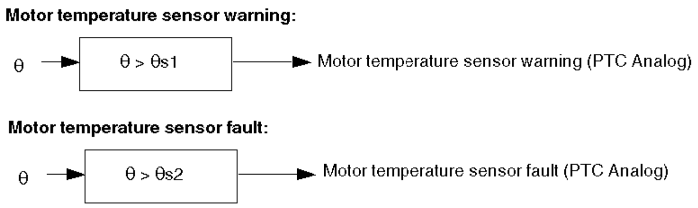
The function is available for all operating states.

Functional Characteristics

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

- 2 configurable thresholds:
  - Motor Temp Sensor Warning Threshold
  - Motor Temp Sensor Fault Threshold
- 2 function outputs:
  - Motor Temp Sensor Warning
  - Motor Temp Sensor Fault
- 1 counting statistic:
  - Motor Temp Sensor Faults Count

Block Diagram



θ Temperature sensing element resistance
θ**s1** Motor temperature sensor warning threshold
θ**s2** Motor temperature sensor fault threshold

Parameter Settings

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

Parameters	Setting Range	Factory Setting
Fault threshold	20...6500 Ω in 0.1 Ω increments	20 Ω
Warning threshold	20...6500 Ω in 0.1 Ω increments	20 Ω

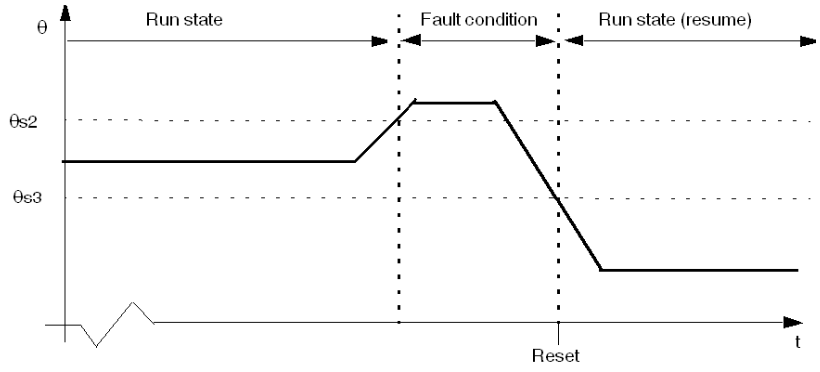
Technical Characteristics

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

Characteristic	Value
Hysteresis	–5 % of Warning threshold and Fault 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 fault with automatic reset and an active Run command:



θ**s2** Fault threshold
θ**s3** Fault re-closing threshold (95% of fault 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 LTM R controller is connected to an analog NTC thermistor embedded in the motor.

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

- a motor temperature sensor warning when the measured resistance falls below a configurable warning threshold.
- a motor temperature sensor fault when the measured resistance falls below a separately set fault threshold.

The fault or warning condition continues until the measured resistance exceeds 105 % of the fault or warning threshold.

Fault and warning monitoring can be separately enabled and disabled.

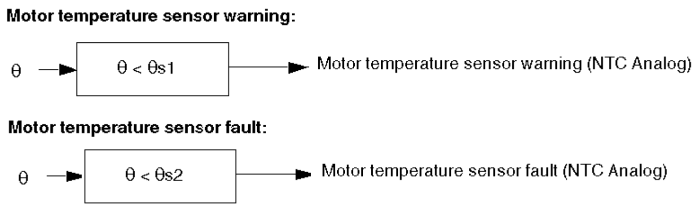
The function is available for all operating states.

Functional Characteristics

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

- 2 configurable thresholds:
  - Warning Threshold
  - Fault Threshold
- 2 function outputs:
  - Motor Temp Sensor Warning
  - Motor Temp Sensor Fault
- 1 counting statistic:
  - Motor Temp Sensor Faults Count

Block Diagram



θ Temperature sensing element resistance
θ**s1** Motor temperature sensor warning threshold
θ**s2** Motor temperature sensor fault threshold

Parameter Settings

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

Parameters	Setting Range	Factory Setting
Fault threshold	20...6500 Ω in 0.1 Ω increments	20 Ω
Warning threshold	20...6500 Ω in 0.1 Ω increments	20 Ω

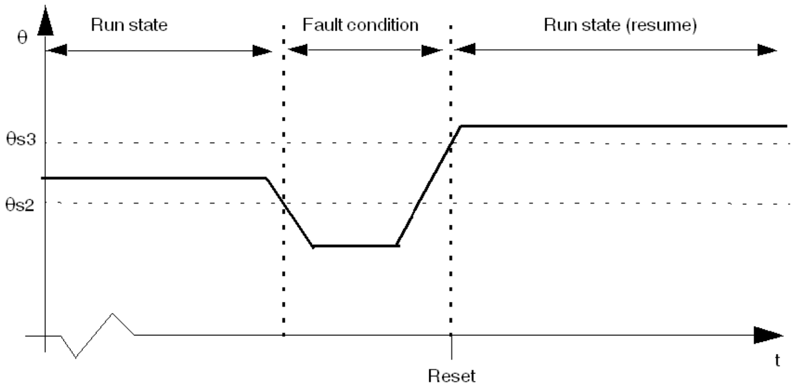
Technical Characteristics

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

Characteristics	Value
Hysteresis	+ 5 % of Warning threshold and Fault 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 fault with automatic reset:



θ**r2** Fault threshold
θ**r3** Fault re-closing threshold (105% of fault 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 LTM R controller detects On Level Current–defined as 20 % of FLC. At the same time the Rapid Cycle Lockout bit is set.

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

- Rapid Cycle Lockout bit remains set
- LTM R controller ignores the Run command. It prevents the motor from restarting
- HMI device (if attached) displays "WAIT"
- LTM R controller Alarm LED flashes red 5 times per second, indicating the LTM R controller has disabled motor outputs thereby preventing an undesirable condition caused by starting the motor
- LTM R controller monitors the wait time–if more than 1 timer is active, the LTM R controller reports the minimum wait time before the longest timer elapses

On power loss, the LTM R controller saves the state of the lockout timer in non-volatile memory. When the LTM R 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 LTM R 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 warning and no fault.

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:

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

In addition, the Rapid Cycle Lockout function:

- disables motor outputs
- causes the LTM R Alarm LED to flash 5 times per second

Parameter Settings

The rapid cycle lockout function has the following parameters:

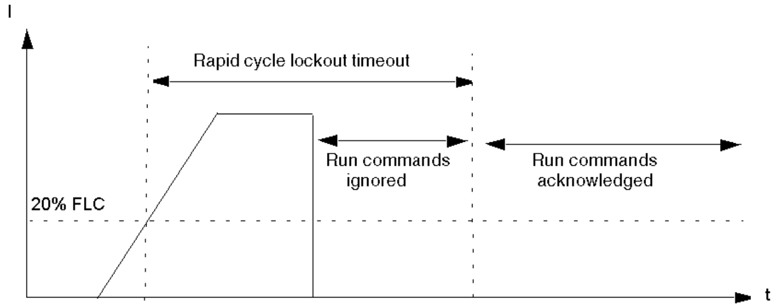
Parameters	Setting Range	Factory Setting
Rapid cycle lockout timeout	0...9999 s in increments of 1 s	0 s

Technical Characteristics

The rapid cycle lockout function has the following characteristics:

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

Example


I
Rapid cycle lockout timeout
Run commands ignored
Run commands acknowledged
20% FLC
t

Section 3.3
Current Motor Protection Functions

Overview

This section describes the current motor protection functions of the LTM R controller.

What Is in This Section?

This section contains the following topics:

Current Phase Imbalance

Description

The current phase imbalance function signals:

- a warning when the current in any phase differs by more than a set percentage from the average current in all 3 phases.
- a fault when the current in any phase differs by more than a separately set percentage from the average current in all 3 phases for a set period of time.

⚠ CAUTION

RISK OF MOTOR OVERHEATING

The Current Phase Imbalance Fault 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 3 phases, use the current phase loss motor protection function.

This function has 2 adjustable fault 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 3 phase current average is the same for 2 phases, the function identifies both phases.

Fault and warning monitoring can be separately enabled and disabled.

The function applies only to 3-phase motors.

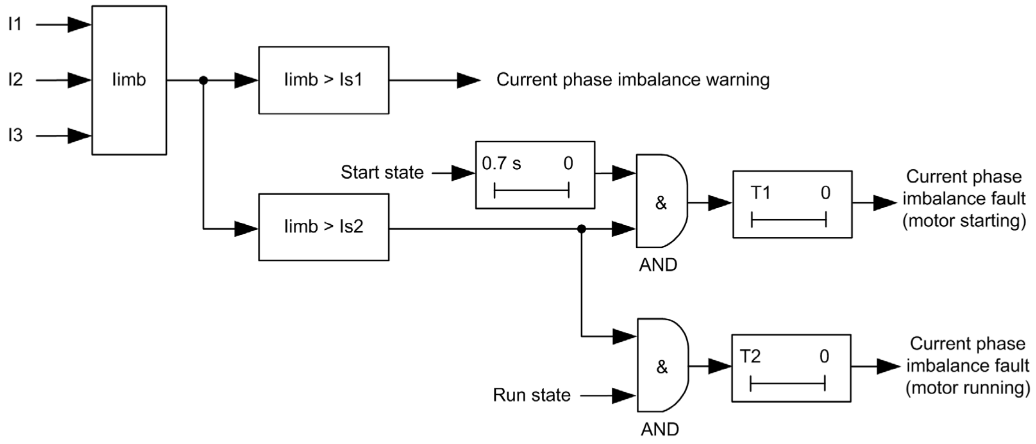
Functional Characteristics

The current phase imbalance function includes the following features:

- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 2 fault time delays:
  - Fault Timeout Starting
  - Fault Timeout Running
- 2 function outputs:
  - Current Phase Imbalance Warning
  - Current Phase Imbalance Fault
- 1 counting statistic:
  - Current Phase Imbalance Faults Count
- 3 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 warning and fault:



I1 Phase 1 current
I2 Phase 2 current
I3 Phase 3 current
Iimb Current imbalance ratio for 3-phase
Is1 Warning threshold
Is2 Fault threshold
T1 Fault timeout starting
T2 Fault timeout running

Parameter Settings

The current phase imbalance function has the following parameters:

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

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

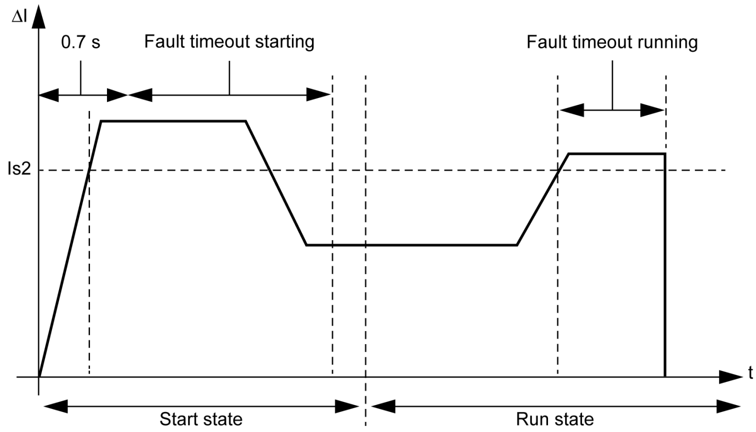
Technical Characteristics

The current phase imbalance function has the following characteristics:

Characteristics	Value
Hysteresis	–5 % of fault or warning 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 3 phase current average
Is2 Fault threshold

Current Phase Loss

Description

The current phase loss function signals:

- a warning when the current in any phase differs by more than 80 % from the average current in all 3 phases.
- a fault when the current in any phase differs by more than 80 % from the average current in all 3 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 3 phases. For smaller current imbalances, use the current phase imbalance motor protection function.

This function has a single adjustable fault 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 3 phase current average is the same for 2 phases, the function identifies both phases.

Fault and warning monitoring can be separately enabled and disabled.

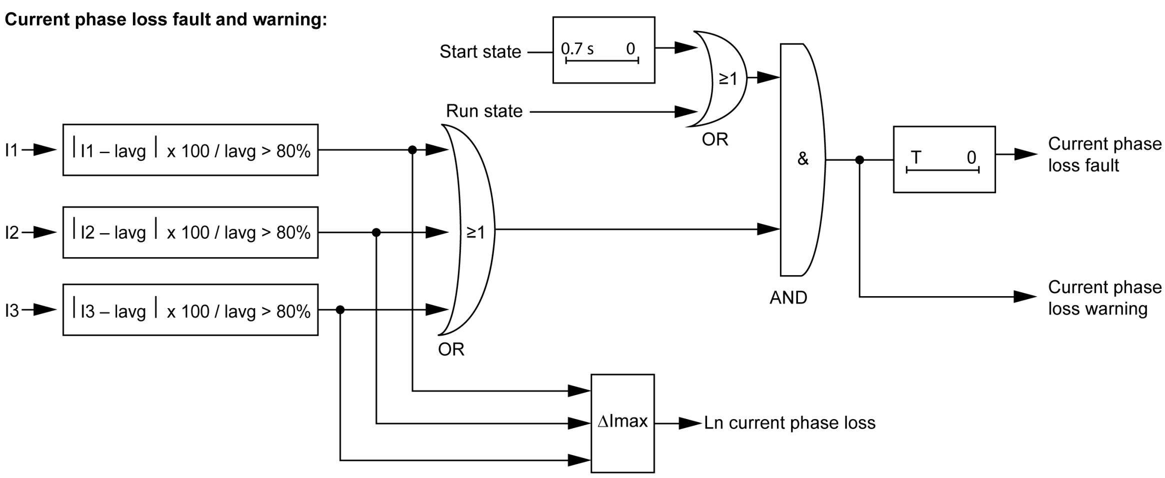
The function applies only to 3-phase motors.

Functional Characteristics

The current phase loss function includes the following features:

- 1 fixed fault and warning threshold equal to 80 % of the 3 phase average current.
- 1 fault time delay:
  - Current Phase Loss Timeout
- 2 function outputs:
  - Current Phase Loss Warning
  - Current Phase Loss Fault
- 1 counting statistic:
  - Current Phase Loss Faults Count
- 3 indicators identifying the phase or phases experiencing the current loss:
  - L1 Current loss
  - L2 Current loss
  - L3 Current loss

Block Diagram



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 3 phase current average
T Fault timeout

Parameter Settings

The current phase loss function has the following configurable parameters:

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

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

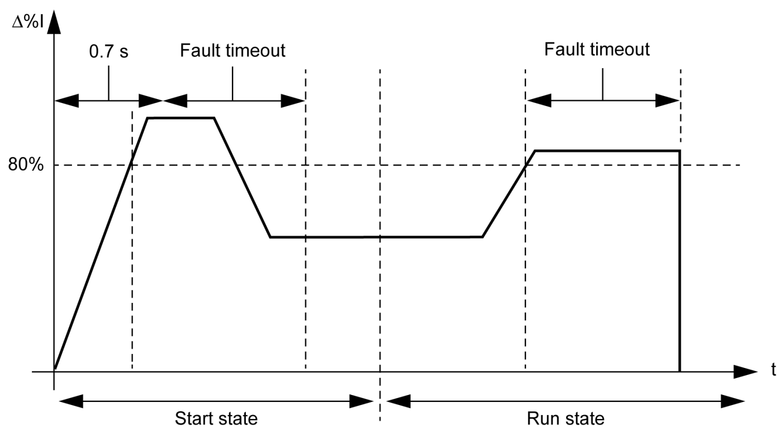
Technical Characteristics

The current phase loss function has the following characteristics:

Characteristics	Value
Hysteresis	75 % of the 3 phase average current
Trip time accuracy	+/–0.1 s or +/–5 %

Example

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



∆%I Percentage difference between current in any phase and the 3 phase current average

Current Phase Reversal

Description

The current phase reversal function signals a fault when it detects that the current phases of a 3-phase motor are out of sequence with the Motor Phases Sequence parameter, ABC or ACB.

NOTE: When the LTM R 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.

This function:

- is active when the motor is in start state or run state
- applies only to 3-phase motors
- has no warning and no timer.

This function can be enabled or disabled.

Functional Characteristics

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

Parameter Settings

The current phase reversal function has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Fault 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 fault 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 LTM R controller detects a long start fault condition whenever the actual current profile, occurring after a start command, varies from the expected profile.

Fault monitoring can be separately enabled and disabled.

This function has no warning.

Start Cycle

The configurable parameters for the Long Start protection function, Long Start Fault Threshold and Long Start Fault Timeout, are used by the LTM R controller in defining and detecting the motor’s start cycle. See *Start Cycle, page 139*.

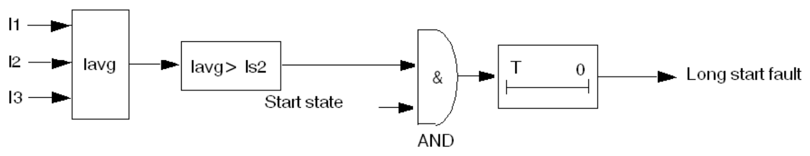
Functional Characteristics

The long start function includes the following features:

- 1 threshold:
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 1 function outputs:
  - Long Start Fault
- 1 counting statistic:
  - Long Start Faults Count

Block Diagram

Long start fault:



I1 Phase 1 current
I2 Phase 2 current
I3 Phase 3 current
Is2 Fault threshold
T Fault timeout

Parameter Settings

The long start function has the following parameters:

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

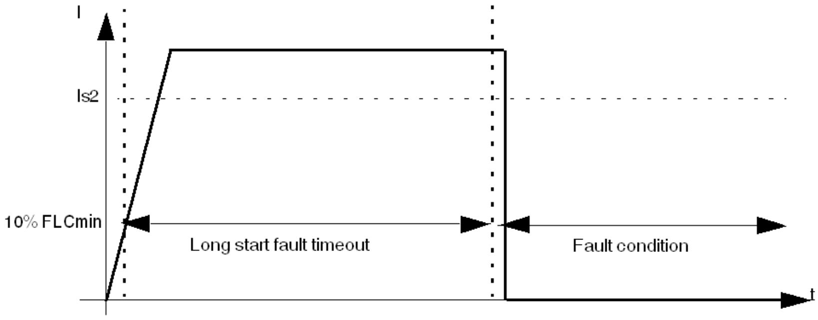
Technical Characteristics

The long start function has the following characteristics:

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

Example

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



Is2 Long start fault threshold

Jam

Description

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

- a warning when current in any phase exceeds a set threshold, after the motor has reached run state.
- a fault 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.

Fault and warning monitoring can be separately enabled and disabled.

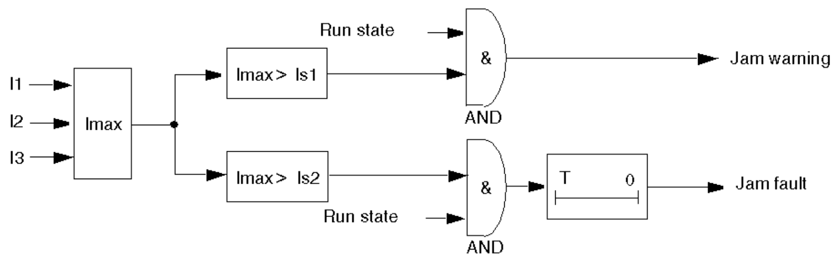
Functional Characteristics

The jam function includes the following features:

- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - Jam Warning
  - Jam Fault
- 1 counting statistic:
  - Jam Faults Count

Block Diagram

Jam warning and fault:



I1 Phase 1 current
I2 Phase 2 current
I3 Phase 3 current
Is1 Warning threshold
Is2 Fault threshold
T Fault timeout

Parameter Settings

The jam function has the following parameters:

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

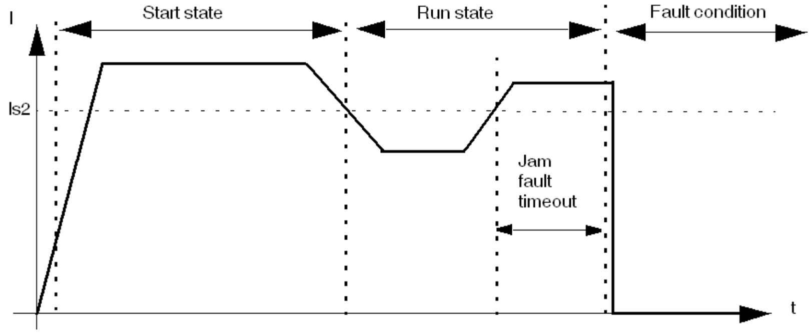
Technical Characteristics

The jam function has the following characteristics:

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

Example

The following diagram describes the occurrence of a jam fault.



Is2 Jam fault threshold

Undercurrent

Description

The undercurrent function signals:

- a warning when the 3-phase Average Current falls below a set threshold, after the motor has reached run state.
- a fault when the 3-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 fault time delay. Fault and warning monitoring can be separately enabled and disabled.

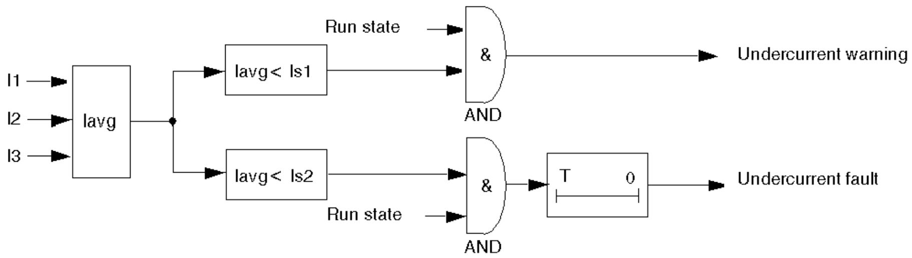
Functional Characteristics

The undercurrent function includes the following features:

- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - Undercurrent Warning
  - Undercurrent Fault
- 1 counting statistic:
  - Undercurrent Faults Count

Block Diagram

Undercurrent warning and fault:



Iavg Average current
Is1 Warning threshold
Is2 Fault threshold
T Fault timer delay

Parameter Settings

The undercurrent function has the following parameters:

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

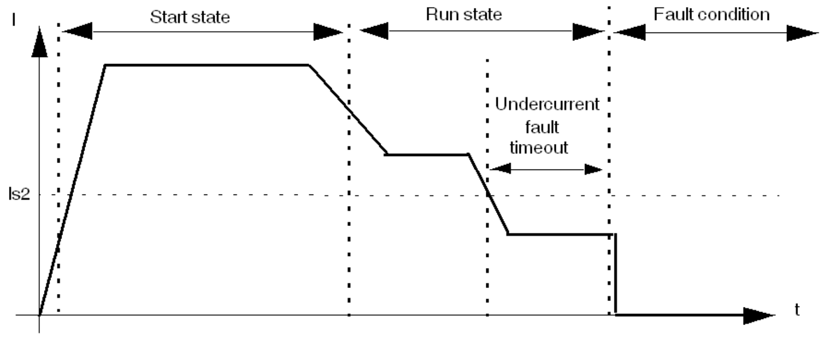
Technical Characteristics

The undercurrent function has the following characteristics:

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

Example

The following diagram describes the occurrence of an undercurrent fault.



Is2 Undercurrent fault threshold

Overcurrent

Description

The overcurrent function signals:

- a warning when current in a phase exceeds a set threshold, after the motor has reached run state.
- a fault when current in a phase continuously exceeds a separately set threshold for a set period of time, after the motor has reached run state.

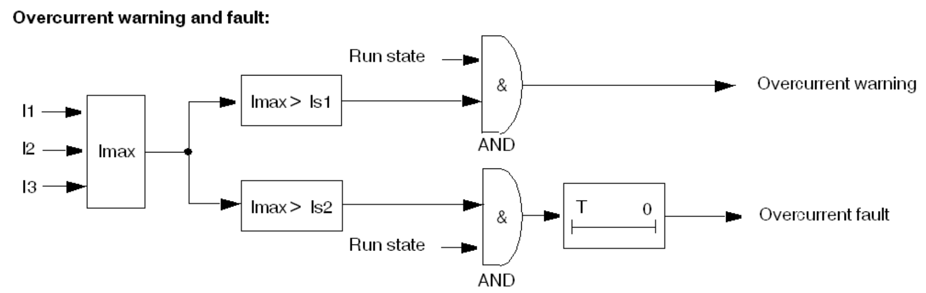
The overcurrent function can be triggered when the equipment is overloaded or a process condition is detected causing current to increase beyond the set threshold. This function has a single fault time delay. Fault and warning monitoring can be separately enabled and disabled.

Functional Characteristics

The overcurrent function includes the following features:

- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - Overcurrent Warning
  - Overcurrent Fault
- 1 counting statistic:
  - Overcurrent Faults Count

Block Diagram



I1 Phase 1 current
I2 Phase 2 current
I3 Phase 3 current
Is1 Warning threshold
Is2 Fault threshold
T Fault timeout

Parameter Settings

The overcurrent function has the following parameters:

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

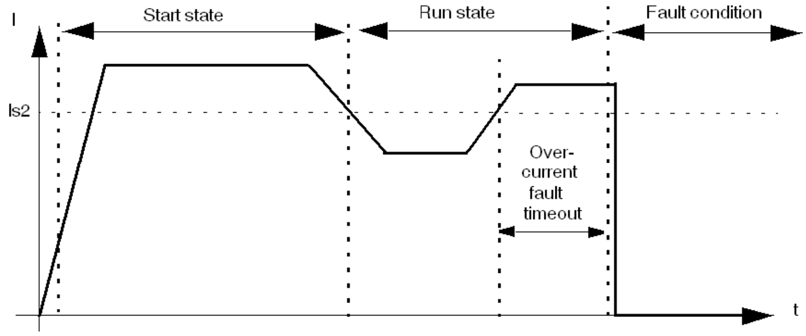
Technical Characteristics

The overcurrent function has the following characteristics:

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

Example

The following diagram describes the occurrence of an overcurrent fault.



Is2 Overcurrent fault threshold

Ground Current

Overview

The LTM R controller can be configured to detect ground current:

- internally, by summing the 3-phase current signals from the secondary of the internal current transformers *(see page 99)*.
- externally, by measuring the current delivered by the secondary of an external ground fault current transformer *(see page 101)*.

Use the Ground Current Mode parameter to select either internal or external ground fault 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
Fault enable	Enable/Disable	Enable
Warning enable	Enable/Disable	Enable
Ground fault 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 FAULT DETECTION

Internal ground current function will not protect people from harm caused by ground current.

Ground fault thresholds must be set to protect the motor and related equipment.

Ground fault 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:

- a warning when the summed current exceeds a set threshold.
- a fault when the summed current continuously exceeds a separately set threshold for a set period of time.

The internal ground current function has a single fault 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.

Fault and warning monitoring can be separately enabled and disabled.

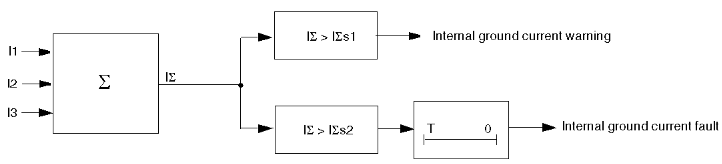
Functional Characteristics

The internal ground current function includes the following features:

- 1 measure of ground current in amperes:
  - Ground Current
- 1 measure of ground current as a % of FLCmin:
  - Ground Current Ratio
- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - Internal Ground Current Warning
  - Internal Ground Current Fault
- 1 counting statistic:
  - Ground Current Faults Count

Block Diagram

Internal ground current warning and fault:



I1 Phase 1 current
I2 Phase 2 current
I3 Phase 3 current
IΣ Summed current
IΣs1 Warning threshold
IΣs2 Fault threshold
T Fault timeout

Parameter Settings

The internal ground current function has the following parameters:

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

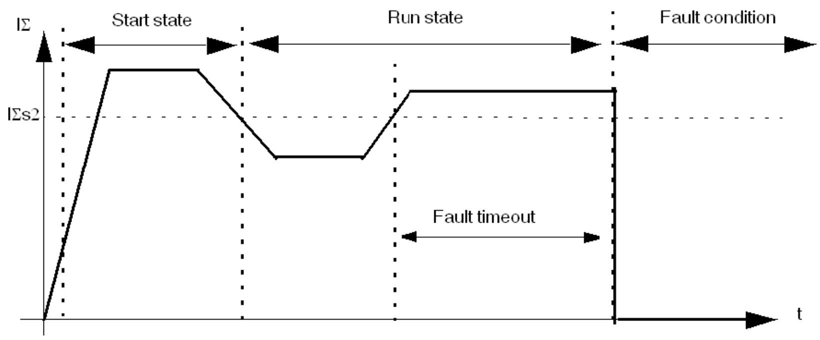
Technical Characteristics

The internal ground current function has the following characteristics:

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

Example

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



IΣs2 internal ground current fault 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 FAULT DETECTION
External ground current function will not protect people from harm caused by ground current.
Ground fault thresholds must be set to protect the motor and related equipment.
Ground fault settings must conform to national and local safety regulations and codes.
Failure to follow these instructions will result in death or serious injury.

The LTM R controller has 2 terminals—Z1 and Z2—that can be connected to an external ground current transformer. The external ground current function measures ground current delivered by the secondary of the external current transformer and signals:

- a warning when the delivered current exceeds a set threshold.
- a fault when the delivered current continuously exceeds a separately set threshold for a set period of time.

The external ground current function has a single fault 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.

Fault and warning monitoring can be separately enabled and disabled.

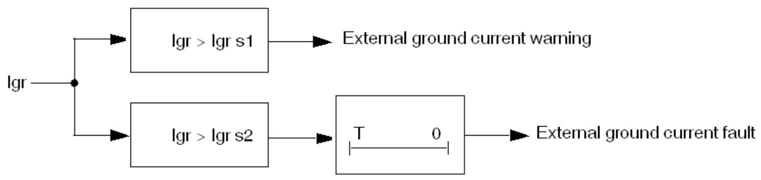
Functional Characteristics

The external ground current function includes the following features:

- 1 measure of ground current in amperes:
  - Ground Current
- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - External Ground Current Warning
  - External Ground Current Fault
- 1 counting statistic:
  - Ground Current Faults Count

Block Diagram

External ground current warning and fault:



Igr Ground current from external ground CT
Igr s1 Warning threshold
Igr s2 Fault threshold
T Fault timeout

Parameter Settings

The external ground current function has the following parameters:

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

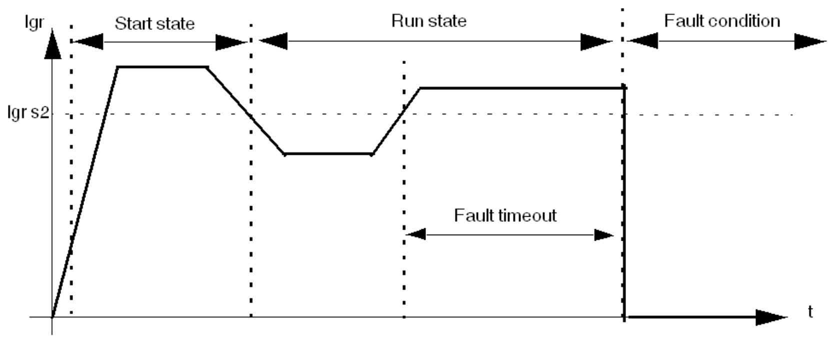
Technical Characteristics

The external ground current function has the following characteristics:

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

Example

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



Igr s2 External ground current fault threshold

Section 3.4
Voltage Motor Protection Functions

Overview

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

What Is in This Section?

This section contains the following topics:

Voltage Phase Imbalance

Description

The voltage phase imbalance function signals:

- a warning when the voltage in any composed phase differs by more than a set percentage from the average voltage in all 3 phases
- a fault when the voltage in any composed phase differs by more than a separately set percentage from the average voltage in all 3 phases for a set period of time

NOTE: A composed phase is the combined measure of 2 phases: L1 + L2, L2 + L3, or L3 + L1.

This function:
- is active when the LTM R 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 3-phase motors

This function has 2 adjustable fault 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 3 phases, use the voltage phase loss motor protection function.

Fault and warning monitoring can be separately enabled and disabled.

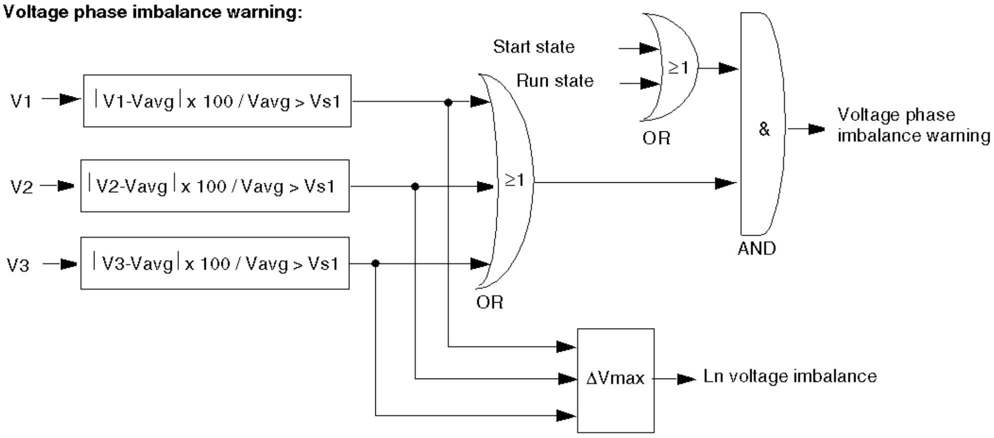
Functional Characteristics

The voltage phase imbalance function includes the following features:

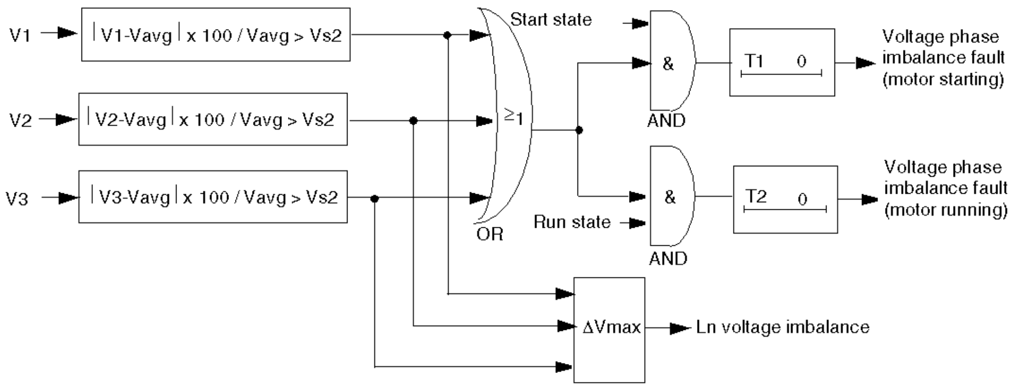
- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 2 fault time delays:
  - Fault Timeout Starting
  - Fault Timeout Running
- 2 function outputs:
  - Voltage Phase Imbalance Warning
  - Voltage Phase Imbalance Fault
- 1 counting statistic:
  - Voltage Phase Imbalance Faults Count
- 3 indicators 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 warning:



Voltage phase imbalance fault:



V1 L1-L2 voltage
V2 L2-L3 voltage
V3 L3-L1 voltage
Ln Line number or numbers with greatest deviation from Vavg
Vs1 Warning threshold
Vs2 Fault threshold
Vavg 3 phase voltage average
T1 Fault timeout starting
T2 Fault timeout running

Parameter Settings

The voltage phase imbalance function has the following parameters:

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

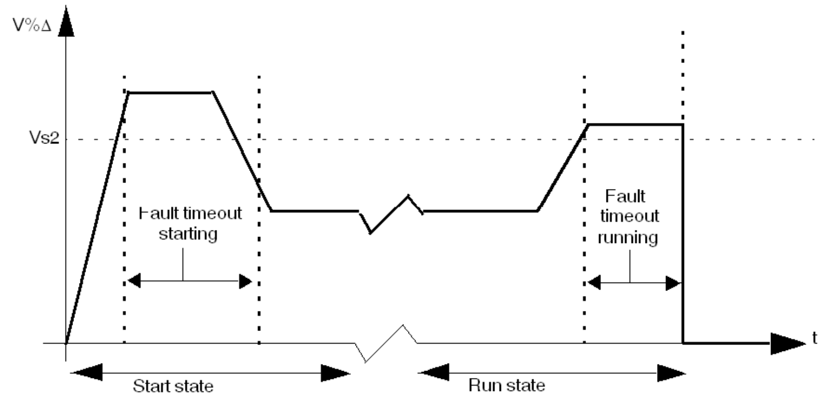
Technical Characteristics

The voltage phase imbalance function has the following characteristics:

Characteristics	Value
Hysteresis	–5 % of Fault threshold or Warning 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 3 phase average voltage
Vs2 Fault threshold

Voltage Phase Loss

Description

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

- a warning when the voltage in any phase differs by more than a 38 % from the average voltage in all 3 phases.
- a fault when the voltage in any phase differs by more than 38 % from the average voltage in all 3 phases for a set period of time.

This function:
- is active when the LTM R 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 or run state
- applies only to 3-phase motors

This function has a single adjustable fault 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 3 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 3 phase voltage average is the same for 2 phases, the function identifies both phases.

Fault and warning monitoring can be separately enabled and disabled.

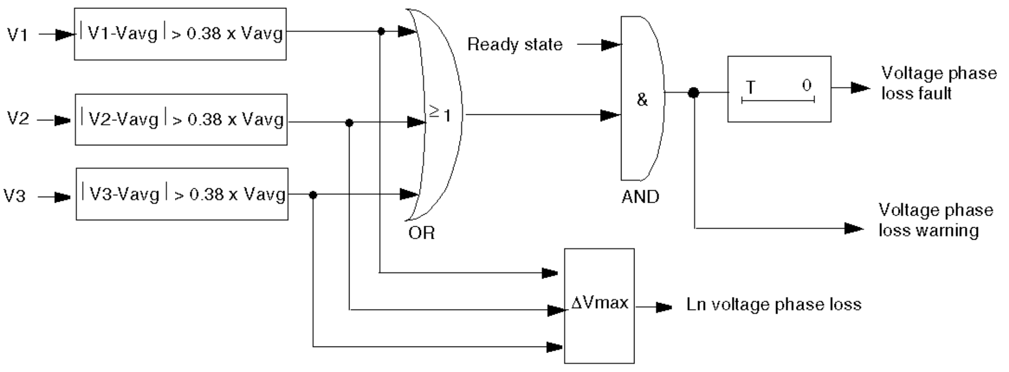
Functional Characteristics

The voltage phase loss function includes the following features:

- A fixed fault and warning threshold equal to 38 % of the 3 phase average voltage.
- A single, adjustable fault time delay:
  - Voltage Phase Loss Timeout
- 2 function outputs:
  - Voltage Phase Loss Warning
  - Voltage Phase Loss Fault
- 1 counting statistic:
  - Voltage Phase Loss Faults Count
- 3 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 fault and warning:



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 3 phase average voltage
T Fault timeout

Parameter Settings

The voltage phase loss function has the following configurable parameters:

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

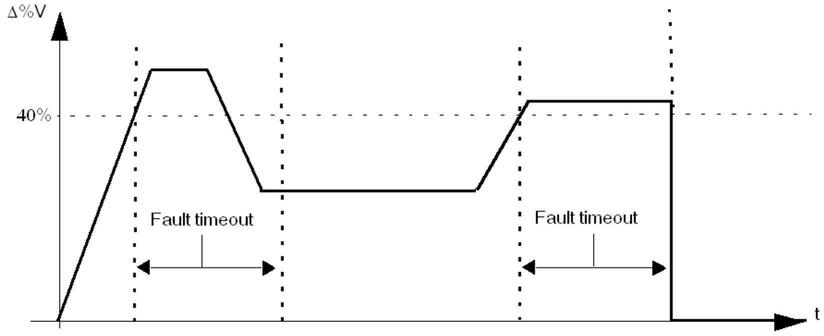
Technical Characteristics

The voltage phase loss function has the following characteristics:

Characteristics	Value
Hysteresis	45 % of the 3 phase average voltage
Trip time accuracy	+/– 0.1 s or +/– 5%

Example

The following diagram describes the occurrence of a voltage phase loss fault of a motor in run state:



ΔV% Percentage difference between voltage in any phase and the 3 phase average voltage

Voltage Phase Reversal

Description

The voltage phase reversal function signals a fault when it detects that the voltage phases of a 3-phase motor are out of sequence, usually indicating a 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 LTM R 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 3-phase motors
- has no warning and no timer

This function can be enabled or disabled.

Functional Characteristics

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

Parameter Settings

The voltage phase reversal function has the following configurable parameters:

Parameters	Setting Range	Factory Setting
Fault 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:

- a warning when voltage in a phase falls below a set threshold.
- a fault when voltage in a phase falls and remains below a separately set threshold for a set period of time.

This function has a single fault time delay. Both the fault and warning 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 LTM R controller is connected to an expansion module.

Fault and warning monitoring can be separately enabled and disabled.

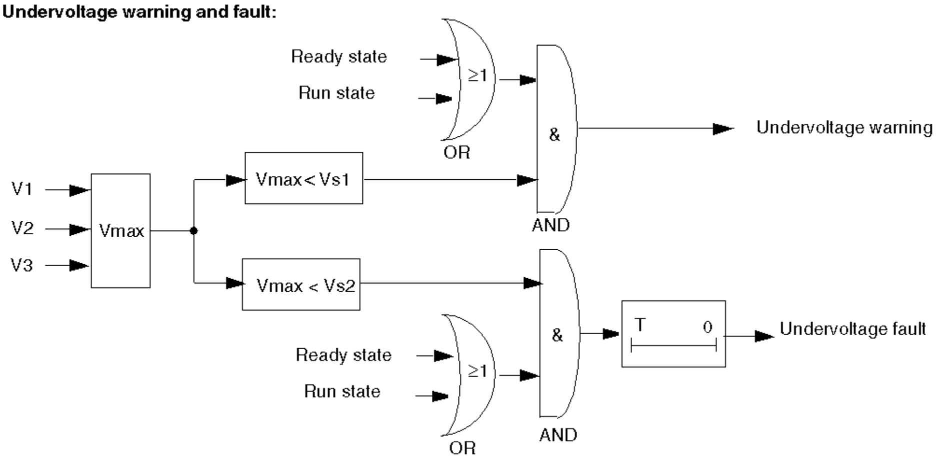
Functional Characteristics

The undervoltage function includes the following features:

- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - Undervoltage Warning
  - Undervoltage Fault
- 1 counting statistic:
  - Undervoltage Faults Count

Block Diagram

Undervoltage warning and fault:



V1 L1-L2 voltage
V2 L2-L3 voltage
V3 L3-L1 voltage
Vs1 Warning threshold
Vs2 Fault threshold
T Fault timeout

Parameter Settings

The undervoltage function has the following parameters:

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

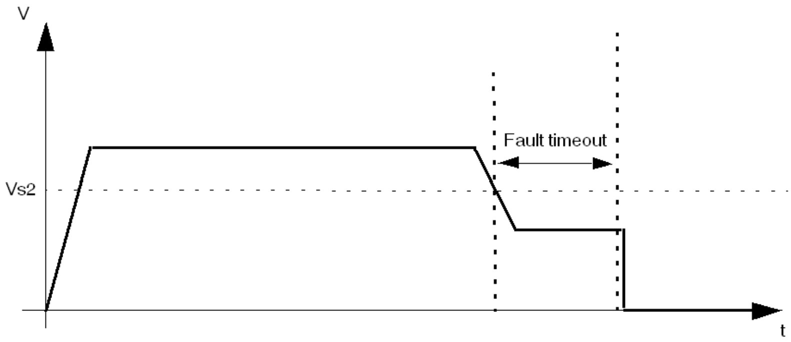
Technical Characteristics

The undervoltage function has the following characteristics:

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

Example

The following diagram describes the occurrence of a undervoltage fault.



Vs2 Undervoltage fault threshold

Overvoltage

Description

The overvoltage function signals:

- a warning when voltage in a phase exceeds a set threshold.
- a fault when voltage in a phase continuously exceeds a separately set threshold for a specified period of time.

This function has a single fault time delay. Both the fault and warning 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 LTM R controller is connected to an expansion module.

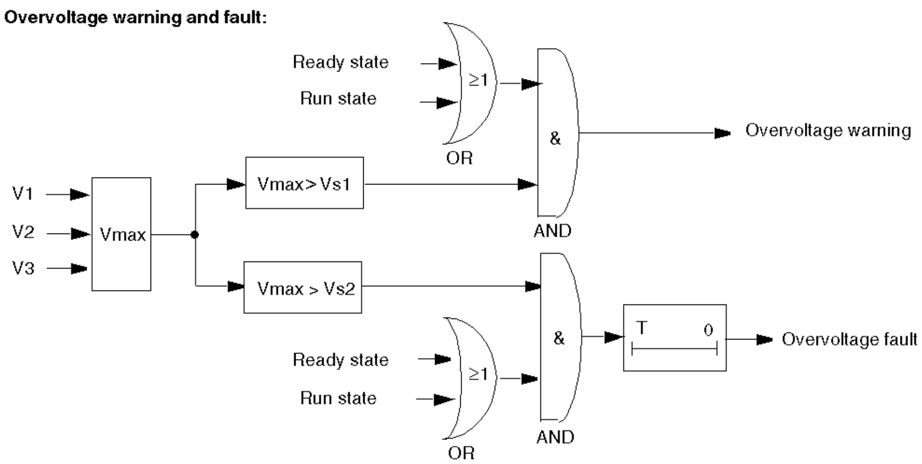
Fault and warning monitoring can be separately enabled and disabled.

Functional Characteristics

The overvoltage function includes the following features:

- 2 thresholds:
  - Warning Threshold
  - Fault Threshold
- 1 fault time delay:
  - Fault Timeout
- 2 function outputs:
  - Overvoltage Warning
  - Overvoltage Fault
- 1 counting statistic:
  - Overvoltage Faults Count

Block Diagram



V1 L1-L2 voltage
V2 L2-L3 voltage
V3 L3-L1 voltage
Vs1 Warning threshold
Vs2 Fault threshold
T Fault timeout

Parameter Settings

The overvoltage function has the following parameters:

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

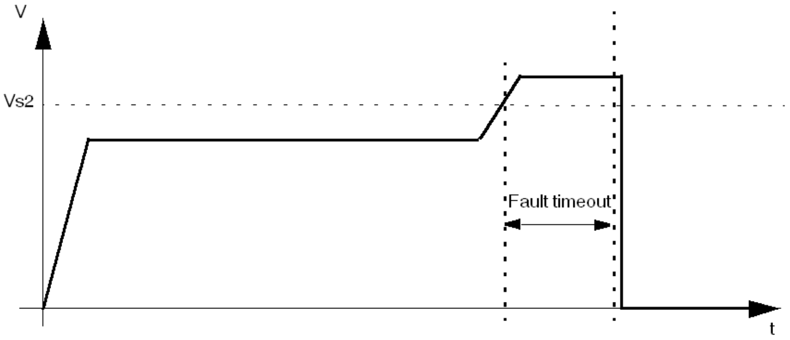
Technical Characteristics

The overvoltage function has the following characteristics:

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

Example

The following diagram describes the occurrence of an overvoltage fault.



Vs2 Overvoltage fault threshold

Voltage Dip Management

Overview

When a voltage dip is detected, the LTM R can perform 2 different functions to shed and reconnect automatically the load:
- Load shedding *(see page 115)*
- Automatic restart *(see page 117)*

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 LTM R 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 LTM R only monitors load shedding when Load Shedding is selected.

With the load shedding function enabled, the LTM R 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 LTM R controller clears the load shedding condition:
- in 2-wire (maintained) configuration, it issues a Run command to re-start the motor,
- in 3-wire (impulse) configuration, it does not automatically re-start 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 LTM R controller's load shedding function should not be enabled.

All voltage dip thresholds and timers can be adjusted when the LTM R 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 LTM E expansion module.

Functional Characteristics

The load shedding function includes the following features:

- 2 thresholds:
  - Voltage Dip Threshold
  - Voltage Dip Restart Threshold
- 2 time delays:
  - Load Shedding Timeout
  - Voltage Dip Restart Timeout
- 1 status flag
  - Load Shedding
- 1 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
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 %

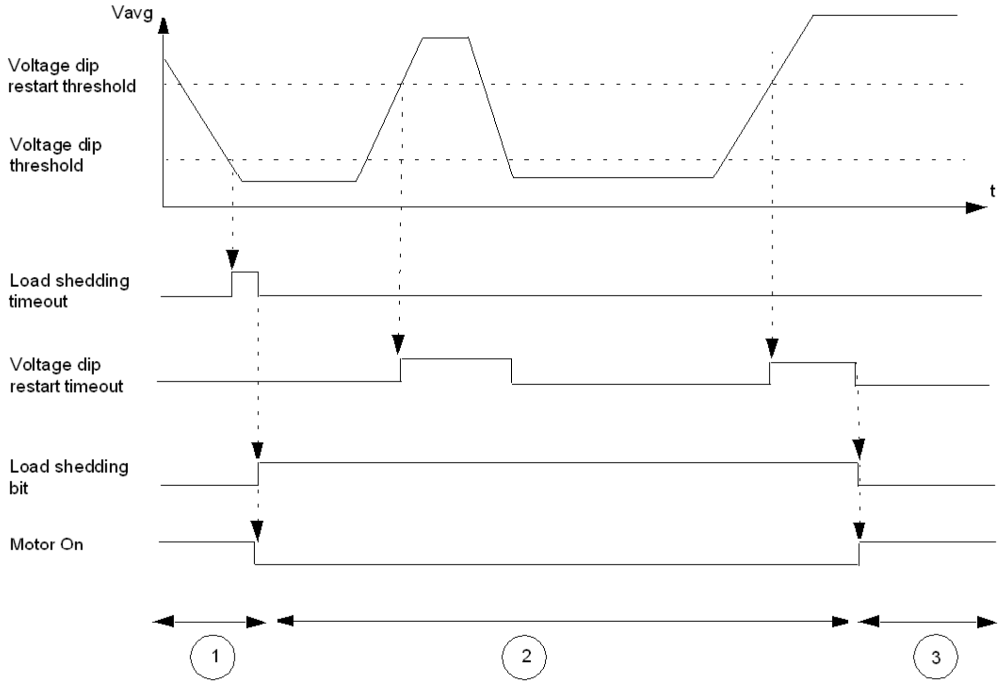
Technical Characteristics

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 LTM R controller provides automatic restart.

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

3 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 LTM R 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 LTM E expansion module.

Functional Characteristics

The automatic restart function includes the following features:

- 3 time delays:
  - Auto Restart Immediate Timeout
  - Auto Restart Delayed Timeout
  - Voltage Dip Restart Timeout
- 5 status flags:
  - Voltage Dip Detection: the LTM R 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
- 3 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:

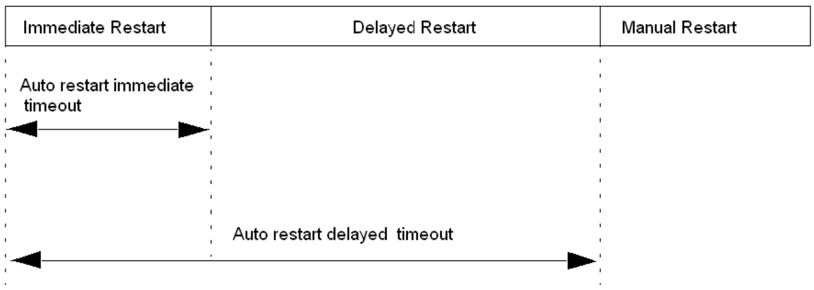
Characteristics	Value
Timing accuracy	+/– 0.1 s or +/– 5%

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 2 possible settings are:
- immediate restart timeout,
- delayed restart timeout (with delay defined by Restart Delay Time).

The following diagram shows the automatic restart phases:

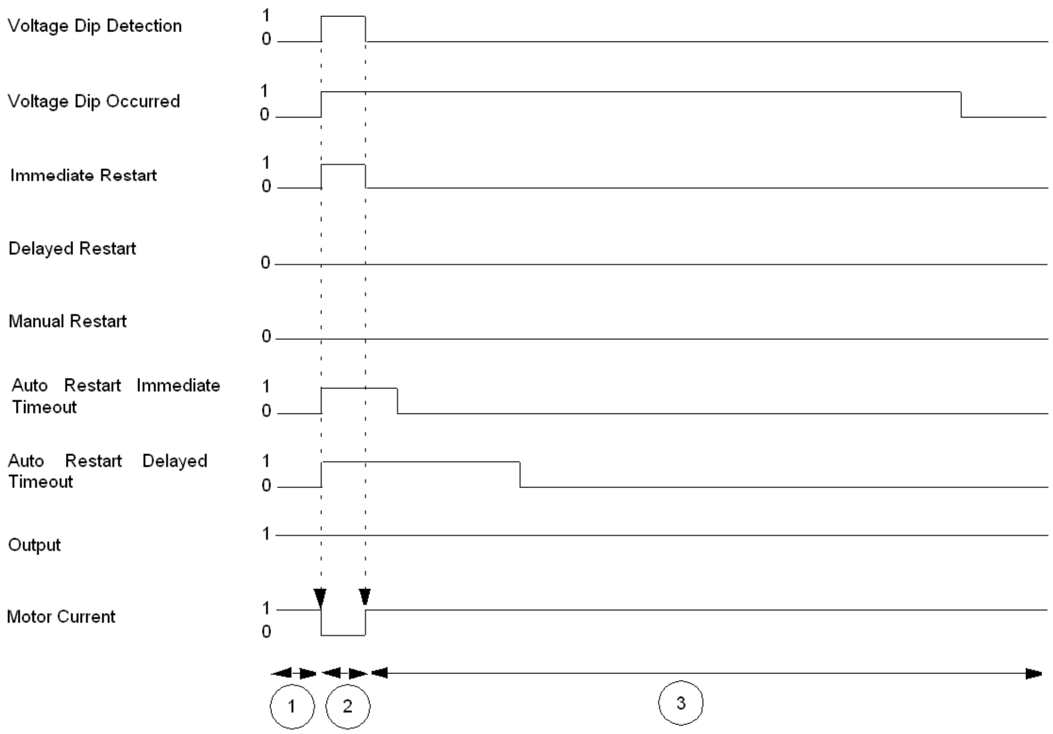


If the voltage dip duration is less than the immediate restart timeout and if the voltage dip is the second one occurring within 1 second, then the motor will require a delayed restart.

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

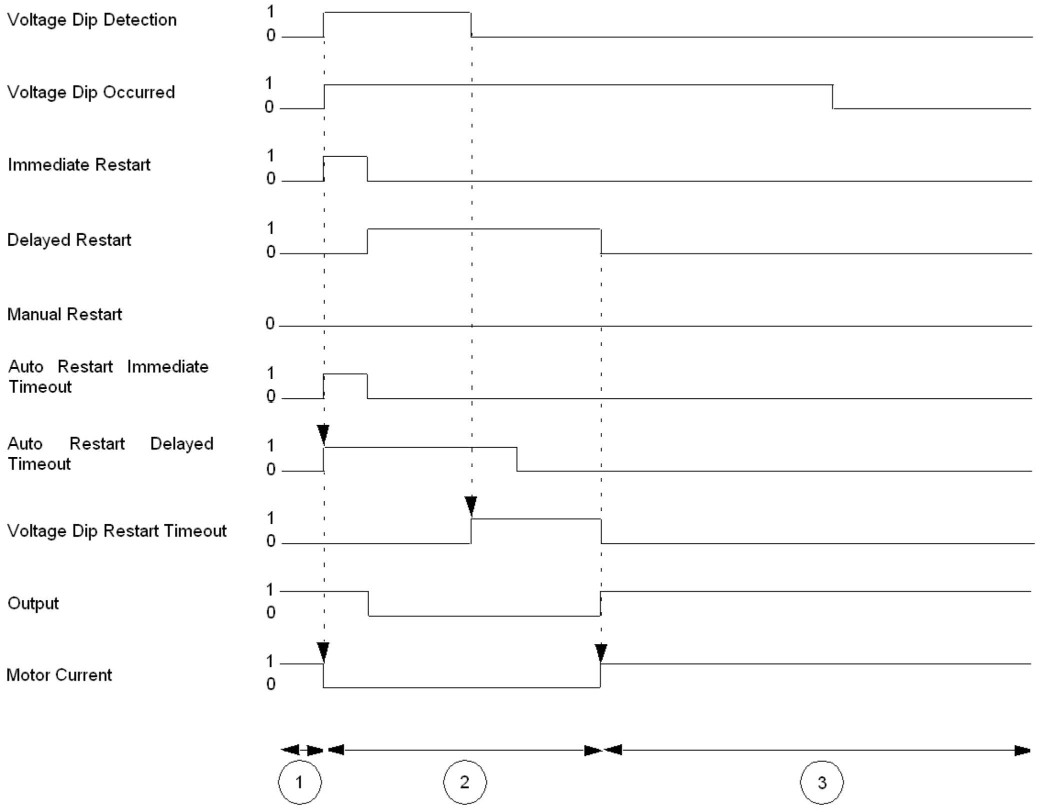
The following diagram is an example of the timing sequence when an immediate restart occurs:



1 Motor running
2 Voltage dip detected, motor stopped
3 Voltage dip cleared, motor automatic restart

Timing Sequence - Delayed Restart

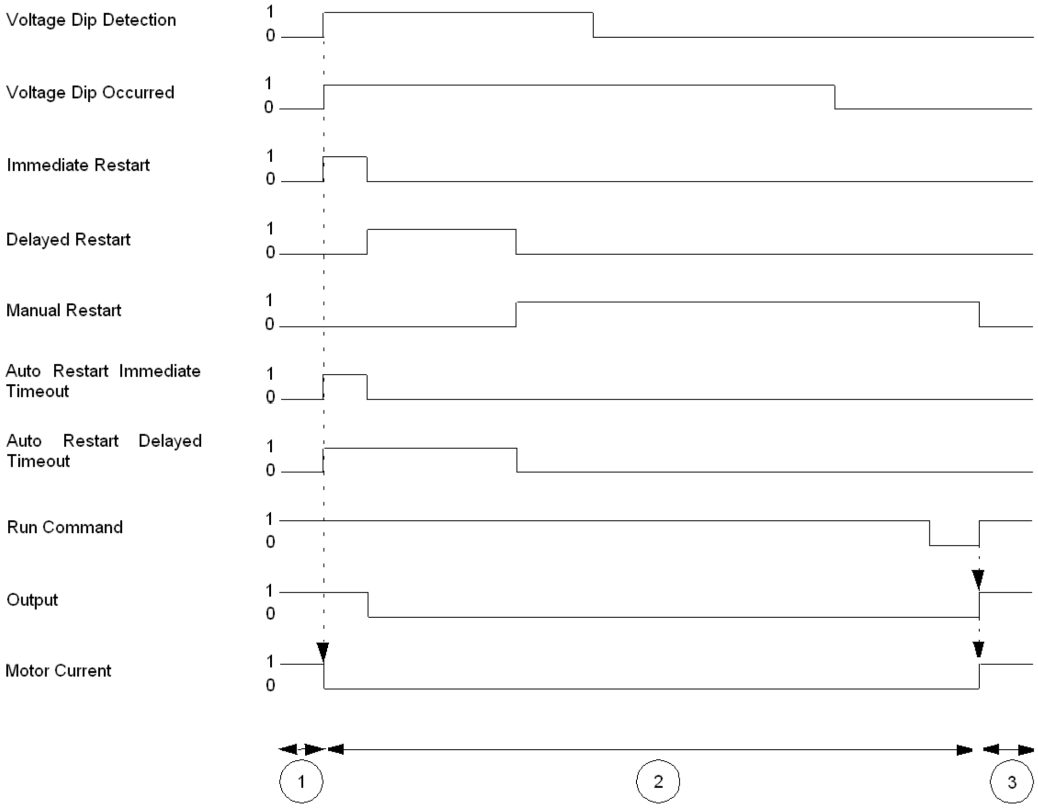
The following diagram is an example of the timing sequence when a delayed restart occurs:



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

Section 3.5
Power Motor Protection Functions

Overview

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

What Is in This Section?

This section contains the following topics:

Underpower

Description

The underpower function signals:

- a warning when the value of active power falls below a set threshold.
- a fault 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 fault time delay. Both the fault and warning 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 LTM R controller is connected to an expansion module.

Fault and warning monitoring can be separately enabled and disabled.

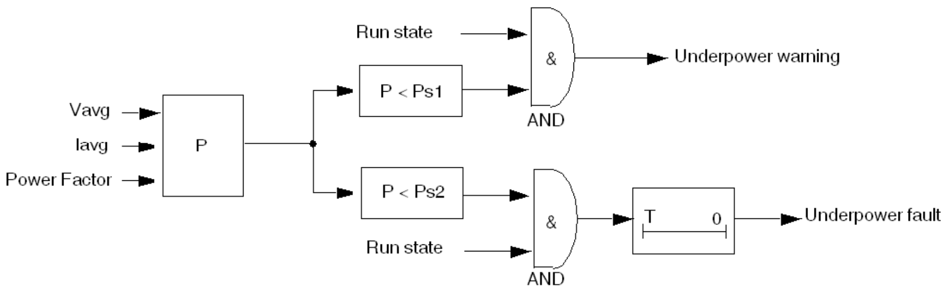
Functional Characteristics

The underpower function includes the following features:

- 2 thresholds:
  - Underpower Warning Threshold
  - Underpower Fault Threshold
- 1 fault time delay:
  - Underpower Fault Timeout
- 2 function outputs:
  - Underpower Warning
  - Underpower Fault
- 1 counting statistic:
  - Underpower Faults Count

Block Diagram

Underpower warning and fault:



Vavg Average rms voltage
Iavg Average rms current
P Power
Ps1 Warning threshold
Ps2 Fault threshold
T Fault timeout

Parameter Settings

The underpower function has the following parameters:

Parameters	Setting Range	Factory Setting
Fault enable	Enable/Disable	Disable
Fault timeout	1...100 s in 1 s increments	60 s
Fault threshold	20...800 % of Motor nominal power in 1 % increments	20 %
Warning enable	Enable/Disable	Disable
Warning threshold	20...800 % of Motor nominal power in 1 % increments	30 %

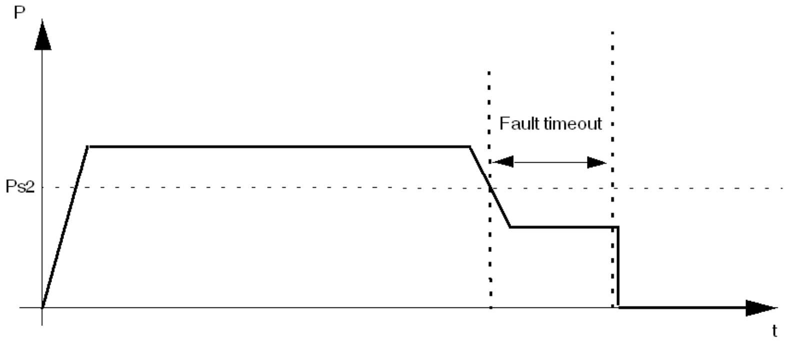
Technical Characteristics

The underpower function has the following characteristics:

Characteristics	Value
Hysteresis	–5 % of Fault threshold or Warning threshold
Accuracy	+/– 5%

Example

The following diagram describes the occurrence of an underpower fault.



Ps2 Underpower fault threshold

Overpower

Description

The overpower function signals:

- a warning when the value of active power exceeds a set threshold.
- a fault 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 fault time delay. Both the fault and warning 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 LTM R controller is connected to an expansion module.

Fault and warning monitoring can be separately enabled and disabled.

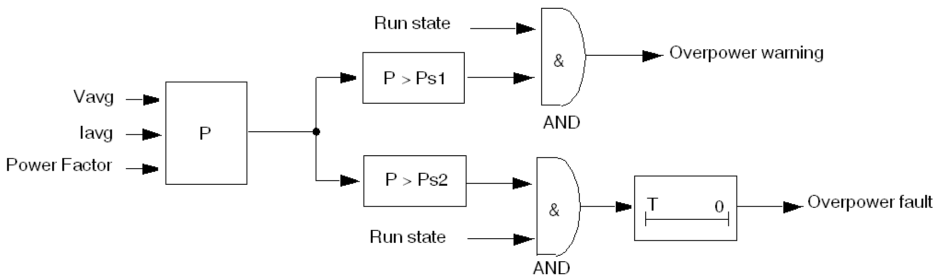
Functional Characteristics

The overpower function includes the following features:

- 2 thresholds:
  - Overpower Warning Threshold
  - Overpower Fault Threshold
- 1 fault time delay:
  - Overpower Fault Timeout
- 2 function outputs:
  - Overpower Warning
  - Overpower Fault
- 1 counting statistic:
  - Overpower Faults Count

Block Diagram

Overpower warning and fault:



Vavg Average rms voltage
Iavg Average rms current
P Power
Ps1 Warning threshold
Ps2 Fault threshold
T Fault timeout

Parameter Settings

The overpower function has the following parameters:

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

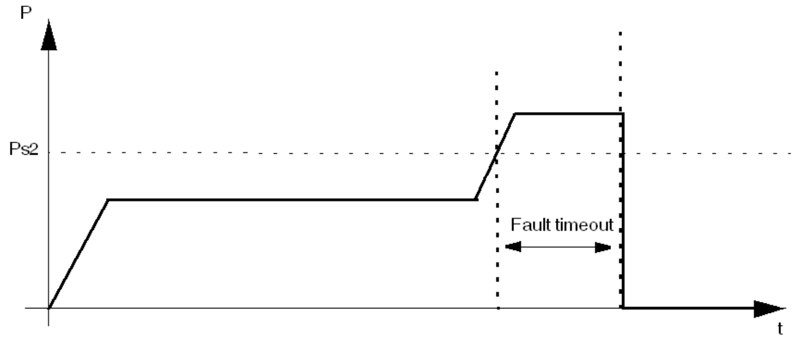
Technical Characteristics

The overpower function has the following characteristics:

Characteristics	Value
Hysteresis	–5 % of Fault threshold or Warning threshold
Accuracy	+/– 5 %

Example

The following diagram describes the occurrence of an overpower fault.



Ps2 Overpower fault threshold

Under Power Factor

Description

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

- a warning when the value of the power factor falls below a set threshold.
- a fault 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 fault time delay.

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

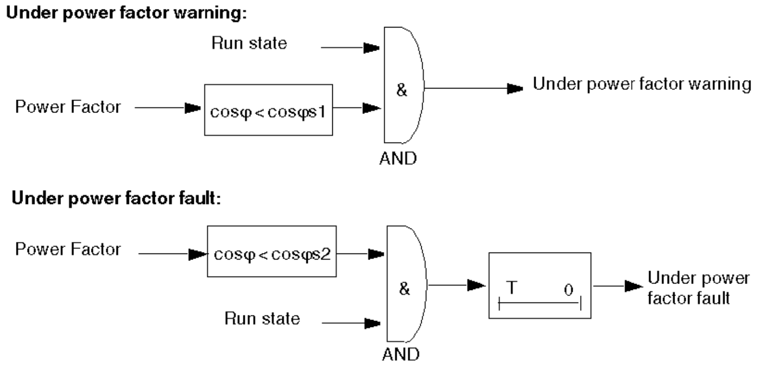
Fault and warning monitoring can be separately enabled and disabled.

Functional Characteristics

The under power factor function includes the following features:

- 2 thresholds:
  - Under Power Factor Warning Threshold
  - Under Power Factor Fault Threshold
- 1 fault time delay:
  - Under Power Factor Fault Timeout
- 2 function outputs:
  - Under Power Factor Warning
  - Under Power Factor Fault
- 1 counting statistic:
  - Under Power Factor Faults Count

Block Diagram



cosφs1 Under power factor warning threshold
cosφs2 Under power factor fault threshold
T Under power factor fault timeout

Parameter Settings

The under power factor function has the following parameters:

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

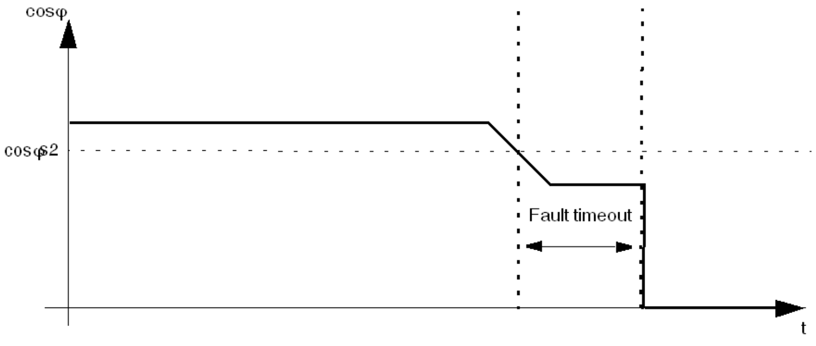
Technical Characteristics

The under power factor function has the following characteristics:

Characteristics	Value
Hysteresis	–5 % of Fault threshold or Warning 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 fault.



cosφs2 Under power factor fault threshold

Over Power Factor

Description

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

- a warning when the value of the power factor exceeds a set threshold.
- a fault 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 fault time delay.

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

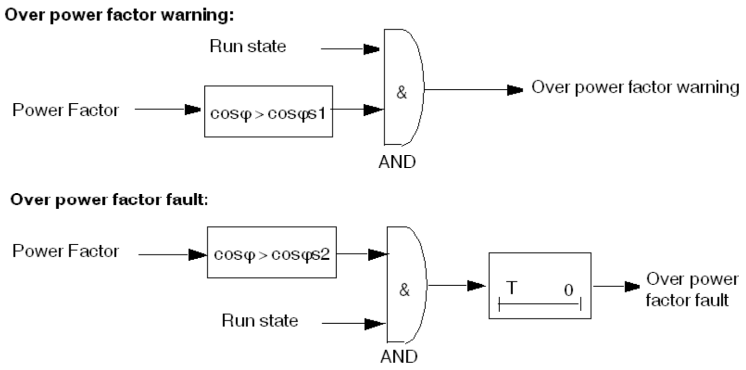
Fault and warning monitoring can be separately enabled and disabled.

Functional Characteristics

The over power factor function includes the following features:

- 2 thresholds:
  - Over Power Factor Warning Threshold
  - Over Power Factor Fault Threshold
- 1 fault time delay:
  - Over Power Factor Fault Timeout
- 2 function outputs:
  - Over Power Factor Warning
  - Over Power Factor Fault
- 1 counting statistic:
  - Over Power Factor Faults Count

Block Diagram



cosφs1 Over power factor warning threshold
cosφs2 Over power factor fault threshold
T Over power factor fault timeout

Parameter Settings

The over power factor function has the following parameters:

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

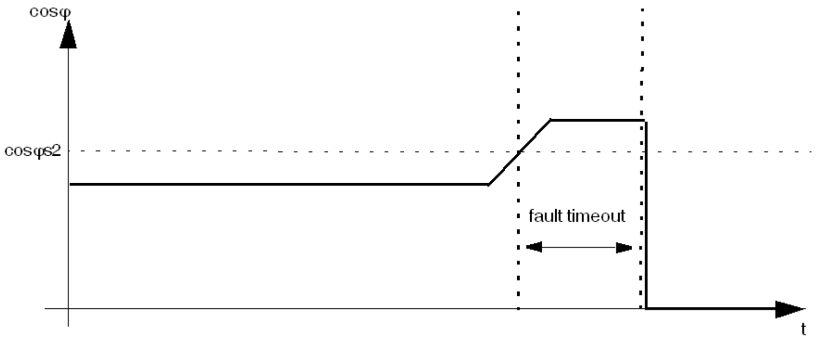
Technical Characteristics

The over power factor function has the following characteristics:

Characteristics	Value
Hysteresis	–5 % of Fault threshold or Warning threshold
Accuracy	+/– 3° or +/– 10 % (for cos $\varphi \geq 0.6$)
Trip time accuracy	+/–0.1 s or +/– 5 %

Example

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



cosφs2 Over power factor fault threshold

Chapter 4
Motor Control Functions

Overview

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

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

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Control Channels and Operating States

Overview

This section describes:

- how to configure control of the LTM R controller outputs, and
- the LTM R controller's operating states, including:
  - how the LTM R controller transitions between operating states during startup, and
  - the motor protection functions provided by the LTM R 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.

What Is in This Section?

This section contains the following topics:

Control Channels

Overview

The LTM R 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 LTM R controller.
- HMI: An HMI device connected to the LTM R controller's HMI port.
- Network: A network PLC connected to the controller network port.

Control Channel Selection

You can easily select between 2 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 LTM CU present
HMI	Yes	Only with an LTM CU 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 LTM CU 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 LTM CU is present, the logic input I.6 and the local/remote button on the LTM CU are used together to select between local and remote control source:

Logic Input I.6	LTM CU 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 LTM R 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 LTM CU, the parameter Stop Terminal Strip Disable is set in the Control Setting register.

HMI

In HMI control, the LTM R 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 LTM CU, the parameter Stop HMI Disable is set in the Control Setting register.

Network

In Network control, a remote PLC sends commands to the LTM R 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 LTM R 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	LTM R 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 LTM R 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 LTM R 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 LTM R 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 LTM R 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

LTM R controller operation cannot be stopped from the terminals when control channel is changed to Terminal Strip control channel if the LTM R controller is:

- operating in Overload operating mode
  - and -
- configured in Bumpless
  - and -
- operated over a network using Network control channel
  - and -
- operating in Run state
  - and -
- configured for 3-wire (impulse) control.

See instructions below.

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 LTM R 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 precautionary steps:

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

Fallback Transitions

The LTM R 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 the topic Communication Loss *(see page 47)*.

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

Operating States

Introduction

The LTM R 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 LTM R controller:
	  • detects no fault
	  • is not performing load shedding
	  • is not counting down the rapid cycle timer
	  • is ready to start

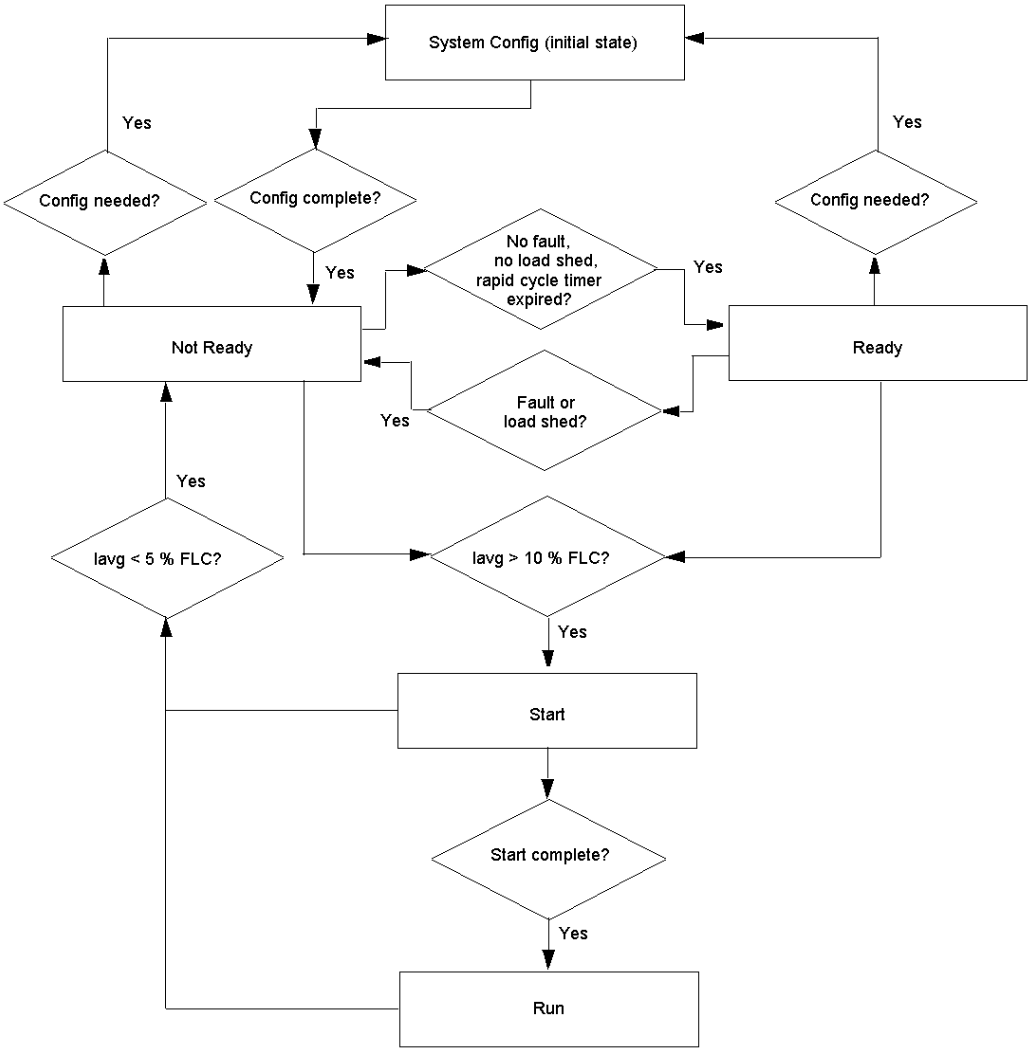
Not Ready	• The motor is stopped.
	• The LTM R controller:
	  • detects a fault
	  • is performing load shedding
	  • is counting down the rapid cycle timer

Start	• The motor starts.
	• The LTM R controller:
	  • detects that current has reached the On Level Current threshold
	  • detects that current has not both crossed and re-crossed the long start fault threshold
	  • continues to count down the long start fault timer.

Run	• The motor is running. • The LTM R controller detects that current has both crossed and re-crossed the long start fault threshold before the LTM R controller fully counted down the long start fault timer.

Operating State Chart

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



Protection Monitoring by Operating States

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

Protection Category	Monitored Fault/Warning	Operating States				
		Sys Config	Ready	Not Ready	Start	Run
Diagnostic	Run Command Check	–	X	–	–	–
	Stop Command Check	–	–	X	X	X
	Run Check Back	–	–	–	X	X
	Stop Check Back	–	–	–	X	X
Wiring / configuration errors	PTC connection	–	X	X	X	X
	CT Reversal	–	–	–	X	–
	Voltage Phase Loss	–	X	X	–	–
	Phase Configuration	–	–	–	X	–
Internal faults	Minor	X	X	X	X	X
	Major	X	X	X	X	X
X Monitored **–** Not monitored						

Protection Category	Monitored Fault/Warning	Operating States				
		Sys Config	Ready	Not Ready	Start	Run
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 Fault (Internal)	–	–	–	X	X
	Ground Fault (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 LTM R 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 LTM R controller compares:

- detected current against the configurable Long Start Fault Threshold parameter, and
- elapsed start cycle time against the configurable Long Start Fault Timeout parameter.

There are 3 start cycle scenarios, each based on the number of times (0,1 or 2) maximum phase current crosses the Long Start Fault Threshold. A description of each scenario is described below.

For information on the statistics the LTM R controller retains describing motor starts, see *Motor Starts Counters, page 55*. For information about the long start protection function, see *Long Start, page 90*.

Start Cycle Operating States

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

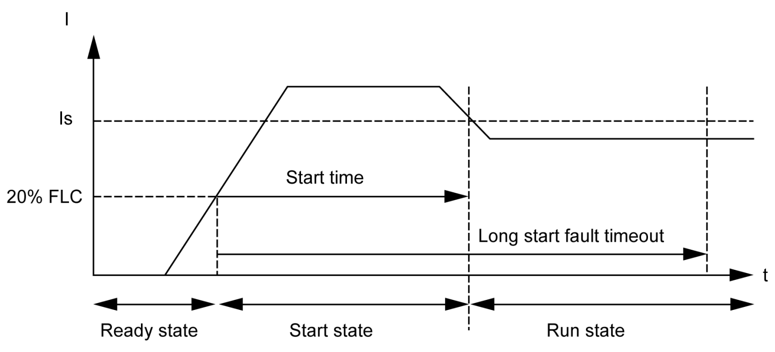
Step	Event	Operating State
1	LTM R controller receives a start command input signal.	Ready
2	The LTM R controller confirms that all startup preconditions exist (e.g. no faults, load shedding, or rapid cycle timer).	Ready
3	The LTM R controller closes the appropriate output contacts designated as terminals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

2 Threshold Crosses

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

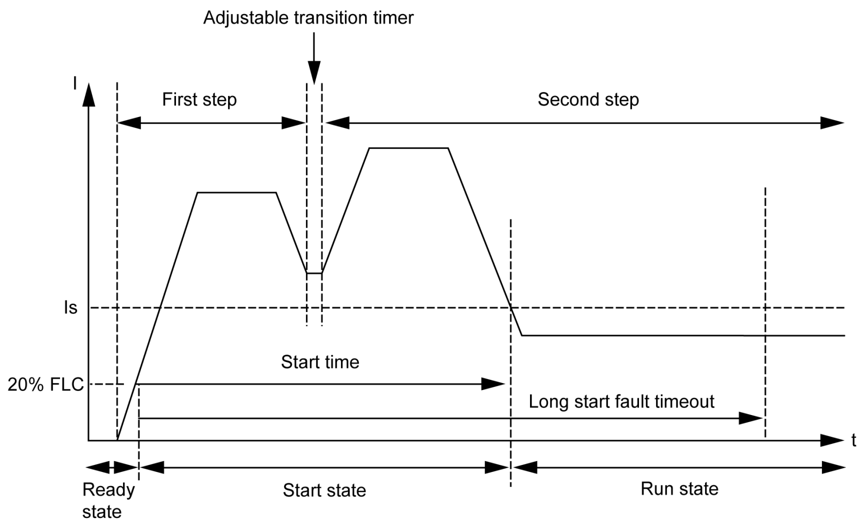
- Current rises above, then drops below, the fault threshold.
- The LTM R controller reports the actual start cycle time, i.e. the time elapsed from detection of On Level Current until the maximum phase current drops below the fault threshold.

Start cycle with 2 threshold crosses, single step:



Is Long start fault threshold

Start cycle with 2 threshold crosses, 2 step:

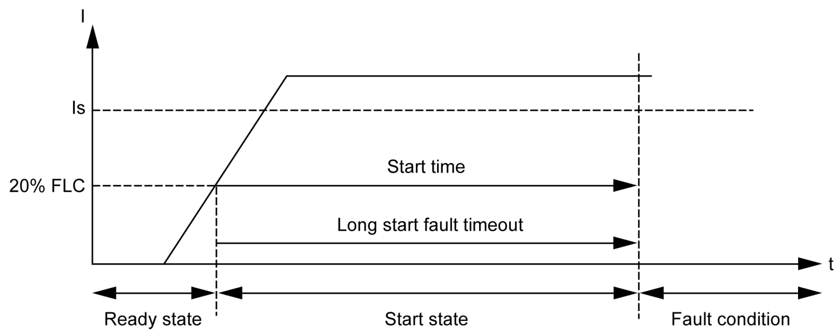


1 Threshold Cross

In this start cycle scenario, the start cycle fails:

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

Start cycle with 1 threshold cross:

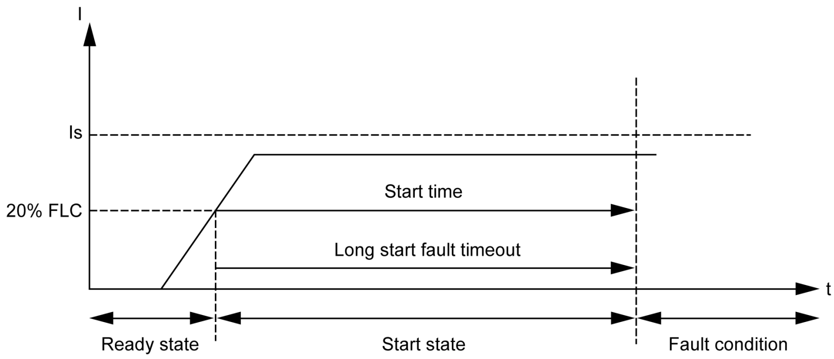


0 Threshold Cross

In this start cycle scenario, the start cycle fails:

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

Start cycle with 0 threshold cross:



Is Long start fault threshold

Section 4.2
Operating Modes

Overview

The LTM R 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 LTM R controller inputs and outputs.

Each predefined operating mode selection includes a control wiring selection:

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

What Is in This Section?

This section contains the following topics:

Control Principles

Overview

The LTM R controller performs control and monitoring functions for single-phase and 3-phase electric motors.

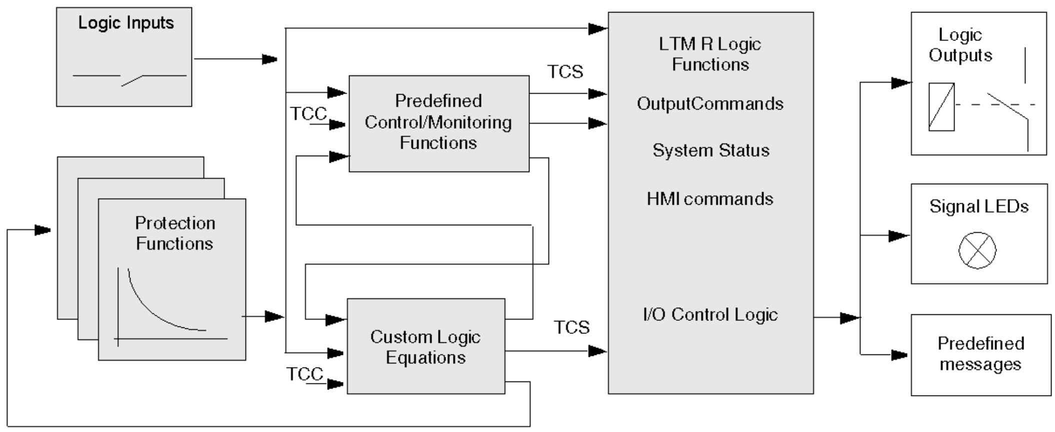
- These functions are predefined and fit the applications most frequently used. They are ready to use and are implemented by simple parameter setting after the LTM R controller has been commissioned.
- The predefined control and monitoring functions can be adapted for particular needs using the custom 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 LTM R controller I/O logic

Operating Principle

The processing of control and monitoring functions has 3 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 displayed below:



Logic Inputs and Outputs

The LTM R controller provides 6 logic inputs and 4 logic outputs. By adding an LTM E expansion module, you can add 4 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 LTM R controller can be configured in 1 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 *(see page 147)*	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 master network controller in remote control, by an HMI tool, or by using custom logic.
Independent *(see page 149)*	Direct-on-line (across-the-line) full-voltage non-reversing motor starting applications
Reverser *(see page 151)*	Direct-on-line (across-the-line) full-voltage reversing motor starting applications
Two-Step *(see page 154)*	Reduced voltage starting motor applications, including: ● Wye-Delta ● Open Transition Primary Resistor ● Open Transition Autotransformer
Two-Speed *(see page 159)*	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 LTM R 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 LTM R 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, see *Control Channels, page 133*.

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.

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 Fault 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 LTM R 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 fault 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 LTM R controller has lost communication with either the network or the HMI, the LTM R 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 the Fallback Condition *(see page 47)* portion of the topic describing Communication Loss.

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

Logic Output	Behavior
O.3	Activated by any enabled protection warning: • Terminals NO 33-34
O.4	Activated by any enabled protection fault: • 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 Fault Management

Overview

When Overload predefined operating mode is selected, the LTM R 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 LTM R 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
- fault and reset actions

Because the LTM R controller can be used in special applications, such as fire pumps that require the motor to run despite a known external fault condition, the predefined control logic is designed so that the control circuit, and not the predefined control logic, determines how the LTM R 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 LTM R 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 LTM R 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 LTM R 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 LTM R 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 Faults and Resets

Predefined control logic manages faults and reset commands as follows:

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

Control Logic and Control Wiring Together Managing Faults

The control circuits, shown in the wiring diagrams in this chapter and in the Appendix, indicate how the LTM R controller’s control logic and the control circuit combine to stop a motor in response to a fault:

- 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 fault.
  - 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 fault 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 fault.
  - 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 fault 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 fault, 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, fault 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 LTM R controller.

Functional Characteristics

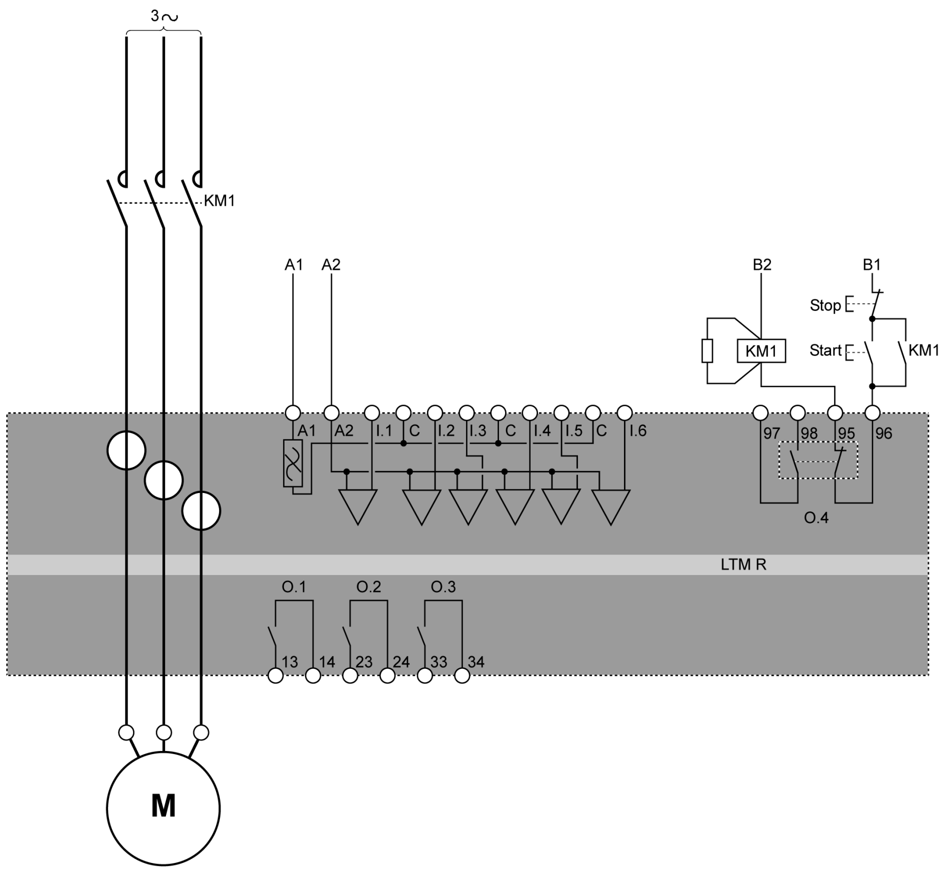
The Overload operating mode includes the following features:

- The LTM R 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 diagnostic error.
  NOTE: In Overload operating mode, diagnostic error is disabled by default. If needed, it can be enabled by the user.
- The LTM R 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 LTM R controller's command word. When the LTM R 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 LTM R controller in a 3-wire (impulse) terminal strip control overload application.



For additional examples of overload operating mode IEC diagrams, refer to relevant diagrams *Overload Mode Wiring Diagrams, page 365*.

For examples of overload operating mode NEMA diagrams, refer to relevant diagrams *Overload Mode Wiring Diagrams, page 384*.

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
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)	Warning signal
O.4 (95, 96, 97, and 98)	Fault 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:

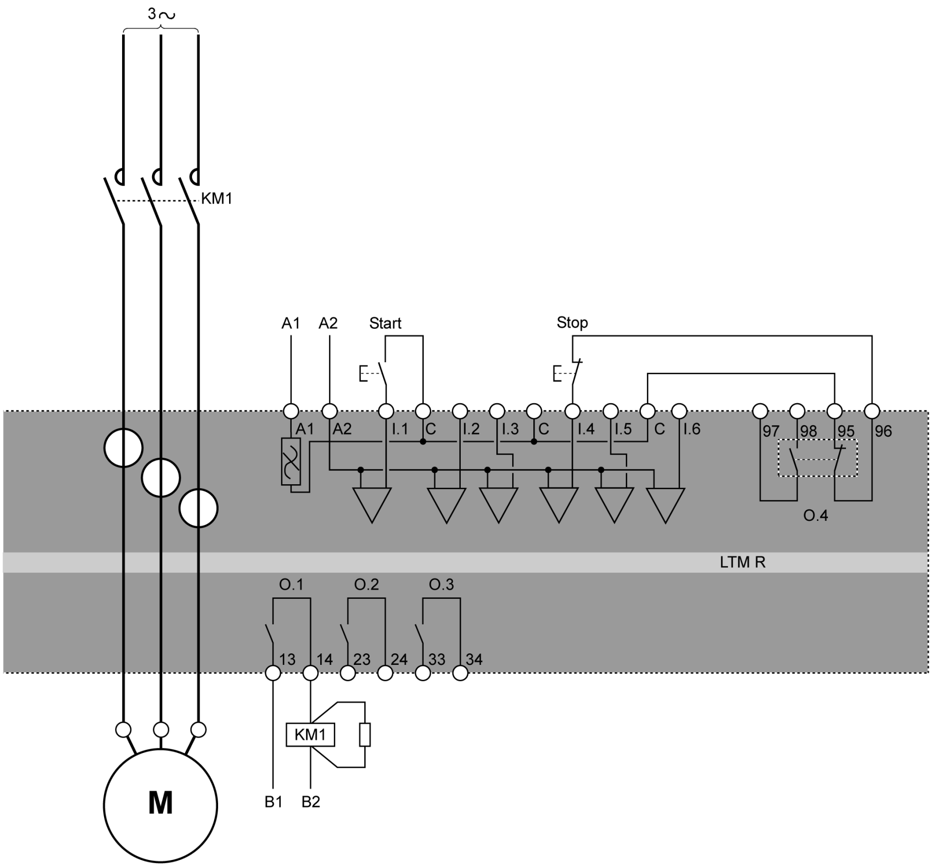
- Accessible in 3 control channels: Terminal Strip, HMI, and Network.
- The LTM R controller does not manage the relationship between logic outputs O.1 and O.2.
- In terminal strip control channel, logic input I.1 controls logic output O.1, and logic input I.2 controls logic output O.2.
- In network or HMI control channels, the Motor Run Forward Command parameter controls logic output O.1 and the Logic Output 23 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 diagnostic error.

NOTE: See *Control Wiring and Fault Management, page 146* for information about the interaction between

- the LTM R 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 LTM R controller in a 3-wire (impulse) terminal strip control independent application.



For additional examples of independent operating mode IEC diagrams, refer to relevant diagrams *Independent Mode Wiring Diagrams, page 369*.

For examples of independent operating mode NEMA diagrams, refer to relevant diagrams *Independent Mode Wiring Diagrams, page 388*.

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

Independent operating mode provides the following logic outputs:

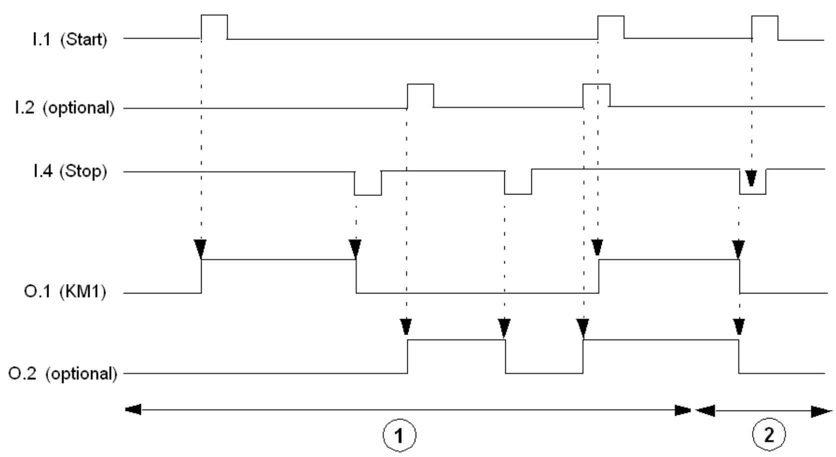
Logic Outputs	Assignment
O.1 (13 and 14)	KM1 contactor control
O.2 (23 and 24)	Controlled by I.2
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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:

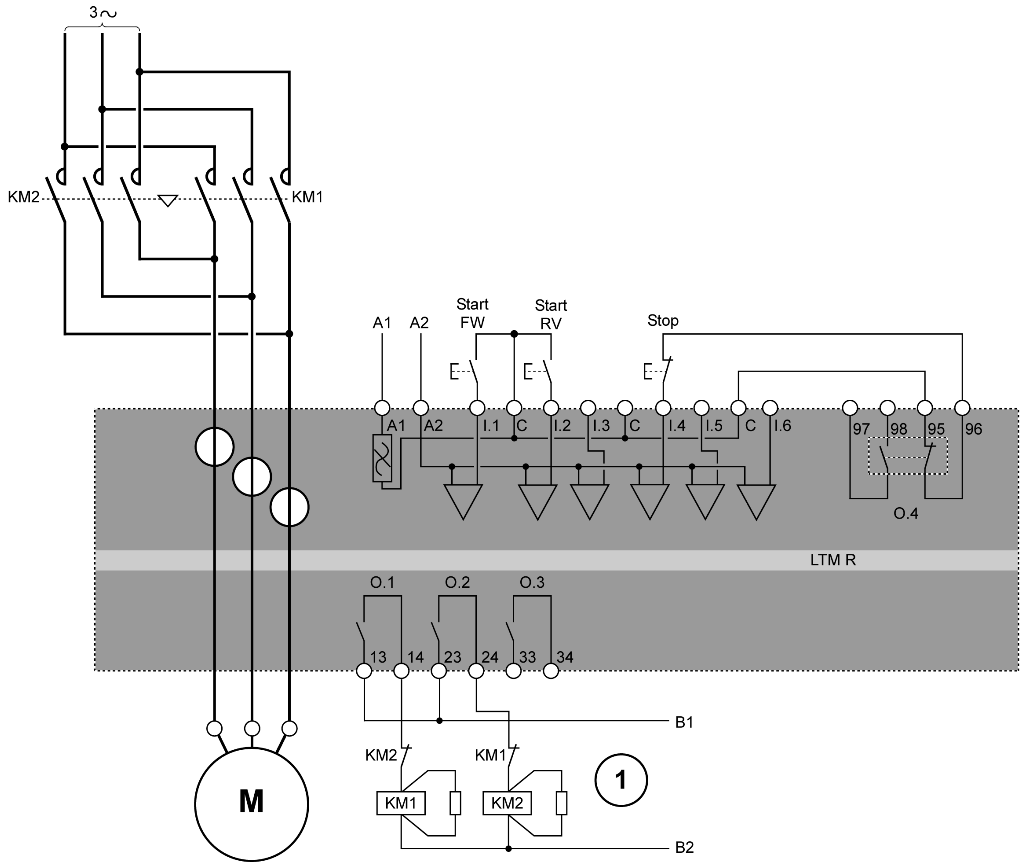
- Accessible in 3 control channels: Terminal Strip, HMI, and Network.
- Firmware interlocking prevents simultaneous activation of the O.1 (forward) and O.2 (reverse) logic outputs: in case of simultaneous forward and reverse commands, only the logic output O.1 (forward) is activated.
- The LTM R controller can change direction from forward to reverse and reverse to forward in 1 of 2 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 diagnostic error.

NOTE: See *Control Wiring and Fault Management, page 146* for information about the interaction between

- the LTM R 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 LTM R 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 LTM R controller firmware interlocks O.1 and O.2.

For additional examples of reverser operating mode IEC diagrams, refer to relevant diagrams *Reverser Mode Wiring Diagrams, page 371*.

For examples of reverser operating mode NEMA diagrams, refer to relevant diagrams *Reverser Mode Wiring Diagrams, page 390*.

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:

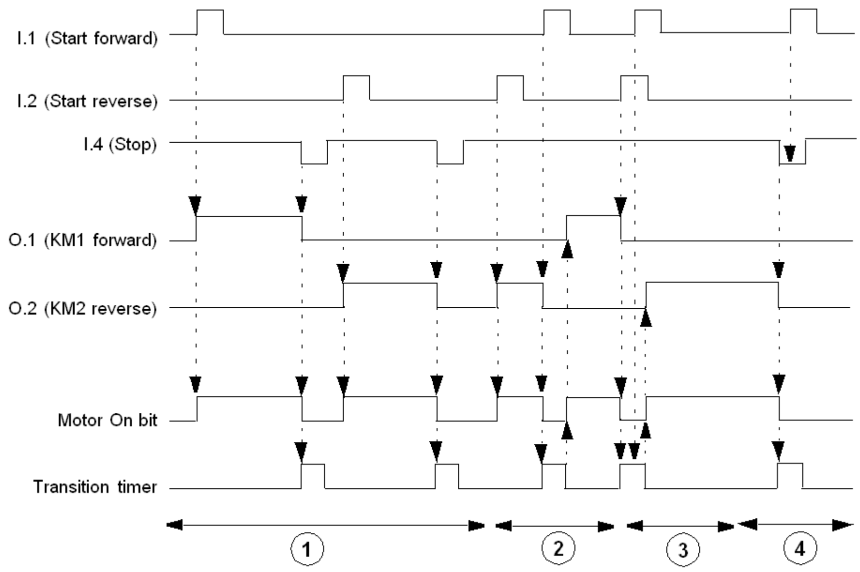
Logic Outputs	Assignment
O.1 (13 and 14)	KM1 contactor control Forward
O.2 (23 and 24)	KM2 contactor control Reverse
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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:

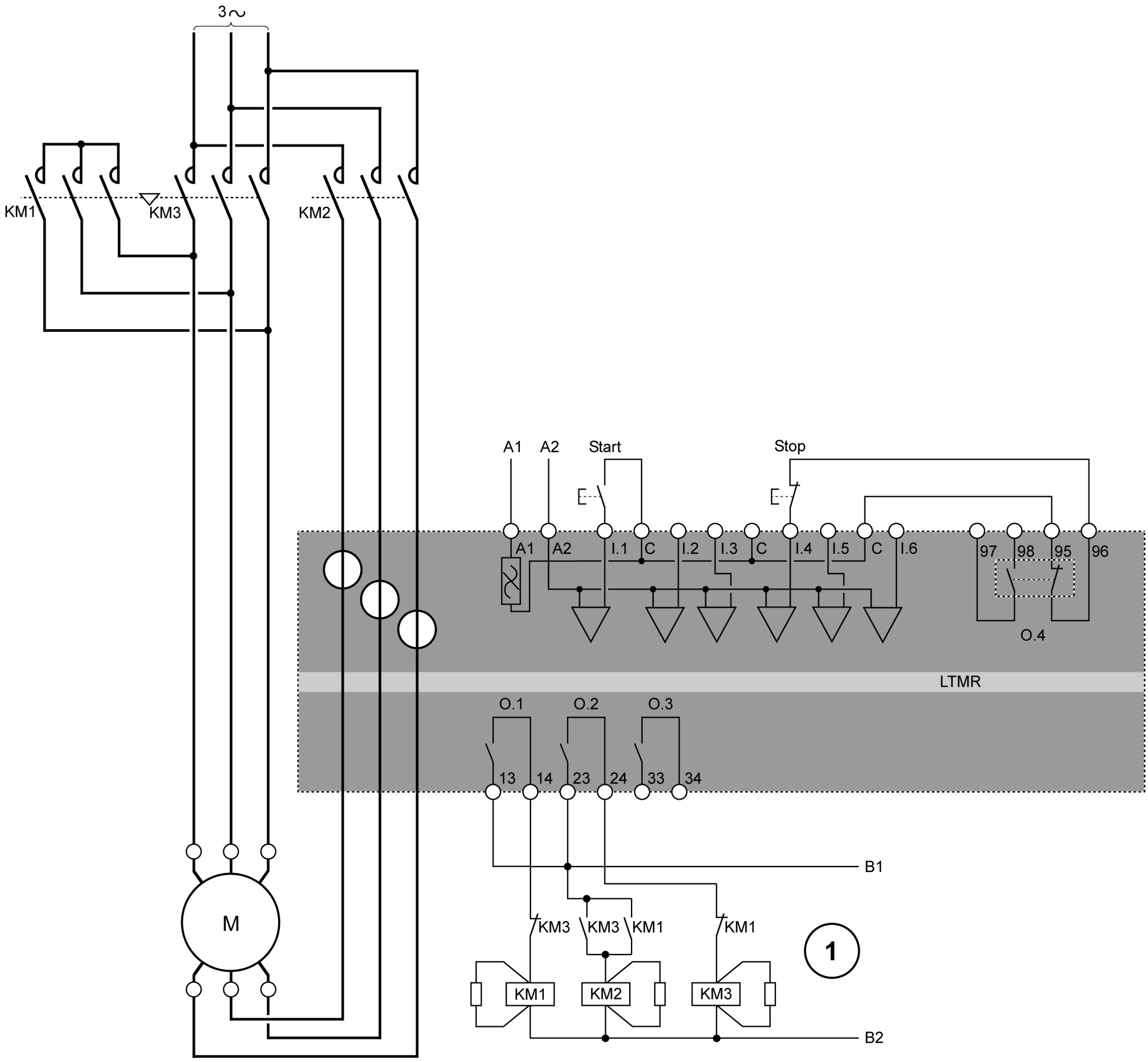
- Accessible in 3 control channels: Terminal Strip, HMI, and Network.
- Two-Step operation settings include:
  - A Motor Step 1 To 2 Timeout that starts when current reaches 10% of FLC min.
  - A Motor Step 1 To 2 Threshold setting.
  - A Motor Transition Timeout setting that starts upon the earlier 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 diagnostic error.

NOTE: See *Control Wiring and Fault Management, page 146* for information about the interaction between:

- the LTM R 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 LTM R controller in a two-step 3-wire (impulse) terminal strip control wye-delta application.



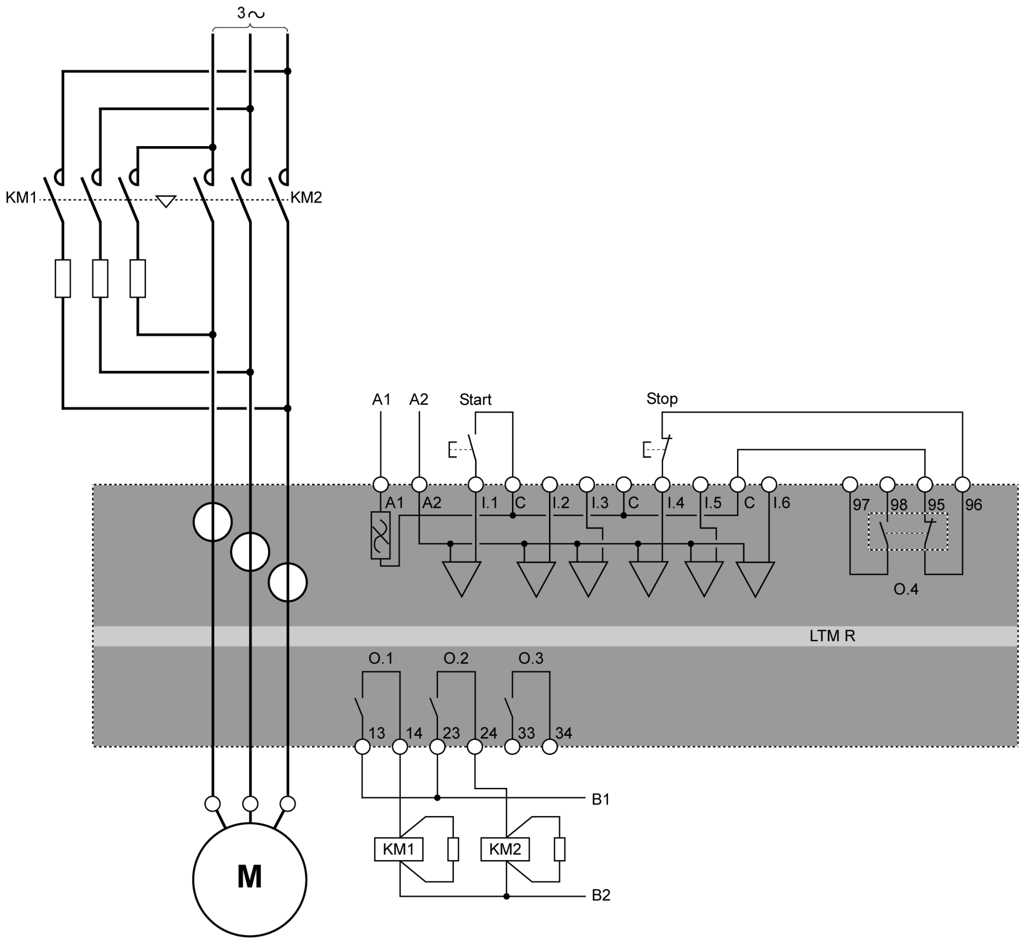
1 The N.C. interlock contacts KM1 and KM3 are not mandatory because the LTM R controller electronically interlocks O.1 and O.2.

For additional examples of two-step Wye-Delta IEC diagrams, refer to relevant diagrams *Two-Step Wye-Delta Mode Wiring Diagrams, page 373*.

For examples of two-step Wye-Delta NEMA diagrams, refer to relevant diagrams *Two-Step Wye-Delta Mode Wiring Diagrams, page 392*.

Two-Step Primary Resistor Application Diagram

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

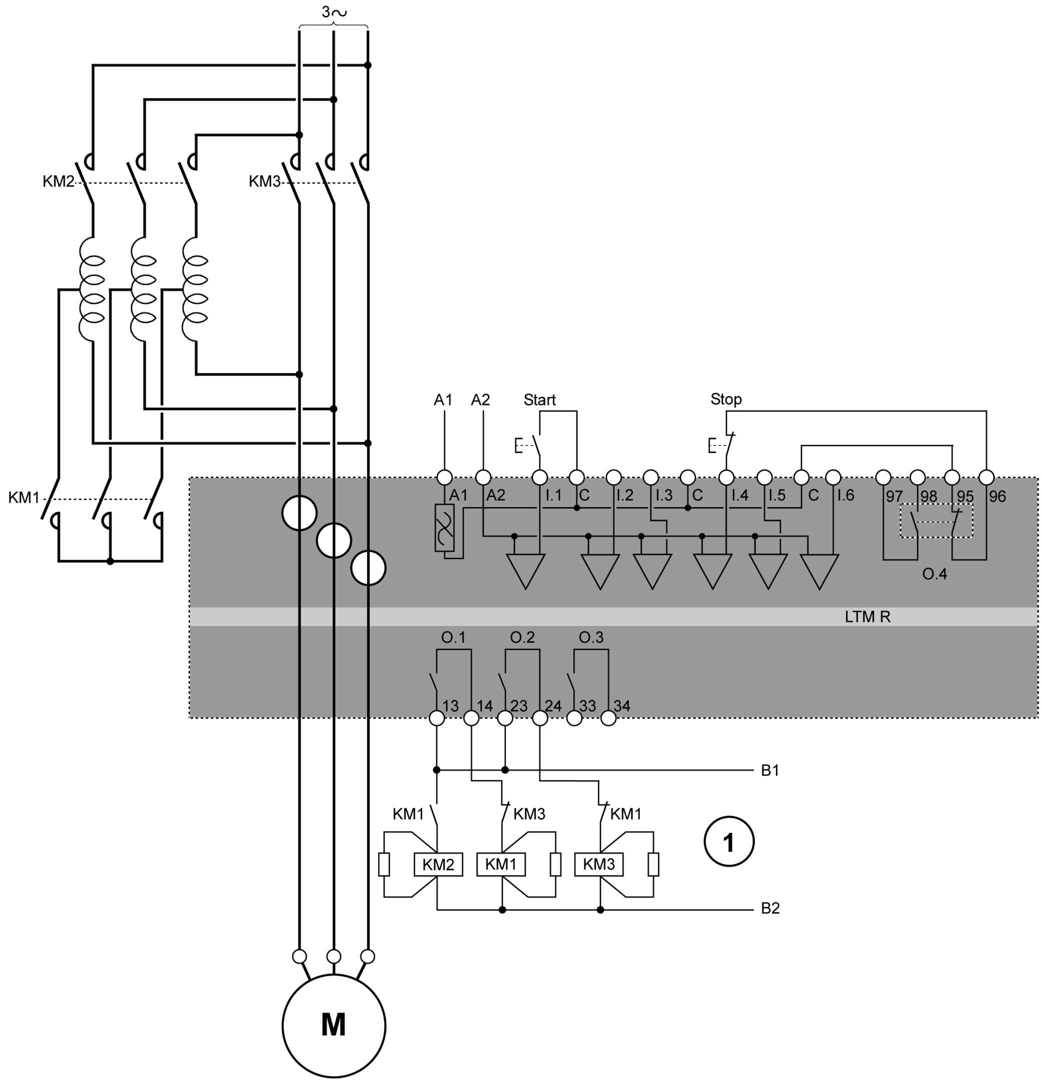


For additional examples of two-step primary resistor IEC diagrams, refer to relevant diagrams *Two-Step Primary Resistor Mode Wiring Diagrams, page 375*.

For examples of two-step primary resistor NEMA diagrams, refer to relevant diagrams *Two-Step Primary Resistor Mode Wiring Diagrams, page 394*.

Two-Step Autotransformer Application Diagram

The following wiring diagram represents a simplified example of the LTM R 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 LTM R controller electronically interlocks O.1 and O.2.

For additional examples of two-step autotransformer IEC diagrams, refer to relevant diagrams *Two-Step Autotransformer Mode Wiring Diagrams, page 377*.

For examples of two-step autotransformer NEMA diagrams, refer to relevant diagrams *Two-Step Autotransformer Mode Wiring Diagrams, page 396*.

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
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:

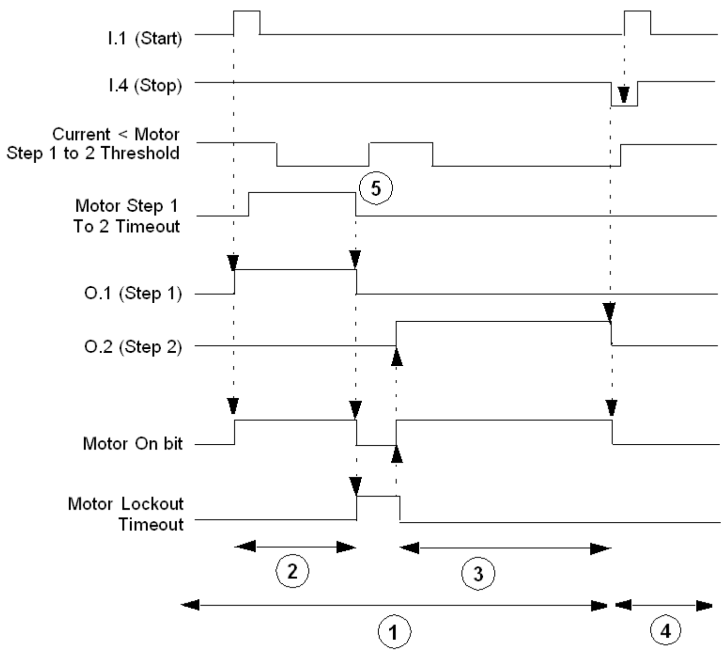
Logic Outputs	Assignment
O.1 (13 and 14)	Step 1 contactor control
O.2 (23 and 24)	Step 2 contactor control
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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:

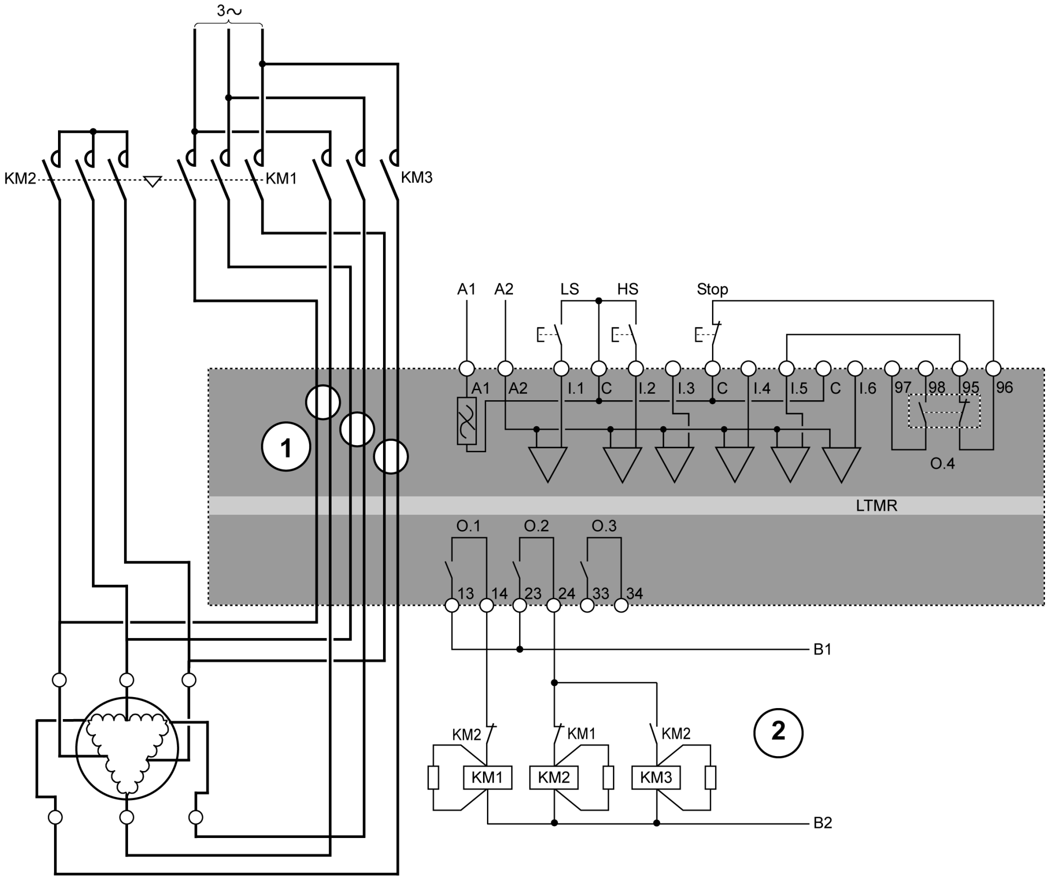
- Accessible in 3 control channels: Terminal Strip, HMI, and Network.
- Firmware interlocking prevents simultaneous activation of O.1 (low speed) and O.2 (high speed) logic outputs.
- 2 measures of FLC:
  - FLC1 (Motor Full Load Current Ratio) at low speed
  - FLC2 (Motor High Speed Full Load Current Ratio) at high speed
- The LTM R controller can change speed in 2 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 diagnostic error.

NOTE: See *Control Wiring and Fault Management, page 146* for information about the interaction between:

- the LTM R 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 LTM R controller in a two-speed 3-wire (impulse) terminal strip control Dahlander consequent pole application.



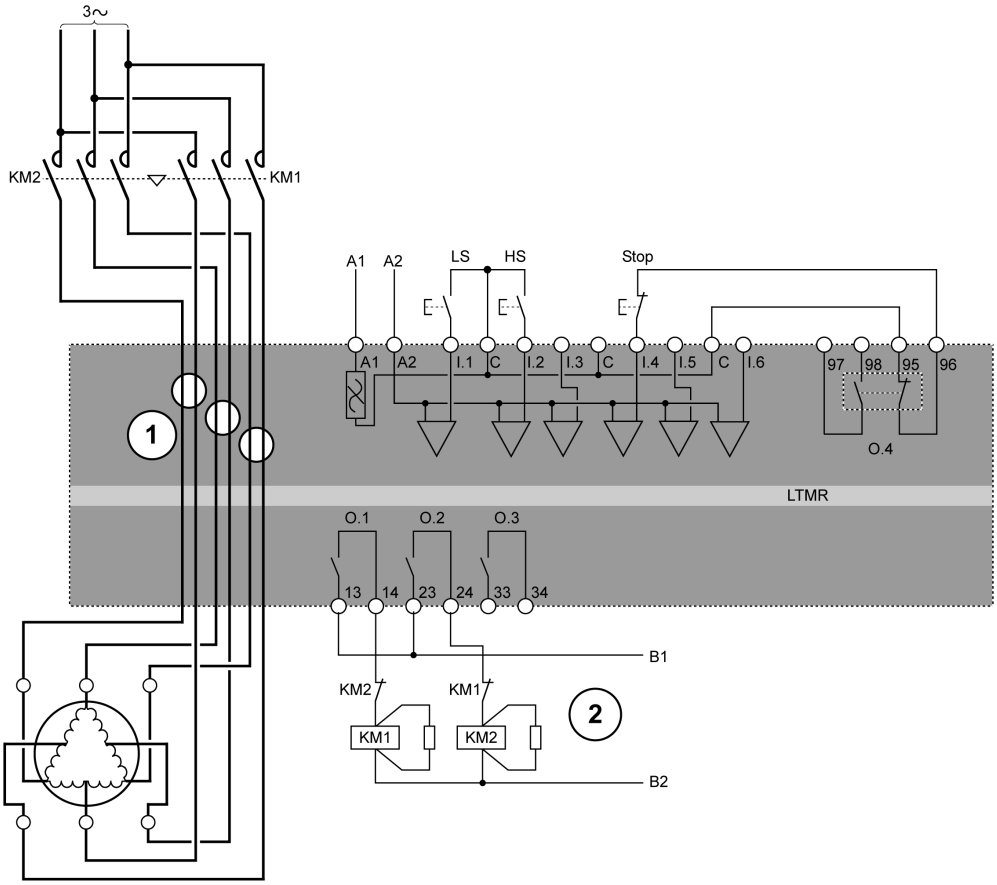
LS Low speed
HS High speed
1 A Dahlander application requires 2 sets of wires passing through the CT windows. The LTM R controller can also be placed upstream of the contactors. If this is the case, and if the Dahlander motor is used in variable torque mode, all the wires downstream of the contactors must be the same size.
2 The N.C. interlock contacts KM1 and KM2 are not mandatory because the LTM R controller firmware interlocks O.1 and O.2.

For additional examples of two-speed Dahlander IEC diagrams, refer to relevant diagrams *Two-Speed Dahlander Mode Wiring Diagrams, page 379*.

For examples of two-speed Dahlander NEMA diagrams, refer to relevant diagrams *Two-Speed Mode Wiring Diagrams: Single Winding (Consequent Pole), page 398*.

Two-Speed Pole-Changing Application Diagram

The following wiring diagram represents a simplified example of the LTM R 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 2 sets of wires passing through the CT windows. The LTM R 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 LTM R controller firmware interlocks O.1 and O.2.

For additional examples of pole-changing IEC diagrams, refer to relevant diagrams *Two-Speed Pole Changing Mode Wiring Diagrams, page 381*.

For examples of pole-changing NEMA diagrams, refer to relevant diagrams *Two-Speed Mode Wiring Diagrams: Separate Winding, page 400*.

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
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:

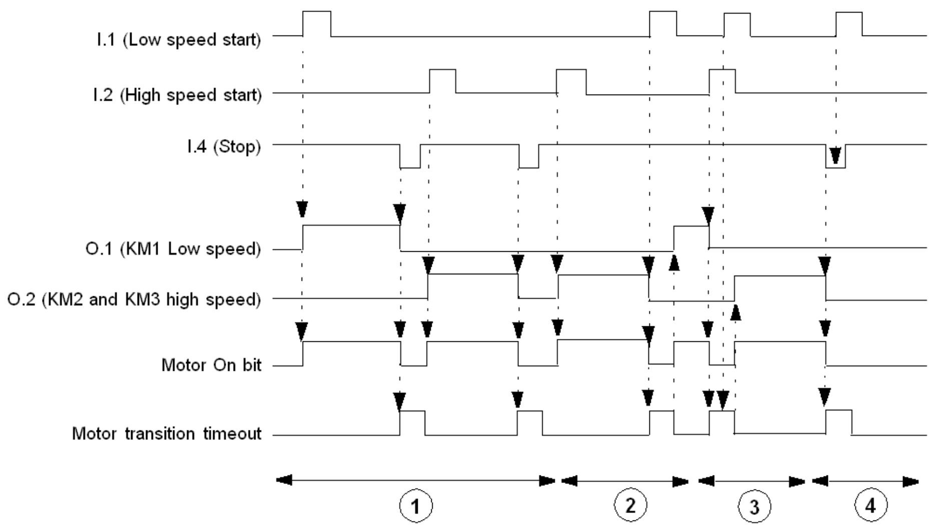
Logic outputs	Assignment
O.1 (13 and 14)	Low speed control
O.2 (23 and 24)	High speed control
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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 LTM R controller I/O logic

Configuration Files

The configuration of the LTM R controller consists of 2 files:
- a configuration file that contains parameter configuration settings
- a logic file that contains a series of logic commands that manage LTM R controller behavior, including:
  - motor start and stop commands
  - motor transitions between steps, speeds and directions
  - the valid control source and transitions between control sources
  - fault and warning 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 LTM R controller diagnostics

When a predefined operating mode is selected, the LTM R controller applies a predefined logic file that permanently resides in the LTM R controller.

When custom operating mode is selected, the LTM R controller uses a customized logic file created in the custom logic editor and downloaded to the LTM R controller from the TeSys T DTM.

Section 4.3
Fault Management and Clear Commands

Overview

This section describes how the LTM R controller manages the fault handling process, and explains:

- how to select a fault reset mode, and
- controller behavior for each fault reset mode selection.

What Is in This Section?

This section contains the following topics:

Fault Management - Introduction

Overview

When the LTM R controller detects a fault condition and activates the appropriate response, the fault becomes latched. Once a fault becomes latched, it remains latched, even if the underlying fault condition is eliminated, until cleared by a reset command.

The setting of the Fault Reset Mode parameter determines how the LTM R controller manages faults. The fault reset mode selections, listed below, are described in the topics that follow:

- Manual *(see page 167)* (Factory setting)
- Automatic *(see page 169)*
- Remote *(see page 172)*

The fault reset mode cannot be changed while a fault remains active. All faults must be reset before the fault reset mode can be changed.

Fault Reset Methods

A Reset command can be issued using any of the following means:

- cycling power
- reset button on the LTM R 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 LTM R 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.

Fault Specific Reset Behaviors

The LTM R controller’s response to faults depends on the nature of the fault that has occurred and how the related protection function is configured. For example:

- Thermal faults can be reset after the Fault Reset Timeout counts down and the utilized thermal capacity falls below the Fault Reset Threshold level.
- If the fault includes a reset timeout setting, the timeout must fully count down before a reset command executes.
- Internal device faults can be reset only by cycling power.
- LTM R controller memory does not retain diagnostic and wiring faults after a power loss, but does retain all other faults after a power loss.
- Internal, diagnostic, and wiring faults cannot be automatically reset.
- All wiring and diagnostic faults can be manually reset by local reset methods.
- For diagnostic faults, network reset commands are valid only in remote (network) control channel.
- For wiring faults, network reset commands are not valid in any control channel.

Fault Characteristics

The LTM R controller fault monitoring functions save the status of communications monitoring and motor protection faults on a power loss so that these faults must be acknowledged and reset as part of an overall motor maintenance strategy.

Protection Category	Monitored Fault	LTM R Controller	LTM R with LTM E	Saved On Power Loss
Diagnostic	Run Command Check	X	X	–
	Stop Command Check	X	X	–
	Run Check Back	X	X	–
	Stop Check Back	X	X	–
X Monitored **–** Not monitored				

Protection Category	Monitored Fault	LTM R Controller	LTM R with LTM E	Saved On Power Loss
Wiring / configuration 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	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 LTM R	X	X	X
	HMI to LTM R	X	X	X
X Monitored **–** Not monitored				

Manual Reset

Introduction

When the Fault Reset Mode parameter is set to **Manual**, the LTM R 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 LTM R 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 LTM R controller's network port—even when the Control Channel is set to **Network**.

Manual Reset Methods

The LTM R controller provides the following manual reset methods:

Protection Category	Monitored Fault	Control Channel		
		Terminal Strip	HMI	Network(1)
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 Back	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
	Stop Check Back	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5
Wiring / configuration 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	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
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
RB Test/Reset button on the LTM R controller front face or an HMI **PC** Power cycle on the LTM R controller **I.5** Set I.5 logic input on the LTM R controller				
(1) Remote network reset commands are not allowed even when the LTM R controller is configured for network control channel.				

Protection Category	Monitored Fault	Control Channel		
		Terminal Strip	HMI	Network(1)
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 LTM R	RB, I.5	RB, I.5	RB, I.5
	LTM E to LTM R	RB, I.5	RB, I.5	RB, I.5
RB Test/Reset button on the LTM R controller front face or an HMI **PC** Power cycle on the LTM R controller **I.5** Set I.5 logic input on the LTM R controller				
(1) Remote network reset commands are not allowed even when the LTM R controller is configured for network control channel.				

Automatic Reset

Introduction

Setting the Fault Reset Mode parameter to **Automatic** lets you:

- configure the LTM R controller to attempt to reset motor protection and communications faults without the intervention of either a human operator or the remote PLC, for example:
  - for a non-networked LTM R controller installed at a location that is physically remote, or locally hard to access
- configure fault handling for each protection fault group in a manner that is appropriate to the faults in that group:
  - set a different timeout delay
  - permit a different number of reset attempts
  - disable automatic fault resetting

The Fault Reset Mode parameter selection determines the available reset methods.

Each protection fault is included in 1 of 3 auto-reset fault groups, based on the characteristics of that fault, as described below. Each fault group has 2 configurable parameters:

- a timeout: the Auto-Reset Group (number 1, 2, or 3) Timeout parameter, and
- a maximum number of permissible fault 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 LTM R 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 LTM R 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 count is cleared and set to 0. A reset is successful if, after reset, the motor runs for 1 minute without a fault of a type in the designated group.

If the maximum number of automatic resets has been reached and if the last reset has failed, 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 fault. 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 fault groups—and require a manual reset—even though the Fault Reset Mode parameter is configured for automatic reset.

Select "5" to enable unlimited auto-reset attempts. After the time delay has expired the LTM R controller continually attempts to reset every fault in that reset group.

Auto-Reset Group 1 (AU-G1)

Group 1 faults require a predefined cooling time after the monitored parameter returns to and falls below a predefined threshold. Group 1 faults include Thermal Overload and Motor Temp Sensor faults. 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...65,535 s	480 s

Auto-Reset Group 2 (AU-G2)

Group 2 faults generally do not include a predefined cooling time delay before a reset can be executed, but can be reset as soon as the fault condition clears. Many group 2 faults can result in some motor overheating, depending upon the severity and duration of the fault 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 failure of the 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...65,535 s	1,200 s

Auto-Reset Group 3 (AU-G3)

Group 3 faults often apply to equipment monitoring and generally do not require a motor cooling period. These faults can be used to detect equipment conditions–for example, an undercurrent fault that detects the loss of a belt, or an overpower fault that detects an increased loading condition in a mixer. You may want to configure group 3 faults 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 equipment failure 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...65,535 s	60 s

Auto-Reset Methods

The LTM R controller allows the following auto-reset methods:

- RB - Test / Reset button on the LTM R or the HMI
- PC - Power cycle on the LTM R controller
- I.5 - Set I.5 logic input on the LTM R
- NC - Network command
- Automatic with conditions configured for the protection function group (where AU-GX = AU-G1, AU-G2, or AU-G3)

The table below lists the possible auto-reset methods for each monitored fault:

Protection Category	Monitored Fault	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 Back	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC
	Stop Check Back	RB, PC, I.5	RB, PC, I.5	RB, PC, I.5, NC

Protection Category	Monitored Fault	Control Channel		
		Terminal Strip	HMI	Network
Wiring / configuration 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	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
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 LTM R	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3
	LTM E to LTM R	RB, I.5, AU-G3	RB, I.5, AU-G3	RB, I.5, NC, AU-G3

Remote Reset

Introduction

Setting the Fault Reset Mode parameter to **Remote** adds resetting faults from the PLC over the LTM R 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 fault.

Remote Reset Methods

The LTM R controller provides the following remote reset methods:

Protection Category	Monitored Fault	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 Back	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
	Stop Check Back	RB, PC, I.5, NC	RB, PC, I.5, NC	RB, PC, I.5, NC
Wiring / configuration 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	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, 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
RB Test/Reset button on the LTM R controller front face or the HMI **PC** Power cycle on the LTM R controller **I.5** Set I.5 logic input on the LTM R controller **NC** Network command				

Protection Category	Monitored Fault	Control Channel		
		Terminal Strip	**HMI**	**Network**
Communication Loss	PLC to LTM R	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
	LTM E to LTM R	RB, I.5, NC	RB, I.5, NC	RB, I.5, NC
RB Test/Reset button on the LTM R controller front face or the HMI **PC** Power cycle on the LTM R controller **I.5** Set I.5 logic input on the LTM R controller **NC** Network command				

Fault and Warning Codes

Fault Codes

Each detected fault is identified by a numerical fault code.

Fault code	Description
0	No error
3	Ground current
4	Thermal overload
5	Long start
6	Jam
7	Current phase imbalance
8	Undercurrent
10	Test
11	HMI port error
12	HMI port communication loss
13	Network port internal error
16	External fault
18	On-Off diagnostic
19	Wiring diagnostic
20	Overcurrent
21	Current phase loss
22	Current phase reversal
23	Motor temp sensor
24	Voltage phase imbalance
25	Voltage phase loss
26	Voltage phase reversal
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTME configuration
34	Temperature sensor short-circuit
35	Temperature sensor open-circuit
36	CT reversal
37	Out of boundary CT ratio
46	Start check
47	Run checkback
48	Stop check
49	Stop checkback
51	Controller internal temperature error
55	Controller internal error (Stack overflow)
56	Controller internal error (RAM error)
57	Controller internal error (RAM checksum error)
58	Controller internal error (Hardware watchdog fault)
60	L2 current detected in single-phase mode
64	Non volatile memory error
65	Expansion module communication error
66	Stuck reset button
67	Logic function error

Fault code	Description
100-104	Network port internal error
109	Network port comm error
111	Faulty device replacement fault
555	Network port configuration error

Warning Codes

Each detected warning is identified by a numerical warning code.

Warning code	Description
0	No warning
3	Ground current
4	Thermal overload
5	Long start
6	Jam
7	Current phase imbalance
8	Undercurrent
10	HMI port
11	LTM R internal temperature
18	Diagnostic
19	Wiring
20	Overcurrent
21	Current phase loss
23	Motor temp sensor
24	Voltage phase imbalance
25	Voltage phase loss
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTM E configuration
46	Start check
47	Run checkback
48	Stop check
49	Stop checkback
109	Network port comm loss
555	Network port configuration

LTM R Controller Clear Commands

Overview

Clear commands allow the user to clear specific categories of LTM R 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 LTM R 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 LTM R 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, see *Reset for Emergency Restart, page 66*.

Clear Controller Settings Command

The Clear Controller Settings Command restores the LTM R 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 LTM R 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.

After the IP addressing parameters are cleared, power must be cycled to the LTM R controller for it .

Chapter 5
Installation

Overview

This chapter describes the physical installation and assembly of the LTM R controller and the LTM E expansion module. It also explains how to connect and wire the controller terminal block, including communication port wiring in both an enclosure or a switchboard.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off all power supplying this equipment before working on it.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices.

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

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 and apply this product.
- Follow all local and national safety codes and standards.
- Follow all electromagnetic compatibility rules described in this manual.
- Follow all installation and wiring rules described in this manual.

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

What Is in This Chapter?

This chapter contains the following sections:

Section 5.1
Installation

Overview

This section describes the installation procedures and wiring principles of the LTM R controller and the LTM E expansion module.

What Is in This Section?

This section contains the following topics:

General Principles

Functional Safety Introduction

The TeSys T motor management system is a part of a global architecture. To provide the functional safety, some risks must be analyzed such as:
- global functional risks,
- risk of hardware and software breakdown,
- electromagnetic environmental risks.

To reduce the electromagnetic environment risks, installation rules and wiring must be respected.

For more information on EMC, refer to the *Electrical Installation Guide* chapter *ElectroMagnetic Compatibility (Wiki version available in English only on www.electrical-installation.org)*.

Installation Rules

Installation rules that must be respected to enable the LTM R to operate correctly include:
- installation rules for the components:
  - association of the LTM R controller with the LTM E expansion module
  - installation in a switchboard such as Okken, Blokset, or another type
- LTM R controller wiring rules *(see page 192)*:
  - wiring of the power supply
  - wiring of the I/Os: logic input wiring and logic output wiring
- communication network wiring rules *(see page 217)*

Installation Rules in a Switchboard

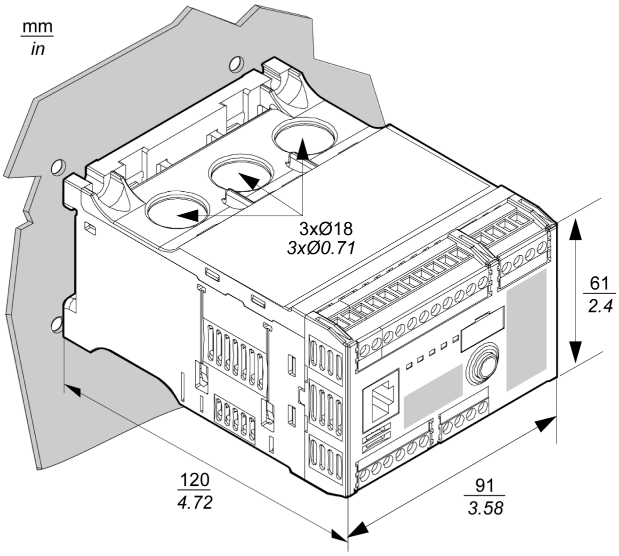
The installation of the LTM R controller in the withdrawable drawer of a switchboard presents constraints specific to the type of switchboard:
- For installation of the LTM R controller in an Okken switchboard, see the *Okken Communications Cabling & Wiring Guide* (available on request).
- For installation of the LTM R controller in a Blokset switchboard, see the *Blokset Communications Cabling & Wiring Guide* (available on request).
- For installation of the LTM R controller in other types of switchboard, follow the specific EMC instructions described in this manual and refer to the relative instructions specific to your type of switchboard.

Dimensions

Overview

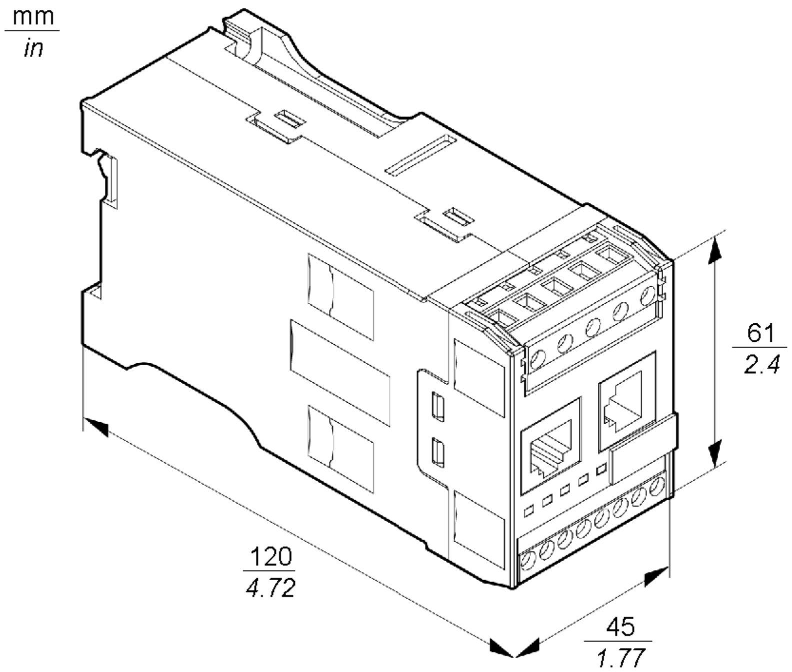
This section presents the dimensions of the LTM R controller and the LTM E expansion module, as well as the dimensions of the clearance zone around the controller and the expansion module. Dimensions are given in both millimeters and inches and apply to all LTM R and LTM E models.

LTM R Controller Dimensions



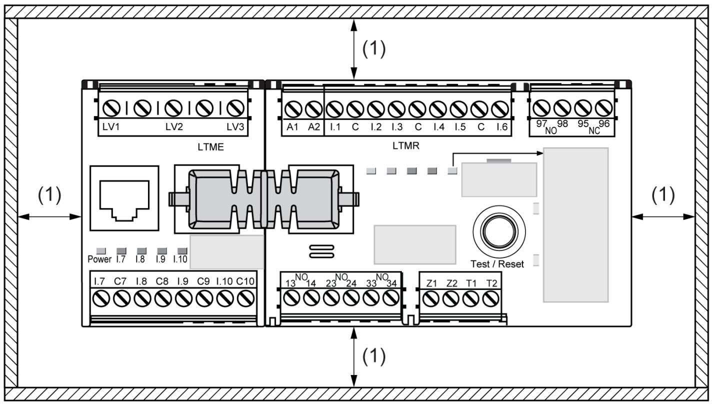
NOTE: The height of the controller may increase when using alternate wiring terminals.

LTM E Expansion Module Dimensions



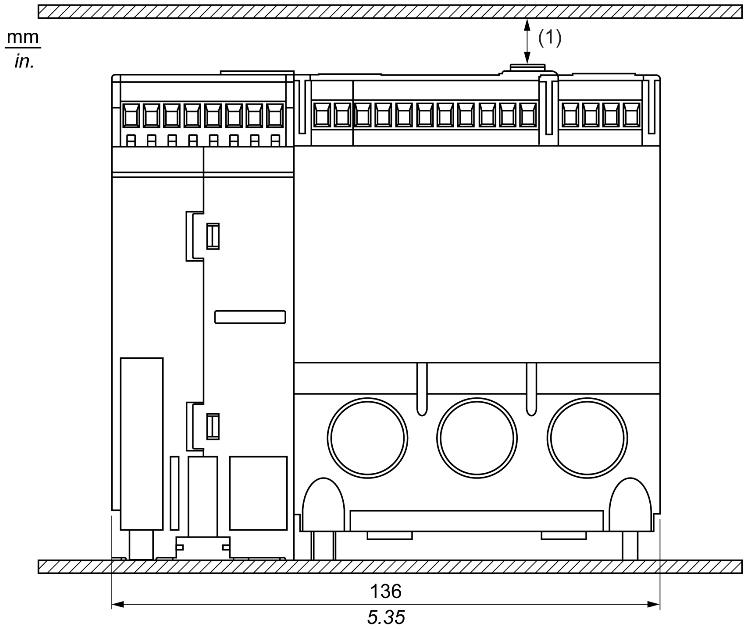
Clearance Zone Dimensions

The maximum rated ambient temperature of the controller depends on the clearance zone dimensions. They are shown in the table below.



(1)

< 9 mm *(0.35 in.)*	45 °C *(113 °F)*
9...40 mm *(0.35...1.57 in.)*	45...55 °C *(113...131 °F)*
> 40 mm *(1.57 in.)*	60 °C *(140 °F)*



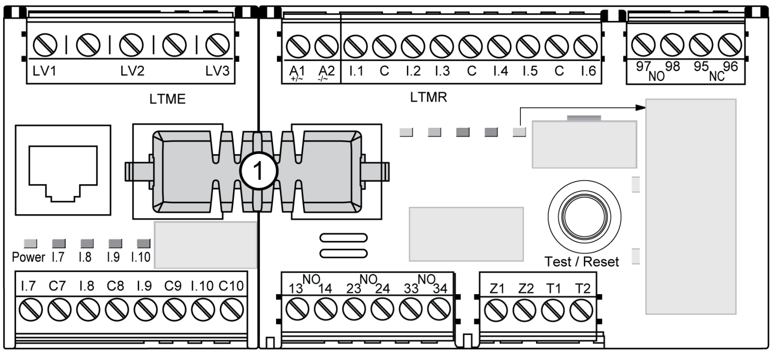
Assembly

Overview

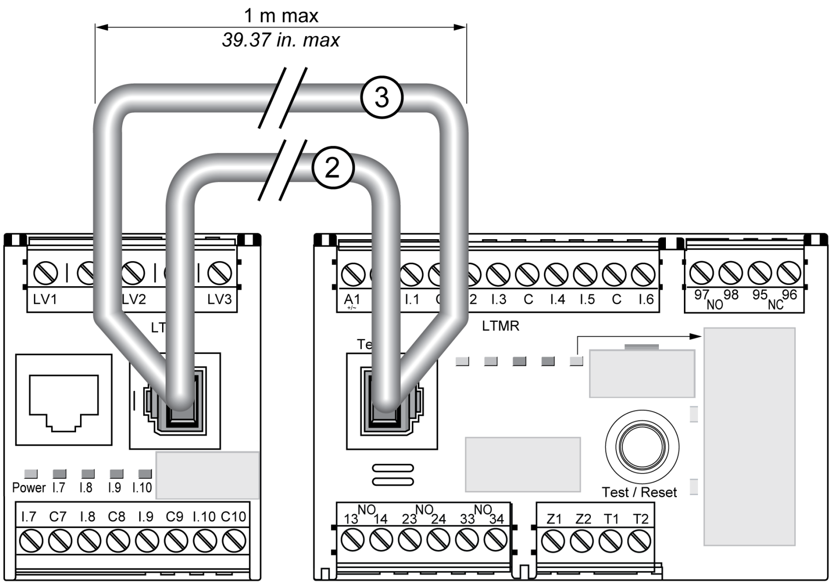
This section describes how to assemble the LTM R controller and the LTM E expansion module in a switchboard.

Connecting the LTM R Controller and the LTM E Expansion Module

It is recommended to mount the LTM R controller and its LTM E expansion module side by side with the LTM E expansion module on the left side of the LTM R controller and connected by the LTMCC004 connecting jumper (**1**).



If it is not possible to mount the LTM R controller and its LTM E expansion module side by side:
- Use only the shielded cables LTM9CEXP03 (**2**) or LTM9CEXP10 (**3**) cables to connect them.
- Ground the shielded cable.
- Separate the LTM9CEXP•• connection cables from all other power or control cables to avoid EMC disturbance.

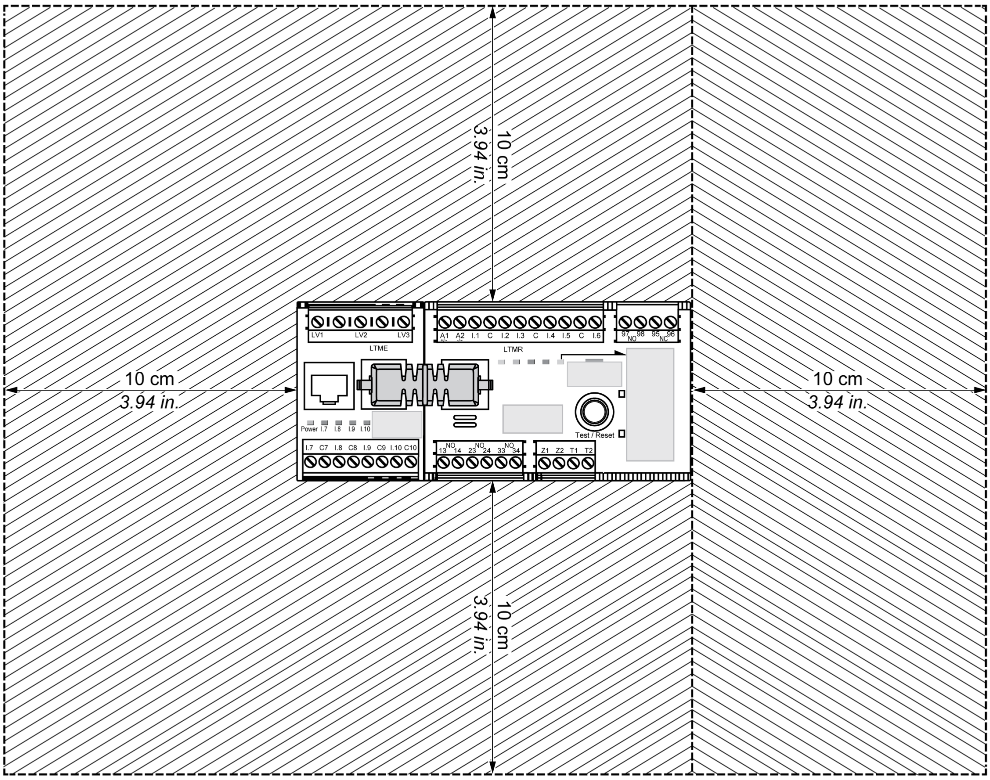


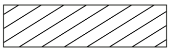
Mounting a Contactor Close to the LTM R Controller

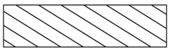
The mounting recommendations of contactors close to LTM R controller are as follows:

- Mount a contactor at a distance of more than 10 cm (3.94 in.) from the LTM R controller and the LTM E expansion module.
- If this is not possible, mount the contactor on the right side of the LTM R controller.

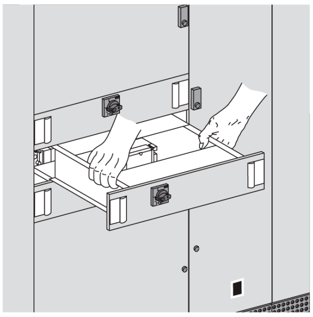
The contactor must be mounted according to the clearance zone dimensions:

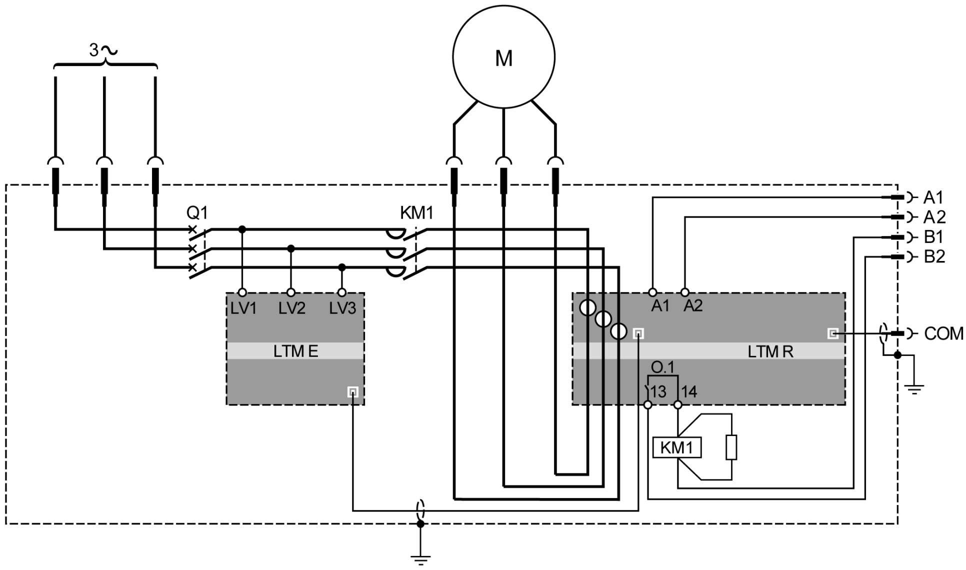


 Do not mount a contactor in this zone.

 Mount a contactor in this zone if you cannot do otherwise.

Example of Mounting in a Withdrawable Drawer of a Switchboard





A1, A2 LTM R controller power supply
B1, B2 Power supply dedicated to logic outputs

Mounting

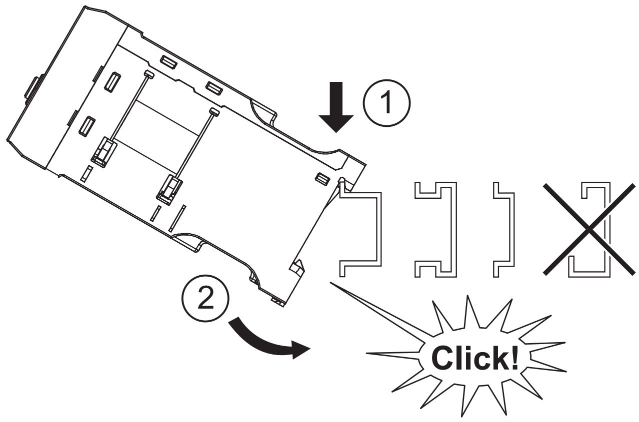
Overview

This section describes how to mount the LTM R controller and the LTM E expansion module on a DIN rail, a solid mounting plate, or a pre-slotted mounting plate (known as a TE plate), such as a Telequick® plate. It also describes the accessories needed for mounting, as well as how to remove each component.

Reminder: The LTM R controller and its LTM E expansion module must be mounted side by side, with the LTM E expansion module on the left side of the LTM R controller, connected by the LTMCC004 connecting jumper *(see page 184)*.

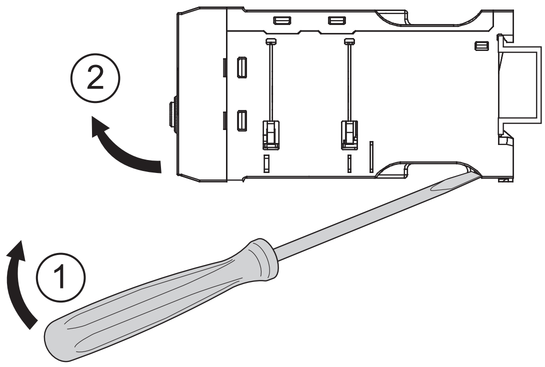
Mounting on DIN Rails

You can mount the controller and the expansion module on a 35 mm (1.38 in.) DIN rail with a thickness of 1.35 mm (0.05 in.) and 0.75 mm (0.02 in.). When mounted, the controller mounting feet may not extend beyond the controller dimensions *(see page 182)*. To mount the controller:

Step	Action
1	On the back of the controller are two DIN rail clips. Fit the top clip onto the DIN rail.
2	Push the controller in toward the DIN rail until the bottom clip catches. The controller clicks into place. 

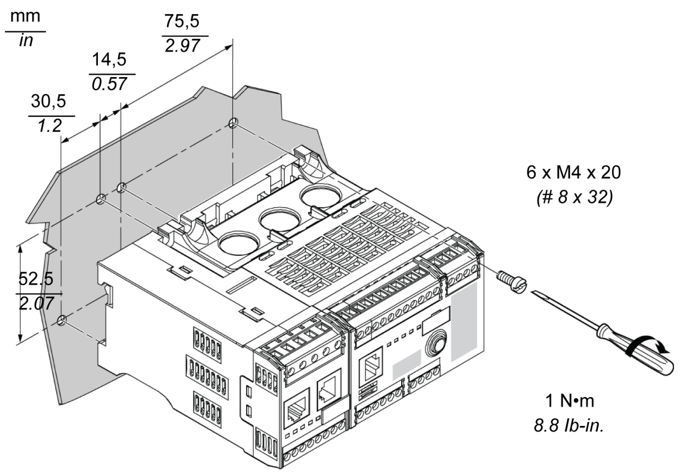
Removing from DIN Rails

To remove the controller from the DIN rail:

Step	Action
1	Using a screwdriver, pull down the white locking mechanism to release the controller.
2	Lift the controller away from the DIN rail. 

Mounting on a Solid Mounting Plate

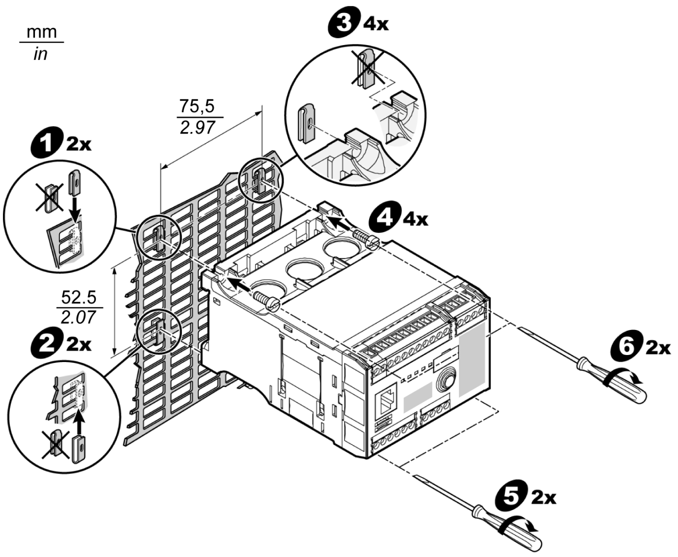
You can mount the controller and the expansion module on a metal mounting plate using ST2.9 steel tapping screws: 4 for the controller and 2 for the expansion module. The thickness of the mounting plate must not exceed 7 mm (0.275 in.). When mounted, the controller mounting feet may extend beyond the controller dimensions *(see page 182)* by 8 mm (0.3 in.) in both directions. To mount the controller and the expansion module on a mounting plate:

Step	Action
1	Locate the 4 mounting holes at each corner of the controller and the 2 mounting holes on the expansion module.
2	Position the controller and expansion module on the mounting plate, making sure to leave enough space for the clearance zone. See *Dimensions, page 182*.
3	Insert each of the 6 tapping screws.
4	Use a screwdriver to tighten each screw and secure the controller and the expansion module in place. Torque to 1 N•m (8.8 lb-in). 

Mounting on a TE Plate

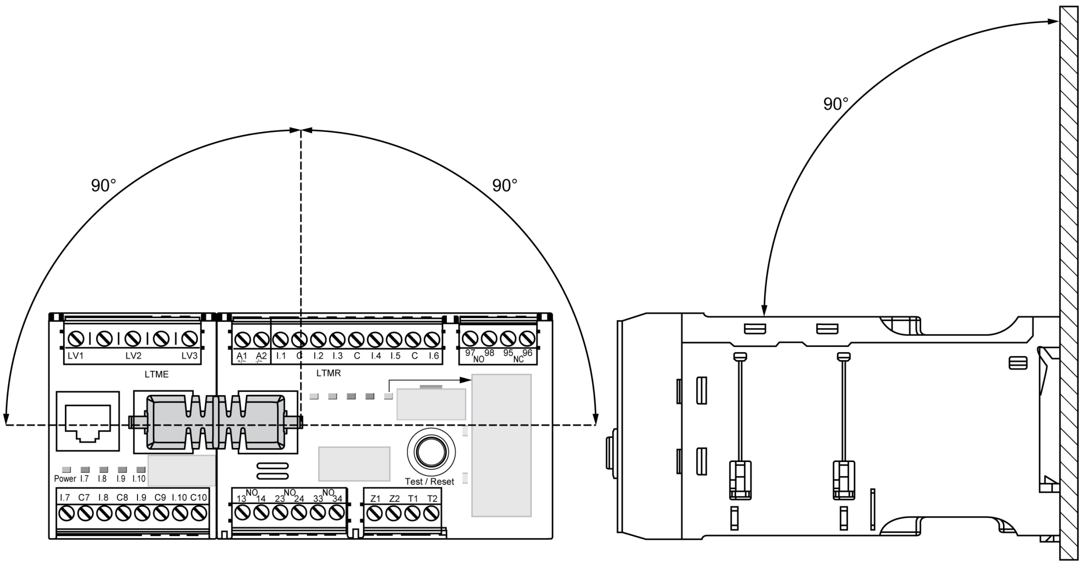
You can mount the controller and the expansion module on a TE plate, such as Telequick®, using 6 mounting clips (AF1 EA4). When mounted, the controller mounting feet may extend beyond the controller dimensions *(see page 182)* by 8 mm (0.3 in.) in both directions. To mount the controller on Telequick®:

Step	Action
1	Attach the 6 mounting clips to Telequick®, as shown in the diagram below. The rounded edge should face upwards for the top clips, and downwards for the bottom clips.
2	Position the controller and expansion module on the clips so that the holes in the clips and the holes in the controller and expansion module align. Insert the screws in the holes and turn them slightly.

Step	Action
3	When the controller and expansion module are properly positioned, tighten first the bottom screws, then the top screws using a screwdriver. Torque to 1 N•m (8.8 lb-in). 

Operating Position

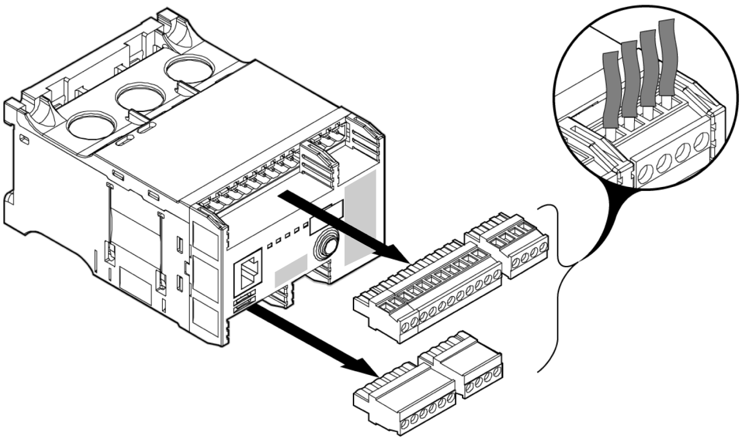
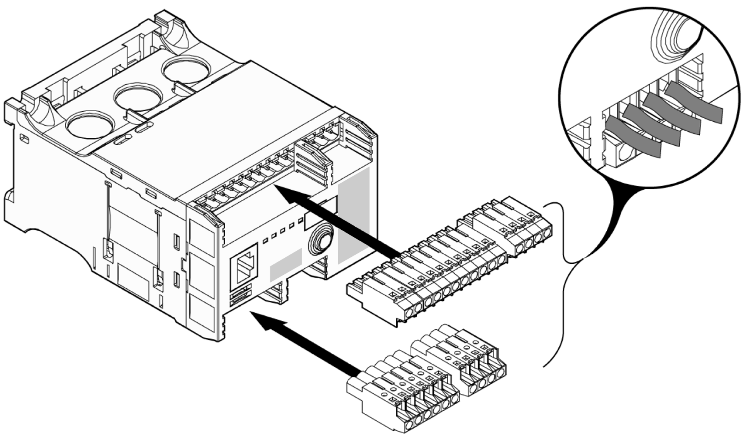
You can mount the controller and the expansion module at an angle of up to 90 degrees perpendicular to the normal vertical mounting plane.



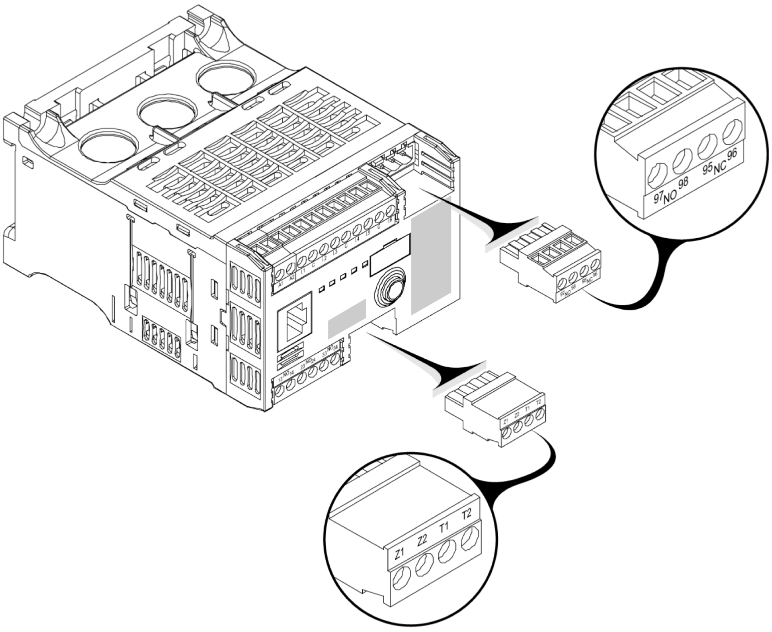
Replacing the Terminal Strips

The standard terminal strips of the controller and expansion module can be replaced with alternative terminal strips, if required. With alternative terminal strips, wires are connected perpendicularly to the controller or expansion module face.

To replace the standard strips with alternative strips:

Step	Action
1	Remove the 6 standard terminal strips using the connector extraction tool LTM9TCT to leverage the strips away from the unit. 
2	Push the alternative strips into place, making sure you position them correctly. 

NOTE: There are two 4-pin terminal strips. These strips are not interchangeable. It is important, therefore, that you read the markings on the terminal strips and follow the diagram below when positioning them.


97 NO 98
95 NC 96
Z1
Z2
T1
T2

Wiring - Generalities

Overview

The wiring of each part of the LTM R controller and the LTM E expansion module is detailed further with its specificities:

- Wiring the current transformers *(see page 196)*.
- Wiring the ground fault current transformers *(see page 201)*.
- Wiring the temperature sensors *(see page 203)*.
- Wiring the power supply *(see page 204)*.
- Wiring the logic inputs *(see page 207)*.
- Wiring the logic outputs *(see page 211)*.
- Wiring the voltage transformers on the LTM E expansion module.

The wiring of the communication port depends on the communication protocol and is described separately *(see page 217)*.

Wiring Rules

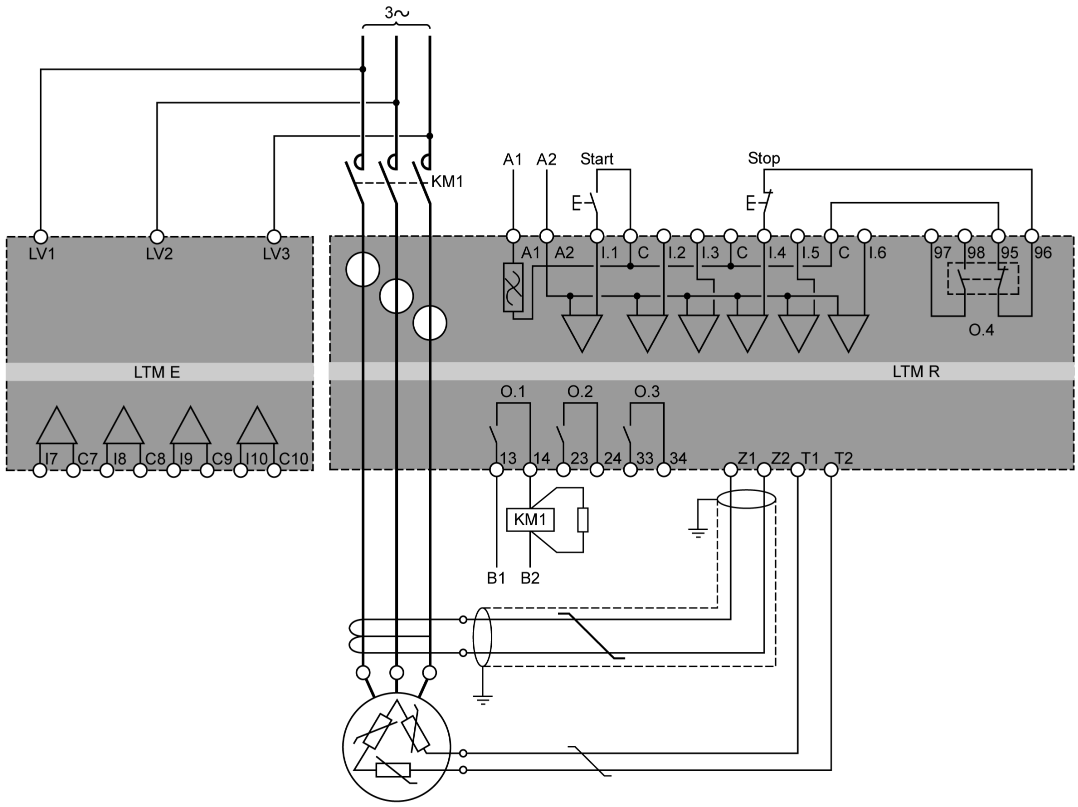
The following wiring rules must be respected in order to reduce disturbance due to EMC on the behavior of the LTM R controller:

- Keep a distance as large as possible between the communication cable and the power and/or control cables (minimum 30 cm or 11.8 in.).
- Cross over different types of cables at right angles, if necessary.
- Do not bend or damage the cables. The minimum bending radius is 10 times the cable diameter.
- Avoid sharp angles of paths or passage of the cable.
- Use shielded cables to connect ground fault current transformers:
  - The cable shield must be connected to a protective ground at both ends.
  - The connection of the cable shield to the protective ground must be as short as possible.
  - Connect together all the shields, if necessary.
  - Perform the grounding of the shield with a collar.
- Add filters on contactor coils for all contactors and relays.
- Place the cable along the grounded plate around the withdrawable drawer.

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

Wiring Diagram Example: LTM R Controls a 3-phase Motor

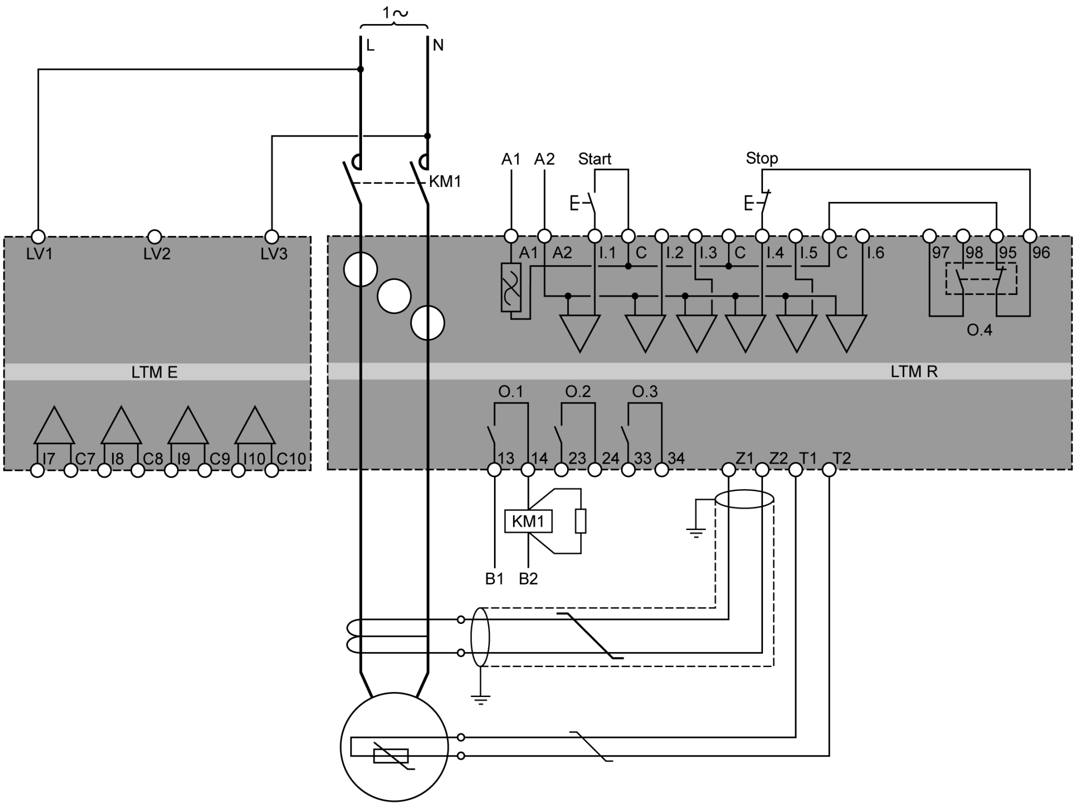
The following diagram shows the wiring of the LTM R controller and its LTM E expansion module used to control a 3-phase motor in 3-wire (impulse) independent mode:



A1, A2 LTM R controller power supply
B1, B2 Power supply dedicated to logic outputs

Wiring Diagram Example: LTM R Controls a Single-phase Motor

The following diagram shows the wiring of the LTM R controller and its LTM E expansion module used to control a single-phase motor in 3-wire (impulse) independent mode:



A1, A2 LTM R controller power supply
B1, B2 Power supply dedicated to logic outputs

LTM R Controller Plug-in Terminals and Pin Assignments

The LTM R controller has the following plug-in terminals and pin assignments:

Terminal Block	Pin	Description
Control voltage, logic input, and common source terminals	A1	Supply voltage input (+ / ~)
	A2	The negative of a power supply for DC models, or the grounded secondary of a control power transformer for AC models (– / ~)
	I.1	Logic input 1
	I.2	Logic input 2
	I.3	Logic input 3
	I.4	Logic input 4
	I.5	Logic input 5
	I.6	Logic input 6
	C	Input common
O.4 Logic output terminals	97–98	NO contact
	95–96	NC contact
	Note: The 97–98 contacts and the 95–96 contacts are on the same relay, so the open/closed status of one pair of contacts is always the opposite of the status of the other pair.	

Terminal Block	Pin	Description
O.1 to O.3 Logic output terminals	13–14	NO contact – logic output 1
	23–24	NO contact – logic output 2
	33–34	NO contact – logic output 3
Ground fault input and temperature sensor input	Z1–Z2	Connection for external ground fault current transformer
	T1–T2	Connection for motor temperature sensors

LTM E Expansion Module Plug-in Terminals and Pin Assignments

The LTM E expansion module has the following plug-in terminals and pin assignments:

Terminal block	Pin	Description
Voltage inputs	LV1	Phase 1 input voltage
	LV2	Phase 2 input voltage
	LV3	Phase 3 input voltage
Logic inputs and common terminals	I.7	Logic input 7
	C7	Common for I.7
	I.8	Logic input I.8
	C8	Common for I.8
	I.9	Logic input I.9
	C9	Common for I.9
	I.10	Logic input I.10
	C10	Common for I.10

Terminal Wiring Characteristics

Both the LTM R controller and LTM E expansion module terminals have the same characteristics.

Terminals have an insulation rating of 320 VAC.

The table below describes the characteristics of cables that may be used to wire the terminals:

Cable Type	No. of Conductors	Conductor Section	
		mm²	AWG
Flexible (stranded) cable	Single conductor	0.2...2.5	24...14
	2 conductors	0.2...1.5	24...16
Solid cable	Single conductor	0.2...2.5	24...14
	2 conductors	0.2...1.0	24...18
Flexible (stranded) cable with insulated cable ends	Single conductor	0.25...2.5	24...14
	2 conductors	0.5...1.5	20...16
Flexible (stranded) cable with non-insulated cable ends	Single conductor	0.25...2.5	24...14
	2 conductors	0.2...1.0	24...18

The table below describes the characteristics of the terminals:

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

Wiring - Current Transformers (CTs)

Overview

The LTM R controller has 3 CT windows through which you can route motor leads to contactor load connections.

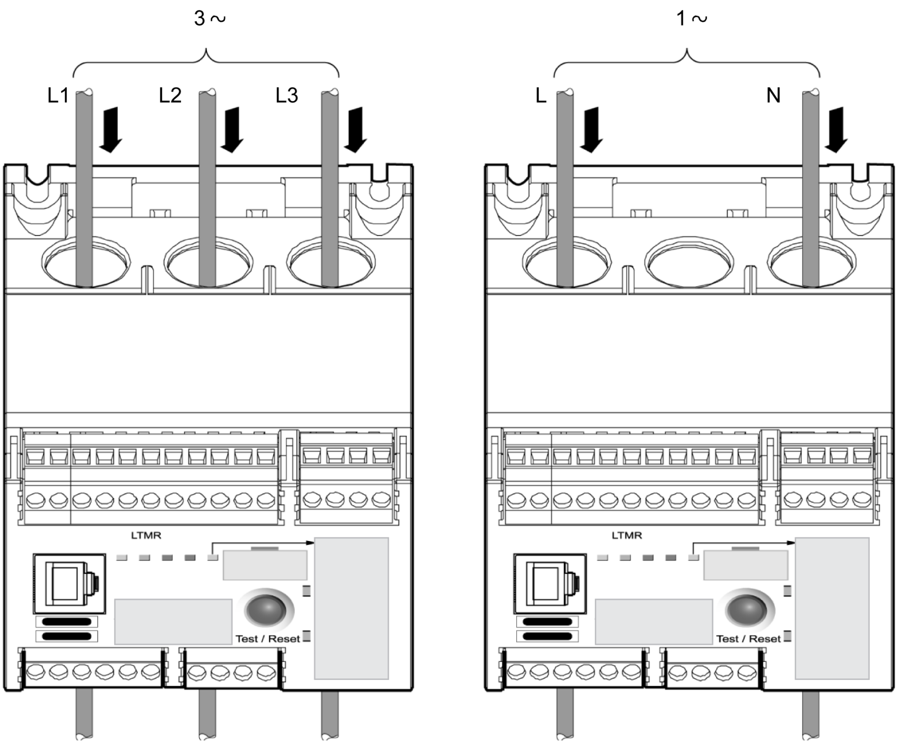
The CT windows enable you to wire the controller in 4 different ways, depending on the voltage and controller model used:

- internal CT wiring through the windows
- internal CT wiring using multiple passes
- internal CT wiring using the lug kit (ref. Class 9999 MLPL)
- external Load CT wiring

This section describes each of these options.

Internal CT Wiring Through the Windows

The following diagrams show typical wiring using the CT windows for either 3-phase or single-phase motors:

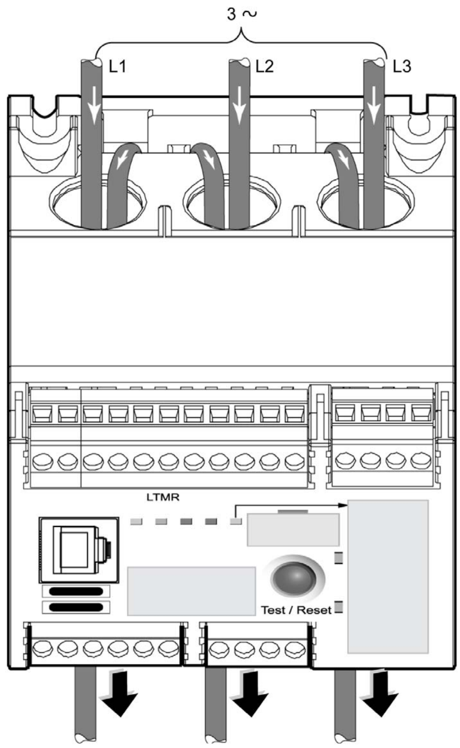


Internal CT Wiring Using Multiple Passes

The controller can physically support up to a maximum of 5 passes of 2.5 mm² (14 AWG) wire through the CT windows. There are 3 looping windows located under the CT windows that physically support up to a maximum of 4 wire loops.

Set the parameter Load CT Multiple Passes to account for the number of times the motor wires pass through the CT window in order to display the correct current readings. For more information, refer to Load Current Transformer settings *(see page 350)*.

The following diagram shows typical wiring using 2 passes (1 wire loop):



Multiply the current by the number of times that the motor wires pass through the CT windows to determine the amount of current passing through the internal current sensors.

Adding multiple passes allows to:
- increase the current sensed by the internal current sensors to a level that the controller can properly detect, or
- provide a more accurate reading by the internal current sensors.

We recommend that you select a controller with an FLC value range that includes the motor FLC. However, if the motor FLC is less than the FLC range of the controller, multiple passes can increase the current level sensed by the internal current sensors to one that the controller can detect.

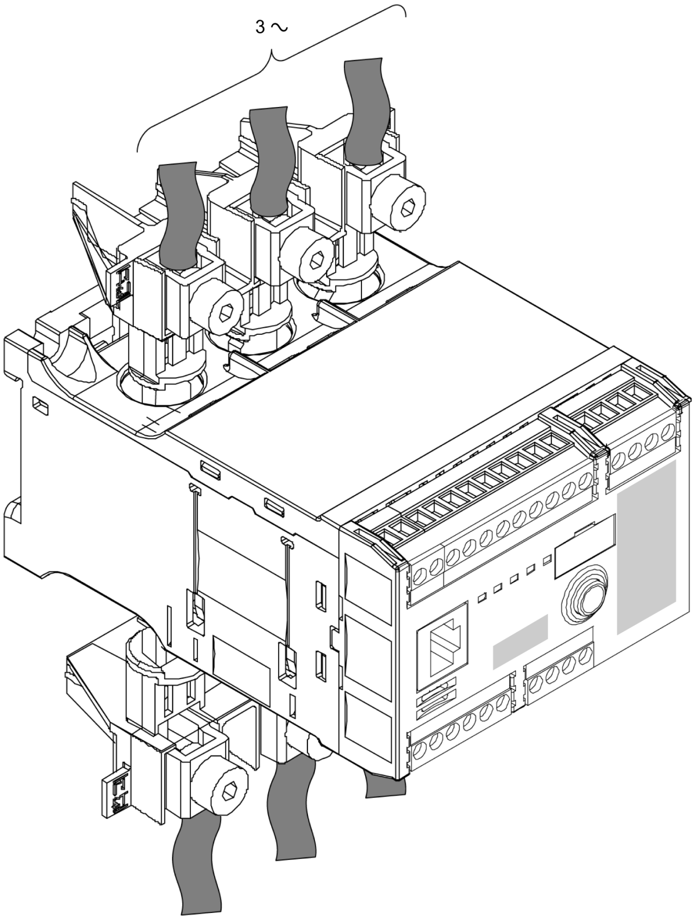
For example, if using a controller with an FLC range of 5 to 100 A, and the motor FLC is 3 A, the controller cannot properly sense the current. In this case, if you pass the power wiring through the internal current sensors of the controller 2 times, the internal current sensors of the controller sense 6 A (2 passes x 3 A), a current level that falls within the FLC range of the controller.

For more information about controller types, see *LTM R Controller, page 15*.

Internal CT Wiring Using a Lug-Lug Kit

The controller accepts the Class 9999 Type MLPL lug-lug kit.

The following diagram shows typical wiring using the lug-lug kit:



NOTE: The lug-lug kit is IP0.

For more information on the lug-lug kit, refer to instruction bulletin 30072-013-101
- supplied with the kit, or
- available from *http://products.schneider-electric.us/support/technical-library* (under Technical Library).

External Load CT Wiring

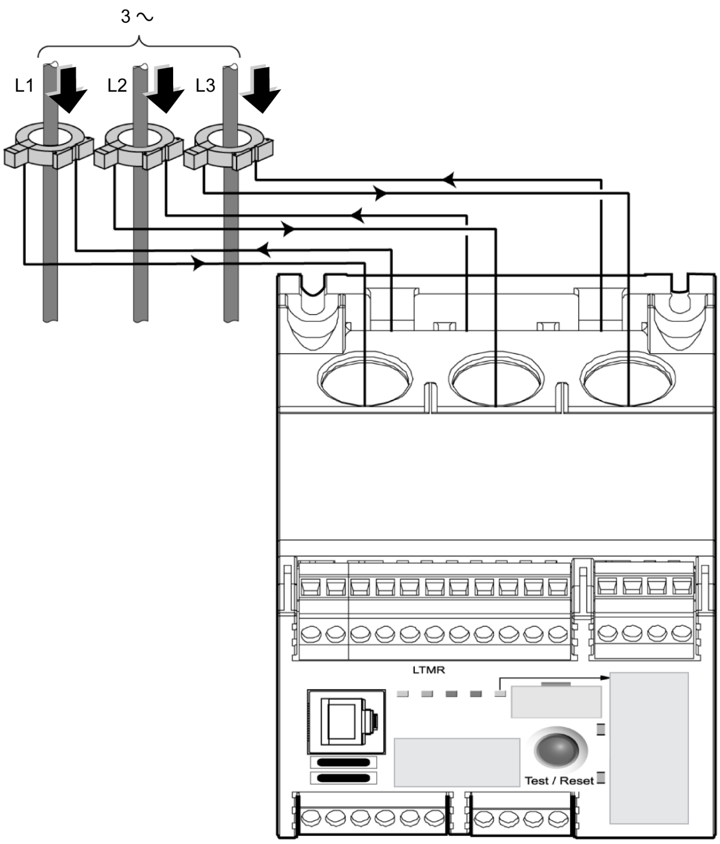
The controller can accept 5 A and 1 A secondary signals from external current transformers. The recommended controller model for these currents is the 0.4-8 A model. Use multiple passes through the controller CT windows, if required.

External CTs are specified with a transformation ratio. The ratio of the external CT is the ratio of the motor input current to the CT output current.

To enable the controller to adjust the FLC range and display the actual line current, set the following parameters:
- Load CT Primary (the first number of the CT ratio)
- Load CT Secondary (the second number of the CT ratio)
- Load CT Multiple Passes (the number of times the CT output wires pass through the controller's internal CT windows)

For more information, refer to Load Current Transformer settings *(see page 350)*.

The following diagram shows wiring using external CTs:

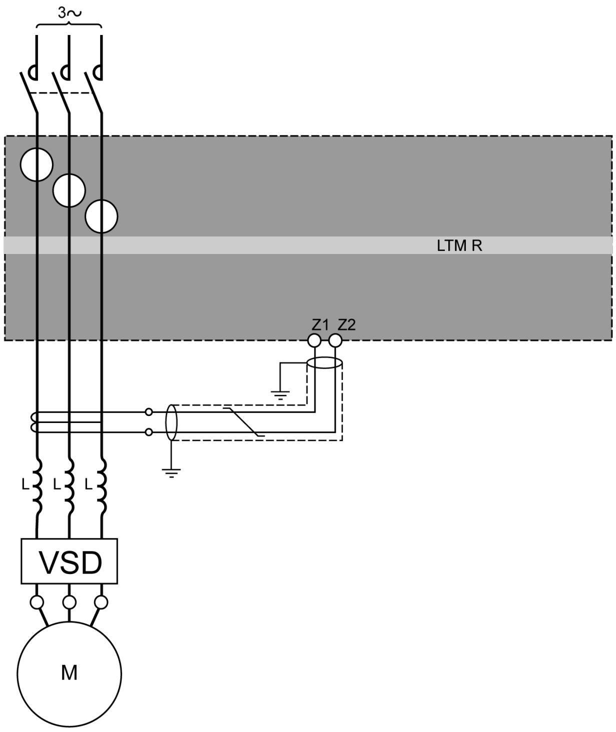


For a description of external CT characteristics, see *Load Current Transformers, page 17*.

CT Wiring in Presence of Variable Speed Drive

When the motor is controlled by a variable speed drive (VSD):

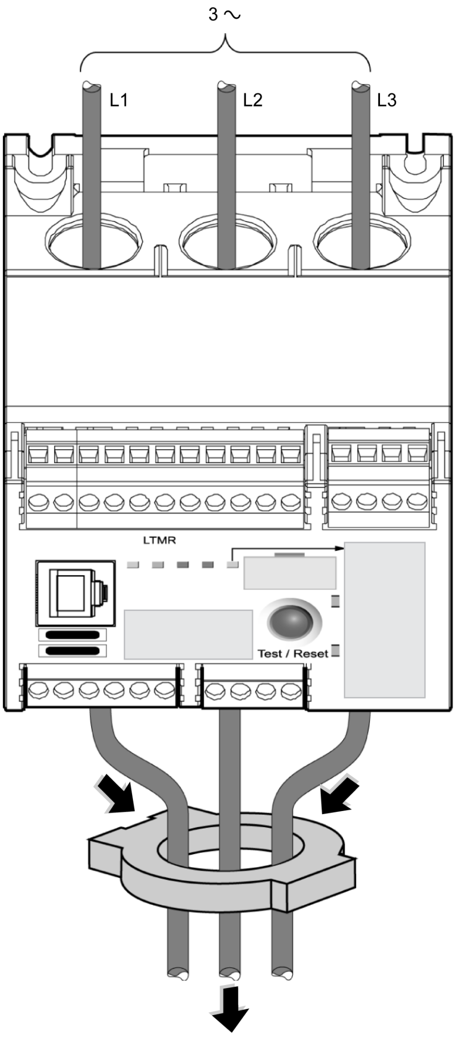
- The current transformers (external or internal) must be mounted upstream of the variable speed drive, and not between the variable speed drive and the motor. The CTs cannot be used between the drive outputs and the motor because the drive can output fundamental frequencies outside the 47-63 Hz range.
- Chokes must be mounted on the 3 phases, between the current transformers (external or internal) and the variable speed drive, to minimize the soft start harmonics current and the voltage disturbances generated by the variable speed drive.



Wiring - Ground Fault Current Transformers

Ground Fault Current Transformer Installation

The following diagram shows a typical LTM R controller installation using a ground fault current transformer (GFCT):



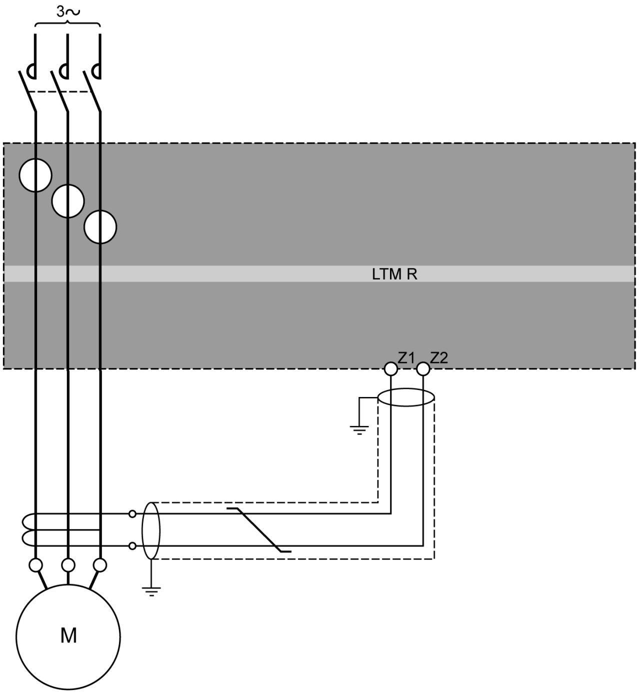
GFCTs are specified with a transformation ratio. The ratio of the GFCT is the ratio of the ground fault current sensed to the current which it outputs.

To enable the controller to correctly measure the actual ground fault current flowing in the circuit, set the following parameters:
- Ground CT Primary (the first number of the GFCT ratio)
- Ground CT Secondary (the second number of the GFCT ratio)

For a description of GFCT characteristics, see *Ground Fault Current Transformers, page 17*.

Ground Fault Current Transformer Wiring

The external ground fault current transformer (GFCT) must be connected to the LTM R controller terminals Z1 and Z2 using a shielded twisted pair cable. The shield must be connected to the earth at both ends by the shortest possible connections.



Wiring - Temperature Sensors

Temperature Sensors

The LTM R controller has 2 terminals dedicated to motor temperature sensing protection: T1 and T2. These terminals return the temperature value measured by resistance temperature detectors (RTDs).

One of the following types of motor temperature sensor can be used:

- PTC Binary
- PT100
- PTC Analog
- NTC Analog

See *Metering and Monitoring Functions, page 27* and *Motor Protection Functions, page 59* for more information on temperature sensors.

Temperature Sensor Wiring

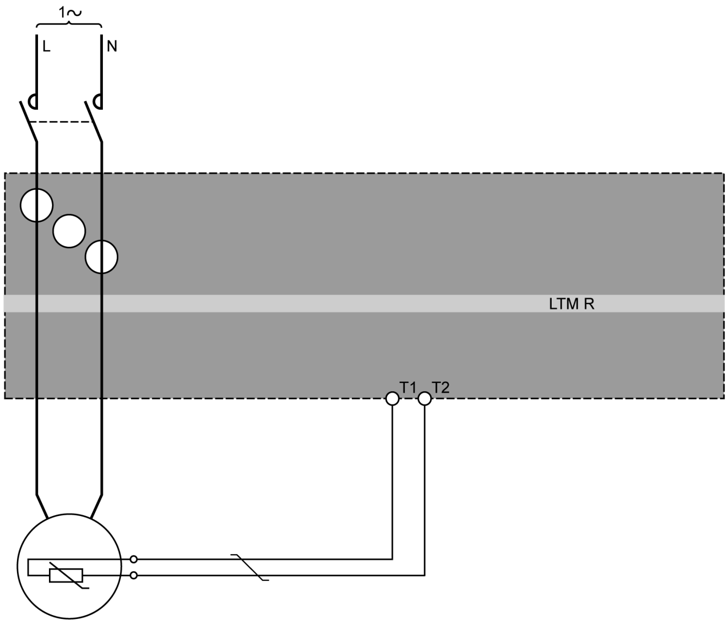
The following table shows the maximum wire lengths for temperature sensor elements:

mm² (AWG)	0.5 (20)	0.75 (18)	1.5 (16)	2.5 (14)
m (ft)	220 (656)	300 (985)	400 (1312)	600 (1970)

Use unshielded twisted pair cable to connect the controller to the temperature sensor.

For the controller to accurately measure the resistance of the temperature-sensing element, you must measure the resistance of the twisted-pair and add it to the desired resistance for protection. This compensates for the lead resistance.

The following diagram shows the wiring of the LTM R controller and the temperature sensor of a single-phase motor:



For more information about wiring, see *Wiring - Generalities, page 192*.

Wiring - Power Supply

Overview

The LTM R controller supply voltage can be:
- 24 VDC, or
- 100…240 VAC

The following table presents LTM R controller and LTM E expansion module association rules:

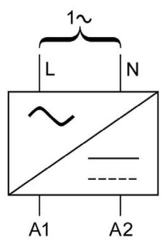
	LTMR•••BD (VDC)	LTMR•••FM (VAC)
LTME••BD (VDC)	X	X
LTME••FM (VAC)	–	X
X Association allowed **–** Association not allowed		

DC Power Supply

A dedicated 24 VDC power supply is necessary to supply:
- one or several LTM R controllers including the logic inputs of the LTM R controller(s)
- the logic inputs of the LTM E expansion module(s)

An additional specific 24 VDC power supply is necessary to supply:
- the LTM R controller logic outputs
- other devices

The LTM R controller DC power supply must have the following characteristics:
- AC/DC converter
- galvanic isolation input AC / output DC: 4 kVAC minimum at 50 Hz
- input voltage: 240 VAC (+15% / -20%)
- output voltage: 24 VDC (+/-10%)



The following Schneider Electric ABL8RPS24••• power supplies are recommended:

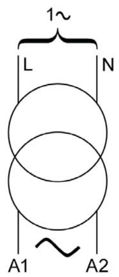
Reference Number	Input Voltage	Output Voltage/Current	Maximum Number of LTM R Controllers Supplied
ABL8RPS24100	200…500 VAC	24 VDC / 10 A	24
ABL8RPS24050	200…500 VAC	24 VDC / 5 A	12
ABL8RPS24030	200…500 VAC	24 VDC / 3 A	8

AC Power Supply

A dedicated AC/AC power supply or UPS is necessary to supply:
- one or several LTM R controllers including the logic inputs of the LTM R controller(s)
- the logic inputs of the LTM E expansion module(s)

An additional specific AC or DC power supply is necessary to supply:
- the LTM R controller logic outputs
- other devices

The LTM R controller AC power supply or UPS must have the following characteristics:
- isolation transformer
- output voltage: 115 or 230 VAC (+15% / -20%)
  - 115 VAC output voltage is recommended
  - with 230 VAC output voltage, an additional LTM9F external filter may be necessary *(see page 205)*
- power according to the number of LTM R controllers (several AC supplies are recommended)



AC Power Supply With LTM9F External Filter

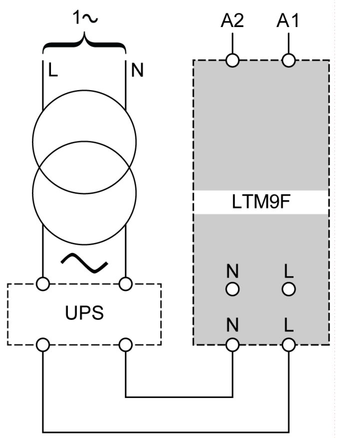
The LTM9F external filter is a power filter dedicated to the LTM R controller with AC supply voltage.

Use an LTM9F external filter when the power supply output voltage exceeds 150 VAC and presents risks of voltage peaks over 300 VAC. This rule applies even when an UPS is used as AC power supply. This is due to the different types of UPS available and their operating modes.

If an LTM9F is required on one LTM R controller with AC supply voltage, an LTM9F must be used on each LTM R controller with AC supply voltage on the system.

The LTM9F external filter must not be used when the power supply output voltage is lower than 150 VAC.

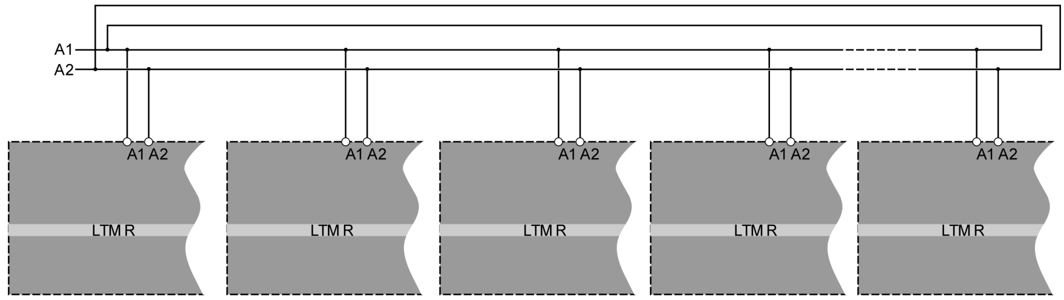
When LTM9F external filter is used with an UPS, the filter is wired after the UPS as shown below:



Power Supply Daisy Chaining

When the same power supply (AC or DC) is used to supply several LTM R controllers, it is recommended to close the loop:

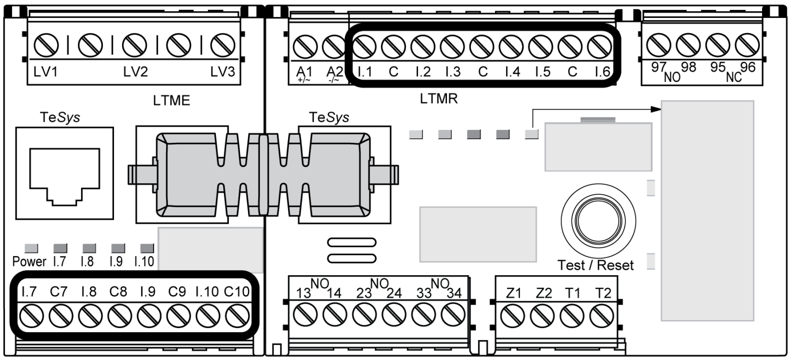
- to avoid power off,
- to reduce voltage drop due to long cables.



Wiring - Logic Inputs

Overview

10 logic inputs maximum are provided:
- 6 logic inputs on the LTM R controller, internally powered by the LTM R
- 4 logic inputs on the LTM E expansion module, independently powered



Logic Inputs of the LTM R Controller

The controller LTM R has 6 logic inputs:
- available via field wiring terminals I.1- I.6
- internally powered by the control voltage of the LTM R controller (the input voltage is the same voltage as the controller supply voltage)
- isolated from the inputs of the LTM E expansion module

The 3 Common (C) terminals of the LTM R controller are connected to the A1 control voltage via an internal filter, as shown in the wiring diagram examples *(see page 192)*.

NOTICE
LOGIC INPUTS DESTRUCTION HAZARD ● Connect the LTM R controller’s inputs using the 3 Common (C) terminals connected to the A1 control voltage via an internal filter. ● Do not connect the Common (C) terminal to the A1 or A2 control voltage inputs. **Failure to follow these instructions can result in equipment damage.**

For more information, see the power supply wiring *(see page 204)* and the technical specifications of the LTM R controller *(see page 340)*.

Logic Inputs of the LTM E Expansion Module

The 4 logic inputs on the LTM E expansion module (I.7 - I.10) are not powered by the control voltage of the LTM R controller.

For more information, refer to the technical specifications of the LTM E controller *(see page 343)* and to the power supply description *(see page 204)*.

Controller AC Inputs Setting

The LTM R controller uses internal filters to obtain a correct AC signal on the inputs.

For more accurate results, this filter can be configured by the controller AC inputs setting register *(see page 315)* to set the voltage supply and activate the adaptive filtering internal feature.

Connection of the Logic Inputs

Two types of connection are possible:
- Direct connection for all information on logic inputs coming from the switchboard.
- Connection via interposing relays for all information on logic inputs coming from outside of the switchboard and mainly connected with long lines.
  Using interposing relays reduces EMC disturbance effects on the LTM R controller and improves the reliability of the information.

Recommended Interposing Relay

Interposing relays must have the following characteristics:
- electromechanical relay with 2.5 kVAC isolation minimum
- self-cleaning or low level contact (I < 5 mA)
- installed in the switchboard as close as possible to the LTM R controller
- AC or DC control circuit voltage, supplied by separate power supply (not supplied by the same power supply as the LTM R controller, to respect the galvanic isolation)

In case of long distances between the process and the LTM R controller, interposing relays with DC control circuit voltage are recommended.

The protection module is mandatory on the interposing relays in order to suppress the surge.

The following Schneider Electric RSB1 interposing relays are recommended:

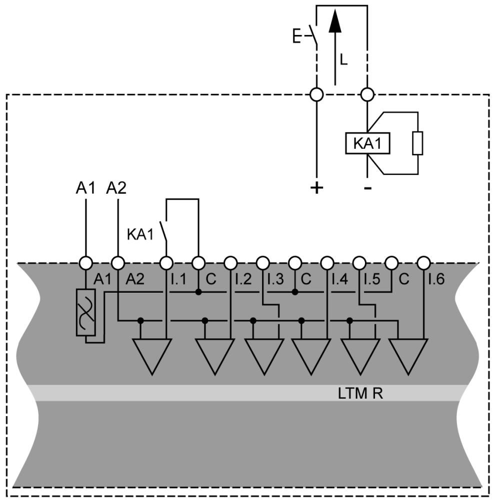
Reference Number	Control Circuit Voltage	Protection Module
RSB1A120•D	6, 12, 24, 48, 60, 110 VDC	Diode RZM040W
RSB1A120•7	24, 48 VAC	RC circuit RZM041BN7
RSB1A120•7	120, 220, 230, 240 VAC	RC circuit RZM041FU7

Use of DC Interposing Relays

The DC interposing relays are recommended because long wires distances can be used to command the relay.

DC RSB1 relay voltage	24 VDC	48 VDC	110 VDC
Maximum distance for wires in parallel without metallic screening	3,000 m (10,000 ft)	3,000 m (10,000 ft)	3,000 m (10,000 ft)
Maximum distance for wires in parallel with metallic screening	3,000 m (10,000 ft)	3,000 m (10,000 ft)	3,000 m (10,000 ft)

The following diagram shows an example when using DC interposing relays:

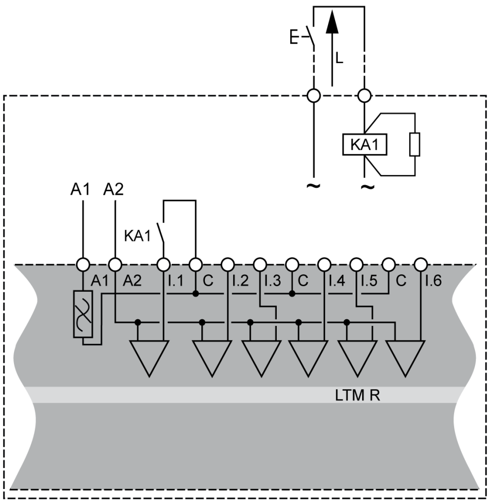


Use of AC Interposing Relays

The use of an AC interposing relay is allowed only on short distances if an AC voltage is mandatory.

AC RSB1 relay voltage	24 VAC	48 VAC	120 VAC	230/240 VAC
Maximum distance for wires in parallel without metallic screening	3,000 m (10,000 ft)	1,650 m (5,500 ft)	170 m (550 ft)	50 m (165 ft)
Maximum distance for wires in parallel with metallic screening	2,620 m (8,600 ft)	930 m (3,000 ft)	96 m (315 ft)	30 m (100 ft)

The following diagram shows an example when using AC interposing relays:



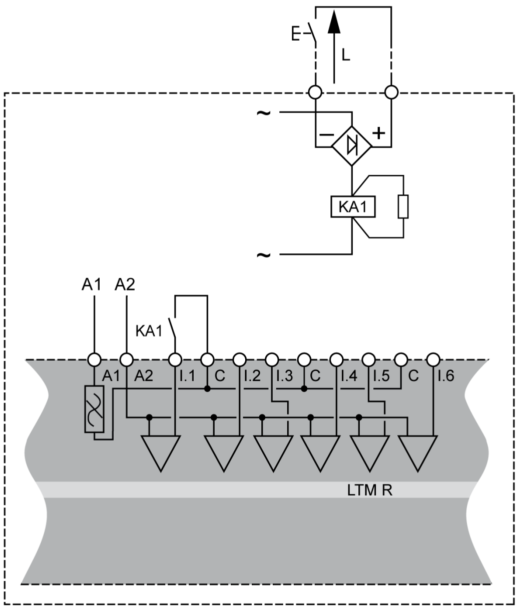
Use of AC Interposing Relays with a Rectifier

The use of AC interposing relay with a rectifier is recommended on long distances if an AC voltage is mandatory.

Add a rectifier composed of 1 A / 1000 V diodes to command an AC interposing relay. In this way, rectified AC current flows in the control cable when the switch in the continuous part is closed.

AC RSB1 relay voltage	24 VAC	48 VAC	120 VAC	230/240 VAC
Maximum distance for wires in parallel without metallic screening	3,000 m (10,000 ft)	3,000 m (10,000 ft)	3,000 m (10,000 ft)	3,000 m (10,000 ft)
Maximum distance for wires in parallel with metallic screening	3,000 m (10,000 ft)	3,000 m (10,000 ft)	3,000 m (10,000 ft)	3,000 m (10,000 ft)

The following diagram shows an example when using AC interposing relays with a rectifier:



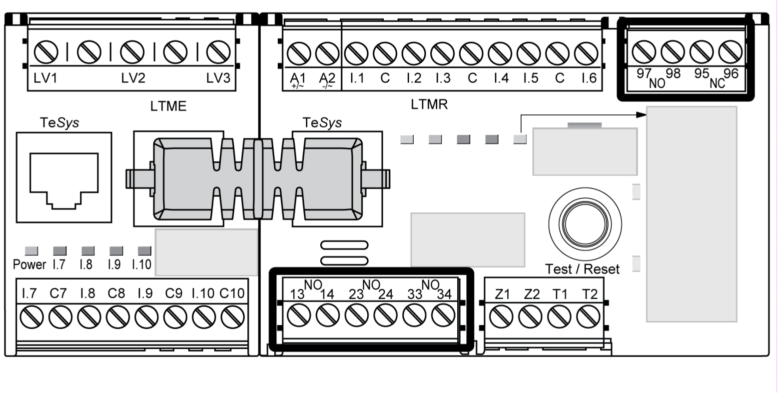
Wiring - Logic Outputs

Overview

The 4 logic outputs of the LTM R controller are relay outputs. The relay outputs command the motor managed by the LTM R controller.

The 4 relay outputs on the LTM R controller are:

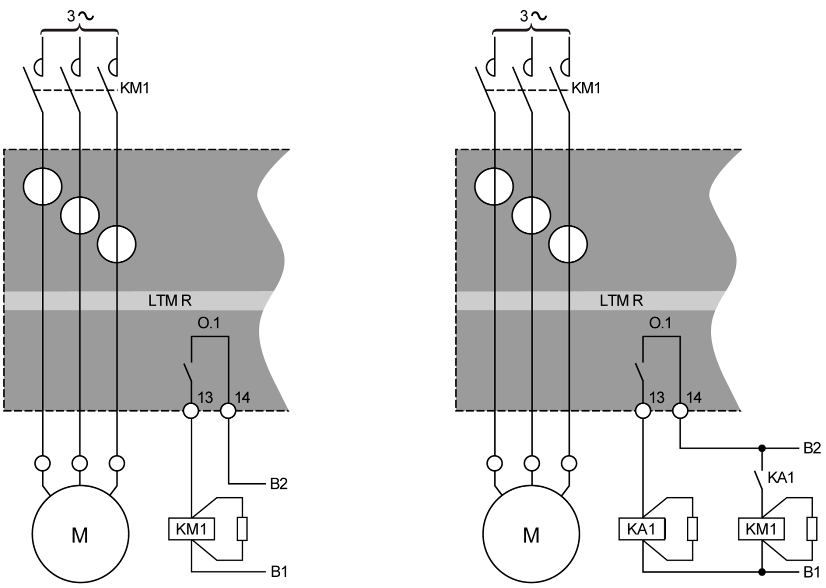
- 3 single pole / single throw (SPST, NO) relay outputs
- 1 double pole / single throw (DPST, NC+NO) relay output



Output Interposing Relays

When an output commands a contactor, an interposing relay may be required depending of the coil voltage and the power required by the contactor used.

The following diagrams illustrate system wiring without and with the use of an interposing relay KA1:



Without interposing relay

With interposing relay

B1, B2 Power supply dedicated to logic outputs

The LTM R controller logic output characteristics are:

- 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

If the LTM R controller logic output is not able to control directly the contactor, an interposing relay is required.

The protection module is mandatory on the interposing relays in order to suppress the surge.

Recommended Contactors

The tables in the appendix, listing the references and characteristics of Schneider Electric contactors, specify whether an interposing relay is required or not *(see page 346)*.

Connecting to an HMI Device

Overview

This section describes how to connect the LTM R controller to an HMI device, such as a Magelis® XBT or a TeSys® T LTM CU, or to a PC running SoMove with the TeSys T DTM. The HMI device must be connected to the RJ45 port on the LTM R controller, or to the HMI interface port (RJ45) on the LTM E expansion module.

The Magelis® XBT HMI device must be powered separately. Connect it to a controller in 1-to-many mode.

Wiring Rules

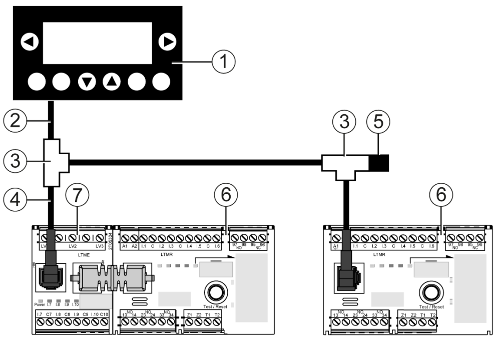
The wiring rules must be respected in order to reduce disturbance on the behavior of the LTM R controller due to EMC.

The exhaustive list of wiring rules is described in the general recommendations *(see page 192)*.

NOTICE
UNINTENDED EQUIPMENT OPERATION
Use Schneider Electric standard cables.
Failure to follow these instructions can result in equipment damage.

Connecting to a Magelis® XBT HMI Device in 1-to-Many Mode

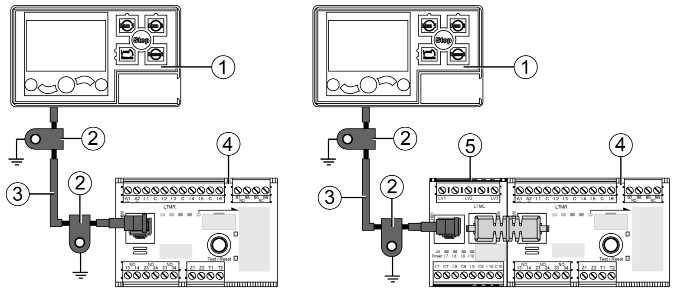
The diagram below shows a 1-to-many connection from the Magelis® XBTN410 HMI to up to 8 controllers, with and without the LTM E expansion module:



1 Magelis® XBTN410 HMI device
2 Magelis® connecting cable XBTZ938
3 T-junction boxes VW3 A8 306 TF••
4 Shielded cable with 2 RJ45 connectors VW3 A8 306 R••
5 Line terminator VW3 A8 306 R
6 LTM R controller
7 LTM E expansion module

Connecting to a TeSys® T LTM CU HMI Device

The diagrams below show the TeSys® T LTM CU HMI device connected to the LTM R controller, without and with the LTM E expansion module:

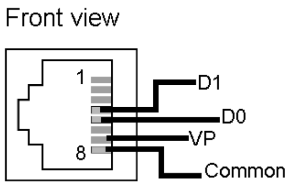


1 LTM CU Control Operator Unit
2 Grounding collar
3 LTM9CU•• HMI device connection cable
4 LTM R controller
5 LTM E expansion module

Connecting to a Generic HMI Device

Connect the LTM R controller and the expansion module to an HMI device of your choice, using a shielded cable for Modbus bus, reference TSX CSA •••.

The RJ45 port pinouts to connect to the HMI port of the LTM R controller or the LTM E expansion module is:

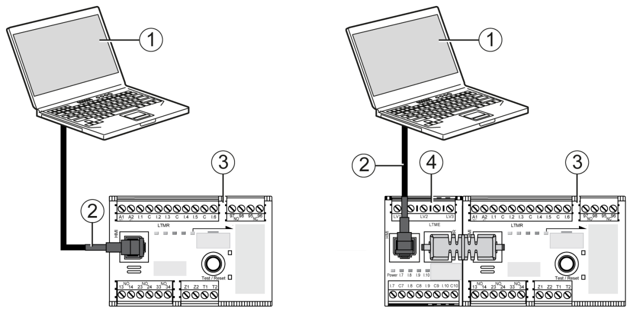


The RJ45 wiring layout is:

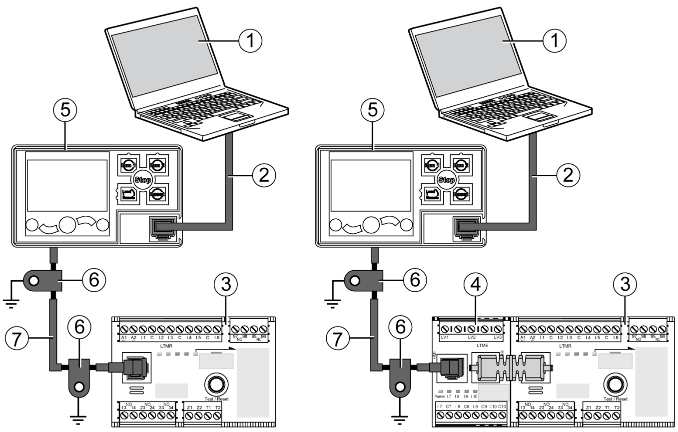
Pin no.	Signal	Description
1	Reserved	Do not connect
2	Reserved	Do not connect
3	–	Not connected
4	D1 or D(B)	Communication between HMI and LTM R controller
5	D0 or D(A)	Communication between HMI and LTM R controller
6	Reserved	Do not connect
7	VP	+7 VDC (100 mA) power supply provided by the LTM R controller
8	Common	Signal and power supply common

Connecting to a PC Running SoMove with the TeSys T DTM in 1-to-1 Mode Using the HMI Port

The diagrams below show a 1-to-1 connection from a PC running SoMove with the TeSys T DTM to the HMI port of the LTM R controller, with and without the LTM E expansion module and the LTM CU:



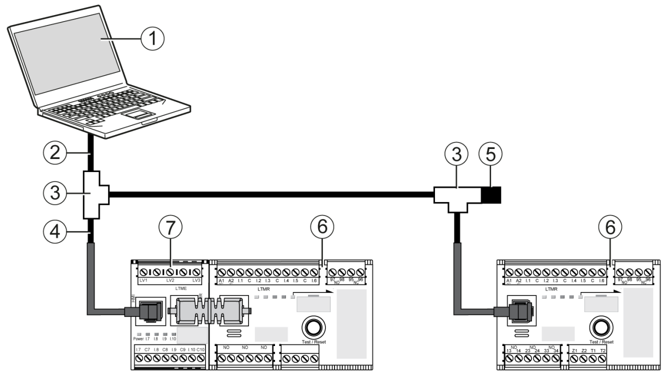
1 PC running SoMove with the TeSys T DTM
2 TCSMCNAM3M0 Modbus USB/RJ45 cable
3 LTM R controller
4 LTM E expansion module



1 PC running SoMove with the TeSys T DTM
2 Cable kit TCSMCNAM3M002P
3 LTM R controller
4 LTM E expansion module
5 LTM CU Control Operator Unit
6 Grounding collar
7 LTM9CU•• HMI device connection cable

Connecting to a PC Running SoMove with the TeSys T DTM in 1-to-Many Mode

The diagram below shows a 1-to-many connection from a PC running SoMove with the TeSys T DTM to up to 8 controllers (with or without the LTM E expansion module):



1 PC running SoMove with the TeSys T DTM
2 Cable kit TCSMCNAM3M002P
3 T-junction boxes VW3 A8 306 TF••, including a shielded cable with 2 RJ45 connectors
4 Shielded cable with 2 RJ45 connectors VW3 A8 306 R••
5 Line terminator VW3 A8 306 R
6 LTM R controller
7 LTM E expansion module

NOTE: This connection requires to define different HMI communication addresses. The factory setting of the HMI port address is 1.

Connection Accessories

The following table lists connection accessories for the Magelis® XBT and other HMI devices:

Designation	Description	Reference
T-junction boxes	Box with 2 RJ45 female connector for trunk cable and an integrated 0.3 m (1 ft) cable with 1 RJ45 male connector for tap-off	VW3 A8 306 TF03
	Box with 2 RJ45 female connector for trunk cable and an integrated 1 m (3.2 ft) cable with 1 RJ45 male connector for tap-off	VW3 A8 306 TF10
Line terminator for RJ45 connector	R = 120 Ω	VW3 A8 306 R
Magelis® connecting cable (Magelis® XBTN410 only)	Length = 2.5 m (8.2 ft) 25 pts SUB-D connector to connect to Magelis® XBT	XBTZ938
Cable kit	Length = 2.5 m (8.2 ft) USB to RS 485 converter	TCSMCNAM3M002P
Communication cables	Length = 0.3 m (1 ft)	VW3 A8 306 R03
	Length = 1 m (3.2 ft)	VW3 A8 306 R10
	Length = 3 m (3.2 ft)	VW3 A8 306 R30
HMI device connection cable	Length = 1 m (3.2 ft)	LTM9CU10
	Length = 3 m (9.6 ft)	LTM9CU30

Section 5.2
Wiring of the Modbus Network

Overview

This section describes how to connect an LTM R controller to an RS 485 Modbus network with an RJ45 or an open-style connector.

It presents 3 possible network topologies.

⚠ WARNING
LOSS OF CONTROL ● The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop. ● Separate or redundant control paths must be provided for critical control functions. ● System control paths may include communication links. Consideration must be given to the implications of anticipated transmission delays or failures of the link.[1] ● Each implementation of an LTM R controller must be individually and thoroughly tested for proper operation before being placed into service. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

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

What Is in This Section?

This section contains the following topics:

Modbus Network Characteristics

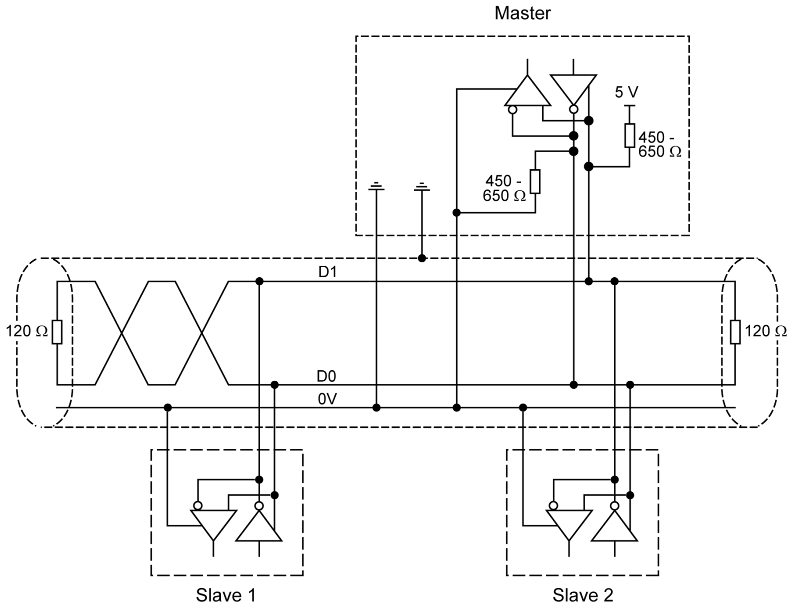
Overview

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

Modbus Network Standard Diagram

The standard diagram corresponds to the Modbus specification on the www.modbus.org site and in particular to the 2-wire multidrop serial bus diagram.

The simplified diagram is as follows:



Characteristics for Connection to the RS 485 Bus

The RS 485 standard allows variants of some characteristics:
- polarization
- line terminator
- number of slaves
- bus length

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

Modbus Communication Port Wiring Terminal Characteristics

General

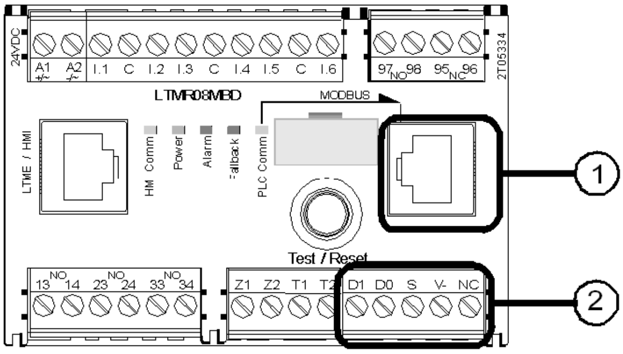
The main physical characteristics of a Modbus port are:

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

Physical Interface and Connectors

The LTM R controller is equipped with 2 connector types, on the front face:
1. a female shielded RJ45 connector,
2. an open-style, pull-apart, terminal block.

The figure shows the LTM R front face with the Modbus connectors:



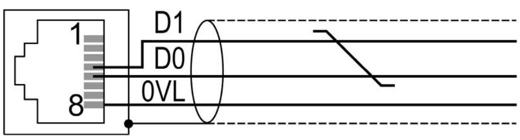
Both connectors are electrically identical. They follow the Modbus interoperability standards.

NOTE: The product must be connected through only 1 port. The use of the RJ45 connector is recommended.

RJ45 Connector Pinout

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

Front view



The RJ45 wiring layout is:

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

Open-Style Terminal Block

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

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

Open-Style Terminal Block Characteristics

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

Wiring of the Modbus Network

Overview

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

This section describes 3 typical cases of connection of LTM R controllers to the bus via its RJ45 connector:
- connection of LTM R controllers installed in an enclosure via T-junction boxes
- connection of LTM R controllers installed in withdrawable drawers via T-junction boxes
- connection of LTM R controllers installed in withdrawable drawers via hardwired cables

Modbus Wiring Rules

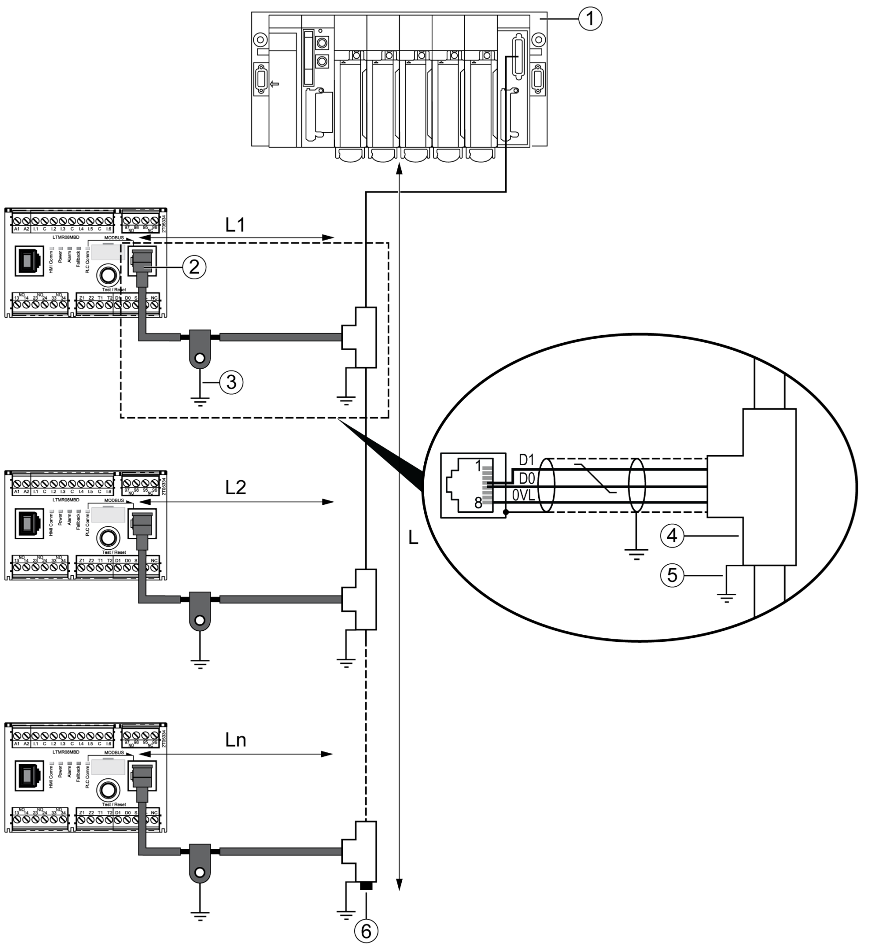
The following wiring rules must be respected in order to reduce disturbance due to EMC on the behavior of the LTM R controller:
- Keep a distance as large as possible between the communication cable and the power or control cables (minimum 30 cm or 11.8 in.).
- Cross over the Modbus cables and the power cables at right angles, if necessary.
- Install the communication cables as close as possible to the grounded plate.
- Do not bend or damage the cables. The minimum bending radius is 10 times the cable diameter.
- Avoid sharp angles of paths or passage of the cable.
- Use the recommended cables only.
- All RJ45 connectors must be metallic.
- A Modbus cable must be shielded:
  - The cable shield must be connected to a protective ground.
  - The connection of the cable shield to the protective ground must be as short as possible.
  - Connect together all the shields, if necessary.
  - Perform the grounding of the shield with a collar.
- When the LTM R controller is installed in a withdrawable drawer:
  - Connect together all the shield contacts of the withdrawable drawer part of the auxiliary connector to the ground of the withdrawable drawer to create an electromagnetic barrier. See the *Okken Communications Cabling & Wiring Guide* (available on request).
  - Do not connect the cable shield at the fixed part of the auxiliary connector.
- Place a line terminator at each end of the bus to avoid malfunctions on the communication bus. A line terminator is generally already integrated in the master.
- Wire the bus between each connector directly, without intermediate terminal blocks.
- The common polarity (0V) must be connected directly to protective ground, preferably at one point only for the entire bus. In general, this point is chosen either on the master device or on the polarization device.

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

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

LTM R Controllers Installed in an Enclosure

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



1 Master (PLC, PC, or communication module) with line terminator
2 Modbus shielded cable with 2 RJ45 connectors VW3 A8 306 R••
3 Grounding of the Modbus cable shield
4 Modbus T-junction boxes VW3 A8 306 TF•• (with cable)
5 Grounding of the Modbus T-junction boxes
6 Line terminator for RJ45 plug VW3 A8 306 R (120 Ω)

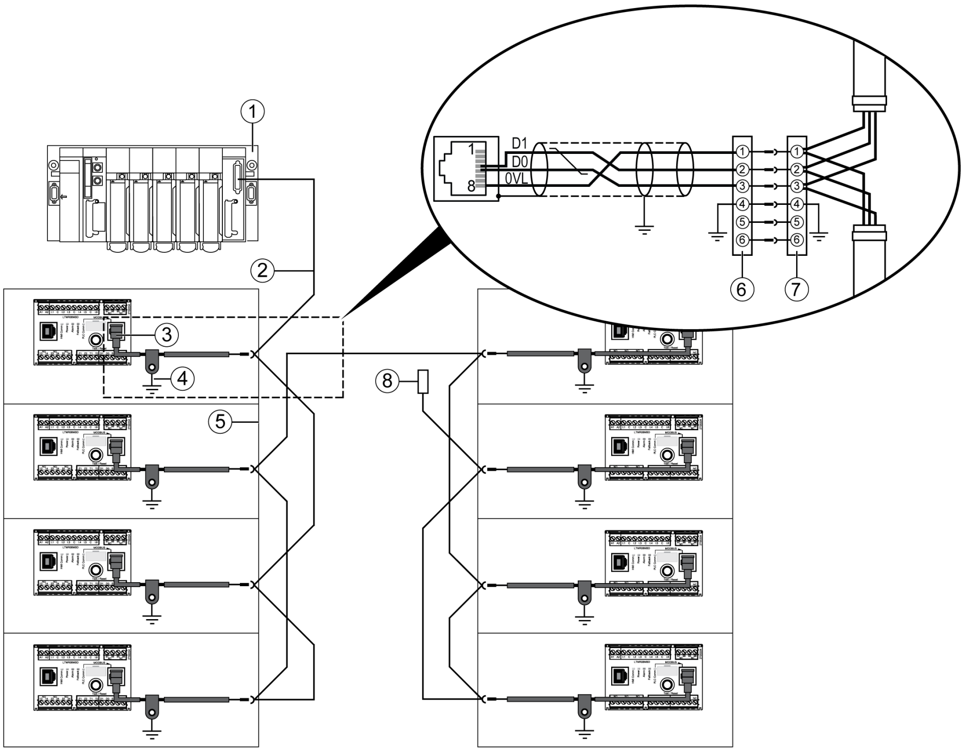
LTM R Controllers Installed in a Blokset or Okken Motor Control Switchboard

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

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

LTM R Controllers Installed in Withdrawable Drawers With Hardwired Cables

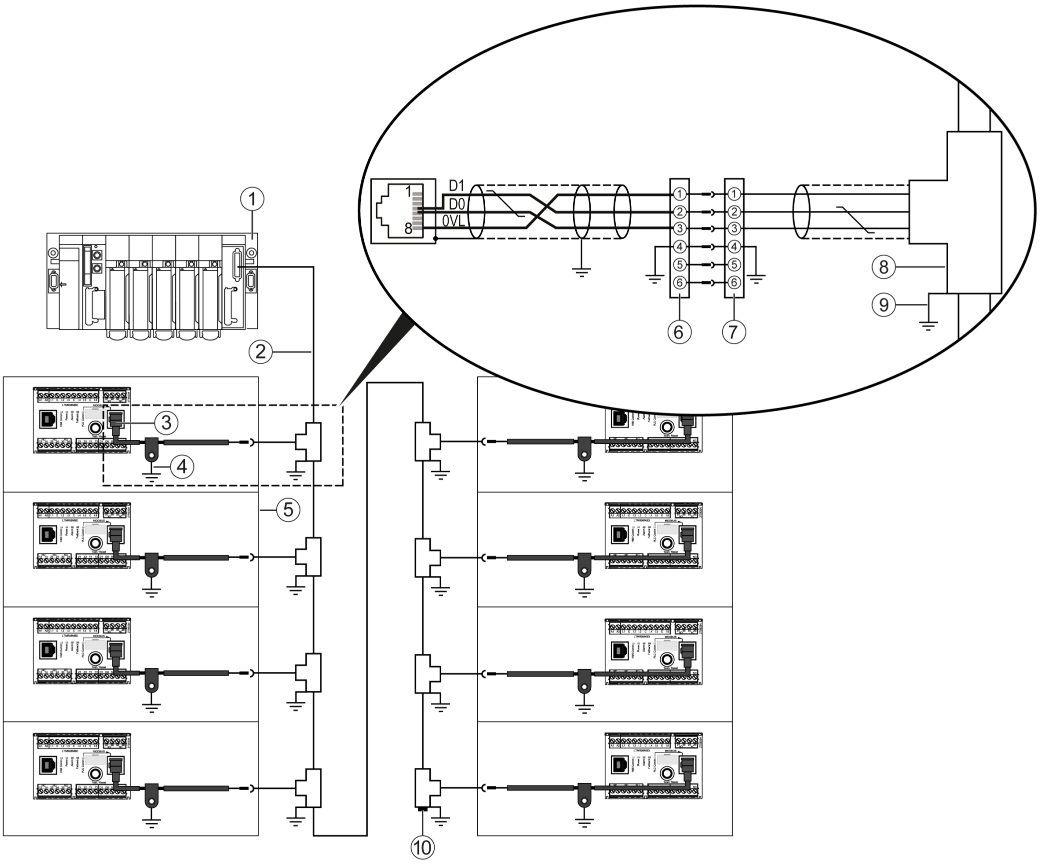
The wiring diagram for connection of LTM R controllers installed in withdrawable drawers to the RS 485 bus via the RJ45 connector and hardwired cables is as follows:



1 Master (PLC, PC, or communication module) with line terminator
2 Modbus shielded cable TSX CSA •00
3 Modbus shielded cable with 1 RJ45 connector VW3 A8 306 D30
4 Grounding of the Modbus cable shield
5 Withdrawable drawer
6 Withdrawable drawer part of the auxiliary connector
7 Fixed part of the auxiliary connector
8 Line terminator VW3 A8 306 DR (120 Ω)

LTM R Controllers Installed in Withdrawable Drawers With T-Junction Boxes

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



1 Master (PLC, PC, or communication module) with line terminator
2 Modbus shielded cable with 2 RJ45 connectors VW3 A8 306 R
3 Modbus shielded cable with 1 RJ45 connector VW3 A8 306 D30
4 Grounding of the Modbus cable shield
5 Withdrawable drawer
6 Withdrawable drawer part of the auxiliary connector
7 Fixed part of the auxiliary connector
8 Modbus T-junction boxes VW3 A8 306 TF• (with cable)
9 Grounding of the Modbus T-junction boxes
10 Line terminator VW3 A8 306 R (120 Ω)

List of Modbus Accessories

Designation	Description	Reference Number
T-junction boxes	Box with 2 RJ45 female connector for trunk cable and an integrated 0.3 m (1 ft) cable with 1 RJ45 male connector for tap-off	VW3 A8 306 TF03
	Box with 2 RJ45 female connector for trunk cable and an integrated 1 m (3.2 ft) cable with 1 RJ45 male connector for tap-off	VW3 A8 306 TF10
Line terminator for RJ45 connector	R = 120 Ω	VW3 A8 306 R
Line terminator for open-style connector	R = 120 Ω	VW3 A8 306 DR

List of Modbus Cables

Designation	Length	Reference Number
Shielded cable for Modbus bus, with 2 RJ45 connectors	0.3 m (1 ft)	VW3 A8 306 R03
	1 m (3.2 ft)	VW3 A8 306 R10
	3 m (9.8 ft)	VW3 A8 306 R30
Shielded cable for Modbus bus, with 1 RJ45 connectors and 1 stripped end	3 m (9.8 ft)	VW3 A8 306 D30
Shielded cable for Modbus bus, with 2 stripped ends	100 m (320 ft)	TSX CSA 100
	200 m (640 ft)	TSX CSA 200
	500 m (1600 ft)	TSX CSA 500
Belden cable	–	–

Chapter 6
Commissioning

Overview

This chapter provides an overview for commissioning the LTM R controller and the LTM E expansion module.

What Is in This Chapter?

This chapter contains the following topics:

Introduction

Introduction

Commissioning must be performed after the physical installation of the LTM R controller, LTM E expansion module and other hardware devices.

The commissioning process includes:

- initialization of the installed devices, and
- configuration of the LTM R controller parameters that are required for operation of the LTM R controller, LTM E expansion module, and other system hardware

The person performing commissioning must be familiar with the system hardware, and how it will be installed and used in the application.

Hardware devices can include:

- motor
- voltage transformers
- external load current transformers
- ground current transformers
- communication network

The product specifications for these devices provide the required parameter information. You need to understand how the LTM R controller will be used to be able to configure the protection, monitoring, and control functions for the application.

For information about configuring control parameters, see *Motor Control Functions, page 131*.

For information about configuring protection parameters, see *Motor Protection Functions, page 59*.

Initialization

The LTM R controller is ready to be initialized after the hardware installation is complete. To initialize the LTM R controller:

- be sure the command to control the motor is off, then
- turn on the LTM R controller

⚠ CAUTION
IMPROPER INITIALIZATION
Disconnect power to the motor before initializing the LTM R controller.
Failure to follow these instructions can result in injury or equipment damage.

Neither the LTM R controller nor the LTM E expansion module require additional hardware configuration (for example, turning dials, or setting dip-switches) to be initialized. When powered up for the first time, the LTM R controller enters an initial state and is ready for commissioning.

Configuration Tools

Identify the configuration control source–and the configuration tool–before configuring parameters. The LTM R controller and LTM E expansion module can be configured locally using an HMI device or remotely via the network connection.

The LTM R controller can be commissioned using:

- an LTM CU control operator unit,
- a PC running SoMove with the TeSys T DTM,
- a PLC connected to the LTM R controller’s network port.

The following parameters identify the configuration control source:

Parameter	Enables Use of This Tool	Factory Setting
Config Via HMI Keypad Enable	TeSys T LTM CU control operator unit	Enabled
Config Via HMI Engineering Tool Enable	PC running SoMove with the TeSys T DTM	Enabled
Config Via Network Port Enable	the network port (PLC or PC running SoMove with TeSys T DTM)	Enabled

This chapter describes commissioning performed using the LTM CU control operator unit, or SoMove with the TeSys T DTM.

Commissioning Process

The commissioning process remains the same, regardless which configuration tool you select. This process includes the following stages:

Stage	Description
First power-up	The LTM R controller initializes, and is ready for parameter configuration.
Configuring required settings	Configure these parameters to move the LTM R controller out of its initialization state. The LTM R controller is ready for operations.
Configuring optional settings	Configure these parameters to support the LTM R controller functions required by the application.
Verifying hardware	Check hardware wiring.
Verifying the configuration	Confirm accurate parameter settings.

First Power-up

Overview

First power-up describes the first time power is cycled to:

- a new LTM R controller, or
- an LTM R controller that has been previously commissioned, but whose parameter settings have been restored to the factory settings, either as a result of:
  - execution of the Clear All Command, or
  - a firmware upgrade

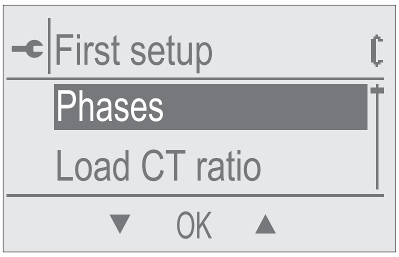
On first power-up, the LTM R controller enters a locked, non-configured state, called the initialized state, and the Controller System Config Required parameter is turned On. The LTM R controller exits this state only after certain parameters, called required parameters, have been configured.

When commissioning is done, the LTM R controller is no longer locked, and is ready for operations. For information on operating states, see *Operating States, page 136*.

First Power-up in the LTM CU

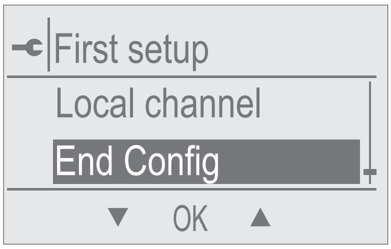
Using the LTM CU control operator unit, configuring the **Menu** →**First Setup** menu parameters clears the Controller System Config Required parameter and brings the LTM R controller out of initialization.

The first time the LTM R controller powers up after leaving the factory, the LTM CU control operator unit LCD automatically displays the First Setup menu, with a list of parameters that need to be configured immediately:

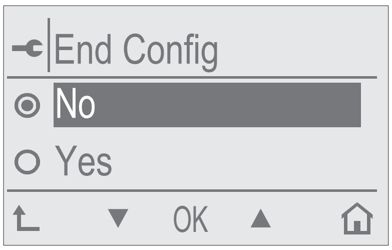


Click OK.

When all parameters are set, the last menu item to show up is End Config:



Click OK.



Click Yes to save the configuration.

When the configuration is saved, the First Setup menu is no longer displayed.

Send a Clear All command to the product to access the first setup menu again.

For more information, see the *TeSys® T LTM CU Control Operator Unit User's Manual*.

First Power-up in SoMove with theTeSys T DTM

Using SoMove with the TeSys T DTM to set all parameters, at the first power up of the LTM R controller, the Controller System Config Required parameter can be cleared by 2 ways:

- In disconnected mode, by clicking **Communication** →**Store to Device** to download the configuration files
- In connected mode, by clicking **Device** →**command** →**exit configuration** after setting all parameters

Both commands bring the LTM R controller out of initialization.

Required and Optional Parameters

Introduction

In addition to the required parameters, configure optional parameters if required at first power-up or later.

In the LTM CU HMI

In the LTM CU HMI, required and optional parameters are located in the 5 sub-menus in the Menu.

In SoMove with the TeSys T DTM

In SoMove with the TeSys T DTM, required and optional parameters are located in tree view items in the **parameter list** tab.

FLC (Full Load Current) Settings

FLC Definition

The Full Load Current (FLC) represents the actual full-load current of the motor being protected by the LTM R controller. The FLC is a motor characteristic and can be found on the motor plate.

Many protection parameters are set as a multiple of FLC.

The FLC can be set from FLCmin to FLCmax.

Examples of FLC settings are detailed below.

Other Definitions

Load CT ratio = Load CT primary / (Load CT secondary * Passes)

Current sensor max = Current range max * Load CT ratio

Current range max is determined by the LTM R controller commercial reference. It is stored in units of 0.1 A and has one of the following values: 8.0, 27.0, or 100.0 A.

Contactor rating is stored in units of 0.1 A and is set by the user between 1.0 and 1000.0 A.

FLCmax is defined as the lower of the Current sensor max and the Contactor rating values.

FLCmin = Current sensor max / 20 (rounded to the nearest 0.01 A.). FLCmin is stored internally in units of 0.01 A.

NOTE:

- The modification of the Contactor rating and/or Load CT ratio modifies the value of the FLC.
- Do not set the FLC below the FLCmin.

Conversion of Amperes to FLC Settings

FLC values are stored as a percentage of FLCmax

FLC (in %) = FLC (in A) / FLCmax

NOTE: FLC values must be expressed as a percentage of FLCmax (resolution of 1 %). If you enter an unauthorized value, the LTM R will round it up to the nearest authorized value. For example, on a 0.4-8 A unit, the step between FLCs is 0.08 A. If you try to set an FLC of 0.43 A, the LTM R will round it up to 0.4 A.

Example 1 (No External CTs)

Data:

- FLC (in A) = 0.43 A
- Current range max = 8.0 A
- Load CT primary = 1
- Load CT secondary = 1
- Passes = 1
- Contactor rating = 810.0 A

Calculated parameters with 1 pass:

- Load CT ratio = Load CT primary / (Load CT secondary * passes) = 1 / (1 * 1) = 1.0
- Current sensor max = Current range max * Load CT ratio = 8.0 * 1.0 = 8.0 A
- FLCmax = min (Current sensor max, Contactor rating) = min (8.0, 810.0) = 8.0 A
- FLCmin = Current sensor max / 20 = 8.0 / 20 = 0.40 A
- FLC (in %) = FLC (in A) / FLCmax = 0.43 / 8.0 = 5 %

Example 2 (No External CTs, Multiple Passes)

Data:

- FLC (in A) = 0.43 A
- Current range max = 8.0 A
- Load CT primary = 1
- Load CT secondary = 1
- Passes = 5
- Contactor rating = 810.0 A

Calculated parameters with 5 passes:

- Load CT ratio = Load CT primary / (Load CT secondary * passes) = 1 / (1 * 5) = 0.2
- Current sensor max = Current range max * Load CT ratio = 8.0 * 0.2 = 1.6 A
- FLCmax = min (Current sensor max, Contactor rating) = min (1.6, 810.0) = 1.6 A
- FLCmin = Current sensor max / 20 = 1.6 / 20 = 0.08 A
- FLC (in %) = FLC (in A) / FLCmax = 0.43 / 1.6 = 27 %

Example 3 (External CTs, Reduced Contactor Rating)

Data:

- FLC (in A) = 135 A
- Current range max = 8.0 A
- Load CT primary = 200
- Load CT secondary = 1
- Passes = 1
- Contactor rating = 150.0 A

Calculated parameters with 1 pass:

- Load CT ratio = Load CT primary / (Load CT secondary * passes) = 200 / (1 * 1) = 200.0
- Current sensor max = Current range max * Load CT ratio = 8.0 * 200.0 = 1600.0 A
- FLCmax = min (Current sensor max, Contactor rating) = min (1600.0, 150.0) = 150.0 A
- FLCmin = Current sensor max / 20 = 1600.0 / 20 = 80.0 A
- FLC (in %) = FLC (in A) / FLCmax = 135 / 150.0 = 90 %

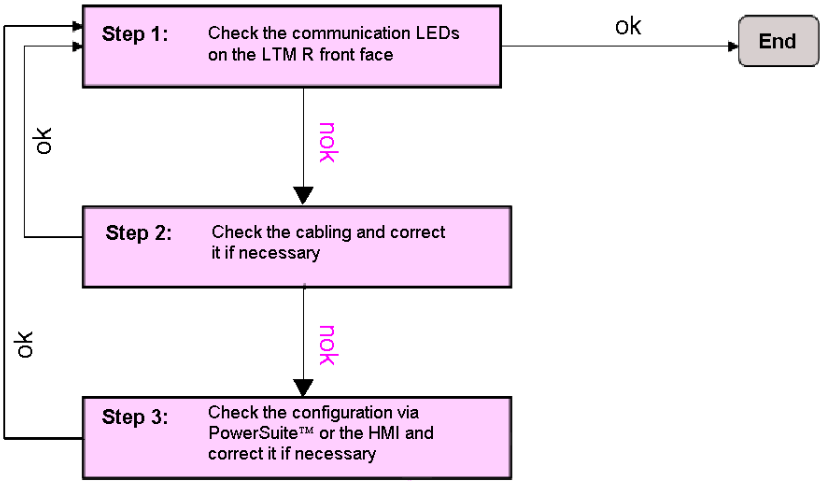
Modbus® Communication Checking

Introduction

Configure the networking function last. Even when the connectors are plugged in, communication between the controller(s) and the PLC cannot start until you enter the correct communication parameters via SoMove with the TeSys T DTM or the HMI. To select the communication parameters, see *Configuration of the LTM R Modbus Network Port, page 288*.

You can then check whether your system can communicate properly.

The Modbus communication checking sequence is:

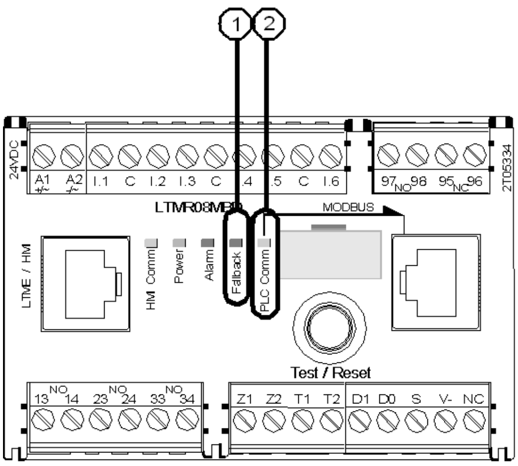


Step 1

On the LTM R front face, check the following 2 LEDs:

1. Fallback
2. PLC Comm

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



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

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

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

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

Step 2

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

Step 3

If the product is still not communicating, check the configuration via:
- SoMove with the TeSys T DTM, or
- the HMI.

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

Verifying System Wiring

Overview

After all required and optional parameters have been configured, be sure to check your system's wiring, which can include:

- motor power wiring
- LTM R controller wiring
- external current transformer wiring
- diagnostic wiring
- I/O wiring

Motor Power Wiring

To verify the motor power wiring, check the following:

Look at...	Action
The motor nameplate	Confirm that the motor generates current and voltage within the ranges of the LTM R controller.
The power wiring diagram	Visually confirm that the actual power wiring matches the intended power wiring, as described in the power wiring diagram.
The list of faults and warnings in SoMove with the TeSys T DTM or the LCD display of the HMI device	Look for any of the following faults or warnings: ● overpower ● underpower ● over power factor ● under power factor
The list of all or read only parameters in SoMove with the TeSys T DTM or the scrolling HMI display of the HMI device	Look for unexpected values in the following parameters: ● active power ● reactive power ● power factor

Control Circuit Wiring

To verify control circuit wiring, check the following:

Look at...	Action
The control wiring diagram	Visually confirm that the actual control wiring matches the intended control wiring, as described in the control wiring diagram.
The LTM R controller Power LED	If the LED is off, the LTM R controller may not be receiving power.
The LTM R controller HMI LED	If the LED is off, the LTM R controller may not be communicating with the LTM CU or the PC running SoMove.
The LTM E expansion module Power LED	If the LED is off, the LTM E expansion module may not be receiving power.

Current Transformer Wiring

Verify the load current transformer wiring and, if the application includes external load current transformers, also verify that wiring by checking the following:

Look at...	Action
The external CT wiring diagram	Visually confirm that the actual wiring matches the intended wiring, as described in the wiring diagram.
The following load CT parameter settings, using SoMove with the TeSys T DTM: ● Load CT Ratio ● Load CT Primary ● Load CT Secondary ● Load CT Multiple Passes	Confirm that the Load CT Ratio parameter, or the combination of Load CT Primary and Load CT Secondary parameters accurately reflect the intended load CT ratio. Visually confirm that the Load CT Multiple Passes parameter accurately reflects the number of passes the wiring makes through the LTM R controller's embedded CT windows.

Look at...	Action
The following load motor parameter setting, using SoMove with the TeSys T DTM: ● Motor Phases	Visually confirm that the motor and LTM R controller are wired for the number of phases set in the Motor Phases parameter.
The following load motor parameter setting, using either SoMove with the TeSys T DTM or the LCD display of the HMI device: ● Motor Phases Sequence	If the motor is a 3-phase motor, visually check that the phase wiring sequence matches the Motor Phases Sequence parameter setting.

Diagnostic Wiring

Verify the wiring for any motor temperature sensing device or external ground current transformer, if the application includes these devices, by checking the following:

Look at...	Action
The wiring diagram	Visually confirm that the actual wiring matches the intended wiring, as described in the wiring diagram.
The external ground CT specifications - and - The following ground CT parameter settings, using SoMove with the TeSys T DTM: ● Ground CT Primary ● Ground CT Secondary	Confirm that the combination of Ground CT Primary and Ground CT Secondary parameters accurately reflect the intended ground CT ratio.
The motor temp sensor specifications -and - The following parameter setting, using either SoMove with the TeSys T DTM or the LCD display of the HMI device: ● Motor Temp Sensor	Confirm that the motor temp sensor actually employed is the same sensor type as set in the Motor Temp Sensor parameter.

I/O Wiring

Verify the wiring for any I/O connections by checking the following:

Look at...	Action
The wiring diagram	Visually confirm that the actual wiring matches the intended wiring, as described in the wiring diagram.
The AUX1 (Run 1), AUX2 (Run 2), and Stop buttons on the HMI device - and - The following parameter setting, using either SoMove with the TeSys T DTM or the LCD display of the HMI device: ● Control Local Channel Setting	Confirm that each command performs the intended start or stop function, when control is via the terminal strip or the HMI port.
The Reset button on the HMI device - and - The following parameter setting, using either SoMove with the TeSys T DTM or the LCD display of the HMI device: ● Thermal Overload Fault Reset	Confirm that the HMI can command a manual fault reset, when control is set to manual.
The PLC, if the LTM R controller is connected to a network - and - The following parameter setting, using either SoMove with the TeSys T DTM or the LCD display of the HMI device: ● Thermal Overload Fault Reset	Confirm that the PLC can command the intended start, stop and remote reset functions.

Verify Configuration

Overview

The final step in the commissioning process is to verify that all configurable parameters used in the application are properly configured.

When performing this task, a master list of all the parameters to be configured and the desired settings is required. It is imperative to compare this list against the actual settings of the configured parameters.

Process

Verifying parameter settings is a 3-part process:

- Transfer the configuration file from the LTM R controller to the PC running SoMove with the TeSys T DTM. This allows to view the LTM R controller's present parameter settings.
  For information on transferring files from the LTM R controller to the PC, refer to the *TeSys T DTM for SoMove FDT Container Online help*.
- Compare the master list of intended parameters and settings against the same settings located in the **parameter list** tab in SoMove with the TeSys T DTM.
- Change the configuration settings as desired. Do this using:
  - either SoMove with the TeSys T DTM, then download the edited file from the PC to the LTM R controller.
    For information on transferring files from the PC to the LTM R controller, refer to the *TeSys T DTM for SoMove FDT Container Online help*.
  - or LTM CU HMI: to edit parameters located in the Menu, navigate to the sub-menu settings and make the appropriate edits.

  For information about required settings, see *Required and Optional Parameters, page 232*.

Chapter 7
Use

Overview

This chapter describes:

- the user interface devices and the hardware configurations you can use to operate the LTM R controller
- how to set parameters with each user interface
- how to perform monitoring, fault handling, and control functions with each user interface.

What Is in This Chapter?

This chapter contains the following sections:

Section 7.1
Using the LTM R Controller Stand-Alone

Overview

This section describes how to use the LTM R controller, either by itself or connected to an LTM E expansion module, in a stand-alone configuration without a user interface device.

What Is in This Section?

This section contains the following topics:

Hardware Configurations

Overview

The LTM R controller, either alone or connected to an LTM E expansion module, can be operated with or without a user interface device.

In any configuration, the LTM R controller can be configured to perform monitoring, fault 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 LTM R controller or LTM E expansion module
Network PLC	Network port on the LTM R controller via the network RJ45 connector or terminal wiring

NOTE: For any instructions about the LTM CU, see the *TeSys® T LTM CU Control Operator Unit User's Manual*.

Stand-Alone Configuration

Overview

Before the LTM R 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 LTM R controller:

Use this control	To

• LEDs:
  • 7 LTM R controller LEDs
  • 5 LTM E expansion module LEDs
	Monitor the state of the LTM R controller and LTM E expansion module

• LTM R controller Test / Reset button	Self test, manage faults, reset to factory settings

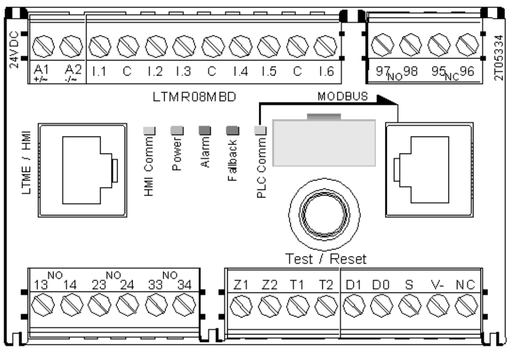
• Programmed operating parameters
• Logic inputs:
  • 6 LTM R controller inputs
  • 4 LTM E expansion module inputs
	Control the:
	• LTM R controller
	• LTM E expansion module
	• Motor
	• Power and control wiring
	• Any connected sensors, including
	  • motor temp sensors
	  • external ground fault CTs

• Programmed protection parameters	Protect the: • LTM R controller • LTM E expansion module • Motor • Equipment

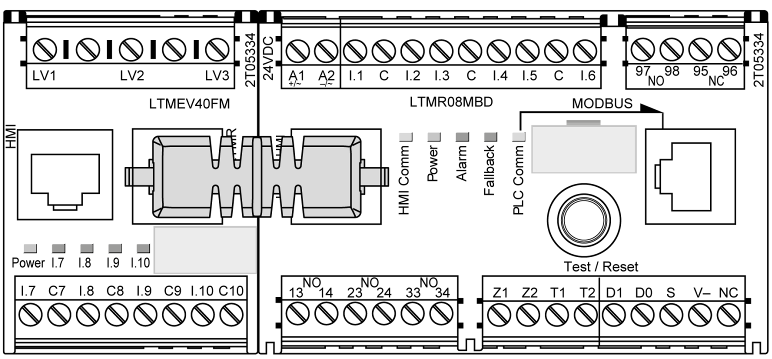
Configurations

The stand-alone physical configurations of the LTM R controller (with and without a connected LTM E expansion module) are depicted below:

The LTM R controller alone



The LTM R controller and LTM E expansion module



LTM R Controller LEDs

Use the 5 LEDs on the face of the LTM R controller to monitor its state, as follows:

LED	Color	Describes	Indicates
HMI Comm	Yellow	Communication activity between LTM R controller and LTM E expansion module	• Flashing yellow = communication • Off = no communication
Power	Green	LTM R controller power or internal fault condition	• Solid green = power-on, no internal faults, and motor off • Flashing green = power-on, no internal faults, and motor on • Off = power-off, or internal faults exist
Alarm/MS	Red	Protection fault or warning, or internal fault condition	• Solid red = internal or protection fault • Flashing red (2 x per s) = warning • Flashing red (5 x per s) = load shed or rapid cycle condition • Off = no faults, warnings, load shed, or rapid cycle (when power is On)
Fallback	Red	Communication connection between LTM R 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
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.			

LTM E Expansion Module LEDs

Use the 5 LEDs on the face of the LTM E expansion module to monitor its operating and communications state, as follows:

LED	Color	Describes	Indicates
Power	Green or red	Module power or internal fault condition	• Solid green = power-on with no internal faults • Solid red = power-on with internal faults • 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
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.			

Test / Reset

Use the Test / Reset button to perform the following LTM R controller's functions:

Function	Description	Procedure
Fault reset	Resets all faults that can be reset. See *Overview, page 165* for more information about resetting faults.	Press the button and release within 3 s.
Self test (See *Self Test with Motor On, page 332*)	Performs a self test if: • No faults 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 LTM R 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 fault	Put the LTM R controller into internal fault condition.	Press and hold the button down for more than 20 s.

Section 7.2
Using the LTM CU Control Operator Unit

What Is in This Section?

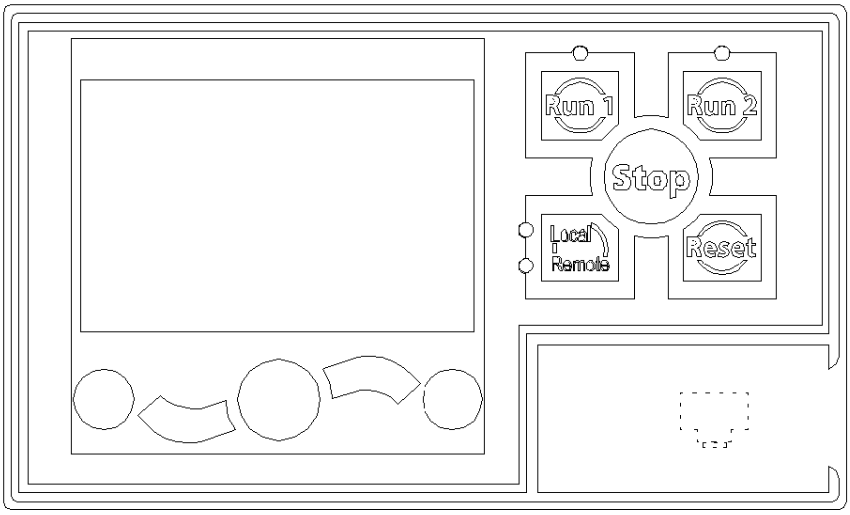
This section contains the following topics:

Presentation of the LTM CU Control Operator Unit

Aim of the Product

The LTM CU Control Operator Unit is a remote operator terminal that enables the configuration, monitoring and control of the LTM R controller, as part of the TeSys T motor management system. The LTM CU has been specially developed to act as the Human Machine Interface (HMI) of the LTM R controller, and is internally powered by the LTM R.

The diagram below shows the LTM CU front face:



LTM CU Functions

The LTM CU can be used to:
- configure parameters for the LTM R controller,
- display information about the LTM R controller configuration and operation,
- monitor detected faults and warnings detected by the controller,
- control the motor locally using the local control interface.

For more Information

See the *TeSys® T LTM CU Control Operator Unit User’s Manual*.

Configuration of the HMI Port

HMI Port

The HMI port is the RJ45 port on the LTM R controller, or on the LTM E expansion module used to connect the LTM R controller to an HMI device, such as a Magelis® XBT or a TeSys® T LTM CU, 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 bits is...
Even	1
None	2

HMI Port Endian Setting

The HMI port endian setting allows to swap the 2 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

HMI port fallback setting *(see page 47)* is used to adjust the fallback mode in case of a loss of communication with the PLC.

Section 7.3
Configuring the Magelis® XBTN410

Overview

The Magelis® XBTN410 HMI can be used to operate up to 8 LTM R controllers, in a 1 HMI to many LTM R 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 *(see page 248)*.

What Is in This Section?

This section contains the following topics:

Installing Magelis® XBT L1000 Programming Software

Overview

The LTM R controller comes with a copy of Magelis® XBT L1000 programming software. You need to:

- install the Magelis XBT L1000 programming software on your PC, and
- use it to transfer a 1-to-many software application to the Magelis XBTN410 HMI.

NOTE: Magelis XBT L1000 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 XBT L1000 programming software, consult its help file and printed documentation.

For instructions on how to download 1-to-many software applications, see *Download 1-to-many Software Application Files, page 251*.

For instructions on how to transfer 1-to-many software applications from your PC to the Magelis XBTN410 HM, see *Transferring Application Software Files to Magelis® XBTN410 HMI, page 252*.

Installation Steps

To install the Magelis XBT L1000 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 on 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 in your name and your company name (or accept the factory settings) and click **Next**.
6	If a screen appears warning 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 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 XBT L1000 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.schneider-electric.com website.

From the schneider-electric website, you can freely obtain the software application file LTM_1T8_(language)_(version).dop.

For instructions on installing the Magelis XBT L1000 programming software, see *Installing Magelis® XBT L1000 Programming Software, page 250*.

For instructions on transferring application files from the Magelis XBT L1000 programming software on your PC to the Magelis XBTN410 HMI, see *Transferring Application Software Files to Magelis® XBTN410 HMI, page 252*.

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, see *Download 1-to-many Software Application Files, page 251*.

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".

Section 7.4
Using the Magelis® XBTN410 HMI (1-to-many)

Overview

This section describes how to use the Magelis® XBTN410 HMI to operate up to 8 LTM R controllers, in a 1 HMI to many LTM R 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 8 LTM R controllers that have previously been commissioned. To commission an individual LTM R controller, use either:

- an LTM CU control operator unit, or
- SoMove with the TeSys T DTM.

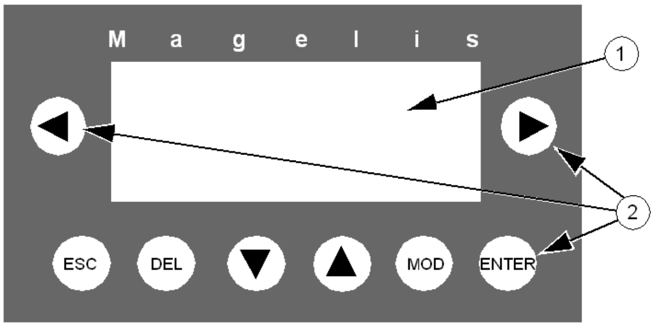
What Is in This Section?

This section contains the following topics:

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 8 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 6 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.

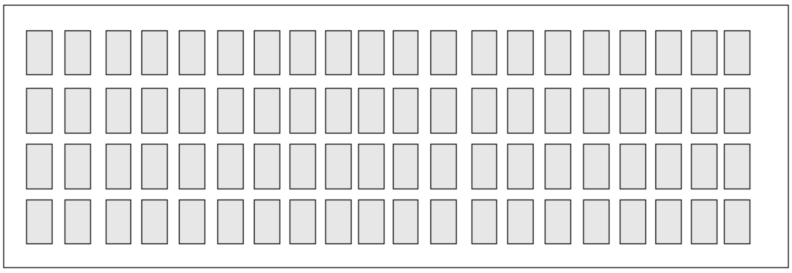
In a 1-to-many configuration, the keypad buttons perform the following functions:

Keys	Use this key to
	• enter the menu structure for a selected LTM R controller at address 1–4 • move to the adjacent left character within a numerical setting value • execute remote reset commands for a selected LTM R controller at address 1–4 • reset statistics to factory settings for a selected LTM R controller • display the description of another fault, when the LCD displays fault messages
	• enter the menu structure for a selected LTM R controller at address 5–8 • move to a lower level in an LTM R 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 LTM R controller at address 5–8 • reset settings to factory settings for a selected LTM R controller • display the description of another fault, when the LCD displays fault 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
MOD	• 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.
ESC	• exit the present level in the HMI menu structure and move up to the next level • exit the selected setting without saving changes.

Keys	Use this key to
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, 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 4 rows of 20 characters, as follows:



In some cases, the LCD displays only 3 text lines, because one line—containing a fault message or page header—is twice the height of normal text.

Pages

The LCD displays pages of text. There are 2 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
Fault message page	● a flashing fault message ● the number of active faults	● automatically when a fault occurs ● by selecting Faults in the Home page

Pages often contain more than 4 lines of text. See *Navigating the Menu Structure (1-to-many), page 258* for instructions on how to navigate within and between pages.

Page examples

The Home page:

The top 4 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 ▶ Faults ▶ Remote Reset ▶ Reset to Defaults ▶

Fault message pages:

The opening fault message page. **Note:** the fault name "THERMAL OVERLOAD" and the LTM R controller address "Controller 1" both flash when displayed.	1/ 2 THERMAL OVERLOAD Controller 1
Click the ▶ button to display additional fault message pages.	2/ 2 GROUND CURRENT Controller 2
Click the ▼ button to scroll down and reveal more of the Ground Current fault message.	Controller 2 CORRECT ORIGIN OF THE GROUND FAULT 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 4 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 LTM R controller.

Navigating the Menu Structure (1-to-many)

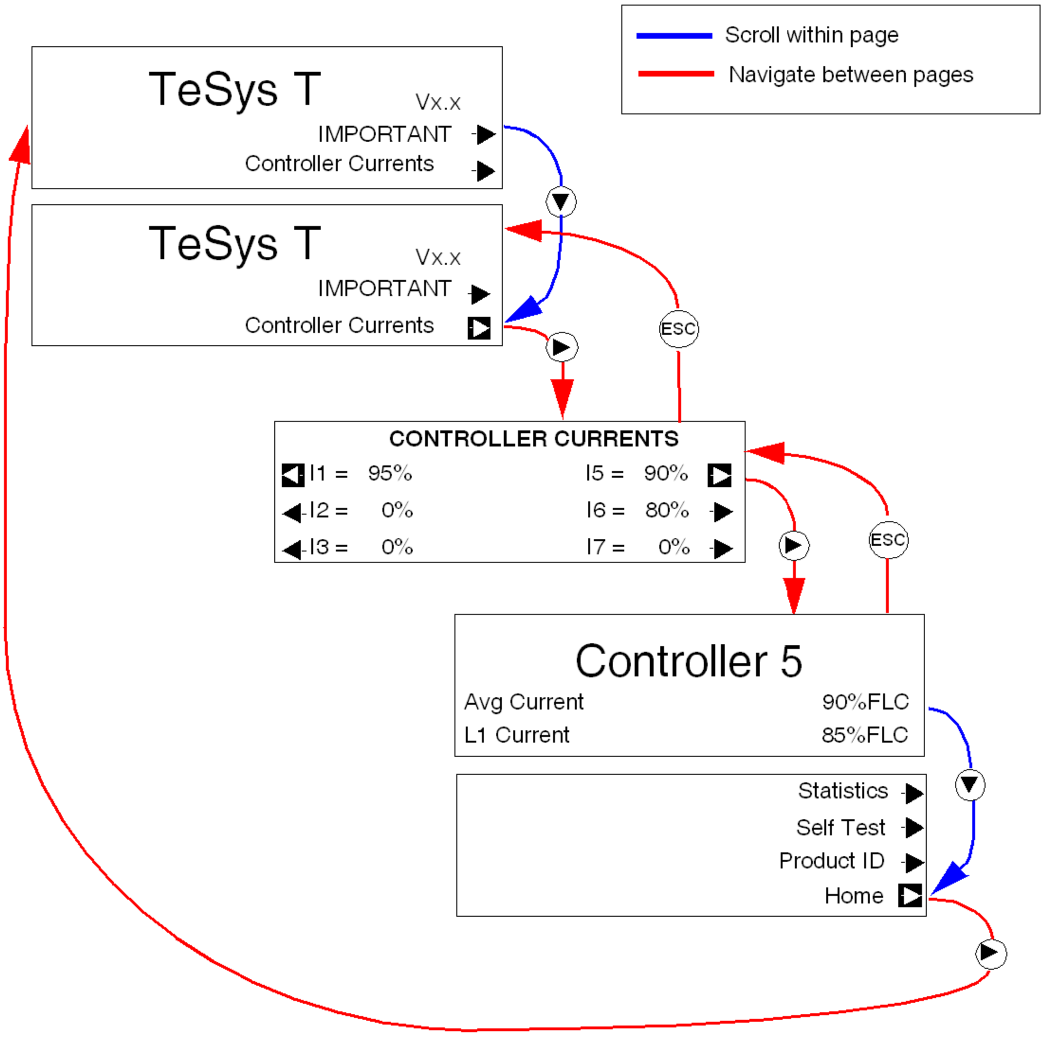
Overview

Use the HMI keypad ▲, ▼, ◀, ▶ and ESC 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

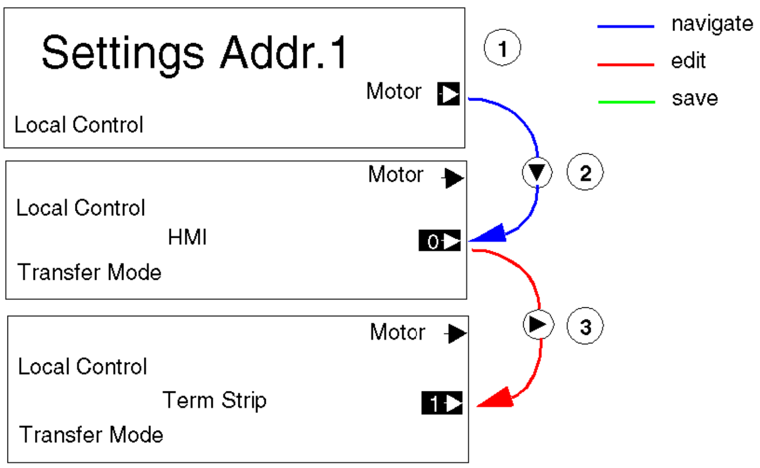
Use the HMI keypad ▲, ▼, ◀, ▶, MOD and ENTER buttons to edit setting values. There are 3 kinds of editable settings:

- 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 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 2 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:

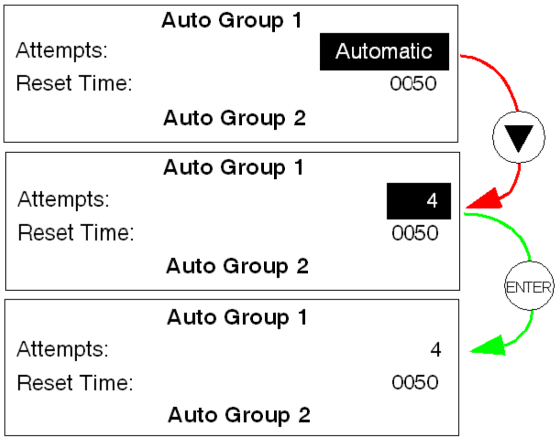
1 The Long Start page opens with no setting selected for editing.
2 Click the MOD button once to select the first displayed numerical field for editing.
3 Click the MOD button a second time to select the next displayed numerical field for editing.

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 below:



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

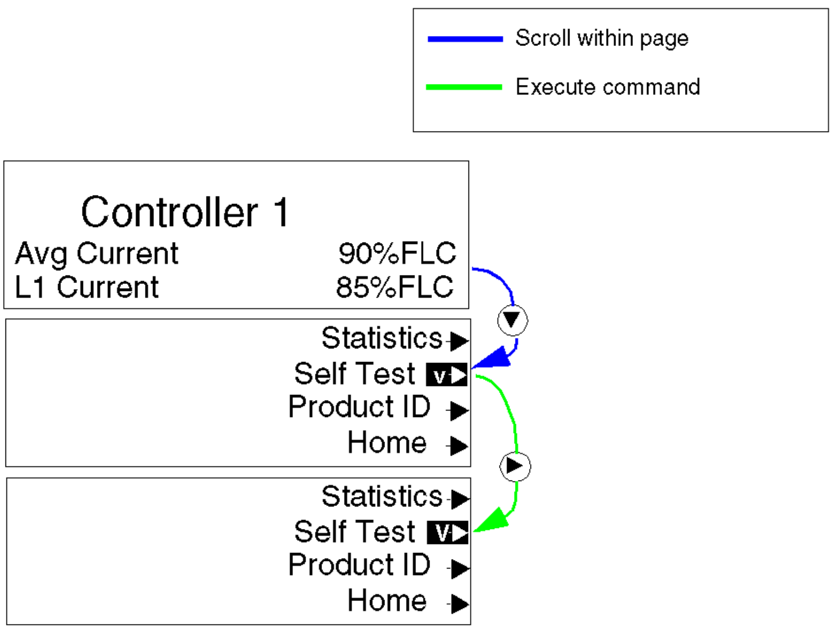
If a value write command is unsuccessful, the HMI displays an error message.

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 faults	Reset page
Reset - Remote	Enables remote resetting of faults	
Reset - Automatic	Enables automatic resetting of faults	

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 below, 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 6 levels of individual pages. The upper menu structure levels provide information and commands for the HMI itself and for all LTM R controllers connected to the HMI. The lower menu structure levels provide settings, statistics and commands for a selected LTM R 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 faults exist.
2	Controller currents page	• Displays average current as a percent of FLC for every LTM R controller. • Provides a link to each LTM R controller's menu structure.
	Controller status page	• Displays operating status (On, Off, Fault) for every LTM R controller. • Provides a link to each LTM R controller's menu structure.
	Fault pages	Displays a series of pages, each page describing an active fault. Opens automatically when a fault exists.
	Remote reset page	Executable commands for the remote reset of each LTM R controller.
	Reset to defaults page	Executable commands to reset statistics or settings for each LTM R controller.
	XBTN reference page	Describes communication settings, application program file, programming software version, and HMI firmware version.
3	Controller page	For a selected LTM R 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 LTM R controller
	Statistics page and sub-pages	Presents statistics for a selected LTM R controller, including fault n-0 and fault n-1 history.
	Product ID page	LTM R controller and LTM E 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 LTM R controllers—all of which are running without faults or warnings.

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 LTM R controller firmware version.
IMPORTANT →	Links to a page with the following CAUTION message: ‘Please 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 LTM R controller.
Controller status →	Links to a page that displays status (On, Off, Fault) and provides links to data and commands for each LTM R controller.
Faults →	Displays a series of fault messages.
Remote Reset →	Links to a page that displays the status of each LTM R controller; and provides a reset command for each LTM R controller.
Reset to defaults →	Links to a page with commands that reset to factory settings each LTM R controller’s statistics or settings.
XBTN Reference →	Links to a page that describes communication speed and parity, programming software and LTM R controller firmware.

Menu Structure - All LTM R Controllers and the HMI (1-to-many)

Overview

Pages located in level 2 of the menu structure contain:

- information and commands for up to 8 connected LTM R controllers, or
- fault information for all LTM R controller, 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 LTM R controllers, and to navigate to other pages as described below:

Level 2	Description
Controller Currents	–
◄ I1=XXXX% I5=XXXX% ►	Opens the Controller page for the selected LTM R 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 Fault status of all connected LTM R controllers, and to navigate to other pages as described below:

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 ►	
Controller currents ►	Opens the Controller Currents page.
Remote reset ►	Opens the Remote Reset page.
Home ►	Returns to the Home page.

Faults Display

The Magelis® XBTN410 HMI displays active faults in a series of pages–1 fault to a page–when:

- a fault occurs, and the display of active faults automatically opens
- you select Faults in the Home page and manually open the display of active faults.

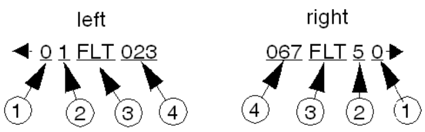
For information about fault management, including the faults display pages, see *Fault Management (1-to-many), page 280*.

Remote Reset Page

Use the Remote Reset page to remotely execute a Fault Reset Command for a faulted LTM R controller–for controllers with Fault Reset Mode set to Remote, and to navigate to other pages:

Level 2		Description
Remote Reset		–
01FLT023	067FLT50	Executes a Fault Reset Command for the selected LTM R controller (1-8) if remote fault 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 4 lines of this page provides the following fault reset information at the indicated locations:



1 fault reset bit (not significant)
2 LTM R controller number (1–8)
3 fault 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 LTM R controller, as displayed below:

Level 2			Description
Reset to defaults			–
Stats	1	Settings	Clears statistics (left arrows) or settings (right arrows) for the selected LTM R 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 LTM R controller that was selected in either the Controller Currents page or the Controller Status page (see *Controller Currents Page, page 265*).

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 LTM R controller
- navigate to editable parameter settings for an LTM R controller
- navigate to read-only statistics and product information for an LTM R controller
- execute the Self Test command for an LTM R 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 LTM R 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 LTM R controller.
Statistics ➔	Links to read-only statistics for the LTM R controller.
Self Test v ➔	Executes the Self Test command. See *Self Test with Motor On, page 332*.
Product ID ➔	Links to product reference numbers and firmware versions for the LTM R 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 (fault)
- 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	LTM R 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
	2step Level	Motor Step 1 to 2 Threshold
	2step Time	Motor Step 1 to 2 Timeout
	Aux Fan	Motor Auxiliary Fan Cooled
	TEMP SENSOR	–
	Fault	Motor Temp Sensor Fault Enable
	Fault Level	Motor Temp Sensor Fault Threshold
	Warn	Motor Temp Sensor Warning Enable
	Warn Level	Motor Temp Sensor Warning Threshold
Local Control		Control Local Channel Setting
Transfer Mode		Control Transfer Mode

Fault Reset Settings

Use the settings page to navigate to and edit the following fault reset settings:

Level 4	Level 5	Parameter name
Settings Addr.1-8		–
Reset	Manual	Fault 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	Fault	Thermal Overload Fault 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 Fault Reset Threshold
		Def O-Time	Thermal Overload Fault Definite Timeout (O-Time)
		Def D-Time	Long Start Fault Timeout (D-Time)
		Warn	Thermal Overload Warning Enable
		Warn Level	Thermal Overload Warning Threshold
	Phase Imb/Loss/Rev	CURR PH IMB	–
		Fault	Current Phase Imbalance Fault Enable
		Fault Level	Current Phase Imbalance Fault Threshold
		FltTimeStrt	Current Phase Imbalance Fault Timeout Starting
		FltTimeRun	Current Phase Imbalance Fault Timeout Running
		Warn	Current Phase Imbalance Warning Enable
		Warn Level	Current Phase Imbalance Warning Threshold
		CURR PH LOSS	–
		Fault	Current Phase Loss Fault Enable
		Fault Time	Current Phase Loss Timeout
		Warn	Current Phase Loss Warning Enable
		CURR PH REV	–
		Fault	Current Phase Reversal Fault Enable
	Long Start	Fault	Long Start Fault Enable
		Fault Level	Long Start Fault Threshold
		Fault Time	Long Start Fault Timeout
	Jam	Fault	Jam Fault Enable
		Fault Level	Jam Fault Threshold
		Fault Time	Jam Fault Timeout
		Warn	Jam Warning Enable
		Warn Level	Jam Warning Threshold

Level 4	Level 5	Level 6	Parameter name
Settings Addr.1-8			**–**
Current (continued)	Under/Over Curr	UNDER CURR	–
		Fault	Undercurrent Fault Enable
		Fault Level	Undercurrent Fault Threshold
		Fault Time	Undercurrent Fault Timeout
		Warn	Undercurrent Warning Enable
		Warn Level	Undercurrent Warning Threshold
		OVER CURR	–
		Fault	Overcurrent Fault Enable
		Fault Level	Overcurrent Fault Threshold
		Fault Time	Overcurrent Fault Timeout
		Warn	Overcurrent Warning Enable
		Warn Level	Overcurrent Warning Threshold
	Ground Current	Fault	Ground Current Mode
		IntFltLvl	Internal Ground Current Fault Threshold
		IntFltTime	Internal Ground Current Fault Timeout
		ExtFltLvl	External Ground Current Fault Threshold
		ExtFltTime	External Ground Current Fault Timeout
		Warn	Ground Current Warning Enable
		IntWarnLvl	Internal Ground Current Warning Threshold
		ExtWarnLvl	External Ground Current Warning 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	–
		Fault	Voltage Phase Imbalance Fault Enable
		Fault Level	Voltage Phase Imbalance Fault Threshold
		FltTimeStart	Voltage Phase Imbalance Fault Timeout Starting
		FltTimeRun	Voltage Phase Imbalance Fault Timeout Running
		Warn	Voltage Phase Imbalance Warning Enable
		Warn Level	Voltage Phase Imbalance Warning Threshold
		VOLT PH LOSS	–
		Fault	Voltage Phase Loss Fault Enable
		Fault Time	Voltage Phase Loss Fault Timeout
		Warn	Voltage Phase Loss Warning Enable
		VOLT PH REV	–
		Fault	Voltage Phase Reversal Fault Enable
	Under/Over Voltage	UNDER VOLT	–
		Fault	Undervoltage Fault Enable
		Fault Level	Undervoltage Fault Threshold
		Fault Time	Undervoltage Fault Timeout
		Warn	Undervoltage Warning Enable
		Warn Level	Undervoltage Warning Threshold
		OVER VOLT	–
		Fault	Overvoltage Fault Enable
		Fault Level	Overvoltage Fault Threshold
		Fault Time	Overvoltage Fault Timeout
		Warn	Overvoltage Warning Enable
		Warn Level	Overvoltage Warning 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	–
		Fault	Underpower Fault Enable
		Fault Level	Underpower Fault Threshold
		Fault Time	Underpower Fault Timeout Starting
		Warn	Underpower Warning Enable
		Warn Level	Underpower Warning Threshold
		OVER POWER	–
		Fault	Overpower Fault Enable
		Fault Level	Overpower Fault Threshold
		Fault Time	Overpower Fault Timeout
		Warn	Overpower Warning Enable
		Warn Level	Overpower Fault Enable
	Under/Over PowFact	UNDER POW FACTOR	–
		Fault	Under Power Factor Fault Enable
		Fault Level	Under Power Factor Fault Threshold
		Fault Time	Under Power Factor Fault Timeout
		Warn	Under Power Factor Warning Enable
		Warn Level	Under Power Factor Warning Threshold
		OVER POW FACTOR	–
		Fault	Over Power Factor Fault Enable
		Fault Level	Over Power Factor Fault Threshold
		Fault Time	Over Power Factor Fault Timeout
		Warn	Over Power Factor Warning Enable
		Warn Level	Over Power Factor Warning 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	Fault	Load Shedding
	Fault Level	Voltage Dip Threshold
	Fault Time	Load Shedding Timeout
	RestartLvl	Voltage Dip Restart Threshold
	RestartTime	Voltage Dip Restart Timeout
Diagnostic	DIAG FAULT	
	Fault	Diagnostic Fault Enable
	Warn	Diagnostic Warning Enable
	WIRING CT REVERSAL	
	Fault	Wiring fault 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	–
	Fault	Network Port Fault Enable
	Fault Time	Network Port Comm Loss Timeout
	Warn	Network Port Warning Enable
	HMI PORT COMM LOSS	–
	Fault	HMI Port Fault Enable
	Warn	HMI Port Warning 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 LTM R 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	LTM R 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 Faults		Faults Count
Th Ovld Flt		Thermal Overload Faults Count
Th Ovld Warn		Thermal Overload Warnings Count
Curr Imb Flt		Current Phase Imbalance Faults Count
LongStart Flt		Long Start Faults Count
UnderCurr Flt		Undercurrent Faults Count
Ground Faults		Ground Current Faults Count
VoltPhImb Flt		Voltage Phase Imbalance Faults Count
Under Volt Flt		Undervoltage Faults Count
Over Volt Flt		Overvoltage Faults Count
HMI Loss Flt		HMI Port Faults Count
Ntwk Int Flt		Network Port Internal Faults Count
Ntwk Cnfg Flt		Network Port Config Faults Count
Ntwk Port Flt		Network Port Faults Count
Cntrl Int Flt		Controller Internal Faults Count
InterPort Flt		Internal Port Faults Count

Level 4	Level 5	Parameter name
Statistics Addr. 1-8		**–**
Fault n-0	Fault Code	Fault 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
Fault n-1	Fault Code	Fault 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 LTM R controller and LTM E 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	LTM R controller number
3	Controller page	Product ID

Product ID

In the Product ID page, you can read the following information about the LTM R controller and LTM E 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 LTM R controllers, or
- current, voltage and power parameters for a selected LTM R controller.

Monitoring Multiple LTM R Controllers

Navigate to the following pages to simultaneously monitor these dynamically changing values for all LTM R controllers:

Page	Value
Controller currents page	Average current ratio
Controller status page	Operating status (On, Off, Fault)

For more information on both pages, see *Controller Currents Page, page 265*.

Monitoring a Single LTM R Controller

Navigate to the Controller page for a selected LTM R 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, see *Controller Page (1-to-many), page 268*.

Fault Management (1-to-many)

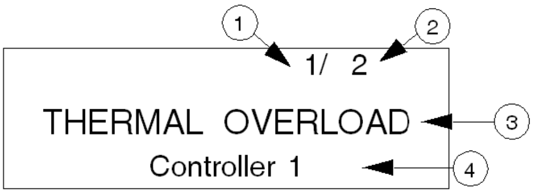
Overview

When a fault occurs, the Magelis® XBTN410 HMI automatically opens a fault display, consisting of 1 page for each active fault. Each page contains the:

- fault name
- address of the LTM R controller experiencing the fault
- total number of unresolved faults

Fault Display Pages

A typical fault display page looks like this:



1 fault display page number
2 total number of active faults
3 fault name (flashing)
4 address of LTM R controller experiencing the fault (flashing)

If more than 1 fault is active, use the and keypad buttons to move back and forth through the fault display pages.

Because some fault messages contain more than 4 lines of text, you may need to use the and keypad buttons to scroll up and down within a fault display page and display the entire fault message.

Opening / Closing the Fault Display

The 1-to-many HMI automatically opens the fault display whenever a fault occurs. When you remove the cause of a specific fault and execute a fault reset command, that fault no longer appears in the fault display.

You can also close the fault display by clicking the ESC keypad button. This does not fix the underlying cause of any fault, nor it does not clear any fault. You can re-open the fault display at any time by navigating to the Home page, scrolling to the Faults command line, then clicking the keypad button.

If you open the fault display when no faults are active, the HMI displays the message "**No Faults 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 LTM R 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 LTM R controller and LTM E expansion module.	Level 3, Controller page. See *Controller Page, page 268* and *Self Test with Motor On, page 332*.
Reset to Defaults: Statistics	Executes the Clear Statistics Command for a selected LTM R controller.	Level 2, Reset to Defaults page. See *Reset to Defaults Page, page 266*.
Reset to Defaults: Settings	Executes the Clear Controller Settings Command for a selected LTM R controller.	Level 2, Reset to Defaults page. See *Reset to Defaults Page, page 266*.
Remote Reset	Performs remote fault reset for a selected LTM R controller	Level 2, Remote Reset page. See *Remote Reset Page, page 266*.

Section 7.5
Using SoMove with the TeSys T DTM

Overview

The following topics show you how to use the LTM R controller when it is connected to a PC running SoMove with the TeSys T DTM.

What Is in This Section?

This section contains the following topics:

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 LTM R controller, as part of the TeSys T motor management system.

Functions

The TeSys T DTM can be used to:
- configure parameters for the LTM R controller,
- display information about the LTM R controller configuration and operation,
- display the status of detected faults and warnings in the LTM R controller,
- control the motor,
- customize operating modes.

For More Information

See 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.schneider-electric.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**.
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.

Section 7.6
Using the Modbus Communication Network

Overview

This section describes how to use the LTM R controller via the network port using the Modbus protocol.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of anticipated transmission delays or failures of the link.(1)
- Each implementation of an LTM R controller must be individually and thoroughly tested for proper operation before being placed into service.

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

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

⚠ WARNING

UNEXPECTED RESTART OF THE MOTOR

Check that the PLC application software:

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

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

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

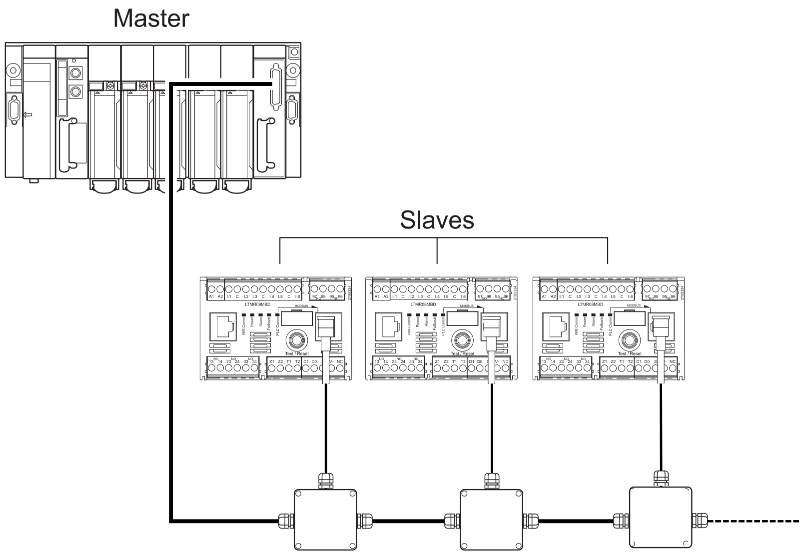
What Is in This Section?

This section contains the following topics:

Modbus® Protocol Principle

Overview

The Modbus protocol is a master-slave protocol:



Only 1 device can transmit on the line at any time.

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

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

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

Modbus Dialog

2 types of dialog are possible between master and slaves:
- The master sends a request to a slave and waits for its response.
- The master broadcasts a request to all slaves without waiting for a response.

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

Transparent Ready

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

Configuration of the LTM R Modbus Network Port

Communication Parameters

Before any communication can start, use the TeSys T DTM or the HMI to configure the Modbus port communication parameters:
- Network port address setting
- Network port baud rate setting
- Network port parity setting
- Network port comm loss timeout
- Network port endian setting

Network Port Address Setting

The device address can be set between 1 and 247.

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

Network Port Baud Rate Setting

Possible transmission rates are:
- 1200 Baud
- 2400 Baud
- 4800 Baud
- 9600 Baud
- 19,200 Baud
- Autodetection

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

Network Port Parity Setting

The parity can be selected from:
- Even
- Odd
- None

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

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

Parity and stop bit behavior is linked:

If the parity is...	Then the number of stop bits is...
even or odd	1
none	2

Network Port Comm Loss Timeout

Network port comm loss timeout is used to determine the timeout value after a loss of communication with the PLC.
- Range: 1-9,999

Network Port Fallback Setting

Network port fallback setting *(see page 47)* is used to adjust the fallback mode in case of a loss of communication with the PLC.

Network Port Endian Setting

The Network port endian setting allows to swap the 2 words in a double word.
- 0 = least significant word first (little endian)
- 1 = most significant word first (big endian, factory setting)

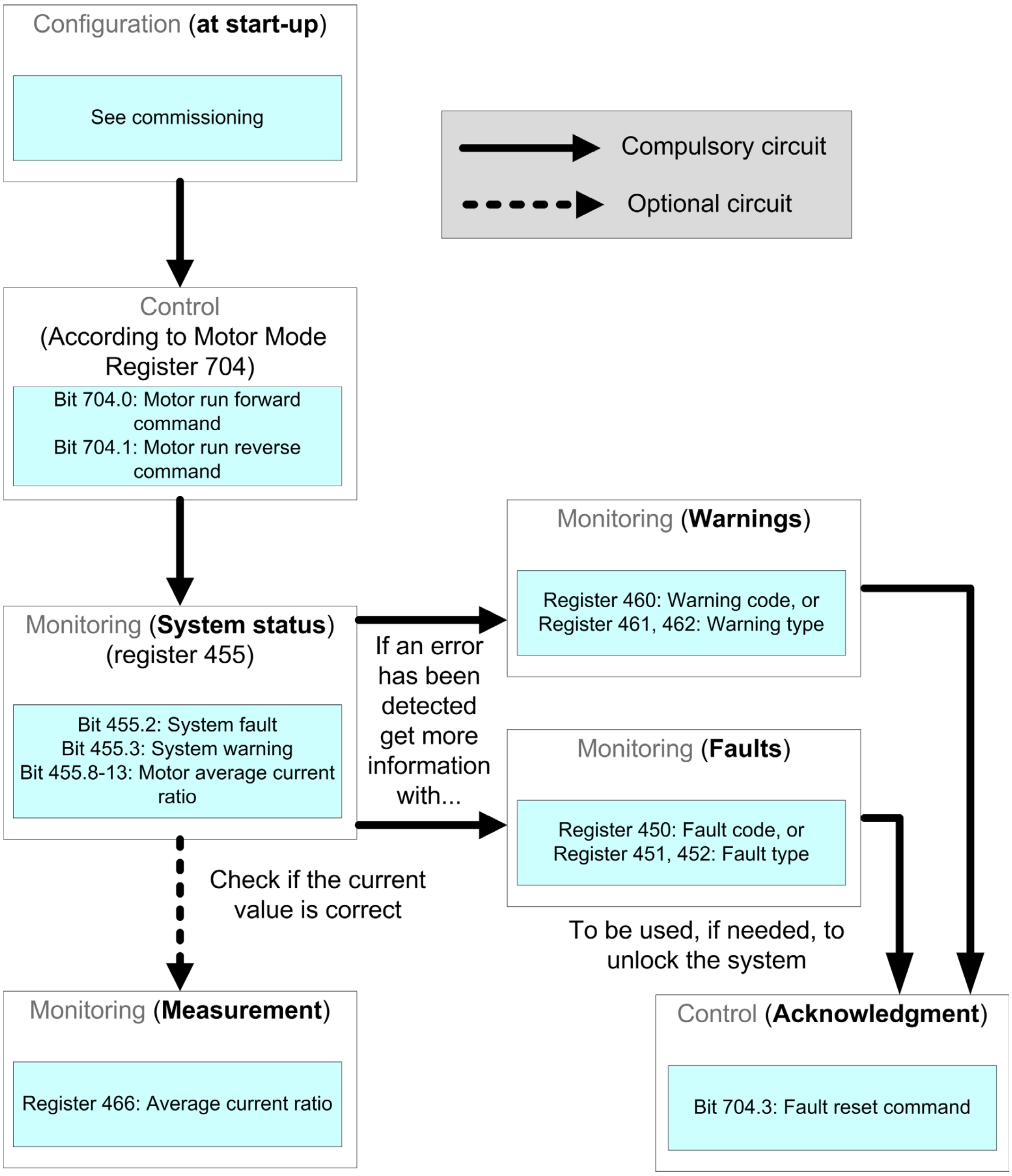
Simplified Control and Monitoring

Overview

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

Modbus Registers for Simplified Operation

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



Modbus® Request and Programming Examples

Modbus Request

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

Code value		Function name	Broadcasting	Modbus standard name
Hexadecimal	Decimal			
0x03	3	Read N output words (multiple registers)	No	Read Holding Register
0x06	6	Write 1 output word (single register)	Yes	Preset Single Register
0x10	16	Write N output words (multiple registers)	Yes	Preset Multiple Registers
0x2B	43	Read identification (identification register)	No	Read Device Identification

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Use of this device on a Modbus network that uses the broadcast function should be considered with caution.

This device has a large number of registers that must not be modified during normal operation. Unintended writing of these registers by the broadcast function may cause unexpected and unwanted product operation.

For more information, refer to the Communication variables list.

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

Example of a Read Operation (Modbus Request Code 3)

The example below describes a READ_VAR request, within a TSX Micro or Premium platform, in order to read the LTM R states at address 4 (slave n° 4) contained in internal word MW0:

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

1 2 3 4 5 6

1 Address of the device with which you wish to communicate: 3 (device address), 0 (channel), 4 (device address on the bus)
2 Type of PL7 objects to be read: MW (internal word)
3 Address of the first register to be read: 455
4 Number of consecutive registers to be read: 1
5 Word table containing the value of the objects read: MW0:1
6 Read report: MW100:4

Example of a Write Operation (Modbus Request Code 16)

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

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

1. Address of the device with which you wish to communicate: 3 (device address), 0 (channel), 4 (device address on the bus)
2. Type of PL7 objects to be written: MW (internal word)
3. Address of the first register to be written: 704
4. Number of consecutive registers to be written: 1
5. Word table containing the value of the objects to be sent: MW502:1
6. Write report: MW200:4

Modbus Exception Management

Overview

The LTM R controller generally follows the Modbus requirements for the Exception Management.

3 special cases apply to the LTM R controller:

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

Bit-Field Registers

Some registers in the Register Map are bit-field. Based on the LTM R controller state, some bits in those registers shall not be writable. In this case, the LTM R controller shall reject the write to those bits meaning that no exception shall be returned. For example, bits that can be written only in configuration mode will be ignored (no exception returned) if the LTM R controller is out of the Sys Config State. The write to the bits not constrained by the LTM R controller state shall however occur.

Exception Code 02 - Illegal Data Address

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

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

Exception Code 03 - Illegal Data Value

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

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

User Map Variables (User Defined Indirect Registers)

Overview

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

You can define several read and write areas.

The user map can be defined via:
- a PC running SoMove with TeSys T DTM
- a PLC via the network port

User Map Variables

User Map variables are divided into 2 groups:

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

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

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

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

Example of Use

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

User Map Address Register	Value Configured	Register
800	452	Fault register 1
801	453	Fault register 2
802	461	Warning register 1
803	462	Warning register 2
804	450	Minimum wait time
805	500	Average current (0.01 A) MSW
806	501	Average current (0.01 A) LSW
850	651	HMI display items register 1
851	654	HMI display items register 2
852	705	Control register 2

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

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

Register Map (Organization of Communication Variables)

Introduction

Communication variables are listed in tables, according to the group (such as identification, statistics, or monitoring) to which they belong. They are associated with an LTM R controller, which may or may not have an LTM E Expansion Module attached.

Communication Variable Groups

Communication variables are grouped according to the following criteria:

Variable groups	Registers
Identification variables	00 to 99
Statistics variables	100 to 449
Monitoring variables	450 to 539
Configuration variables	540 to 699
Command variables	700 to 799
User Map variables	800 to 999
Custom Logic variables	1200 to 1399

Table Structure

Communication variables are listed in 4-column tables:

Column 1 Register (in decimal format)	Column 2 Variable type (see *Data Types, page 296*)	Column 3 Variable name and access via Read-only or Read/Write Modbus requests	Column 4 Note: code for additional information

Note

The Note column gives a code for additional information.

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

The code can be:
- numerical (1 to 9), for specific hardware combinations
- alphabetical (A to Z), for specific system behaviors.

If the note is...	Then the variable is...
1	available for the LTM R + LTM EV40 combination
2	always available but with a value equal to 0 if no LTM EV40 is connected
3 - 9	Not used

If the note is...	Then...
A	the variable can be written only when the motor is off(1)
B	the variable can be written only in configuration mode (e.g. static characteristics)(1)
C	the variable can be written only with no fault(1)
D - Z	Not used
(1) Restrictions A, B and C may apply only to bits, not to whole registers. If you try to write a value when a restriction is applied, the bit will not be changed and no exception code will be returned. Exception codes are returned at register level, not at bit level.	

Unused Addresses

Unused addresses fall into 3 categories:
- **Not significant**, in Read-only tables, means that you should ignore the value read, whether equal to 0 or not.
- **Reserved**, in Read/Write tables, means that you must write 0 in these variables.
- **Forbidden**, means that read or write requests are rejected, that these addresses are not accessible at all.

Data Formats

Overview

The data format of a communication variable can be integer, Word, or Word[n], as described below. For more information about a variable size and format, see *Data Types, page 296*.

Integer (Int, UInt, DInt, IDInt)

Integers fall into the following categories:
- **Int**: signed integer using one register (16 bits)
- **UInt**: unsigned integer using one register (16 bits)
- **DInt**: signed double integer using 2 registers (32 bits)
- **UDInt**: unsigned double integer using 2 registers (32 bits)

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

Example:

Address 474, **UInt**, Frequency (x 0.01 Hz).

Word

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

Example:

Address 455, **Word**, System Status Register 1.

bit 0	System ready
bit 1	System on
bit 2	System fault
bit 3	System warning
bit 4	System tripped
bit 5	Fault reset authorized
bit 6	*(Not significant)*
bit 7	Motor running
bits 8-13	Motor average current ratio
bit 14	Control via HMI
bit 15	Motor starting (in progress)

Word[n]

Word[n]: Data encoded on contiguous registers.

Examples:

Addresses 64 to 69, **Word[6]**, Controller Commercial Reference (DT_CommercialReference *(see page 296)*).

Addresses 655 to 658, **Word[4]**, (DT_DateTime *(see page 297)*).

Data Types

Overview

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

List of Data Types

Here is the list of the most commonly used data types:
- DT_ACInputSetting
- DT_CommercialReference
- DT_DateTime
- DT_ExtBaudRate
- DT_ExtParity
- DT_FaultCode
- DT_FirmwareVersion
- DT_Language5
- DT_OutputFallbackStrategy
- DT_PhaseNumber
- DT_ResetMode
- DT_WarningCode

These data types are described below.

DT_ACInputSetting

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

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

DT_CommercialReference

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

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

Example:

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

If Controller Commercial Reference = LTM R:

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

DT_DateTime

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

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

Where:
- S = second
  The format is 2 BCD digits.
  The value range is [00-59] in BCD.
- 0 = unused
- H = hour
  The format is 2 BCD digits.
  The value range is [00-23] in BCD.
- m = minute
  The format is 2 BCD digits.
  The value range is [00-59] in BCD.
- M = month
  The format is 2 BCD digits.
  The value range is [01-12] in BCD.
- D = day
  The format is 2 BCD digits.
  The value range is (in BCD):
  [01-31] for months 01, 03, 05, 07, 08, 10, 12
  [01-30] for months 04, 06, 09, 11
  [01-29] for month 02 in a leap year
  [01-28] for month 02 in a non-leap year.
- Y = year
  The format is 4 Binary Coded Decimal (BCD) digits.
  The value range is [2006-2099] in BCD.

Data entry format and value range are:

Data entry format	DT#YYYY-MM-DD-HH:mm:ss	
Minimum value	DT#2006-01-01:00:00:00	January 1, 2006
Maximum value	DT#2099-12-31-23:59:59	December 31, 2099
Note: If you give values outside the limits, the system will return an error.		

Example:

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

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

Register	15 12	11 8	7 4	3 0
655	3	2	0	0
656	0	7	5	0
657	0	9	0	4
658	2	0	0	8

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

DT_ExtBaudRate

DT_ExtbaudRate depends on the bus used:

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

Value	Description
1200	1200 Baud
2400	2400 Baud
4800	4800 Baud
9600	9600 Baud
19200	19,200 Baud
65535	Autodetection (factory setting)

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

Value	Description
65535	Autobaud (factory setting)

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

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

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

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

DT_ExtParity

DT_ExtParity depends on the bus used:

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

Value	Description
0	None
1	Even
2	Odd

DT_FaultCode

DT_FaultCode format is an **enumeration** of fault codes:

Fault code	Description
0	No error
3	Ground current
4	Thermal overload
5	Long start
6	Jam
7	Current phase imbalance
8	Undercurrent
10	Test
11	HMI port error
12	HMI port communication loss
13	Network port internal error
16	External fault
18	On-Off diagnostic
19	Wiring diagnostic
20	Overcurrent
21	Current phase loss
22	Current phase reversal
23	Motor temp sensor
24	Voltage phase imbalance
25	Voltage phase loss
26	Voltage phase reversal
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTME configuration
34	Temperature sensor short-circuit
35	Temperature sensor open-circuit
36	CT reversal
37	Out of boundary CT ratio
46	Start check
47	Run checkback
48	Stop check
49	Stop checkback
51	Controller internal temperature error
55	Controller internal error (Stack overflow)
56	Controller internal error (RAM error)
57	Controller internal error (RAM checksum error)
58	Controller internal error (Hardware watchdog fault)
60	L2 current detected in single-phase mode
64	Non volatile memory error
65	Expansion module communication error
66	Stuck reset button
67	Logic function error

Fault code	Description
100-104	Network port internal error
109	Network port comm error
111	Faulty device replacement fault
555	Network port configuration error

DT_FirmwareVersion

DT_FirmwareVersion format is an **XY000 array** that describes a firmware revision:
- X = major revision
- Y = minor revision.

Example:

Address 76, **UInt**, Controller firmware version.

DT_Language5

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

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

Example:

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

DT_OutputFallbackStrategy

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

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

DT_PhaseNumber

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

Value	Description
1	1 phase
2	3 phases

DT_ResetMode

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

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

DT_WarningCode

DT_WarningCode format is an **enumeration** of warning codes:

Warning code	Description
0	No warning
3	Ground current
4	Thermal overload
5	Long start
6	Jam
7	Current phase imbalance
8	Undercurrent
10	HMI port
11	LTM R internal temperature
18	Diagnostic
19	Wiring
20	Overcurrent
21	Current phase loss
23	Motor temp sensor
24	Voltage phase imbalance
25	Voltage phase loss
27	Undervoltage
28	Overvoltage
29	Underpower
30	Overpower
31	Under power factor
32	Over power factor
33	LTM E configuration
46	Start check
47	Run checkback
48	Stop check
49	Stop checkback
109	Network port comm loss
555	Network port configuration

Identification Variables

Identification Variables

Identification variables are described below:

Register	Variable type	Read-only variables	*Note, page 294*
0-34		*(Not significant)*	
35-40	Word[6]	Expansion commercial reference (See *DT_CommercialReference, page 296*)	1
41-45	Word[5]	Expansion serial number	1
46	UInt	Expansion ID code	
47	UInt	Expansion firmware version (See *DT_FirmwareVersion, page 300*)	1
48	UInt	Expansion compatibility code	1
49-60		*(Not significant)*	
61	UInt	Network port ID code	
62	UInt	Network port firmware version (See *DT_FirmwareVersion, page 300*)	
63	UInt	Network port compatibility code	
64-69	Word[6]	Controller commercial reference (See *DT_CommercialReference, page 296*)	
70-74	Word[5]	Controller serial number	
75	UInt	Controller ID code	
76	UInt	Controller firmware version (See *DT_FirmwareVersion, page 300*)	
77	UInt	Controller compatibility code	
78	UInt	Current scale ratio (0.1 %)	
79	UInt	Current sensor max	
80		*(Not significant)*	
81	UInt	Current range max (x 0.1 A)	
82-94		*(Not significant)*	
95	UInt	Load CT ratio (x 0.1 A)	
96	UInt	Full load current max (maximum FLC range, *FLC = Full Load Current*) (x 0.1 A)	
97-99		*(Forbidden)*	

Statistics Variables

Statistics Overview

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

Statistics variable groups	Registers
Global statistics	100 to 121
LTM monitoring statistics	122 to 149
Last trip statistics and extension	150 to 179 300 to 309
Trip n-1 statistics and extension	180 to 209 330 to 339
Trip n-2 statistics and extension	210 to 239 360 to 369
Trip n-3 statistics and extension	240 to 269 390 to 399
Trip n-4 statistics and extension	270 to 299 420 to 429

Global Statistics

The global statistics are described below:

Register	Variable type	Read-only variables	*Note, page 294*
100-101		*(Not significant)*	
102	UInt	Ground current faults count	
103	UInt	Thermal overload faults count	
104	UInt	Long start faults count	
105	UInt	Jam faults count	
106	UInt	Current phase imbalance faults count	
107	UInt	Undercurrent faults count	
109	UInt	HMI port faults count	
110	UInt	Controller internal faults count	
111	UInt	Internal port faults count	
112	UInt	*(Not significant)*	
113	UInt	Network port config faults count	
114	UInt	Network port faults count	
115	UInt	Auto-resets count	
116	UInt	Thermal overload warnings count	
117-118	UDInt	Motor starts count	
119-120	UDInt	Operating time (s)	
121	Int	Controller internal temperature max (° C)	

LTM Monitoring Statistics

The LTM monitoring statistics are described below:

Register	Variable type	Read-only variables	*Note, page 294*
122	UInt	Faults count	
123	UInt	Warnings count	
124-125	UDInt	Motor LO1 closings count	
126-127	UDInt	Motor LO2 closings count	
128	UInt	Diagnostic faults count	
129	UInt	*(Reserved)*	
130	UInt	Overcurrent faults count	
131	UInt	Current phase loss faults count	
132	UInt	Motor temperature sensor faults count	
133	UInt	Voltage phase imbalance faults count	1
134	UInt	Voltage phase loss faults count	1
135	UInt	Wiring faults count	1
136	UInt	Undervoltage faults count	1
137	UInt	Overvoltage faults count	1
138	UInt	Underpower faults count	1
139	UInt	Overpower faults count	1
140	UInt	Under power factor faults count	1
141	UInt	Over power factor faults count	1
142	UInt	Load sheddings count	1
143-144	UDInt	Active power consumption (x 0.1 kWh)	1
145-146	UDInt	Reactive power consumption (x 0.1 kVARh)	1
147	UInt	Auto restart immediate count	
148	UInt	Auto restart delayed count	
149	UInt	Auto restart manual count	

Last Fault (n-0) Statistics

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

Register	Variable type	Read-only variables	*Note, page 294*
150	UInt	Fault code n-0	
151	UInt	Motor full load current ratio n-0 (% FLC max)	
152	UInt	Thermal capacity level n-0 (% trip level)	
153	UInt	Average current ratio n-0 (% FLC)	
154	UInt	L1 current ratio n-0 (% FLC)	
155	UInt	L2 current ratio n-0 (% FLC)	
156	UInt	L3 current ratio n-0 (% FLC)	
157	UInt	Ground current ratio n-0 (x 0.1 % FLC min)	
158	UInt	Full load current max n-0 (x 0.1 A)	
159	UInt	Current phase imbalance n-0 (%)	
160	UInt	Frequency n-0 (x 0.1 Hz)	2
161	UInt	Motor temperature sensor n-0 (x 0.1 Ω)	
162-165	Word[4]	Date and time n-0 (See *DT_DateTime, page 297*)	
166	UInt	Average voltage n-0 (V)	1
167	UInt	L3-L1 voltage n-0 (V)	1

Register	Variable type	Read-only variables	*Note, page 294*
168	UInt	L1-L2 voltage n-0 (V)	1
169	UInt	L2-L3 voltage n-0 (V)	1
170	UInt	Voltage phase imbalance n-0 (%)	1
171	UInt	Active power n-0 (x 0.1 kW)	1
172	UInt	Power factor n-0 (x 0.01)	1
173-179		*(Not significant)*	

N-1 Fault Statistics

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

Register	Variable type	Read-only variables	*Note, page 294*
180	UInt	Fault code n-1	
181	UInt	Motor full load current ratio n-1 (% FLC max)	
182	UInt	Thermal capacity level n-1 (% trip level)	
183	UInt	Average current ratio n-1 (% FLC)	
184	UInt	L1 current ratio n-1 (% FLC)	
185	UInt	L2 current ratio n-1 (% FLC)	
186	UInt	L3 current ratio n-1 (% FLC)	
187	UInt	Ground current ratio n-1 (x 0.1 % FLC min)	
188	UInt	Full load current max n-1 (x 0.1 A)	
189	UInt	Current phase imbalance n-1 (%)	
190	UInt	Frequency n-1 (x 0.1 Hz)	2
191	UInt	Motor temperature sensor n-1 (x 0.1 Ω)	
192-195	Word[4]	Date and time n-1 (See *DT_DateTime, page 297*)	
196	UInt	Average voltage n-1 (V)	1
197	UInt	L3-L1 voltage n-1 (V)	1
198	UInt	L1-L2 voltage n-1 (V)	1
199	UInt	L2-L3 voltage n-1 (V)	1
200	UInt	Voltage phase imbalance n-1 (%)	1
201	UInt	Active power n-1 (x 0.1 kW)	1
202	UInt	Power factor n-1 (x 0.01)	1
203-209	UInt	*(Not significant)*	

N-2 Fault Statistics

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

Register	Variable type	Read-only variables	*Note, page 294*
210	UInt	Fault code n-2	
211	UInt	Motor full load current ratio n-2 (% FLC max)	
212	UInt	Thermal capacity level n-2 (% trip level)	
213	UInt	Average current ratio n-2 (% FLC)	
214	UInt	L1 current ratio n-2 (% FLC)	
215	UInt	L2 current ratio n-2 (% FLC)	
216	UInt	L3 current ratio n-2 (% FLC)	
217	UInt	Ground current ratio n-2 (x 0.1 % FLC min)	
218	UInt	Full load current max n-2 (x 0.1 A)	
219	UInt	Current phase imbalance n-2 (%)	
220	UInt	Frequency n-2 (x 0.1 Hz)	2
221	UInt	Motor temperature sensor n-2 (x 0.1 Ω)	
222-225	Word[4]	Date and time n-2 (See *DT_DateTime, page 297*)	
226	UInt	Average voltage n-2 (V)	1
227	UInt	L3-L1 voltage n-2 (V)	1
228	UInt	L1-L2 voltage n-2 (V)	1
229	UInt	L2-L3 voltage n-2 (V)	1
230	UInt	Voltage phase imbalance n-2 (%)	1
231	UInt	Active power n-2 (x 0.1 kW)	1
232	UInt	Power factor n-2 (x 0.01)	1
233-239		*(Not significant)*	

N-3 Fault Statistics

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

Register	Variable type	Read-only variables	*Note, page 294*
240	UInt	Fault code n-3	
241	UInt	Motor full load current ratio n-3 (% FLC max)	
242	UInt	Thermal capacity level n-3 (% trip level)	
243	UInt	Average current ratio n-3 (% FLC)	
244	UInt	L1 current ratio n-3 (% FLC)	
245	UInt	L2 current ratio n-3 (% FLC)	
246	UInt	L3 current ratio n-3 (% FLC)	
247	UInt	Ground current ratio n-3 (x 0.1 % FLC min)	
248	UInt	Full load current max n-3 (0.1 A)	
249	UInt	Current phase imbalance n-3 (%)	
250	UInt	Frequency n-3 (x 0.1 Hz)	2
251	UInt	Motor temperature sensor n-3 (x 0.1 Ω)	
252-255	Word[4]	Date and time n-3 (See *DT_DateTime, page 297*)	
256	UInt	Average voltage n-3 (V)	1
257	UInt	L3-L1 voltage n-3 (V)	1
258	UInt	L1-L2 voltage n-3 (V)	1
259	UInt	L2-L3 voltage n-3 (V)	1

Register	Variable type	Read-only variables	*Note, page 294*
260	UInt	Voltage phase imbalance n-3 (%)	1
261	UInt	Active power n-3 (x 0.1 kW)	1
262	UInt	Power factor n-3 (x 0.01)	1
263-269		*(Not significant)*	

N-4 Fault Statistics

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

Register	Variable type	Read-only variables	*Note, page 294*
270	UInt	Fault code n-4	
271	UInt	Motor full load current ratio n-4 (% FLC max)	
272	UInt	Thermal capacity level n-4 (% trip level)	
273	UInt	Average current ratio n-4 (% FLC)	
274	UInt	L1 current ratio n-4 (% FLC)	
275	UInt	L2 current ratio n-4 (% FLC)	
276	UInt	L3 current ratio n-4 (% FLC)	
277	UInt	Ground current ratio n-4 (x 0.1 % FLC min)	
278	UInt	Full load current max n-4 (x 0.1 A)	
279	UInt	Current phase imbalance n-4 (%)	
280	UInt	Frequency n-4 (x 0.1 Hz)	2
281	UInt	Motor temperature sensor n-4 (x 0.1 Ω)	
282-285	Word[4]	Date and time n-4 (See *DT_DateTime, page 297*)	
286	UInt	Average voltage n-4 (V)	1
287	UInt	L3-L1 voltage n-4 (V)	1
288	UInt	L1-L2 voltage n-4 (V)	1
289	UInt	L2-L3 voltage n-4 (V)	1
290	UInt	Voltage phase imbalance n-4 (%)	1
291	UInt	Active power n-4 (x 0.1 kW)	1
292	UInt	Power factor n-4 (x 0.01)	1
293-299		*(Not significant)*	

Last Fault (n-0) Statistics Extension

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

Register	Variable type	Read-only variables	*Note, page 294*
300-301	UDInt	Average current n-0 (x 0.01 A)	
302-303	UDInt	L1 current n-0 (x 0.01 A)	
304-305	UDInt	L2 current n-0 (x 0.01 A)	
306-307	UDInt	L3 current n-0 (x 0.01 A)	
308-309	UDInt	Ground current n-0 (mA)	
310	UInt	Motor temperature sensor degree n-0 (°C)	

N-1 Fault Statistics Extension

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

Register	Variable type	Read-only variables	*Note, page 294*
330-331	UDInt	Average current n-1 (x 0.01 A)	
332-333	UDInt	L1 current n-1 (x 0.01 A)	
334-335	UDInt	L2 current n-1 (x 0.01 A)	
336-337	UDInt	L3 current n-1 (x 0.01 A)	
338-339	UDInt	Ground current n-1 (mA)	
340	UInt	Motor temperature sensor degree n-1 (°C)	

N-2 Fault Statistics Extension

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

Register	Variable type	Read-only variables	*Note, page 294*
360-361	UDInt	Average current n-2 (x 0.01 A)	
362-363	UDInt	L1 current n-2 (x 0.01 A)	
364-365	UDInt	L2 current n-2 (x 0.01 A)	
366-367	UDInt	L3 current n-2 (x 0.01 A)	
368-369	UDInt	Ground current n-2 (mA)	
370	UInt	Motor temperature sensor degree n-2 (°C)	

N-3 Fault Statistics Extension

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

Register	Variable type	Read-only variables	*Note, page 294*
390-391	UDInt	Average current n-3 (x 0.01 A)	
392-393	UDInt	L1 current n-3 (x 0.01 A)	
394-395	UDInt	L2 current n-3 (x 0.01 A)	
396-397	UDInt	L3 current n-3 (x 0.01 A)	
398-399	UDInt	Ground current n-3 (mA)	
400	UInt	Motor temperature sensor degree n-3 (°C)	

N-4 Fault Statistics Extension

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

Register	Variable type	Read-only variables	*Note, page 294*
420-421	UDInt	Average current n-4 (x 0.01 A)	
422-423	UDInt	L1 current n-4 (x 0.01 A)	
424-425	UDInt	L2 current n-4 (x 0.01 A)	
426-427	UDInt	L3 current n-4 (x 0.01 A)	
428-429	UDInt	Ground current n-4 (mA)	
430	UInt	Motor temperature sensor degree n-4 (°C)	

Monitoring Variables

Monitoring Overview

Monitoring variables are grouped according to the following criteria:

Monitoring variable groups	Registers
Monitoring of faults	450 to 454
Monitoring of status	455 to 459
Monitoring of warnings	460 to 464
Monitoring of measurements	465 to 539

Monitoring of faults

Variables for monitoring of faults are described below:

Register	Variable type	Read-only variables	*Note, page 294*
450	UInt	Minimum wait time (s)	
451	UInt	Fault code (code of the last fault, or of the fault that takes priority) (See *DT_FaultCode, page 299*.)	
452	Word	Fault register 1	
		bits 0-1 *(Reserved)*	
		bit 2 Ground current fault	
		bit 3 Thermal overload fault	
		bit 4 Long start fault	
		bit 5 Jam fault	
		bit 6 Current phase imbalance fault	
		bit 7 Undercurrent fault	
		bit 8 *(Reserved)*	
		bit 9 Test fault	
		bit 10 HMI port fault	
		bit 11 Controller internal fault	
		bit 12 Internal port fault	
		bit 13 *(Not significant)*	
		bit 14 Network port config fault	
		bit 15 Network port fault	
453	Word	Fault register 2	
		bit 0 External system fault	
		bit 1 Diagnostic fault	
		bit 2 Wiring fault	
		bit 3 Overcurrent fault	
		bit 4 Current phase loss fault	
		bit 5 Current phase reversal fault	
		bit 6 Motor temperature sensor fault	1
		bit 7 Voltage phase imbalance fault	1
		bit 8 Voltage phase loss fault	1
		bit 9 Voltage phase reversal fault	1
		bit 10 Undervoltage fault	1
		bit 11 Overvoltage fault	1
		bit 12 Underpower fault	1
		bit 13 Overpower fault	1
		bit 14 Under power factor fault	1
		bit 15 Over power factor fault	1

Register	Variable type	Read-only variables	*Note, page 294*
454	Word	Fault register 3	
		bit 0 LTM E configuration fault	
		bit 1 LTM R configuration fault	
		bits 2-15 *(Reserved)*	

Monitoring of status

Variables for monitoring of status are described below:

Register	Variable type	Read-only variables	*Note, page 294*
455	Word	System status register 1	
		bit 0 System ready	
		bit 1 System on	
		bit 2 System fault	
		bit 3 System warning	
		bit 4 System tripped	
		bit 5 Fault reset authorized	
		bit 6 Controller power	
		bit 7 Motor running (with detection of a current, if greater than 10% FLC)	
		bits 8-13 Motor average current ratio 32 = 100% FLC - 63 = 200% FLC	
		bit 14 Control via HMI	
		bit 15 Motor starting (start in progress) 0 = descending current is less than 150% FLC 1 = ascending current is greater than 10% FLC	
456	Word	System status register 2	
		bit 0 Auto-reset active	
		bit 1 *(Not significant)*	
		bit 2 Fault power cycle requested	
		bit 3 Motor restart time undefined	
		bit 4 Rapid cycle lockout	
		bit 5 Load shedding	1
		bit 6 Motor speed 0 = FLC1 setting is used 1 = FLC2 setting is used	
		bit 7 HMI port comm loss	
		bit 8 Network port comm loss	
		bit 9 Motor transition lockout	
		bits 10-15 *(Not significant)*	

Register	Variable type	Read-only variables	*Note, page 294*
457	Word	Logic inputs status	
		bit 0 Logic input 1	
		bit 1 Logic input 2	
		bit 2 Logic input 3	
		bit 3 Logic input 4	
		bit 4 Logic input 5	
		bit 5 Logic input 6	
		bit 6 Logic input 7	1
		bit 7 Logic input 8	1
		bit 8 Logic input 9	1
		bit 9 Logic input 10	1
		bit 10 Logic input 11	1
		bit 11 Logic input 12	1
		bit 12 Logic input 13	1
		bit 13 Logic input 14	1
		bit 14 Logic input 15	1
		bit 15 Logic input 16	1
458	Word	Logic outputs status	
		bit 0 Logic output 1	
		bit 1 Logic output 2	
		bit 2 Logic output 3	
		bit 3 Logic output 4	
		bit 4 Logic output 5	1
		bit 5 Logic output 6	1
		bit 6 Logic output 7	1
		bit 7 Logic output 8	1
		bits 8-15 *(Reserved)*	
459	Word	I/O status	
		bit 0 Input 1	
		bit 1 Input 2	
		bit 2 Input 3	
		bit 3 Input 4	
		bit 4 Input 5	
		bit 5 Input 6	
		bit 6 Input 7	
		bit 7 Input 8	
		bit 8 Input 9	
		bit 9 Input 10	
		bit 10 Input 11	
		bit 11 Input 12	
		bit 12 Output 1 (13-14)	
		bit 13 Output 2 (23-24)	
		bit 14 Output 3 (33-34)	
		bit 15 Output 4 (95-96, 97-98)	

Monitoring of warnings

Variables for monitoring of warnings are described below:

Register	Variable type	Read-only variables	*Note, page 294*
460	UInt	Warning code (See *DT_WarningCode, page 301*.)	
461	Word	Warning register 1	
		bits 0-1 *(Not significant)*	
		bit 2 Ground current warning	
		bit 3 Thermal overload warning	
		bit 4 *(Not significant)*	
		bit 5 Jam warning	
		bit 6 Current phase imbalance warning	
		bit 7 Undercurrent warning	
		bits 8-9 *(Not significant)*	
		bit 10 HMI port warning	
		bit 11 Controller internal temperature warning	
		bits 12-14 *(Not significant)*	
		bit 15 Network port warning	
462	Word	Warning register 2	
		bit 0 *(Not significant)*	
		bit 1 Diagnostic warning	
		bit 2 *(Reserved)*	
		bit 3 Overcurrent warning	
		bit 4 Current phase loss warning	
		bit 5 Current phase reversal warning	
		bit 6 Motor temperature sensor warning	
		bit 7 Voltage phase imbalance warning	1
		bit 8 Voltage phase loss warning	1
		bit 9 *(Not significant)*	1
		bit 10 Undervoltage warning	1
		bit 11 Overvoltage warning	1
		bit 12 Underpower warning	1
		bit 13 Overpower warning	1
		bit 14 Under power factor warning	1
		bit 15 Over power factor warning	1
463	Word	Warning register 3	
		bit 0 LTM E configuration warning	
		bits 1-15 *(Reserved)*	
464	UInt	Motor temperature sensor degree (° C)	

Monitoring of measurements

Variables for monitoring of measurements are described below:

Register	Variable type	Read-only variables	*Note, page 294*
465	UInt	Thermal capacity level (% trip level)	
466	UInt	Average current ratio (% FLC)	
467	UInt	L1 current ratio (% FLC)	
468	UInt	L2 current ratio (% FLC)	
469	UInt	L3 current ratio (% FLC)	
470	UInt	Ground current ratio (x 0.1 % FLC min)	
471	UInt	Current phase imbalance (%)	
472	Int	Controller internal temperature (° C)	
473	UInt	Controller config checksum	
474	UInt	Frequency (x 0.01 Hz)	2
475	UInt	Motor temperature sensor (x 0.1 Ω)	
476	UInt	Average voltage (V)	1
477	UInt	L3-L1 voltage (V)	1
478	UInt	L1-L2 voltage (V)	1
479	UInt	L2-L3 voltage (V)	1
480	UInt	Voltage phase imbalance (%)	1
481	UInt	Power factor (x 0.01)	1
482	UInt	Active power (x 0.1 kW)	1
483	UInt	Reactive power (x 0.1 kVAR)	1
484	Word	Auto restart status register	
		bit 0 Voltage dip occurred	
		bit 1 Voltage dip detection	
		bit 2 Auto restart immediate condition	
		bit 3 Auto restart delayed condition	
		bit 4 Auto restart manual condition	
		bits 5-15 *(Not significant)*	
485	Word	Controller last power off duration	
486-489	Word	*(Not significant)*	
490	Word	Network port monitoring	
		bit 0 Network port monitoring	
		bit 1 Network port connected	
		bit 2 Network port self-testing	
		bit 3 Network port self-detecting	
		bit 4 Network port bad config	
		bits 5-15 *(Not significant)*	
491	UInt	Network port baud rate (See *DT_ExtBaudRate, page 298.*)	
492		*(Not significant)*	
493	UInt	Network port parity (See *DT_ExtParity, page 298.*)	
494-499		*(Not significant)*	
500-501	UDInt	Average current (x 0.01 A)	
502-503	UDInt	L1 current (x 0.01 A)	
504-505	UDInt	L2 current (x 0.01 A)	
506-507	UDInt	L3 current (x 0.01 A)	
508-509	UDInt	Ground current (mA)	

Register	Variable type	Read-only variables	*Note, page 294*
510	UInt	Controller port ID	
511	UInt	Time to trip (x 1 s)	
512	UInt	Motor last start current ratio (% FLC)	
513	UInt	Motor last start duration (s)	
514	UInt	Motor starts per hour count	
515	Word	Phase imbalances register	
		bit 0 L1 current highest imbalance	
		bit 1 L2 current highest imbalance	
		bit 2 L3 current highest imbalance	
		bit 3 L1-L2 voltage highest imbalance	1
		bit 4 L2-L3 voltage highest imbalance	1
		bit 5 L3-L1 voltage highest imbalance	1
		bits 6-15 *(Not significant)*	
516 - 523		*(Reserved)*	
524 - 539		*(Forbidden)*	

Configuration Variables

Configuration Overview

Configuration variables are grouped according to the following criteria:

Configuration variable groups	Registers
Configuration	540 to 649
Setting	650 to 699

Configuration Variables

The configuration variables are described below:

Register	Variable type	Read / Write variables	*Note, page 294*
540	UInt	Motor operating mode 2 = 2-wire overload 3 = 3-wire overload 4 = 2-wire independent 5 = 3-wire independent 6 = 2-wire reverser 7 = 3-wire reverser 8 = 2-wire 2-step 9 = 3-wire 2-step 10 = 2-wire 2-speed 11 = 3-wire 2-speed 256-511 = Custom logic program (0-255)	B
541	UInt	Motor transition timeout (s)	
542-544		*(Reserved)*	
545	Word	Controller AC inputs setting register	
		bits 0-3 Controller AC logic inputs configuration (see *DT_ACInputSetting, page 296*)	
		bits 4-15 *(Reserved)*	
546	UInt	Thermal overload setting	B
		bits 0-2 Motor temperature sensor type 0 = None 1 = PTC binary 2 = PT100 3 = PTC analog 4 = NTC analog	
		bits 3-4 Thermal overload mode 0 = Definite 2 = Inverse thermal	
		bits 5-15 *(Reserved)*	
547	UInt	Thermal overload fault definite timeout (s)	
548		*(Reserved)*	
549	UInt	Motor temperature sensor fault threshold (x 0.1 Ω)	
550	UInt	Motor temperature sensor warning threshold (x 0.1 Ω)	
551	UInt	Motor temperature sensor fault threshold degree (° C)	
552	UInt	Motor temperature sensor warning threshold degree (° C)	
553	UInt	Rapid cycle lockout timeout (s)	
554		*(Reserved)*	
555	UInt	Current phase loss timeout (x 0.1 s)	
556	UInt	Overcurrent fault timeout (s)	
557	UInt	Overcurrent fault threshold (% FLC)	
558	UInt	Overcurrent warning threshold (% FLC)	

Register	Variable type	Read / Write variables	*Note, page 294*
559	Word	Ground current fault configuration	B
		bit 0 Ground current mode	
		bit 1 Ground fault disabled while starting	
		bits 2-15 *(Reserved)*	
560	UInt	Ground CT primary	
561	UInt	Ground CT secondary	
562	UInt	External ground current fault timeout (x 0.01 s)	
563	UInt	External ground current fault threshold (x 0.01 A)	
564	UInt	External ground current warning threshold (x 0.01 A)	
565	UInt	Motor nominal voltage (V)	1
566	UInt	Voltage phase imbalance fault timeout starting (x 0.1 s)	1
567	UInt	Voltage phase imbalance fault timeout running (x 0.1 s)	1
568	UInt	Voltage phase imbalance fault threshold (% imb)	1
569	UInt	Voltage phase imbalance warning threshold (% imb)	1
570	UInt	Overvoltage fault timeout (x 0.1 s)	1
571	UInt	Overvoltage fault threshold (% Vnom)	1
572	UInt	Overvoltage warning threshold (% Vnom)	1
573	UInt	Undervoltage fault timeout	1
574	UInt	Undervoltage fault threshold (% Vnom)	1
575	UInt	Undervoltage warning threshold (% Vnom)	1
576	UInt	Voltage phase loss fault timeout (x 0.1 s)	1
577	Word	Voltage dip setting	1
		bits 0-1 Voltage dip mode 0 = None (factory setting) 1 = Load shedding 2 = Auto-restart	
		bits 3-15 *(Reserved)*	
578	UInt	Load shedding timeout (s)	1
579	UInt	Voltage dip threshold (% Vnom)	1
580	UInt	Voltage dip restart timeout (s)	1
581	UInt	Voltage dip restart threshold (% Vnom)	1
582	UInt	Auto restart immediate timeout (x 0.1 s)	
583	UInt	Motor nominal power (x 0.1 kW)	1
584	UInt	Overpower fault timeout (s)	1
585	UInt	Overpower fault threshold (% Pnom)	1
586	UInt	Overpower warning threshold (% Pnom)	1
587	UInt	Underpower fault timeout (s)	1
588	UInt	Underpower fault threshold (% Pnom)	1
589	UInt	Underpower warning threshold (% Pnom)	1
590	UInt	Under power factor fault timeout (x 0.1 s)	1
591	UInt	Under power factor fault threshold (x 0.01 PF)	1
592	UInt	Under power factor warning threshold (x 0.01 PF)	1
593	UInt	Over power factor fault timeout (x 0.1 s)	1
594	UInt	Over power factor fault threshold (x 0.01 PF)	1
595	UInt	Over power factor warning threshold (x 0.01 PF)	1
596	UInt	Auto restart delayed timeout (s)	
597-599		*(Reserved)*	
600		*(Not significant)*	

Register	Variable type	Read / Write variables	*Note, page 294*
601	Word	General configuration register 1	
		bit 0 Controller system config required 0 = exit the configuration menu 1 = go to the configuration menu	A
		bits 1-7 *(Reserved)*	
		Control mode configuration, bits 8-10 (one bit is set to 1):	
		bit 8 Config via HMI keypad enable	
		bit 9 Config via HMI engineering tool enable	
		bit 10 Config via network port enable	
		bit 11 Motor star-delta	B
		bit 12 Motor phases sequence 0 = A B C 1 = A C B	
		bits 13-14 Motor phases (see *DT_PhaseNumber, page 300*)	B
		bit 15 Motor auxiliary fan cooled (factory setting = 0)	
602	Word	General configuration register 2	
		bits 0-2 Fault reset mode (see *DT_ResetMode, page 300*)	C
		bit 3 HMI port parity setting 0 = none 1 = even (factory setting)	
		bits 4-8 *(Reserved)*	
		bit 9 HMI port endian setting	
		bit 10 Network port endian setting	
		bit 11 HMI motor status LED color	
		bits 12-15 *(Reserved)*	
603	UInt	HMI port address setting	
604	UInt	HMI port baud rate setting (Baud)	
605		*(Reserved)*	
606	UInt	Motor trip class (s)	
607		*(Reserved)*	
608	UInt	Thermal overload fault reset threshold (% trip level)	
609	UInt	Thermal overload warning threshold (% trip level)	
610	UInt	Internal ground current fault timeout (x 0.1 s)	
611	UInt	Internal ground current fault threshold (% FLCmin)	
612	UInt	Internal ground current warning threshold (% FLCmin)	
613	UInt	Current phase imbalance fault timeout starting (x 0.1 s)	
614	UInt	Current phase imbalance fault timeout running (x 0.1 s)	
615	UInt	Current phase imbalance fault threshold (% imb)	
616	UInt	Current phase imbalance warning threshold (% imb)	
617	UInt	Jam fault timeout (s)	
618	UInt	Jam fault threshold (% FLC)	
619	UInt	Jam warning threshold (% FLC)	
620	UInt	Undercurrent fault timeout (s)	
621	UInt	Undercurrent fault threshold (% FLC)	
622	UInt	Undercurrent warning threshold (% FLC)	
623	UInt	Long start fault timeout (s)	
624	UInt	Long start fault threshold (% FLC)	
625		*(Reserved)*	

Register	Variable type	Read / Write variables	*Note, page 294*
626	UInt	HMI display contrast setting	
		bits 0-7 HMI display contrast setting	
		bits 8-15 HMI display brightness setting	
627	UInt	Contactor rating (0.1 A)	
628	UInt	Load CT primary	B
629	UInt	Load CT secondary	B
630	UInt	Load CT multiple passes (passes)	B
631	Word	Fault enable register 1	
		bits 0-1 *(Reserved)*	
		bit 2 Ground current fault enable	
		bit 3 Thermal overload fault enable	
		bit 4 Long start fault enable	
		bit 5 Jam fault enable	
		bit 6 Current phase imbalance fault enable	
		bit 7 Undercurrent fault enable	
		bit 8 *(Reserved)*	
		bit 9 Self test enable 0 = disable 1 = enable (factory setting)	
		bit 10 HMI port fault enable	
		bits 11-14 *(Reserved)*	
		bit 15 Network port fault enable	
632	Word	Warning enable register 1	
		bit 0 *(Not significant)*	
		bit 1 *(Reserved)*	
		bit 2 Ground current warning enable	
		bit 3 Thermal overload warning enable	
		bit 4 *(Reserved)*	
		bit 5 Jam warning enable	
		bit 6 Current phase imbalance warning enable	
		bit 7 Undercurrent warning enable	
		bits 8- 9 *(Reserved)*	
		bit 10 HMI port warning enable	
		bit 11 Controller internal temperature warning enable	
		bits 12-14 *(Reserved)*	
		bit 15 Network port warning enable	

Register	Variable type	Read / Write variables	*Note, page 294*
633	Word	Fault enable register 2	
		bit 0 *(Reserved)*	
		bit 1 Diagnostic fault enable	
		bit 2 Wiring fault enable	
		bit 3 Overcurrent fault enable	
		bit 4 Current phase loss fault enable	
		bit 5 Current phase reversal fault enable	
		bit 6 Motor temperature sensor fault enable	
		bit 7 Voltage phase imbalance fault enable	1
		bit 8 Voltage phase loss fault enable	1
		bit 9 Voltage phase reversal fault enable	1
		bit 10 Undervoltage fault enable	1
		bit 11 Overvoltage fault enable	1
		bit 12 Underpower fault enable	1
		bit 13 Overpower fault enable	1
		bit 14 Under power factor fault enable	1
		bit 15 Over power factor fault enable	1
634	Word	Warning enable register 2	
		bit 0 *(Reserved)*	
		bit 1 Diagnostic warning enable	
		bit 2 *(Reserved)*	
		bit 3 Overcurrent warning enable	
		bit 4 Current phase loss warning enable	
		bit 5 *(Reserved)*	
		bit 6 Motor temperature sensor warning enable	
		bit 7 Voltage phase imbalance warning enable	1
		bit 8 Voltage phase loss warning enable	1
		bit 9 *(Reserved)*	1
		bit 10 Undervoltage warning enable	1
		bit 11 Overvoltage warning enable	1
		bit 12 Underpower warning enable	1
		bit 13 Overpower warning enable	1
		bit 14 Under power factor warning enable	1
		bit 15 Over power factor warning enable	1
635-6		*(Reserved)*	
637	UInt	Auto-reset attempts group 1 setting (resets)	
638	UInt	Auto-reset group 1 timeout (s)	
639	UInt	Auto-reset attempts group 2 setting (resets)	
640	UInt	Auto-reset group 2 timeout (s)	
641	UInt	Auto-reset attempts group 3 setting (resets)	
642	UInt	Auto-reset group 3 timeout (s)	
643	UInt	Motor step 1 to 2 timeout (x 0.1 s)	
644	UInt	Motor step 1 to 2 threshold (% FLC)	
645	UInt	HMI port fallback setting (see *DT_OutputFallbackStrategy, page 300*)	
646-649		*(Reserved)*	

Setting Variables

The setting variables are described below:

Register	Variable type	Read / Write variables	*Note, page 294*
650	Word	HMI language setting register:	
		bits 0-4 HMI language setting (see *DT_Language5, page 300*)	
		bits 5-15 *(Not significant)*	
651	Word	HMI display items register 1	
		bit 0 HMI display average current enable	
		bit 1 HMI display thermal capacity level enable	
		bit 2 HMI display L1 current enable	
		bit 3 HMI display L2 current enable	
		bit 4 HMI display L3 current enable	
		bit 5 HMI display ground current enable	
		bit 6 HMI display motor status enable	
		bit 7 HMI display current phase imbalance enable	
		bit 8 HMI display operating time enable	
		bit 9 HMI display I/O status enable	
		bit 10 HMI display reactive power enable	
		bit 11 HMI display frequency enable	
		bit 12 HMI display starts per hour enable	
		bit 13 HMI display control mode enable	
		bit 14 HMI display start statistics enable	
		bit 15 HMI motor temperature sensor enable	
652	UInt	Motor full load current ratio, FLC1 (% FLCmax)	
653	UInt	Motor high speed full load current ratio, FLC2 (% FLCmax)	
654	Word	HMI display items register 2	
		bit 0 HMI display L1-L2 voltage enable	1
		bit 1 HMI display L2-L3 voltage enable	1
		bit 2 HMI display L3-L1 voltage enable	1
		bit 3 HMI display average voltage enable	1
		bit 4 HMI display active power enable	1
		bit 5 HMI display power consumption enable	1
		bit 6 HMI display power factor enable	1
		bit 7 HMI display average current ratio enable	
		bit 8 HMI display L1 current ratio enable	1
		bit 9 HMI display L2 current ratio enable	1
		bit 10 HMI display L3 current ratio enable	1
		bit 11 HMI display thermal capacity remaining enable	
		bit 12 HMI display time to trip enable	
		bit 13 HMI display voltage phase imbalance enable	1
		bit 14 HMI display date enable	
		bit 15 HMI display time enable	
655-658	Word[4]	Date and time setting (See *DT_DateTime, page 297*)	
659	Word	HMI display items register 3	
		bit 0 HMI display temperature sensor degree CF	
		bits 1-15 *(Reserved)*	

Register	Variable type	Read / Write variables	*Note, page 294*
660-681		*(Reserved)*	
682	UInt	Network port fallback setting (see *DT_OutputFallbackStrategy, page 300*)	
683	Word	Control setting register *(see page 133)*	
		bits 0-1 *(Reserved)*	
		bit 2 Control remote local default mode (with LTM CU) 0 = remote 1 = local	
		bit 3 *(Reserved)*	
		bit 4 Control remote local buttons enable (with LTM CU) 0 = disable 1 = enable	
		bits 5-6 Control remote channel setting (with LTM CU) 0 = network 1 = terminal strip 2 = HMI	
		bit 7 *(Reserved)*	
		bit 8 Control local channel setting 0 = terminal strip 1 = HMI	
		bit 9 Control direct transition 0 = stop required during transition 1 = stop not required during transition	
		bit 10 Control transfer mode 0 = bump 1 = bumpless	
		bit 11 Stop terminal strip disable 0 = enable 1 = disable	
		bit 12 Stop HMI disable 0 = enable 1 = disable	
		bits 13-15 *(Reserved)*	
684-692		*(Reserved)*	
693	UInt	Network port comm loss timeout (x 0.01 s) (Modbus only)	
694	UInt	Network port parity setting (Modbus only)	
695	UInt	Network port baud rate setting (Baud) (see *DT_ExtBaudRate, page 298*)	
696	UInt	Network port address setting	
697-699		*(Not significant)*	

Command Variables

Command Variables

Command variables are described below:

Register	Variable type	Read / Write variables	*Note, page 294*
700	Word	Logic outputs command register	
		bit 0 Logic output 1 command	
		bit 1 Logic output 2 command	
		bit 2 Logic output 3 command	
		bit 3 Logic output 4 command	
		bit 4 Logic output 5 command	1
		bit 5 Logic output 6 command	1
		bit 6 Logic output 7 command	1
		bit 7 Logic output 8 command	1
		bits 8-15 *(Reserved)*	
701-703		*(Reserved)*	
704	Word	Control register 1	
		bit 0 Motor run forward command	
		bit 1 Motor run reverse command	
		bit 2 *(Reserved)*	
		bit 3 Fault reset command	
		bit 4 *(Reserved)*	
		bit 5 Self test command	
		bit 6 Motor low speed command	
		bits 7-15 *(Reserved)*	
705	Word	Control register 2	
		bit 0 Clear all command Clear all parameters, except: ● Motor LO1 closings count ● Motor LO2 closings count ● Controller internal temperature max ● Thermal capacity level	
		bit 1 Clear statistics command	
		bit 2 Clear thermal capacity level command	
		bit 3 Clear controller settings command	
		bit 4 Clear network port settings command	
		bits 5-15 *(Reserved)*	
706-709		*(Reserved)*	
710-799		*(Forbidden)*	

User Map Variables

User Map Variables

User Map variables are described below:

User map variable groups	Registers
User Map addresses	800 to 899
User Map values	900 to 999

Register	Variable type	Read/Write variables	*Note, page 294*
800-898	Word[99]	User map addresses setting	
899		*(Reserved)*	

Register	Variable type	Read/Write variables	*Note, page 294*
900-998	Word[99]	User map values	
999		*(Reserved)*	

Custom Logic Variables

Custom Logic Variables

Custom logic variables are described below:

Register	Variable type	Read-only variables	Note (*see page 294*)
1200	Word	Custom logic status register	
		bit 0 Custom logic run	
		bit 1 Custom logic stop	
		bit 2 Custom logic reset	
		bit 3 Custom logic second step	
		bit 4 Custom logic transition	
		bit 5 Custom logic phase reverse	
		bit 6 Custom logic network control	
		bit 7 Custom logic FLC selection	
		bit 8 *(Reserved)*	
		bit 9 Custom logic auxiliary 1 LED	
		bit 10 Custom logic auxiliary 2 LED	
		bit 11 Custom logic stop LED	
		bit 12 Custom logic LO1	
		bit 13 Custom logic LO2	
		bit 14 Custom logic LO3	
		bit 15 Custom logic LO4	
1201	Word	Custom logic version	
1202	Word	Custom logic memory space	
1203	Word	Custom logic memory used	
1204	Word	Custom logic temporary space	
1205	Word	Custom logic non volatile space	
1206-1249		*(Reserved)*	

Register	Variable type	Read/Write variables	Note (*see page 294*)
1250	Word	Custom logic setting register 1	
		bit 0 (Reserved)	
		bit 1 Logic input 3 external ready enable	
		bits 2-15 (Reserved)	
1251-1269		*(Reserved)*	
1270	Word	Custom logic command register 1	
		bit 0 Custom logic external fault command	
		bits 1-15 (Reserved)	
1271-1279		*(Reserved)*	

Register	Variable type	Read-only variables	Note (*see page 294*)
1280	Word	Custom logic monitoring register 1	
		bit 0 (Reserved)	
		bit 1 Custom logic system ready	
		bits 2-15 (Reserved)	
1281-1300		*(Reserved)*	

Register	Variable type	Read/Write variables	Note (*see page 294*)
1301-1399	Word[99]	General purpose registers for logic functions	

Chapter 8
Maintenance

Overview

This chapter describes the maintenance and self-diagnostic features of the LTM R controller and the expansion module.

⚠ 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.

What Is in This Chapter?

This chapter contains the following topics:

Detecting Problems

Overview

The LTM R controller and the expansion module perform self-diagnostic checks at power-up and during operation.

Problems with either the LTM R controller or expansion module can be detected using

- Power and Alarm LEDs on the LTM R controller,
- Power and Input LEDs on the expansion module,
- LCD Display on either a Magelis® XBTN410 HMI device or a TeSys® T LTM CU Control Operator Unit connected to the LTM R controller's HMI port, or
- SoMove with the TeSys T DTM running on a PC connected to the LTM R controller's HMI port.

Device LEDs

The LEDs on the LTM R controller and expansion module can indicate the following problems:

LTM R LED			LTM E LED	Problem
Power	**Alarm**	**PLC Alarm**	**Power**	
Off	Solid red	-	-	Internal fault
On	Solid red	-	-	Protection fault
On	Flashing red (2x per second)	-	-	Protection warning
On	Flashing red (5x per second)	-	-	Load shed or rapid cycle
On	-	-	Solid red	Internal fault

Magelis® XBT HMI Device

The Magelis® XBTN410 HMI automatically displays information about a fault or warning, including LTM R controller self-diagnostic faults and warnings, when it occurs.

For information about the display of faults and warnings when the HMI is used in a 1-to-many configuration, see *Fault Management (1-to-many), page 280*.

LTM CU Control Operator Unit

The TeSys® T LTM CU Control Operator Unit automatically displays information about a fault or warning.

For more information, see Faults and Warnings Display in *TeSys® T LTM CU Control Operator Unit User's Manual*.

SoMove with the TeSys T DTM

SoMove with the TeSys T DTM displays a visual array of active faults and warnings, including LTM R controller self-diagnostic faults and warnings, when these faults occur.

For information about this display of active faults and warnings, refer to the *TeSys T DTM for SoMove FDT Container Online help*.

Troubleshooting

Self-Diagnostic Tests

The LTM R controller performs self-diagnostic tests at power-up and during operation. These tests, the errors they detect, and the steps to take in response to a problem are described below:

Type	Error	Action
Major internal faults	Internal temperature fault	This fault indicates a warning at 80° C, a minor fault at 85° C, and a major fault at 100° C. Take steps to reduce ambient temperature, including: ● add an auxiliary cooling fan ● remount the LTM R controller and expansion module to provide more surrounding free space. If the condition persists: **1** Cycle power. **2** Wait 30 s. **3** If the fault persists, replace the LTM R controller.
	CPU failure	These faults indicate a hardware failure. Take the following steps: **1** Cycle power. **2** Wait 30 s. **3** If the fault persists, replace the LTM R controller.
	Program checksum error	
	RAM test error	
	Stack overflow	
	Stack underflow	
	Watchdog timeout	
Minor internal faults	Invalid configuration error	Indicates either a bad checksum (Config checksum error) or good checksum but bad data (Invalid config error). Both caused by hardware failure. Take the following steps: **1** Cycle power and wait 30 s. **2** Reset the configuration settings to factory settings. **3** If the fault persists, replace the LTM R controller.
	Configuration checksum (EEROM) error	
	Internal network communications failure	These faults indicate a hardware failure. Take the following steps: **1** Cycle power and wait 30 s. **2** If the fault persists, replace the LTM R controller.
	A/D out of range error	

Diagnostic errors	Start command check	Check the following:
		● relay outputs
		● all wiring, including:
		  ● control wiring circuit, including all electromechanical devices
		  ● power wiring circuit, including all components
		  ● load CT wiring.
		After all checks are complete:
		1 Reset the fault.
		2 If the fault persists, cycle power and wait 30 s.
		3 If the fault persists, replace the LTM R controller.

	Stop command check	
	Stop check back	
	Run check back	

<table>
<tr><th>Type</th><th>Error</th><th>Action</th></tr>
<tr><td rowspan="5">Wiring/config errors</td><td>CT reversal error</td><td>Correct the polarity of the CTs. Be sure that:
● all external CTs face the same direction
● all load CT wiring passes through windows in the same direction

After the check is complete:
1 Perform a fault reset.
2 If the fault persists, cycle power and wait 30 s.
3 If the fault still persists, replace the LTM R controller.</td></tr>
<tr><td>Current/Voltage phase reversal error</td><td rowspan="2">Check:
● L1, L2 and L3 wiring connection to be sure wires are not crossed
● Motor Phases Sequence parameter setting (ABC versus ACB)

After all checks are complete:
1 Perform a fault reset.
2 If the fault persists, cycle power and wait 30 s.
3 If the fault persists, replace the LTM R controller.</td></tr>
<tr><td>Phase configuration error</td></tr>
<tr><td>PTC connection error</td><td>Check for:
● short circuit or open circuit in the motor temp sensor wiring
● wrong type of motor temp sensing device
● improper configuration of parameters for selected device.

After all checks are complete:
1 Perform a fault reset.
2 If the fault persists, cycle power and wait 30 s.
3 If the fault persists, replace the LTM R controller.</td></tr>
<tr><td>Voltage phase loss error</td><td>Check for:
● improper wiring, such as loose terminations
● blown fuse
● cut wire
● single-phase motor configured for 3-phase operation
● failure to wire a single phase motor through both A and C load CT windows
● failure of power source (for example, utility power failure).

After all checks are complete:
1 Perform fault reset.
2 If the fault persists, cycle power and wait 30 s.
3 If the fault persists, replace the LTM R controller.</td></tr>
</table>

Preventive Maintenance

Overview

The following protective measures should be performed between major system checks, to help maintain your system and protect it against irrecoverable hardware or software failure:

- Continuously review operating statistics,
- Save LTM R controller parameter configuration settings to a backup file,
- Maintain the LTM R controller's operating environment,
- Periodically perform a LTM R controller self test,
- Check the LTM R controller internal clock to ensure accuracy.

Statistics

The LTM R controller collects the following types of information:

- real-time voltage, current, power, temperature, I/O and fault data
- a count of the number of faults, by fault type, that occurred since last power-up
- a time-stamped history of the state of the LTM R controller (displaying measures of voltage, current, power, and temperature) at the moment that each of the previous 5 faults occurred

Use either SoMove with the TeSys T DTM, a Magelis® XBTN410 HMI, or a TeSys® T LTM CU Control Operator Unit to access and review these statistics. Analyze this information to determine whether the actual record of operations indicates a problem.

Configuration Settings

In the event of irrecoverable LTM R controller failure, you can quickly restore configuration settings if you saved these settings to a file. When the LTM R controller is first configured, and every subsequent time any configuration settings are changed, use SoMove with the TeSys T DTM to save the parameter settings to a file.

To save a configuration file:
- Select **File** →**Save As...**.

To restore the saved configuration file:
1. Open the saved file: Select **File** →**Open** (then navigate to the file).
2. Download the configuration to the new controller.
3. Select **Communication** →**Store to Device**.

Environment

Like any other electronic device, the LTM R controller is affected by its physical environment. Provide a friendly environment by taking common-sense preventive measures, including:

- Scheduling periodic examinations of battery packs, fuses, power strips, batteries, surge suppressors, and power supplies.
- Keeping the LTM R controller, the panel, and all devices clean. An unobstructed flow of air will prevent dust build-up, which can lead to a short-circuit condition.
- Remaining alert to the possibility of other equipment producing electromagnetic radiation. Be sure no other devices cause electromagnetic interference with the LTM R controller.

Self Test with Motor Off

Perform a self test by either
- holding down the Test/Reset button on the face of the LTM R controller for more than 3 seconds and up to 15 seconds, or
- setting the Self Test Command parameter.

A self test can be performed only if
- no faults exist,
- the Self Test Enable parameter is set (factory setting).

The LTM R controller performs the following checks during a self test:

- Watchdog check
- RAM check

During the self-test sequence, the LTM R controller calibrates the thermal memory time constant, which keeps track of time while it is not powered.

If any of the above tests fails, a minor internal fault occurs. If not, the self test continues and the LTM R controller performs:

- LTM E expansion module test (if it is connected to an expansion module). If this test fails, the LTM R controller experiences a minor internal fault.
- Internal communication test. If this test fails, the LTM R controller experiences a minor internal fault.
- LED test: turns all LEDs off, then turns each LED on in sequence:
  - HMI communication activity LED
  - Power LED
  - Fallback LED
  - PLC communication activity LED

  At the end of the test, all LEDs return to their initial state.
- Output relay test: opens all relays, and restores them to their original state only after a reset command executes, or power is cycled.
  If current is measured during the relay self test, the LTM R controller experiences a minor internal fault.

During the LTM R self test, a "self test" string displays on the HMI device.

During a self test, the LTM R controller sets the Self Test Command parameter to 1. When the self test finishes, this parameter is reset to 0.

Self Test with Motor On

Perform a self test by using

- the Test/Reset button on the face of the LTM R controller,
- Menus command from the HMI connected to the RJ45 port,
- SoMove with the TeSys T DTM, or
- PLC.

When the motor is On, performing a self test simulates a thermal fault, in order to check if the logic output O.4 is working correctly. It triggers a Thermal Overload fault.

During a self test, the LTM R controller sets the Self Test Command parameter to 1. When the self test finishes, this parameter is reset to 0.

Internal Clock

To ensure an accurate record of faults, be sure to maintain the LTM R controller's internal clock. The LTM R controller time stamps all faults, using the value stored in the Date And Time Setting parameter.

Internal clock accuracy is +/-1 second per hour. If power is continuously applied for 1 year, the internal clock accuracy is +/-30 minutes per year.

If power is turned Off for 30 minutes or less, the LTM R controller retains its internal clock settings, with accuracy of +/- 2 minutes.

If power is turned Off for more than 30 minutes, the LTM R controller resets its internal clock to the time when power was turned Off.

Replacing an LTM R Controller and LTM E Expansion Module

Overview

Questions to consider in advance of replacing either an LTM R controller or an LTM E expansion module are:

- is the replacement device the same model as the original?
- have the configuration settings of the LTM R controller been saved, and are they available to be transferred to its replacement?

Be sure the motor is turned off before replacing either the LTM R controller or the LTM E expansion module.

Replacing the LTM R Controller

The time to plan for the replacement of an LTM R controller is:

- when the LTM R controller settings are initially configured, and
- any time that one or more of its settings are subsequently re-configured

Because setting values may not be accessible when the LTM R controller is replaced, for example, in case of device failure, you should create a record of setting values whenever they are made.

Using SoMove with the TeSys T DTM, all of the LTM R controller's configured settings, except for date and time, can be saved to a file. Once saved, you can use SoMove with the TeSys T DTM to transfer these settings either to the original LTM R controller or to its replacement.

NOTE: Only configured settings are saved. Historical statistical data is not saved, and therefore cannot be applied to a replacement LTM R controller.

For information on how to use SoMove software to create, save and transfer configuration setting files, refer to the *SoMove Lite Online Help*.

Replacing the Expansion Module

The primary consideration in replacing an LTM E expansion module, is to replace it with the same model, 24 VDC or 110-240 VAC, as the original.

Retiring Devices

Both the LTM R controller and the LTM E expansion module contain electronic boards that require particular treatment at the end of their useful life. When retiring a device be sure to observe all applicable laws, regulations and practices.

Communication Warnings and Faults

Introduction

Communication warnings and faults are managed in a standard way, like any other types of warnings and faults.

The presence of a fault is signaled by various indicators:
- State of the LEDs (1 LED is dedicated to communication: **PLC Comm**, see *Modbus® Communication Checking, page 235*)
- State of the output relays
- Warning
- Message(s) displayed on HMI screen
- Presence of an exception code (such as a report from the PLC)

PLC Communication Loss

A communication loss is managed like any other fault.

The LTM R controller monitors the communication with the PLC. Using an adjustable network idle time (timeout), the LTM R controller watchdog function can report a network loss (firmware watchdog).

In the event of a network loss, the LTM R controller can be configured to take certain actions. These depend on the control mode that the LTM R controller was operating in prior to the network loss.

If PLC-LTM R controller communication is lost while the LTM R controller is in network control mode, the LTM R controller enters the fallback state. If PLC- LTM R controller communication is lost while the LTM R controller is in local control mode, and then the control mode is changed to network control, the LTM R controller enters the fallback state.

If PLC-LTM R controller communication is restored while the control mode is set to network control, the LTM R controller exits the fallback state. If the control mode is changed to local control, the LTM R exits from the fallback state, regardless of the state of PLC-controller communications.

The table below defines the available actions that the LTM R controller can take during a communication loss that the user can select when configuring the LTM R controller.

Network communication loss actions:

LTM R Controller Output Control Mode Prior to Network Loss	Available LTM R Actions After PLC-LTM R Controller Network Loss
Terminal Strip	Fault and Warning control possibilities: ● Signal nothing ● Activate a warning ● Activate a fault ● Activate a fault and warning
HMI	Fault and Warning control possibilities: ● Signal nothing ● Activate a warning ● Activate a fault ● Activate a fault and warning
Network	Fault and Warning control possibilities: ● Signal nothing ● Activate a warning ● Activate a fault ● Activate a fault and warning ● The behavior of the LO1 and LO2 relays depends on the motor controller mode and on the fallback strategy chosen

HMI Communication Loss

The LTM R controller monitors the communication with any approved HMI device. Using a fixed network idle time (timeout), the LTM R controller watchdog function can report a network loss. In the event of a communication loss, the LTM R controller can be configured to take certain actions. These depend on the control mode that the LTM R controller was operating in prior to the communication loss.

If HMI-controller communication is lost while the LTM R controller is in HMI control mode, the LTM R controller enters the fallback state. If HMI-LTM R controller communication is lost while the LTM R controller is not in HMI control mode, and then the control mode is changed to HMI control, the LTM R controller enters the fallback state.

If HMI-controller communication is restored while the control mode is set to HMI control, the LTM R exits from the fallback state. If the control mode is changed to Terminal Strip or Network control, the LTM R exits from the fallback state, regardless of the state of HMI-controller communications.

The table below defines the available actions that the LTM R controller may take during a communication loss. Select one of these actions when configuring the LTM R controller.

HMI communication loss actions:

LTM R Controller Output Control Mode Prior to Network Loss	Available LTM R Controller Actions After HMI-LTM R Controller Network Loss
Terminal Strip	Fault and Warning control possibilities: ● Signal nothing ● Activate a warning ● Activate a fault ● Activate a fault and warning
HMI	Fault and Warning control possibilities: ● Signal nothing ● Activate a warning ● Activate a fault ● Activate a fault and warning
Network	Fault and Warning control possibilities: ● Signal nothing ● Activate a warning ● Activate a fault ● Activate a fault and warning ● The behavior of the LO1 and LO2 relays depends on the motor controller mode and on the fallback strategy chosen

NOTE: For more information about a communication loss and the fallback strategy, refer to the Fallback Condition *(see page 47)* portion of the topic describing Communication Loss.

Appendices

What Is in This Appendix?

The appendix contains the following chapters:

Appendix A
Technical Data

Overview

This appendix presents technical data related to the LTM R controller and the LTM E expansion module.

What Is in This Chapter?

This chapter contains the following topics:

Technical Specifications of the LTM R Controller

Technical Specifications

The LTM R controller meets the following specifications:

Certification[1]	UL, CSA, CE, CTIC'K, CCC, NOM, GOST, IACS E10 (BV, LROS, DNV, GL, RINA, ABS, RMRos), ATEX		
Conformity to Standards	IEC/EN 60947-4-1, UL 508, CSA C22.2 no.14, IACS E10		
European Community directives	CE marking, satisfies the essential requirements of the low voltage (LV) machinery 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 UL508, CSA C22-2 no. 14		690 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[2]		15 gn
Resistance to vibration	According to IEC60068-2-6[2]	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
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 EN610-4-6[3]		10 V rms level 3

(1) Some certifications are in progress.
(2) Without modifying the state of the contacts in the least favorable direction.
(3) 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.

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)
(1) Some certifications are in progress. (2) Without modifying the state of the contacts in the least favorable direction. (3) 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 Characteristics

The LTM R 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	0V < 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

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 LTM E Expansion Module

Technical Specifications

The LTM E expansion module meets the following specifications:

Certifications[1]	UL, CSA, CE, CTIC'K, CCC, NOM, GOST, IACS E10 (BV, LROS, DNV, GL, RINA, ABS, RMRos), ATEX		
Conformity to Standards	IEC/EN 60947-4-1, UL 508 - CSA C22-2, IACSE10		
European Community directives	CE marking. Satisfies the essential requirements of the low voltage (LV) machinery 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 UL508, CSA C22-2 no. 14		690 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
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[2]	>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[3]		30 g 3 axis and 6 directions
Resistance to vibration	According to IEC60068-2-6[3]		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		10V/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

(1) Some certifications are in progress.
(2) he maximum rated ambient temperature of the LTM E expansion module depends on the installation spacing with the LTM R controller.
(3) Without modifying the state of the contacts in the least favorable direction.
(4) 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.

Immunity to radioelectric fields	According to EN61000-4-6[(4)]		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)	–

(1) Some certifications are in progress.
(2) he maximum rated ambient temperature of the LTM E expansion module depends on the installation spacing with the LTM R controller.
(3) Without modifying the state of the contacts in the least favorable direction.
(4) 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.

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	0V < V < 40 V
		Current	15 mA maximum	15 mA maximum
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[1]	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 to 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
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 %	No
Reactive power consumption (kVARh)	+/– 15 %	No
(1) Note: The accuracy levels presented in this table are typical accuracy levels. Actual accuracy levels may be lower or greater than these values.		

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

TeSys® D IEC Contactors

Catalog references and characteristics for TeSys® D IEC contactors are listed in the table below. 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
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 table below. Coil voltages are grouped according to whether an interposing relay is required:

<table>
<tr><th rowspan="2">TeSys® F catalog references</th><th rowspan="2">Control Circuit Frequency (Hz)</th><th rowspan="2">VA or W maintained (max)</th><th colspan="2">Coil voltages</th></tr>
<tr><th>interposing relay not required</th><th>interposing relay required</th></tr>
<tr><td rowspan="3">LC1F115</td><td>50</td><td>45</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240</td><td>AC = 380/400, 415/440, 500, 660, 1000</td></tr>
<tr><td rowspan="2">60</td><td>45</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240, 265/277, 380, 415, 460/480, 660, 1000</td><td></td></tr>
<tr><td>5</td><td></td><td>DC = 24, 48, 110, 125, 220/230, 250, 440/460</td></tr>
<tr><td rowspan="3">LC1F150</td><td>50</td><td>45</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240</td><td>AC = 380/400, 415/440, 500, 660, 1000</td></tr>
<tr><td rowspan="2">60</td><td>45</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240, 265/277, 380, 415, 460/480, 660, 1000</td><td></td></tr>
<tr><td>5</td><td></td><td>DC = 24, 48, 110, 125, 220/230, 250, 440/460</td></tr>
<tr><td rowspan="3">LC1F185(1)</td><td>50</td><td>55</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240</td><td>AC = 380/400, 415/440, 500, 660, 1000</td></tr>
<tr><td rowspan="2">60</td><td>55</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240, 265/277, 380, 415, 460/480, 660, 1000</td><td></td></tr>
<tr><td>5</td><td></td><td>DC = 24, 48, 110, 125, 220/230, 250, 440/460</td></tr>
<tr><td rowspan="3">LC1F225(1)</td><td>50</td><td>55</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240</td><td>AC = 380/400, 415/440, 500, 660, 1000</td></tr>
<tr><td rowspan="2">60</td><td>55</td><td>AC = 24, 42, 48, 110/115, 127, 220/230, 240</td><td>AC = 265/277, 380, 415, 460/480, 660, 1000</td></tr>
<tr><td>5</td><td></td><td>DC = 24, 48, 110, 125, 220/230, 250, 440/460</td></tr>
</table>

TeSys® F catalog references	Control Circuit Frequency (Hz)	VA or W maintained (max)	Coil voltages	
			interposing relay not required	interposing relay required
LC1F265	40...400(2)	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, 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

(1) Dual-parallel contactors of this size require an interposing relay.

(2) 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 Type S Contactors

Catalog references and characteristics for NEMA Type S contactors are listed in the table below. Coil voltages are grouped according to whether an interposing relay is required:

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			
	89		115, 120, 208, 220, 240	277, 380, 440, 480, 550, 600
4				
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				

Appendix B
Configurable Parameters

Overview

The configurable parameters for the LTM R controller and the LTM E expansion module are described below. The sequence of parameter configuration depends on the configuration tool utilized, either an HMI device or SoMove with the TeSys T DTM.

Parameters are grouped according to the TeSys T DTM **parameter list** tab. To help you find the link with the variable tables in the Use chapter, each parameter has its corresponding register number attached.

⚠ WARNING
RISK OF UNINTENDED CONFIGURATION AND OPERATION When modifying parameter settings of the LTM R controller: ● Be especially careful if you change parameter settings when the motor is running. ● Disable network control of the LTM R controller to prevent unintended parameter configuration and operation. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

What Is in This Chapter?

This chapter contains the following topics:

Main Settings

Phases

Parameter	Setting Range	Factory Setting
Motor phases	• 3-phase motor • single-phase motor	3-phase motor

Operating Mode

Parameter	Setting Range	Factory Setting
Motor operating mode	• Overload 2-wire • Overload 3-wire • Independent 2-wire • Independent 3-wire • Reverser 2-wire • Reverser 3-wire • Two-step 2-wire • Two-step 3-wire • Two-speed 2-wire • Two-speed 3-wire • Custom	Independent 3-wire
Motor star-delta	0 = disabled 1 = enabled	0

Contactor

Parameter	Setting Range	Factory Setting
Contactor rating	1...1,000 A in increments of 0.1 A	810 A

Motor

Parameter	Setting Range	Factory Setting
Motor nominal voltage	110…690 V	400 V
Motor nominal power	0.134...1339.866 HP	10.05 HP
Motor nominal power	0.1...999.9 kW in increments of 0.1 kW	7.5 kW
Motor auxiliary fan cooled	• Disable • Enable	Disable
Motor full load current ratio (FLC1)	5...100 % FLCmax in increments of 1 %	5 % FLCmax
Motor full load current	–	–
Motor high speed full load current ratio (FLC2)	5...100 % FLCmax in increments of 1 %	5 % FLCmax
Motor high speed full load current (FLC2)	0...100 A in increments of 1 A	5 A

Load Current Transformer

Parameter	Setting Range	Factory Setting
Load CT primary	1...65,535 in increments of 1	1
Load CT secondary	1...500 in increments of 1	1
Load CT multiple passes	1...100 passes in increments of 1	1

Ground Current Transformer

Parameter	Setting Range	Factory Setting
Ground current mode	• Internal • External	Internal
Ground CT primary	1...65,535 in increments of 1	1
Ground CT secondary	1...65,535 in increments of 1	1

Control

Operating Mode

Parameter	Setting Range	Factory Setting
Control direct transition	On / Off	Off
Motor transition timeout	0...999.9 s	1 s
Motor Step 1 to 2 threshold	20...800 % FLC in increments of 1 %	150 % FLC
Motor Step 1 to 2 timeout	0.1...999.9 s	5 s

Inputs/Outputs

Parameter	Setting Range	Factory Setting
Controller AC logic inputs configuration	• Unknown • Lower than 170V 50Hz • Lower than 170V 60Hz • Greater than 170V 50Hz • Greater than 170V 60Hz	Unknown
Logic input 3 external ready enable	• Disable • Enable	Disable

Rapid Cycle

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

Local/Remote Control

Parameter	Setting Range	Factory Setting
Control remote channel setting	• Network • Terminal strip • HMI	Network
Control local channel setting	• Terminal strip • HMI	Terminal strip
Control transfer mode	• Bump • Bumpless	Bump
Control remote local buttons enable	• Disable • Enable	Disable
Control remote local default mode	• Remote • Local	Remote
Stop HMI disable	• Enable • Disable	Disable
Stop terminal strip disable	• Enable • Disable	Disable

Diagnostic

Parameter	Setting Range	Factory Setting
Diagnostic fault enable	• Disable • Enable	Enable
Diagnostic warning enable	• Disable • Enable	Enable
Wiring fault enable	• Disable • Enable	Enable
Motor phases sequence	• A B C • A C B	A B C

Fault and Warning

Parameter	Setting Range	Factory Setting
Fault reset mode	• Manual or HMI • Remote by network • Automatic	Manual or HMI
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...9,999 s in increments of 1 s	480 s
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 in increments of 1 s	1,200 s
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 in increments of 1 s	60 s

Communication

Network Port

Parameter	Setting Range	Factory Setting
Network port address setting	1...247	1
Network port baud rate setting	• 1200 • 2400 • 4800 • 9600 • 19,200 • Self detection	Self detection
Network port parity setting	• None • Even • Odd	Even
Network port endian setting	• LSW first (little endian) • MSW first (big endian)	MSW first (big endian)
Network port comm loss timeout	0.01...99.99 s in increments of 0.01 s	60 s
Network port fallback setting	• Hold LO1 LO2 • Run (2-step) or off • LO1, LO2 off • LO1, LO2 on (ovl, ind, cust) or off • LO1 on or off (2-step) • LO2 on or off (2-step)	LO1, LO2 off
Network port fault enable	• Disable • Enable	Disable
Network port warning enable	• Disable • Enable	Disable
Config via network port enable	• Forbidden • Allowed	Allowed

HMI Port

Parameter	Setting Range	Factory Setting
HMI port address setting	1...247	1
HMI port baud rate setting	• 4800 • 9600 • 19,200 • Self detection	19,200 bits/s
HMI port parity setting	• None • Even	Even
HMI port endian setting	• LSW first (little endian) • MSW first (big endian)	MSW first (big endian)
HMI port fallback setting	• Hold LO1 LO2 • Run (2-step) or off • LO1, LO2 off • LO1, LO2 on (ovl, ind, cust) or off • LO1 on or off (2-step) • LO2 on or off (2-step)	LO1, LO2 off
HMI port fault enable	• Disable • Enable	Disable
HMI port warning enable	• Disable • Enable	Disable
Config via HMI engineering tool enable	• Forbidden • Allowed	Allowed
Config via HMI keypad enable	• Forbidden • Allowed	Allowed

Thermal

Thermal Overload

Parameter	Setting Range	Factory Setting
Thermal overload mode	• Definite • Inverse thermal	Inverse thermal
Motor trip class	• Motor class 5 • Motor class 10 • Motor class 15 • Motor class 20 • Motor class 25 • Motor class 30	Motor class 5
Thermal overload fault enable	• Disable • Enable	Enable
Thermal overload fault reset threshold	35...95 % in increments of 1 %	75 %
Thermal overload warning enable	• Disable • Enable	Enable
Thermal overload warning threshold	10...100 % in increments of 1 %	85 %
Long start fault timeout	1...200 s in increments of 1 s	10 s
Thermal overload fault enable	• Disable • Enable	Enable
Thermal overload fault definite timeout	1...300 s in increments of 1 s	10 s
Thermal overload warning enable	• Disable • Enable	Enable

Motor Temperature

Parameters	Setting range	Factory setting
Motor temperature sensor type	• None • PTC binary • PT100 • PTC analog • NTC analog	None
Motor temperature sensor fault enable	• Disable • Enable	Disable
Motor temperature sensor fault threshold	20...6,500 Ω	20 Ω
Motor temperature sensor fault threshold degree	0...200 °C	0 °C
Motor temperature sensor warning enable	• Disable • Enable	Disable
Motor temperature sensor warning threshold	20...6,500 Ω	20 Ω
Motor temperature sensor warning threshold degree	0...200 °C	0 °C

Current

Ground Current

Parameters	Setting range	Factory setting
Ground current disable while motor starting	• No • Yes	No
Ground current fault enable	• Disable • Enable	Enable
Internal ground current fault threshold	20...500 % FLCmin in increments of 1 %	30 % FLCmin
Internal ground current fault timeout	0.5...25 s in increments of 0.1 s	1 s
External ground current fault threshold	0.01...20 A in increments of 0.01 A	1 A
External ground current fault timeout	0.1...25 s in increments of 0.01 s	0.5 s
Ground Current warning enable	• Disable • Enable	Enable
Internal ground current warning threshold	50...500 % FLCmin in increments of 1 %	50 % FLCmin
External ground current warning threshold	0.01...20 A in increments of 0.01 A	1 A

Phases

Parameters	Setting range	Factory setting
Current phase imbalance fault enable	• Disable • Enable	Enable
Current phase imbalance fault threshold	10...70 % in increments of 1 %	10 %
Current phase imbalance fault timeout starting	0.2...20 s in increments of 0.1 s	0.7 s
Current phase imbalance fault timeout running	0.2...20 s in increments of 0.1 s	5 s
Current phase imbalance warning enable	• Disable • Enable	Disable
Current phase imbalance warning threshold	10...70 % in increments of 1 %	10 %
Current phase loss fault enable	• Disable • Enable	Enable
Current phase loss timeout	0.1...30 s in increments of 0.1 s	3 s
Current phase loss warning enable	• Disable • Enable	Enable
Current phase reversal fault enable	• Disable • Enable	Disable

Long Start

Parameters	Setting range	Factory setting
Long start fault enable	• Disable • Enable	Enable
Long start fault threshold	100...800 % FLC in increments of 1 %	100 % FLC
Long start fault timeout	1...200 s in increments of 1 s	10 s

Jam

Parameters	Setting range	Factory setting
Jam fault enable	• Disable • Enable	Enable
Jam fault threshold	100...800 % FLC in increments of 1 %	200 % FLC
Jam fault timeout	1...30 s in increments of 1 s	5 s
Jam warning enable	• Disable • Enable	Disable
Jam warning threshold	100...800 % FLC in increments of 1 %	200 % FLC

Undercurrent

Parameters	Setting range	Factory setting
Undercurrent Fault Enable	• Disable • Enable	Disable
Undercurrent Fault Threshold	30...100 % FLC in increments of 1 %	50 % FLC
Undercurrent Fault Timeout	1...200 s in increments of 1 s	10 s
Undercurrent Warning Enable	• Disable • Enable	Disable
Undercurrent Warning Threshold	30...100 % FLC in increments of 1 %	50 % FLC

Overcurrent

Parameters	Setting range	Factory setting
Overcurrent fault enable	• Disable • Enable	Disable
Overcurrent Fault Threshold	20...800 % FLC in increments of 1 %	200 % FLC
Overcurrent fault timeout	1...250 s in increments of 1 s	10 s
Overcurrent warning enable	• Disable • Enable	Disable
Overcurrent warning threshold	20...800 % FLC in increments of 1 %	200 % FLC

Voltage

Phases

Parameters	Setting range	Factory setting
Voltage phase imbalance fault enable	● Disable ● Enable	Disable
Voltage phase imbalance fault threshold	3...15 % of the calculated imbalance in increments of 1 %	10 % imbalance
Voltage phase imbalance fault timeout starting	0.2...20 s in increments of 1 s	0.7 s
Voltage phase imbalance fault timeout running	0.2...20 s in increments of 1 s	2 s
Voltage phase imbalance warning enable	● Disable ● Enable	Disable
Voltage phase imbalance warning threshold	3...15 % of the calculated imbalance in increments of 1 %	10 % imbalance
Voltage phase loss fault enable	● Disable ● Enable	Disable
Voltage phase loss fault timeout	0.1...30 s in increments of 0.1 s	3 s
Voltage phase loss warning enable	● Disable ● Enable	Disable
Voltage phase reversal fault enable	● Disable ● Enable	Disable

Undervoltage

Parameters	Setting range	Factory setting
Undervoltage fault enable	● Disable ● Enable	Disable
Undervoltage fault threshold	70...99 % of Motor nominal voltage in increments of 1 %	85 % of Motor nominal voltage
Undervoltage fault timeout	0.2...25 s in increments of 0.1 s	3 s
Undervoltage warning enable	● Disable ● Enable	Disable
Undervoltage warning threshold	70...99 % of Motor nominal voltage in increments of 1 %	85 % of Motor nominal voltage

Overvoltage

Parameters	Setting range	Factory setting
Overvoltage fault enable	● Disable ● Enable	Disable
Overvoltage fault threshold	101...115 % of Motor nominal voltage in increments of 1 %	110 % of Motor nominal voltage
Overvoltage fault timeout	0.2...25 s in increments of 0.1 s	3 s
Overvoltage warning enable	● Disable ● Enable	Disable
Overvoltage warning threshold	101...115 % of Motor nominal voltage in increments of 1 %	110 % of Motor nominal voltage

Voltage Dip

Parameters	Setting range	Factory setting
Voltage dip mode	• None • Load shedding • Auto-restart	None
Voltage dip threshold	50...115 % of Motor nominal voltage in increments of 1 %	65 % of Motor nominal voltage
Load shedding timeout	1...9999 s in increments of 1 s	10 s
Voltage dip restart threshold	65...115 % of Motor nominal voltage in increments of 1 %	90 % of Motor nominal voltage
Voltage dip restart timeout	0...9999 s in increments of 1 s	2 s
Voltage dip threshold	50...115 % of Motor nominal voltage in increments of 1 %	65 % of Motor nominal voltage
Voltage dip restart threshold	65...115 % of Motor nominal voltage in increments of 1 %	90 % of Motor nominal voltage
Voltage dip restart timeout	0...9999 s in increments of 1 s	2 s
Auto restart immediate timeout	0...0.4 s in increments of 0.1 s	0.2 s
Auto restart delayed timeout	0...301 s in increments of 1 s	4 s

Power

Underpower

Parameters	Setting range	Factory setting
Underpower fault enable	● Disable ● Enable	Disable
Underpower fault threshold	20...800 % of Motor nominal power in increments of 1 %	20 % of Motor nominal power
Underpower fault timeout	1...100 s in increments of 1 s	60 s
Underpower warning enable	● Disable ● Enable	Disable
Underpower warning threshold	20...800 % of Motor nominal power in increments of 1 %	30 % of Motor nominal power

Overpower

Parameters	Setting range	Factory setting
Overpower fault enable	● Disable ● Enable	Disable
Overpower fault threshold	20...800 % of Motor nominal power in increments of 1 %	150 % of Motor nominal power
Overpower fault timeout	1...100 s in increments of 1 s	60 s
Overpower warning enable	● Disable ● Enable	Disable
Overpower warning threshold	20...800 % of Motor nominal power in increments of 1 %	150 % of Motor nominal power

Under Power Factor

Parameters	Setting range	Factory setting
Under power factor fault enable	● Disable ● Enable	Disable
Under power factor fault threshold	0...1 in increments of 0.01	0.6
Under power factor fault timeout	1...25 s in increments of 0.1 s	10 s
Under power factor warning enable	● Disable ● Enable	Disable
Under power factor warning threshold	0...1 in increments of 0.01	0.6

Over Power Factor

Parameters	Setting range	Factory setting
Over power factor fault enable	● Disable ● Enable	Disable
Over power factor fault threshold	0...1 in increments of 0.01	0.9
Under power factor fault timeout	1...25 s in increments of 0.1 s	10 s
Over power factor warning enable	● Disable ● Enable	Disable
Over power factor warning threshold	0...1 in increments of 0.01	0.9

HMI

HMI Display

Parameter	Setting Range	Factory Setting
HMI language setting	–	English
HMI display contrast setting	0...255	127
HMI display brightness setting	0...255	127
HMI motor status LED color	● Red ● Green	Red

HMI Keyboard

Parameter	Setting Range	Factory Setting
Control remote local buttons enable	● Disable ● Enable	Disable
Stop HMI disable	● Yes ● No	No

HMI Display Scroll View

Parameter	Setting Range	Factory Setting
HMI display motor status enable	● Hidden ● Displayed	Hidden
HMI display date enable	● Hidden ● Displayed	Hidden
HMI display time enable	● Hidden ● Displayed	Hidden
HMI display operating time enable	● Hidden ● Displayed	Hidden
HMI display starts per hour enable	● Hidden ● Displayed	Hidden
HMI display I/O status enable	● Hidden ● Displayed	Hidden
HMI display control mode enable	● Hidden ● Displayed	Hidden
HMI display thermal capacity level enable	● Hidden ● Displayed	Hidden
HMI display thermal capacity remaining enable	● Hidden ● Displayed	Hidden
HMI display time to trip enable	● Hidden ● Displayed	Hidden
HMI motor temperature sensor enable	● Hidden ● Displayed	Hidden
HMI display temperature sensor degree CF	● °C ● °F	°C
HMI display average current enable	● Hidden ● Displayed	Displayed
HMI display L1 current enable	● Hidden ● Displayed	Hidden
HMI display L2 current enable	● Hidden ● Displayed	Hidden
HMI display L3 current enable	● Hidden ● Displayed	Hidden
HMI display average current ratio enable	● Hidden ● Displayed	Hidden
HMI display L1 current ratio enable	● Hidden ● Displayed	Hidden

Parameter	Setting Range	Factory Setting
LHMI display L2 current ratio enable	• Hidden • Displayed	Hidden
HMI display L3 current ratio enable	• Hidden • Displayed	Hidden
HMI display current phase imbalance enable	• Hidden • Displayed	Hidden
HMI display ground current enable	• Hidden • Displayed	Hidden
HMI display start statistics enable	• Hidden • Displayed	Hidden
HMI display average voltage enable	• Hidden • Displayed	Hidden
HMI display L1-L2 voltage enable	• Hidden • Displayed	Hidden
HMI display L2-L3 voltage enable	• Hidden • Displayed	Hidden
HMI display L3-L1 voltage enable	• Hidden • Displayed	Hidden
HMI display voltage phase imbalance enable	• Hidden • Displayed	Hidden
HMI display frequency enable	• Hidden • Displayed	Hidden
HMI display power factor enable	• Hidden • Displayed	Hidden
HMI display active power enable	• Hidden • Displayed	Hidden
HMI display reactive power enable	• Hidden • Displayed	Hidden
HMI display power consumption enable	• Hidden • Displayed	Hidden

Appendix C
Wiring Diagrams

Overview

The LTM R operating mode wiring diagrams can be drawn according to IEC or NEMA standards.

DANGER
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH ● Turn off all power supplying this equipment before working on it. ● Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. **Failure to follow these instructions will result in death or serious injury.**

NOTICE
LOGIC INPUTS DESTRUCTION HAZARD ● Connect the LTM R controller's inputs using the 3 Common (C) terminals connected to the A1 control voltage via an internal filter. ● Do not connect the Common (C) terminal to the A1 or A2 control voltage inputs. **Failure to follow these instructions can result in equipment damage.**

What Is in This Chapter?

This chapter contains the following sections:

Section C.1
IEC Format Wiring Diagrams

Overview

This section contains the wiring diagrams corresponding to the 5 pre-configured operating modes:

Overload	Monitoring of the motor load where control (start/stop) of the motor load is achieved by a mechanism other than the controller
Independent	Direct-on-line (across-the-line) full-voltage non-reversing motor starting applications
Reverser	Direct-on-line (across-the-line) full-voltage reversing motor starting applications
Two-Step	Reduced voltage starting motor applications, including: ● Wye-Delta ● Open Transition Primary Resistor ● Open Transition Autotransformer
Two-Speed	Two-speed motor applications for motor types, including: ● Dahlander (consequent pole) ● Pole Changer

Each application is described individually, with:

1 complete application diagram (including power and control)	3-wire (impulse) terminal strip control
3 partial diagrams (control logic input wiring variants)	2-wire (maintained) terminal strip control
	3-wire (impulse) terminal strip control with network control selectable
	2-wire (maintained) terminal strip control with network control selectable

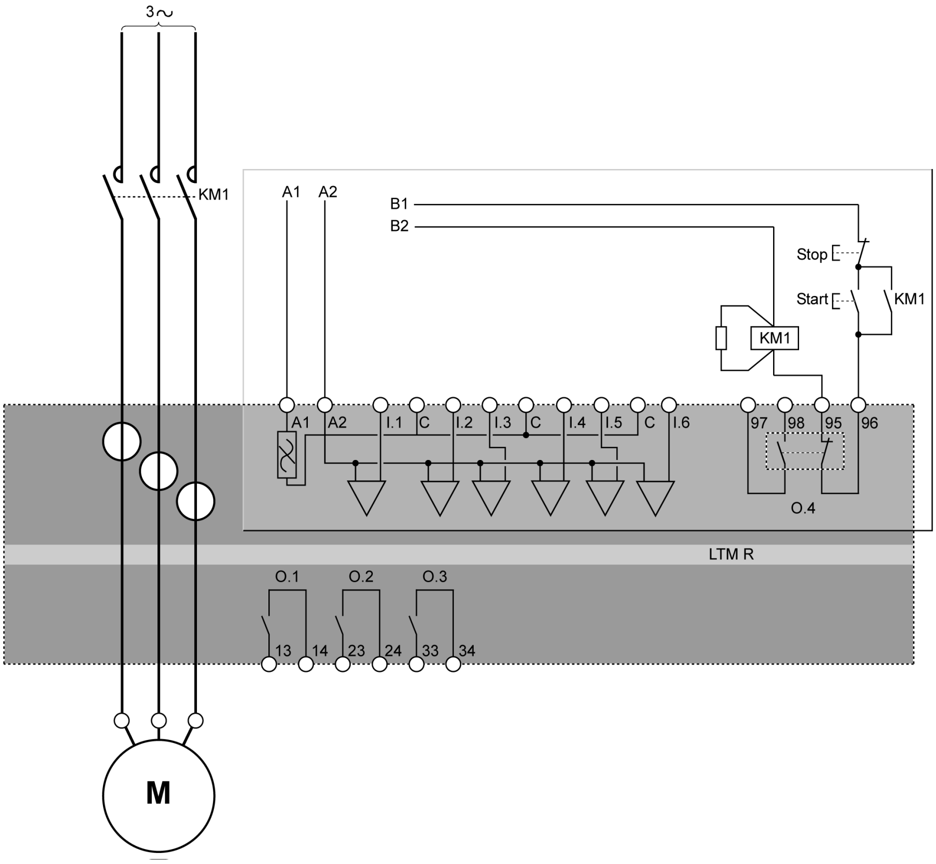
What Is in This Section?

This section contains the following topics:

Overload Mode Wiring Diagrams

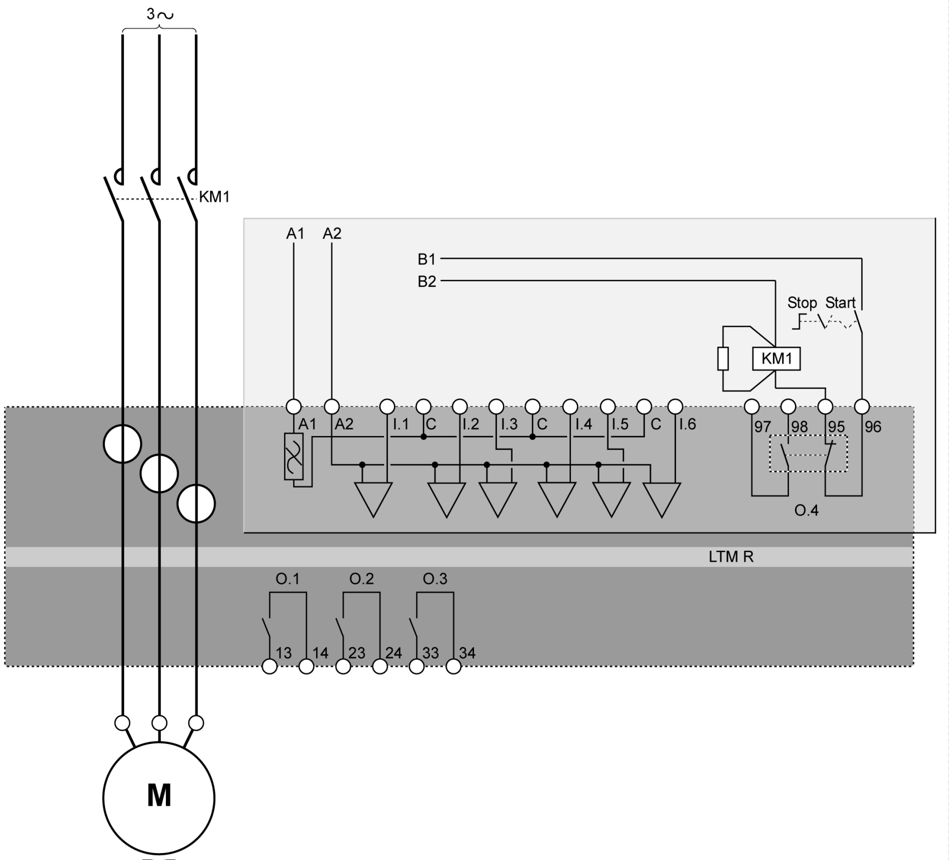
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



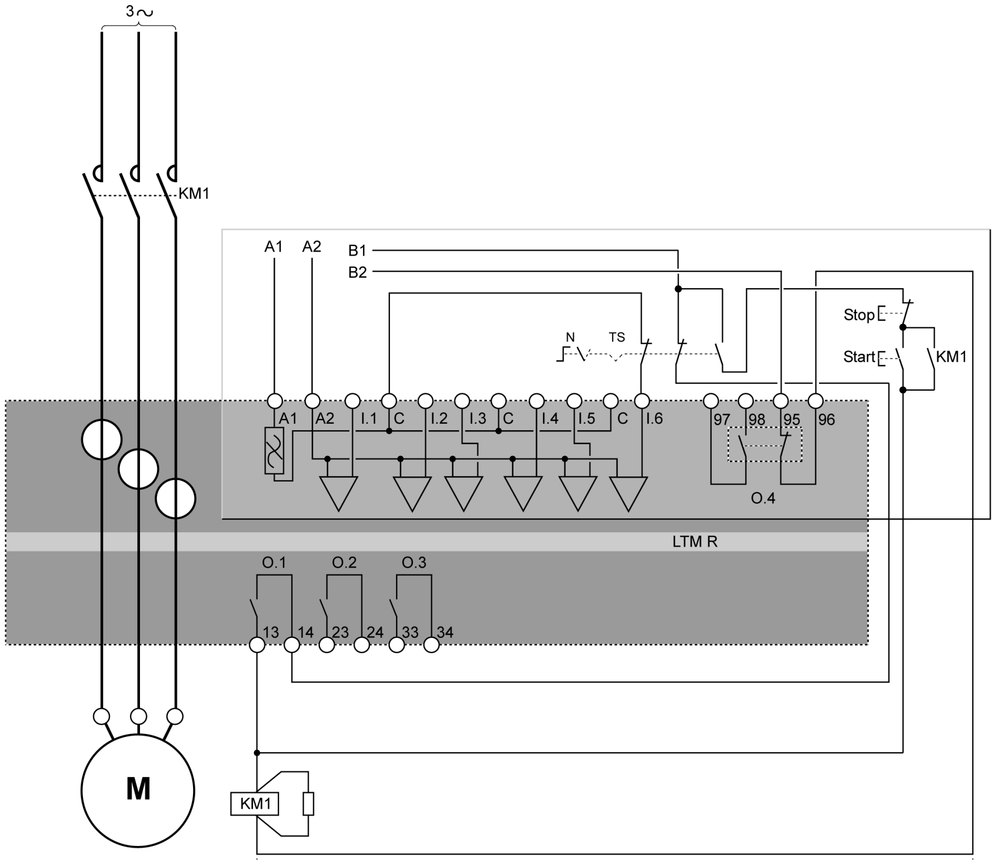
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

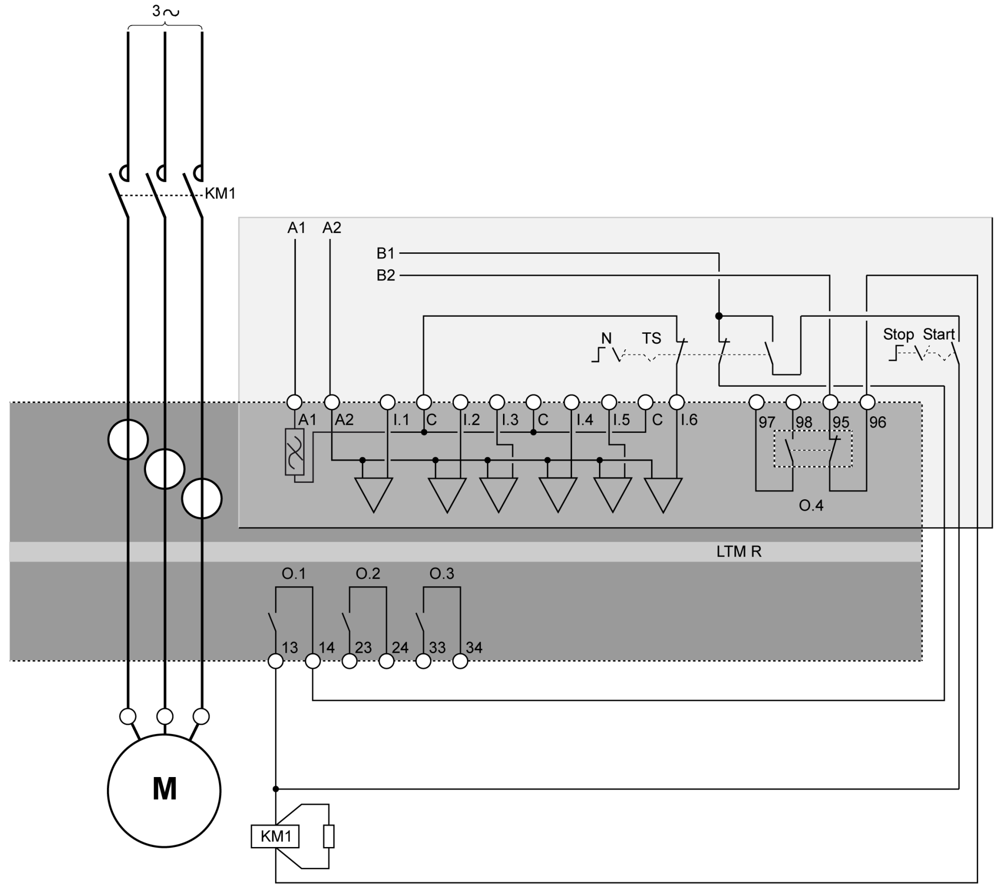
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



N Network
TS Terminal strip

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

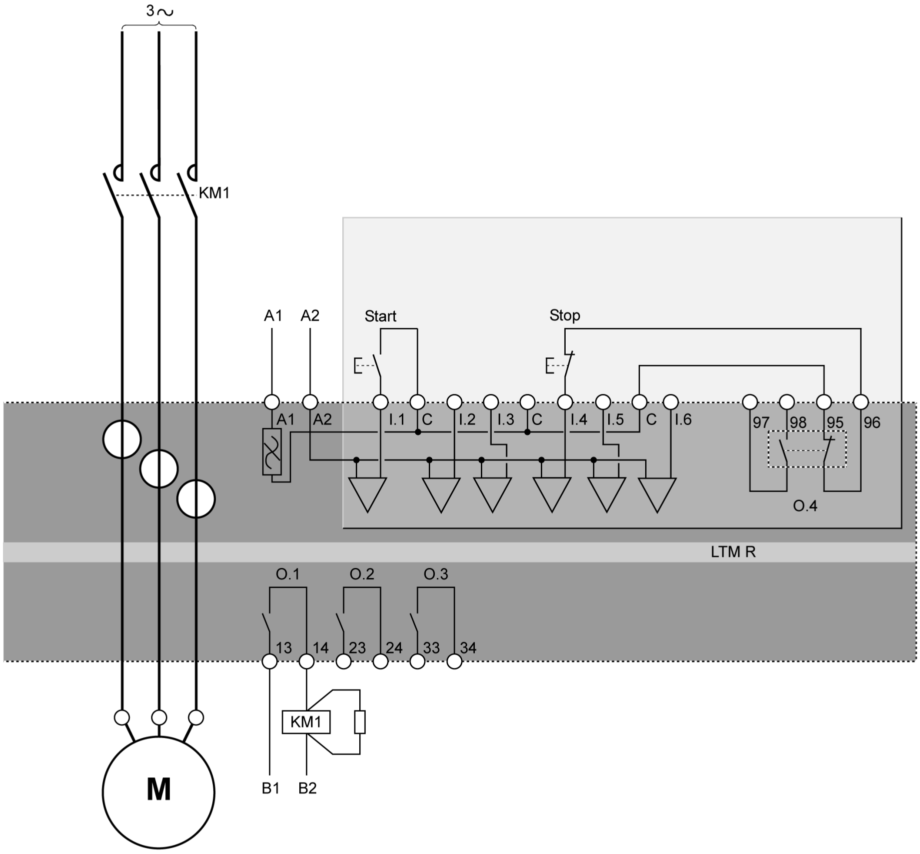


N Network
TS Terminal strip

Independent Mode Wiring Diagrams

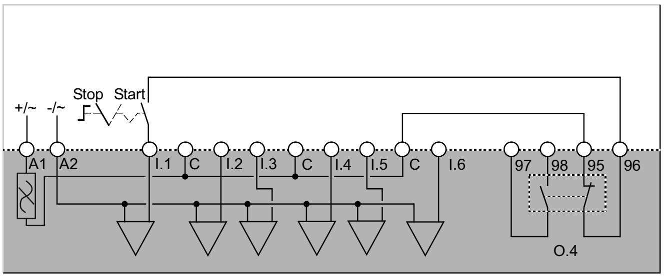
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



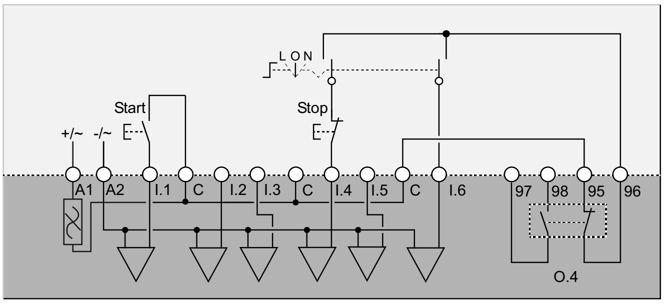
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

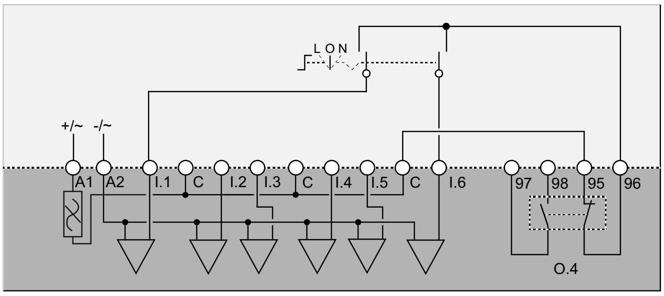
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

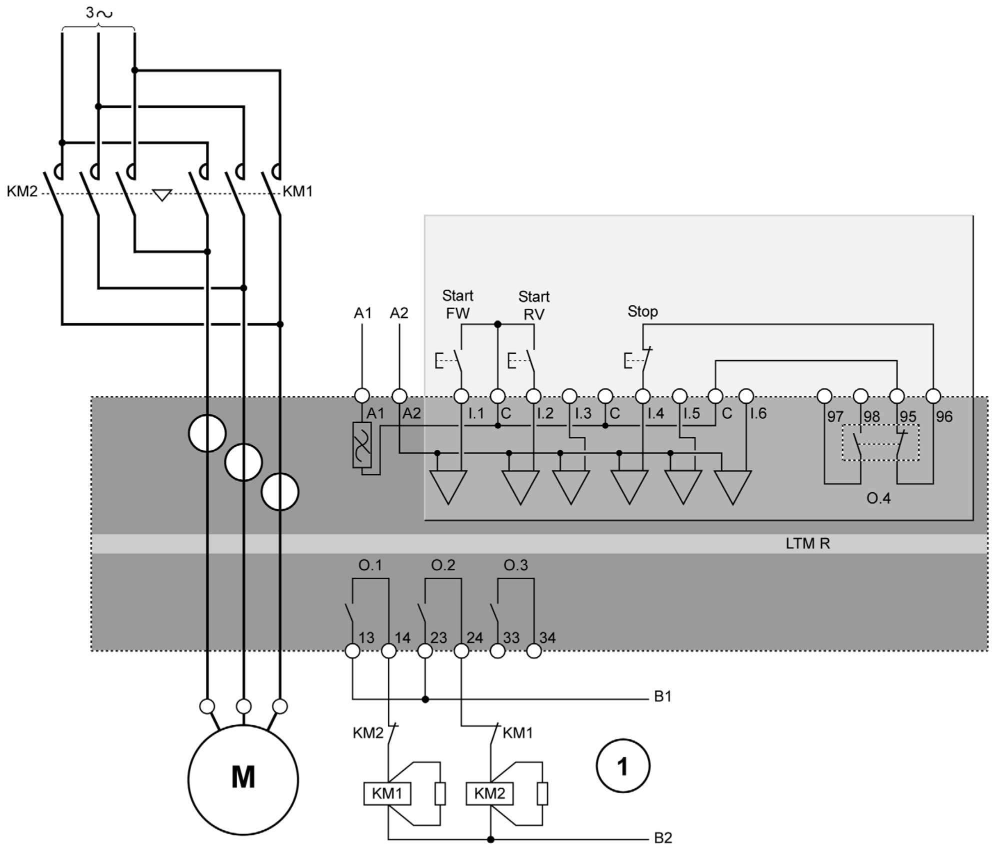


L Terminal strip control
O Off
N Network control

Reverser Mode Wiring Diagrams

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

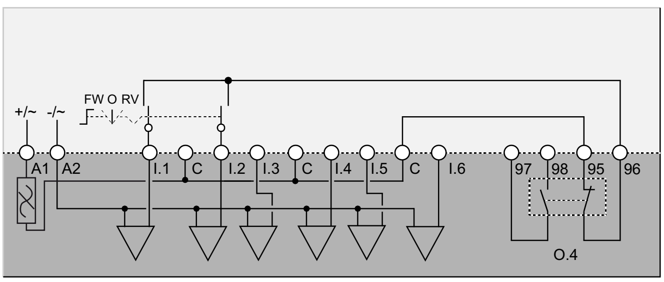
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



Start FW Start forward
Start RV Start reverse
1 The N.C. interlock contacts KM1 and KM2 are not mandatory because the controller electronically interlocks O.1 and O.2.

Application Diagram with 2-Wire (Maintained) Terminal Strip Control

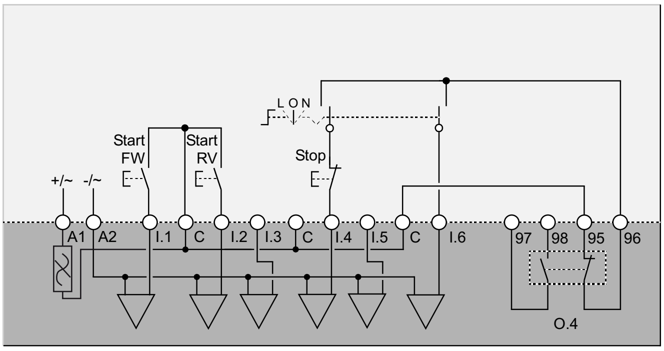
The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



FW Forward
O Off
RV Reverse

Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

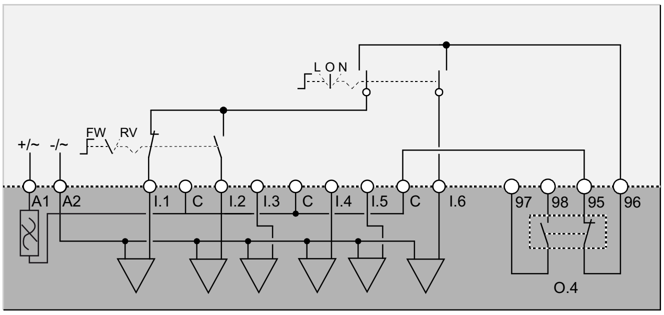
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control
Start FW Start forward
Start RV Start reverse

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

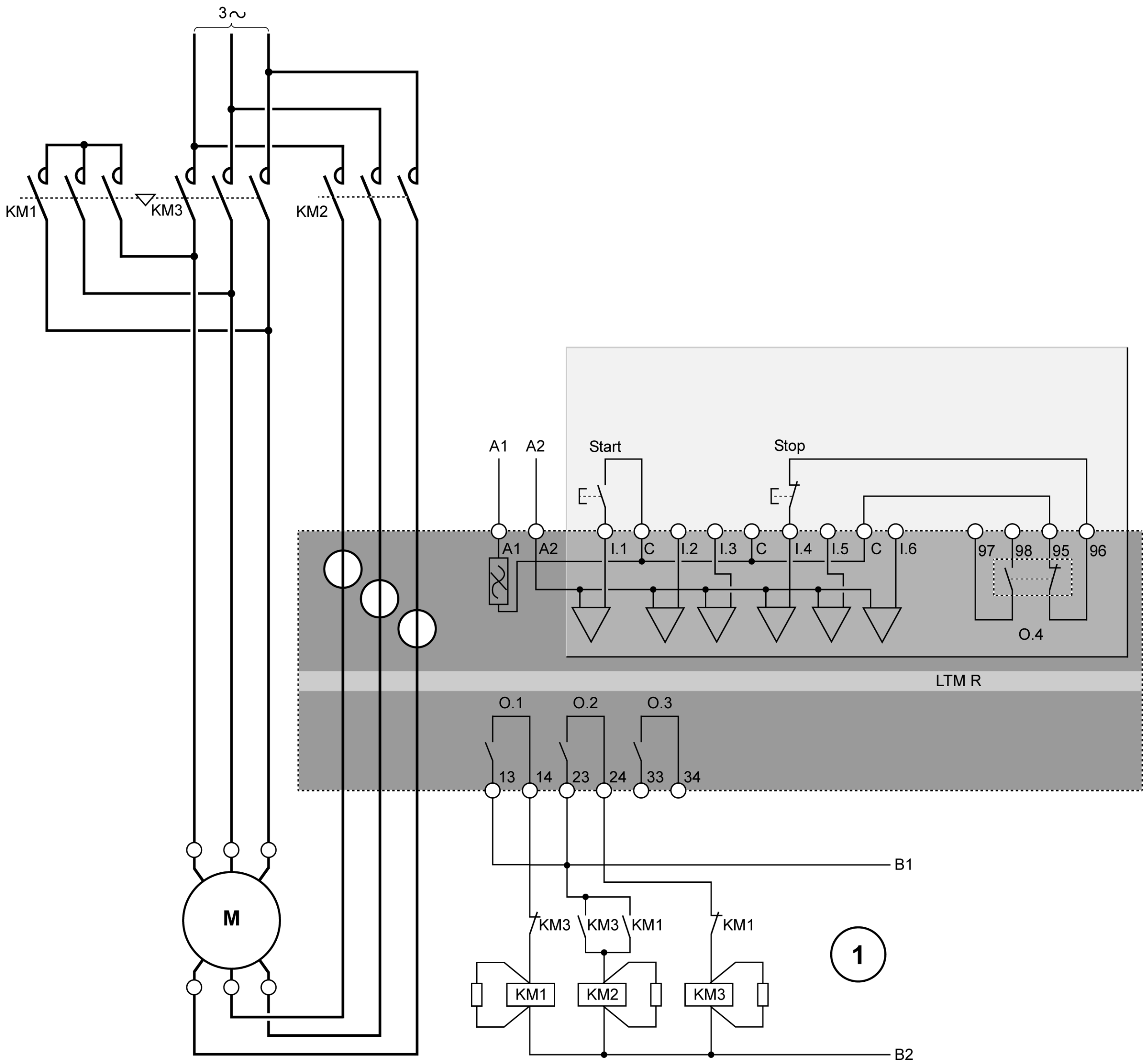


L Terminal strip control
O Off
N Network control
FW Forward
RV Reverse

Two-Step Wye-Delta Mode Wiring Diagrams

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

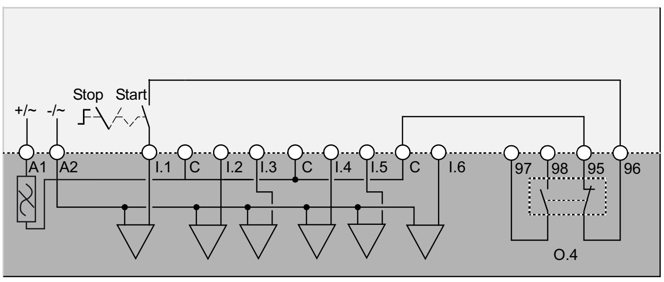
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



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

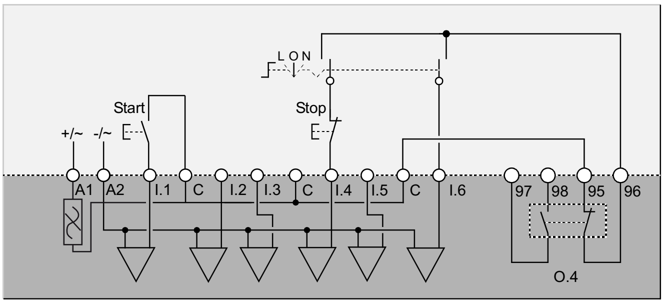
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

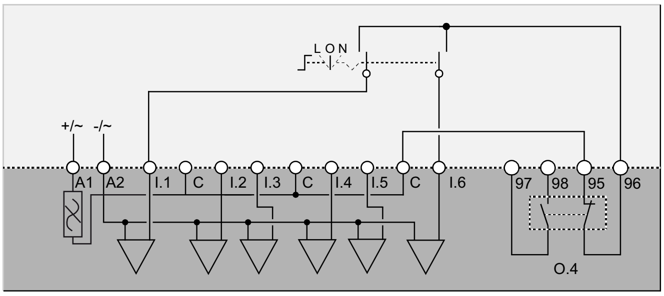
The following application diagram features 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

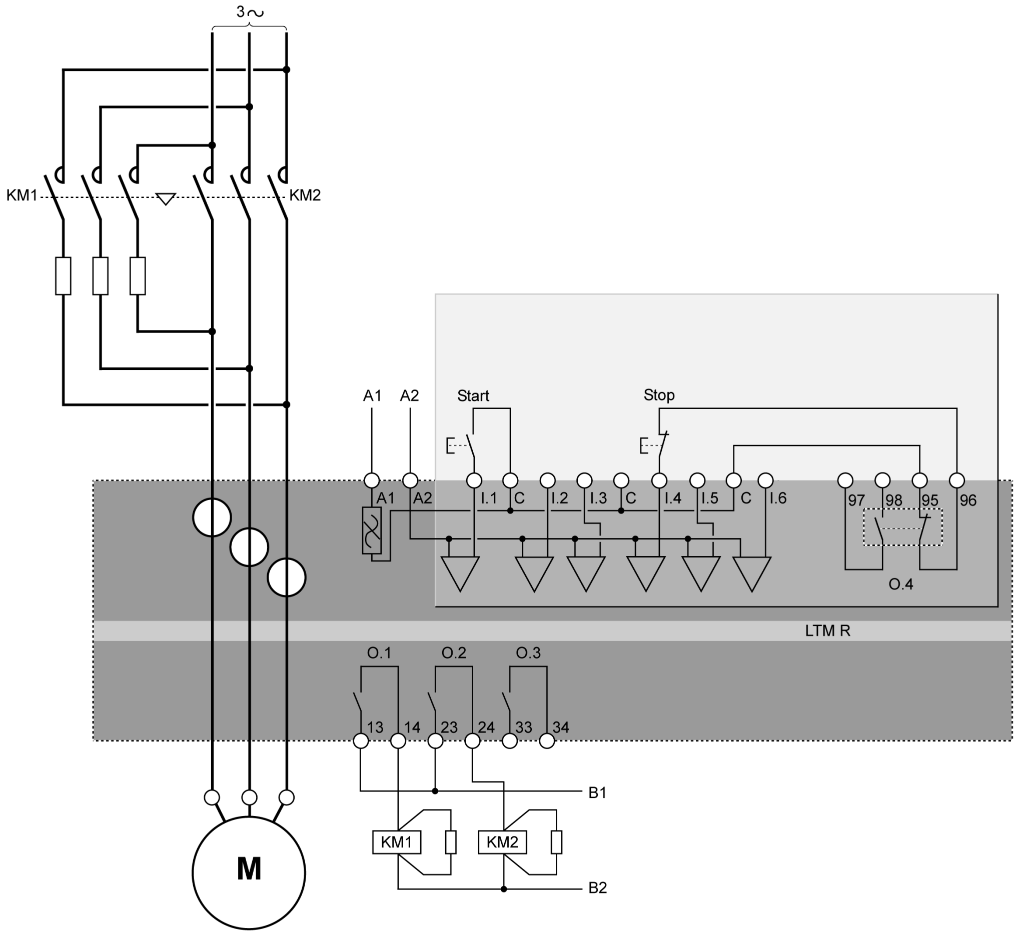


L Terminal strip control
O Off
N Network control

Two-Step Primary Resistor Mode Wiring Diagrams

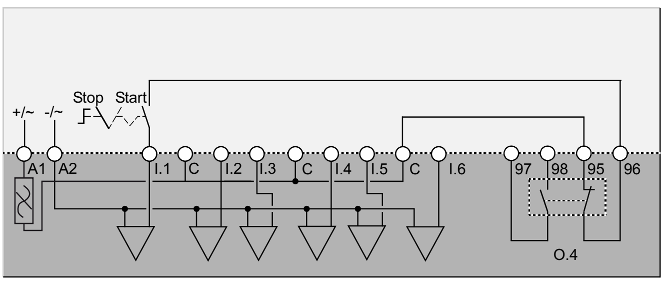
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



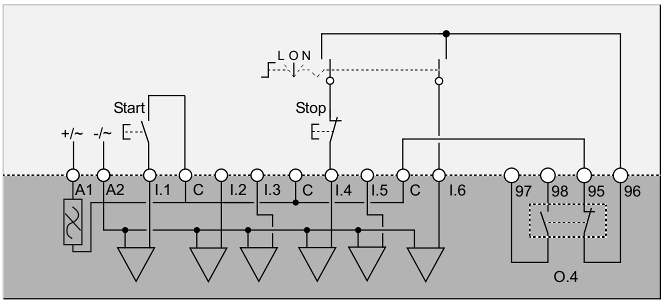
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

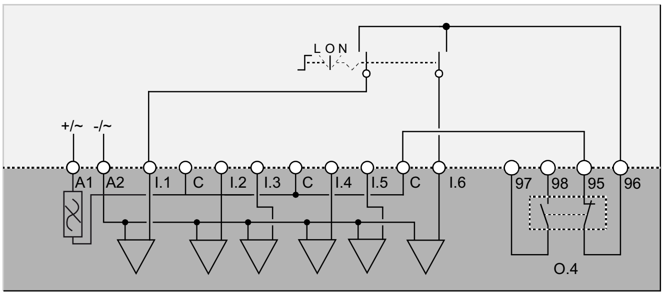
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

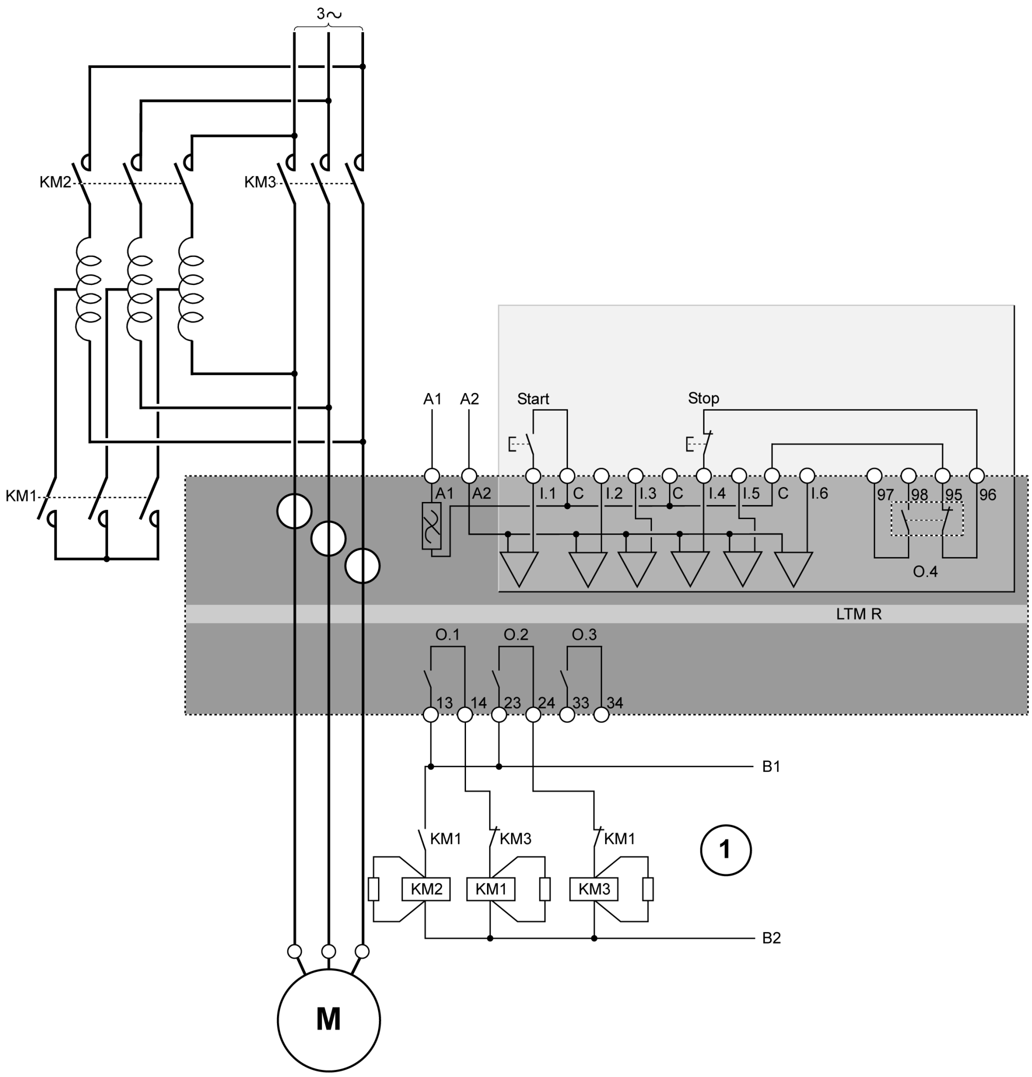


L Terminal strip control
O Off
N Network control

Two-Step Autotransformer Mode Wiring Diagrams

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

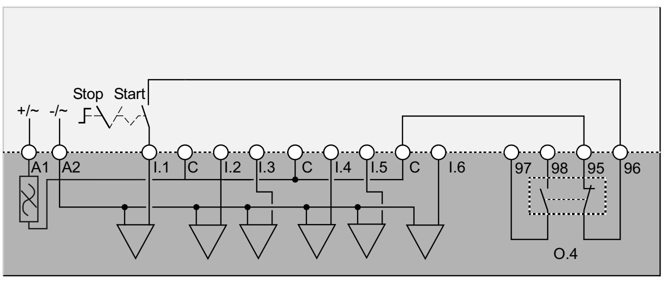
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



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

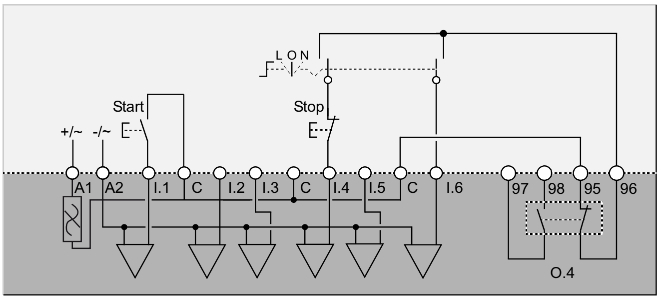
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

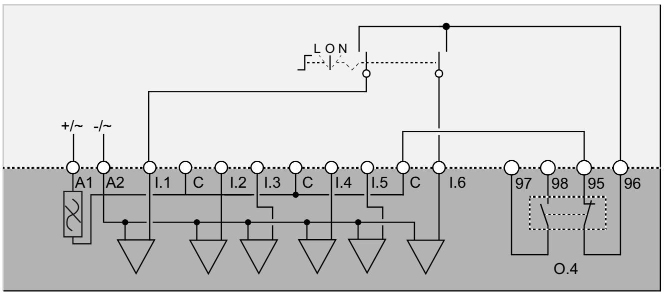
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

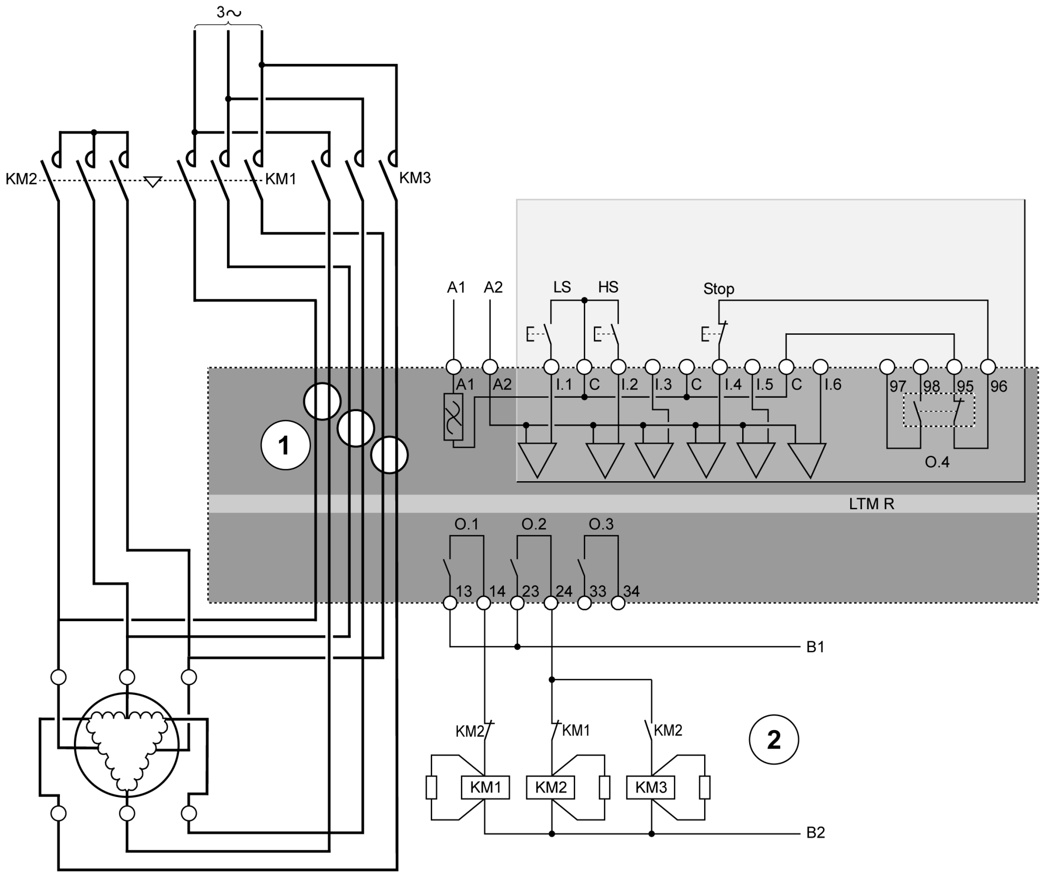


L Terminal strip control
O Off
N Network control

Two-Speed Dahlander Mode Wiring Diagrams

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

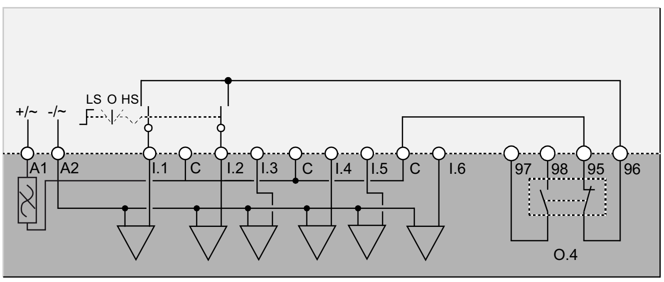
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



LS Low speed
HS High speed
1 A Dahlander application requires 2 sets of wires passing through the CT windows. The 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 controller electronically interlocks O.1 and O.2.

Application Diagram with 2-Wire (Maintained) Terminal Strip Control

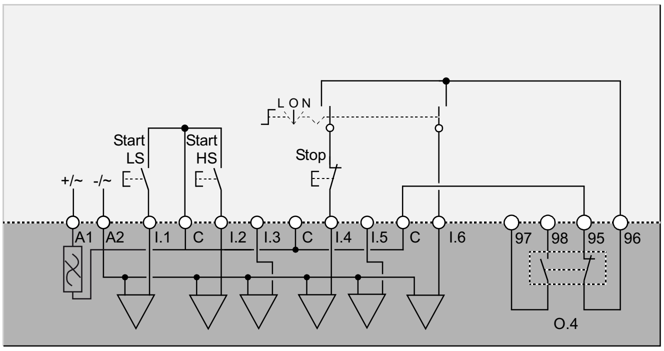
The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



LS Low speed
O Off
HS High speed

Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

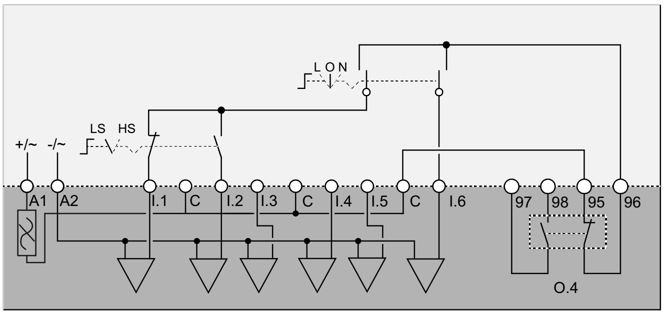
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control
LS Low speed
HS High speed

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

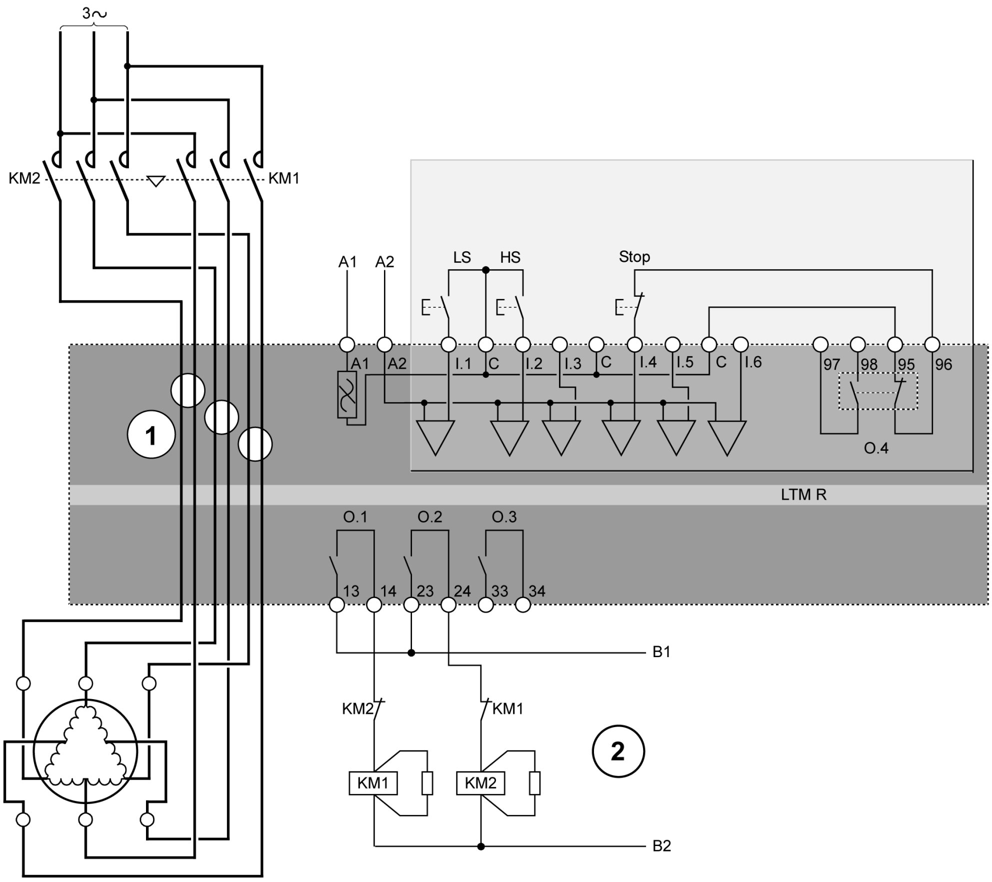


L Terminal strip control
O Off
N Network control
LS Low speed
HS High speed

Two-Speed Pole Changing Mode Wiring Diagrams

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

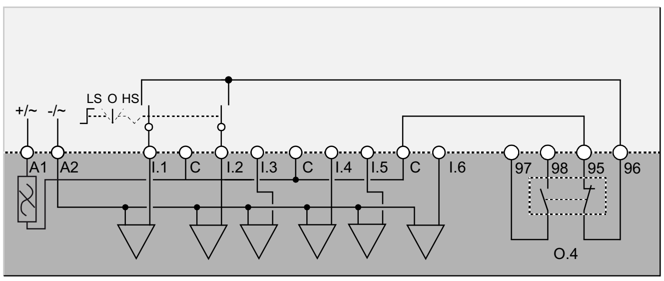
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



LS Low speed
HS High speed
1 A pole-changing application requires 2 sets of wires passing through the CT windows. The 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 controller firmware interlocks O.1 and O.2.

Application Diagram with 2-Wire (Maintained) Terminal Strip Control

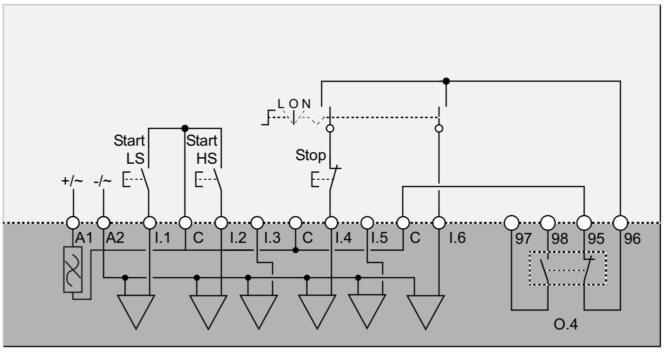
The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



LS Low speed
O Off
HS High speed

Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

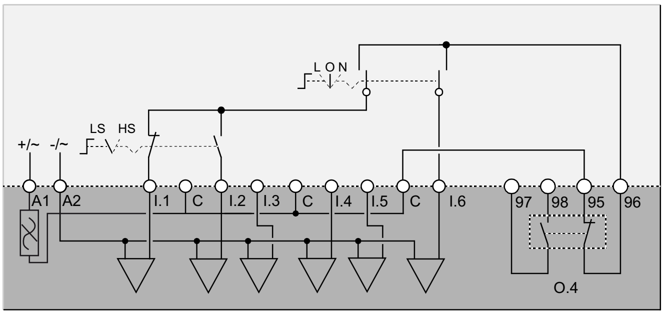
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control
Start LS Start Low speed
Start HS Start High speed

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:



L Terminal strip control
O Off
N Network control
LS Low speed
HS High speed

Section C.2
NEMA Format Wiring Diagrams

Overview

This section contains the wiring diagrams corresponding to the 5 pre-configured operating modes:

Overload	Monitoring of the motor load where control (start/stop) of the motor load is achieved by a mechanism other than the controller
Independent	Direct-on-line (across-the-line) full-voltage non-reversing motor starting applications
Reverser	Direct-on-line (across-the-line) full-voltage reversing motor starting applications
Two-Step	Reduced voltage starting motor applications, including: ● Wye-Delta ● Open Transition Primary Resistor ● Open Transition Autotransformer
Two-Speed	Two-speed motor applications for motor types, including: ● Dahlander (consequent pole) ● Pole Changer

Each application is described individually, with:

1 complete application diagram (including power and control)	3-wire (impulse) terminal strip control
3 partial diagrams (control logic input wiring variants)	2-wire (maintained) terminal strip control
	3-wire (impulse) terminal strip control with network control selectable
	2-wire (maintained) terminal strip control with network control selectable

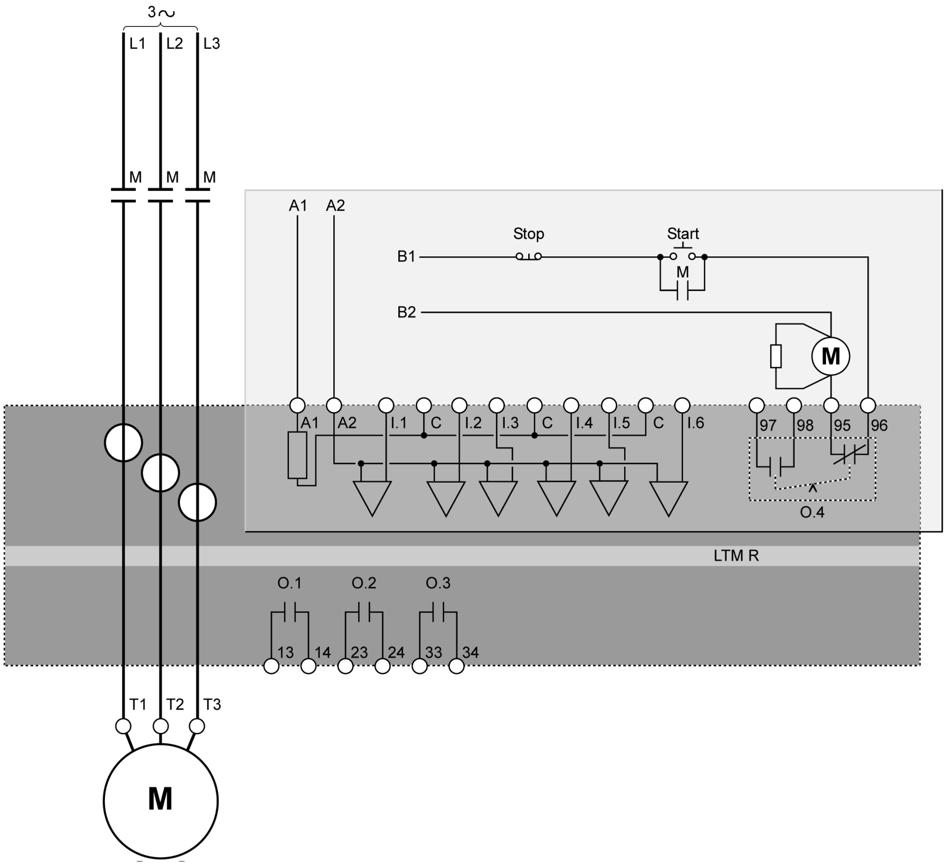
What Is in This Section?

This section contains the following topics:

Overload Mode Wiring Diagrams

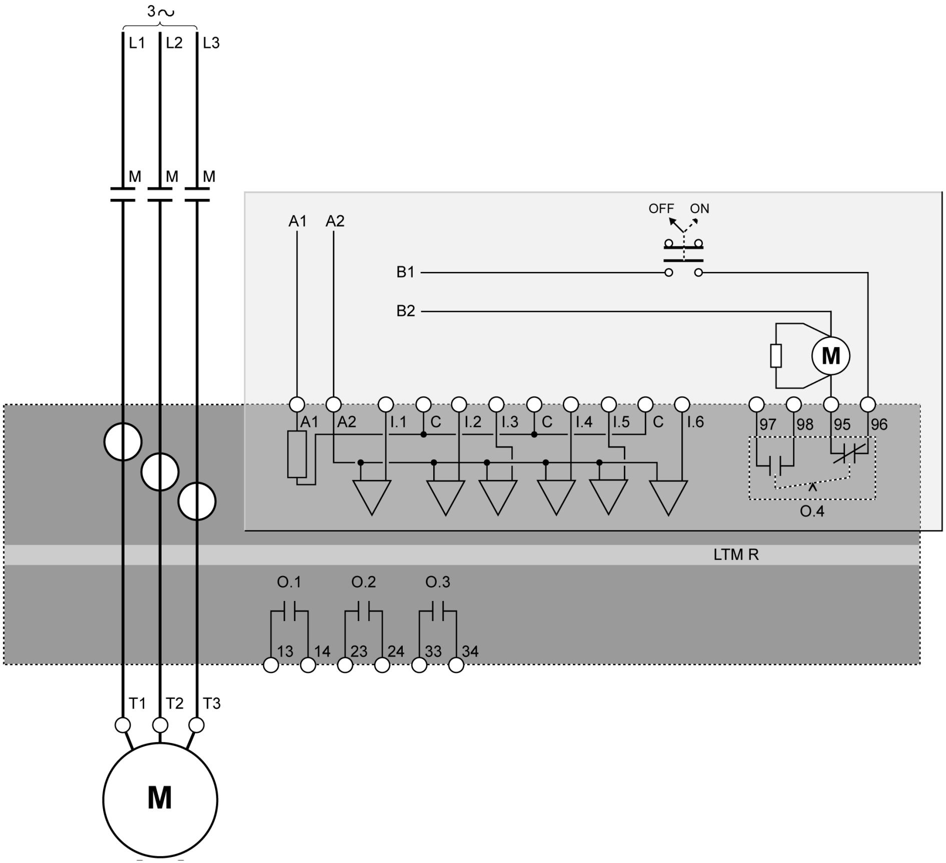
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



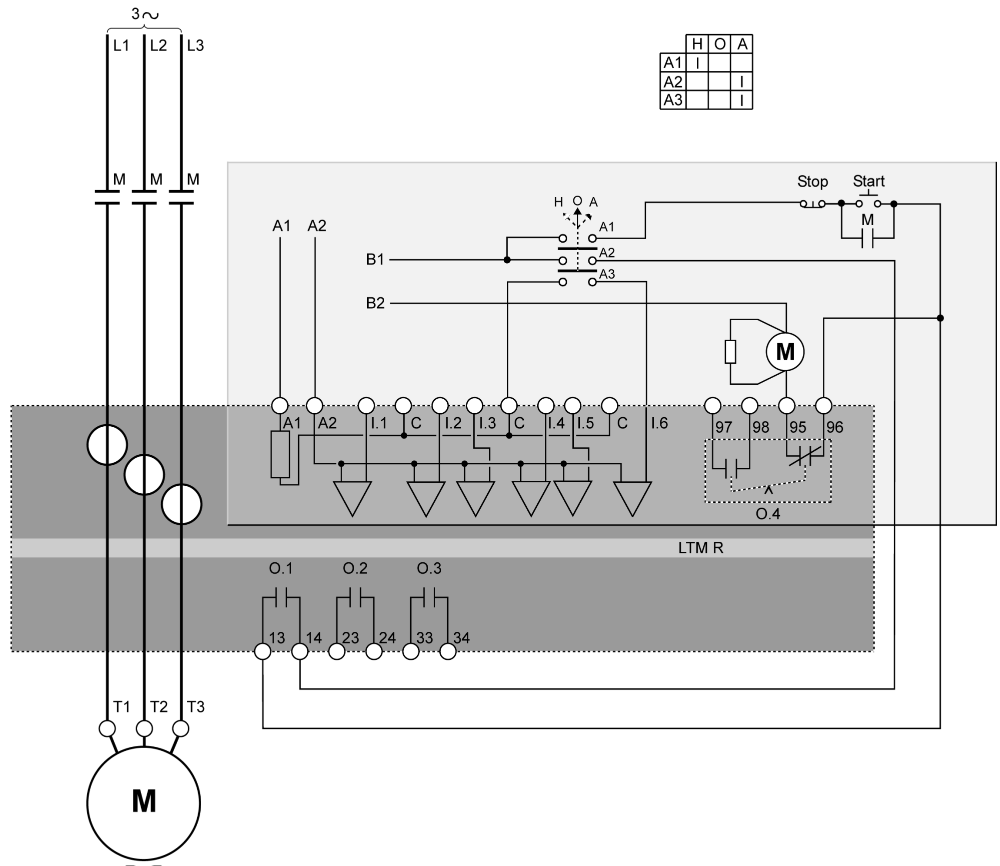
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

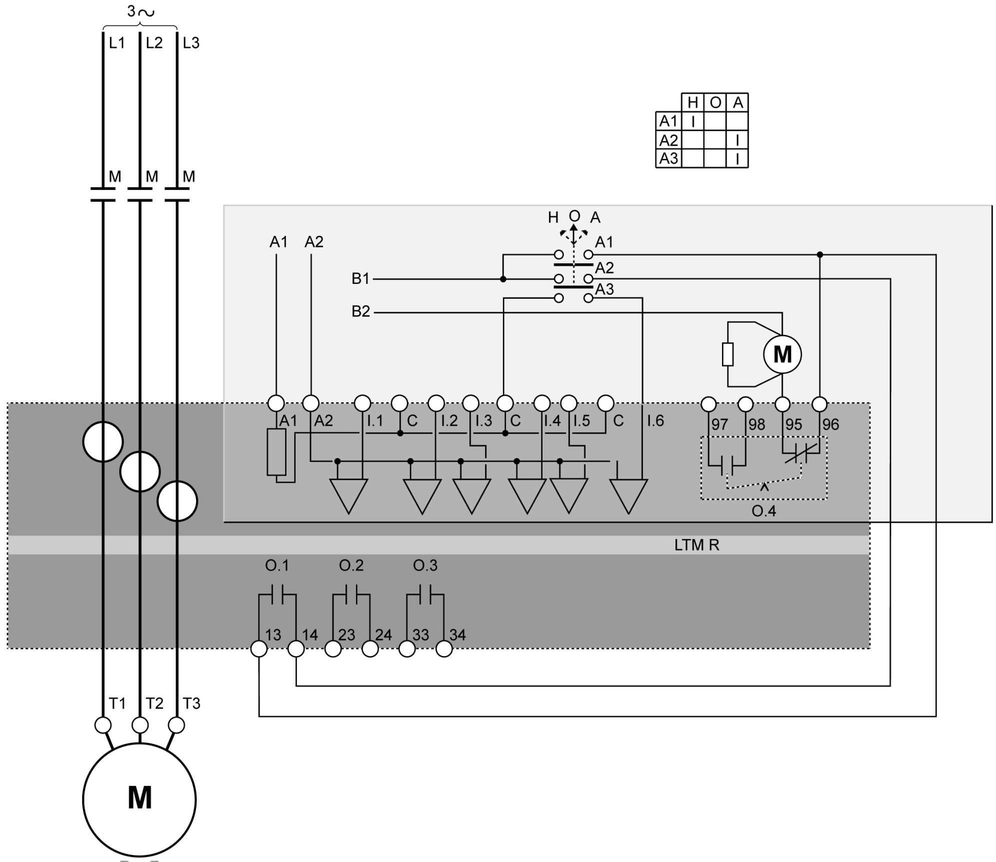
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

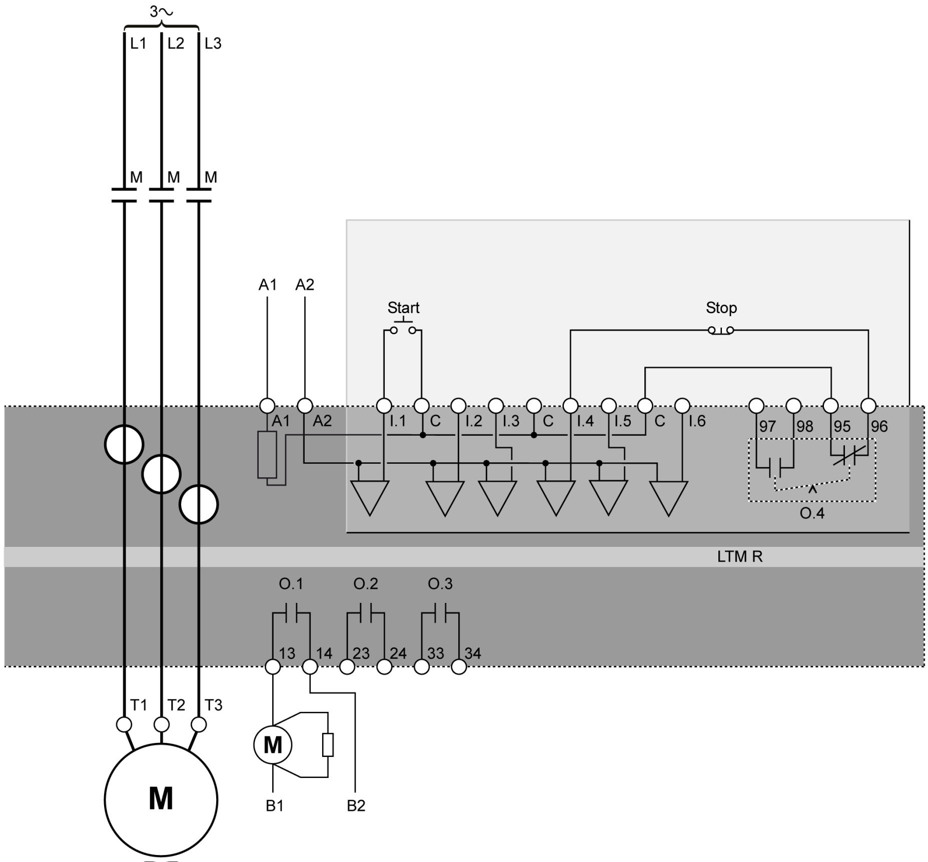


H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Independent Mode Wiring Diagrams

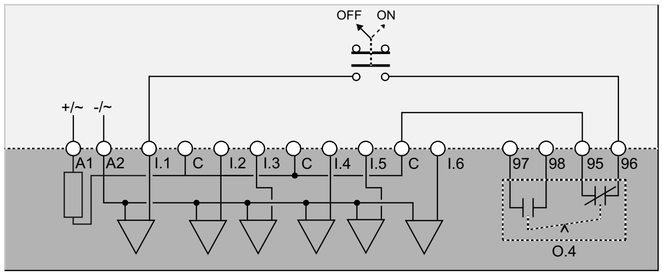
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



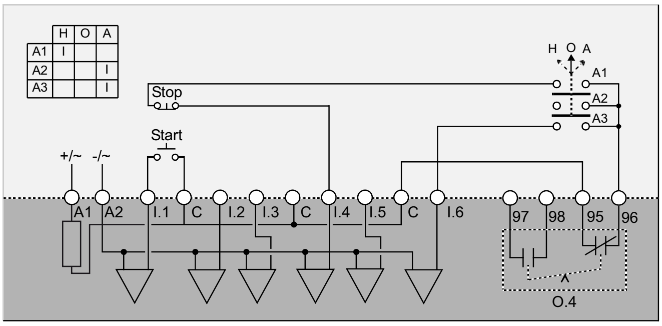
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

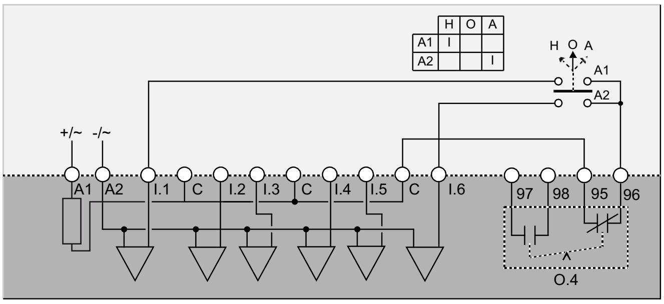
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

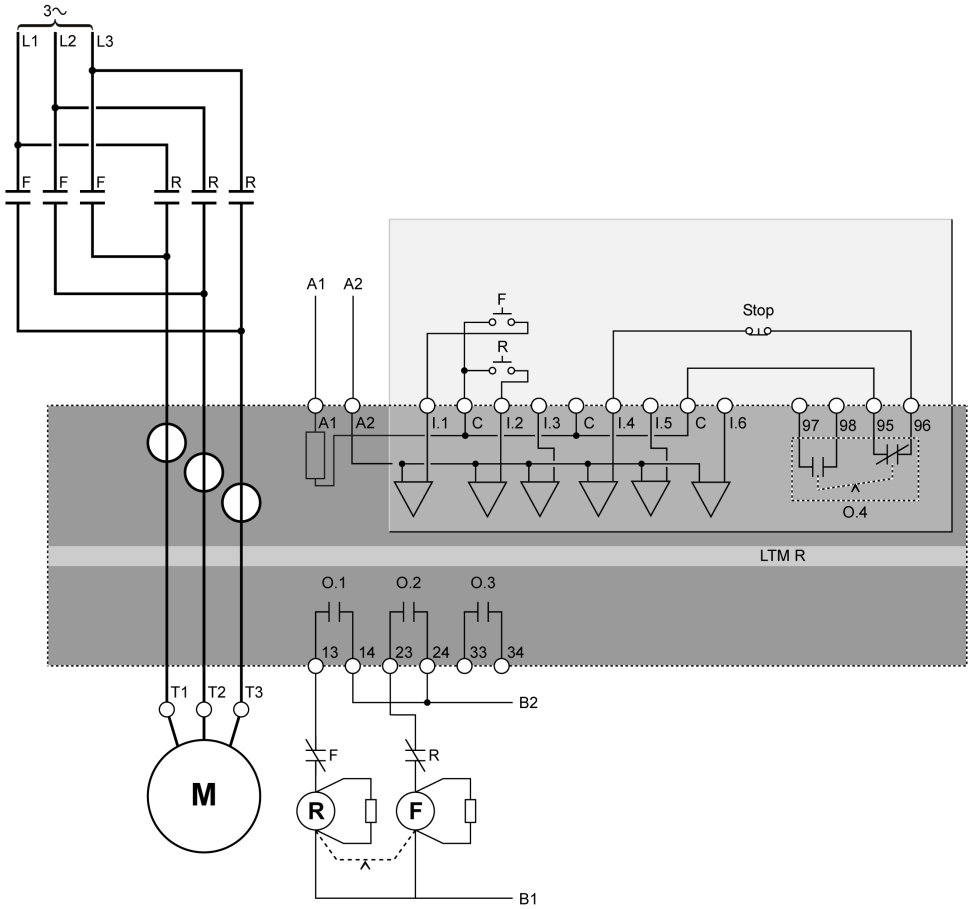


H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Reverser Mode Wiring Diagrams

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

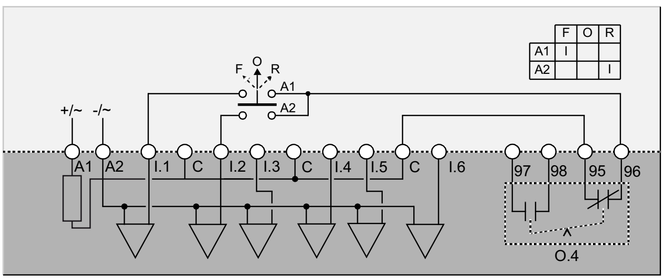
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



F Forward
R Reverse

Application Diagram with 2-Wire (Maintained) Terminal Strip Control

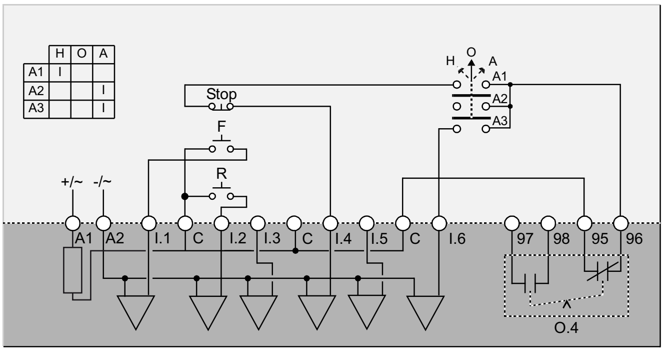
The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



F Forward
O Off
R Reverse

Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

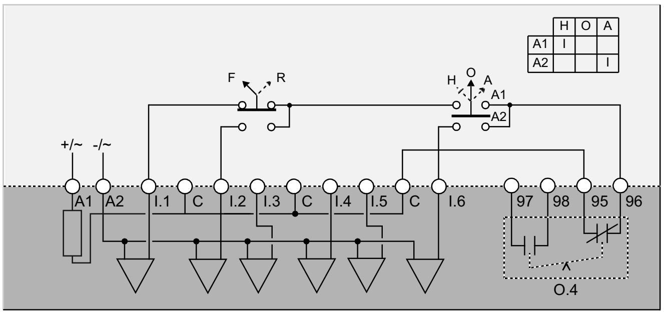
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



F Forward
R Reverse
H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

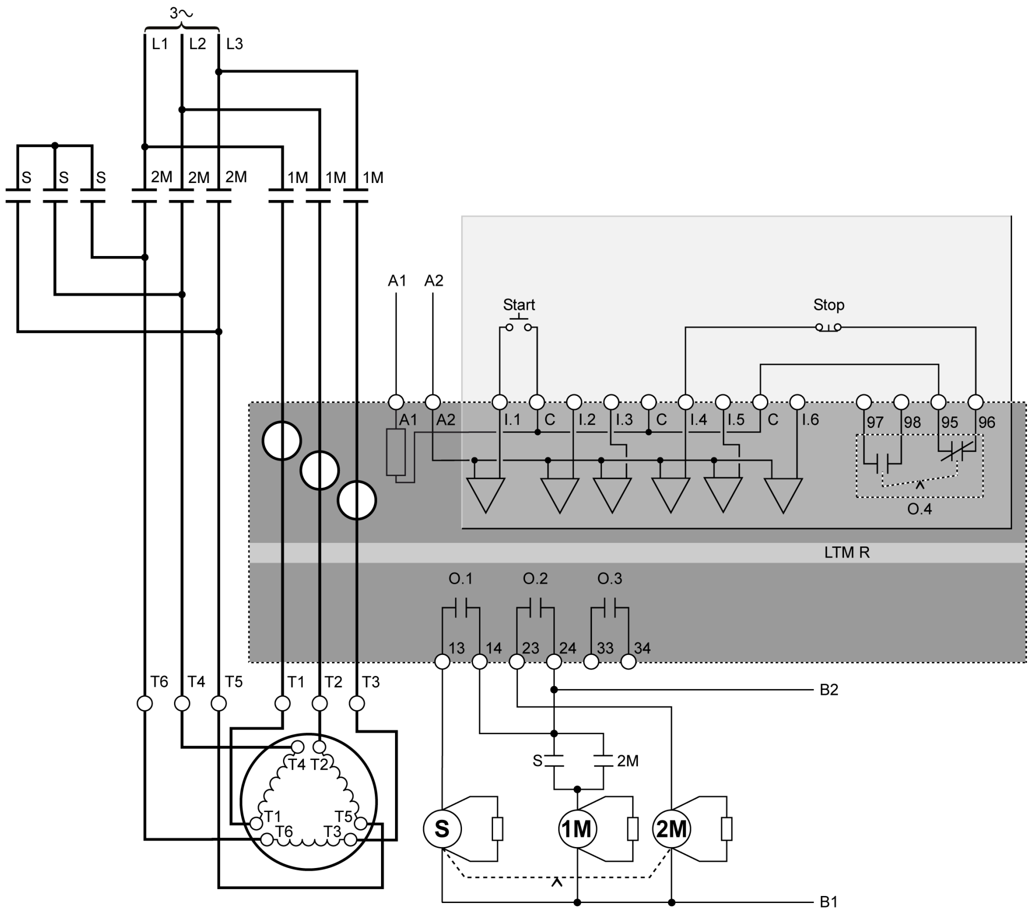


F Forward
R Reverse
H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Two-Step Wye-Delta Mode Wiring Diagrams

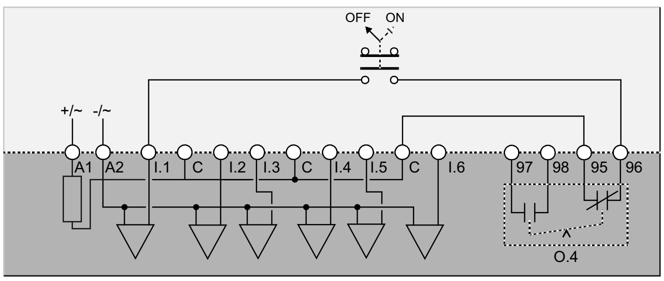
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



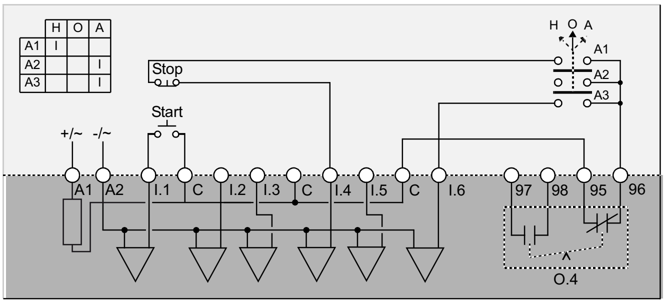
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

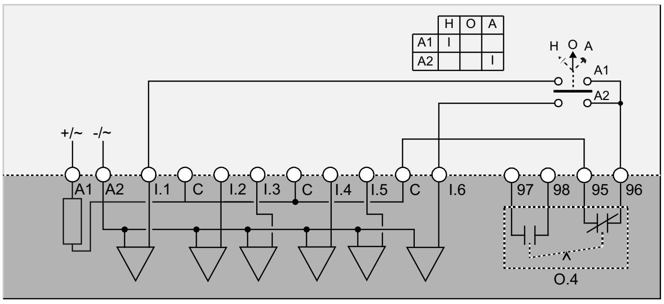
The following application diagram features 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

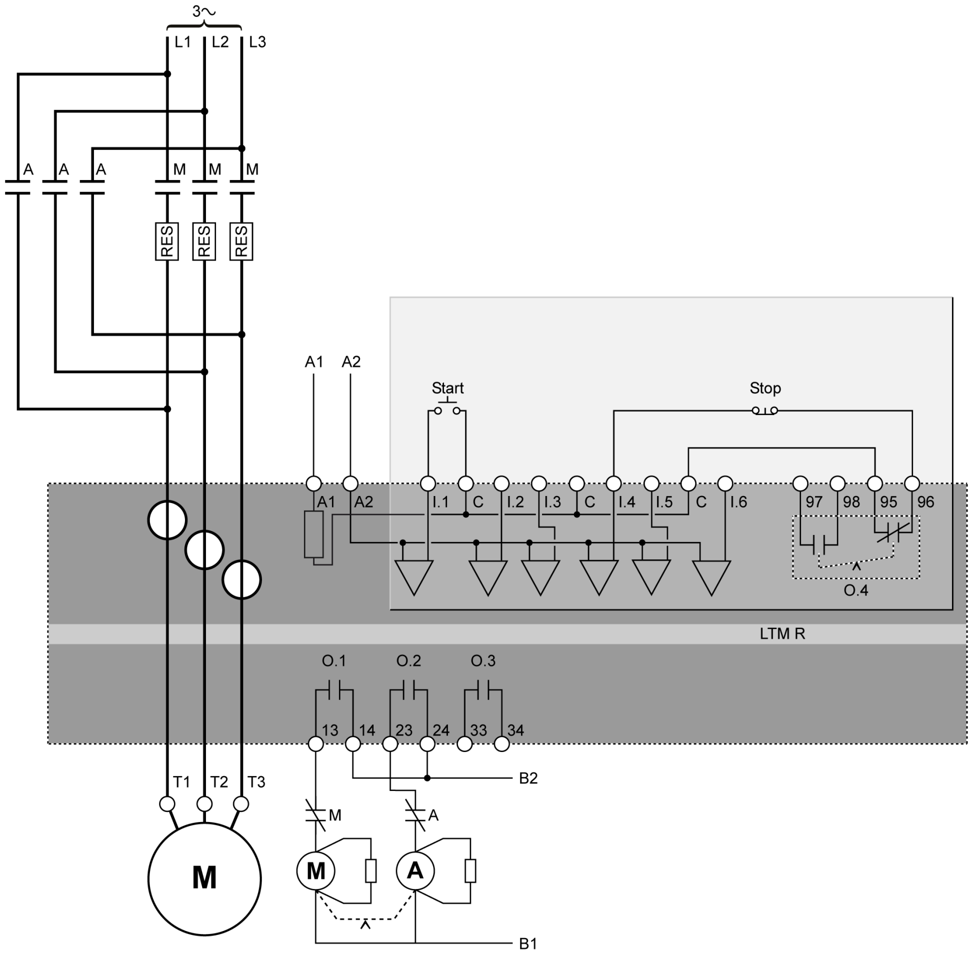


H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Two-Step Primary Resistor Mode Wiring Diagrams

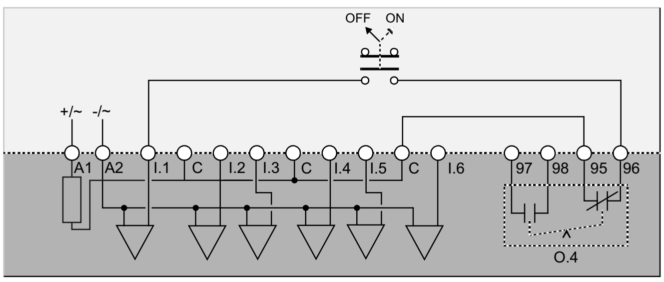
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



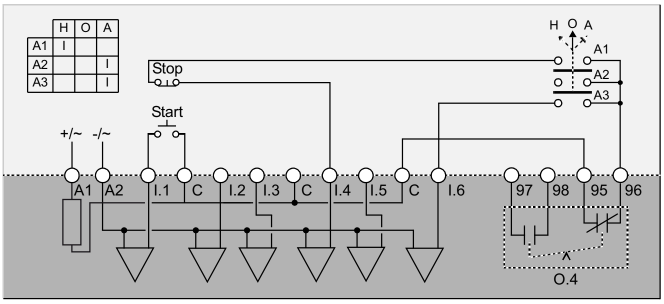
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

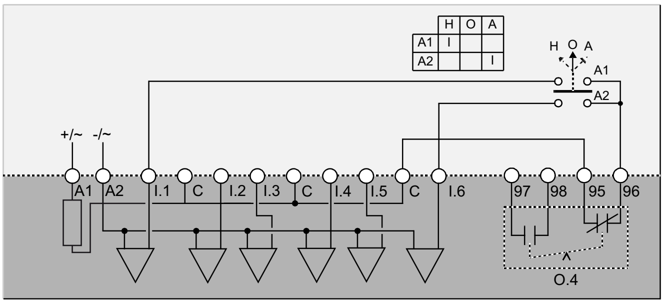
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

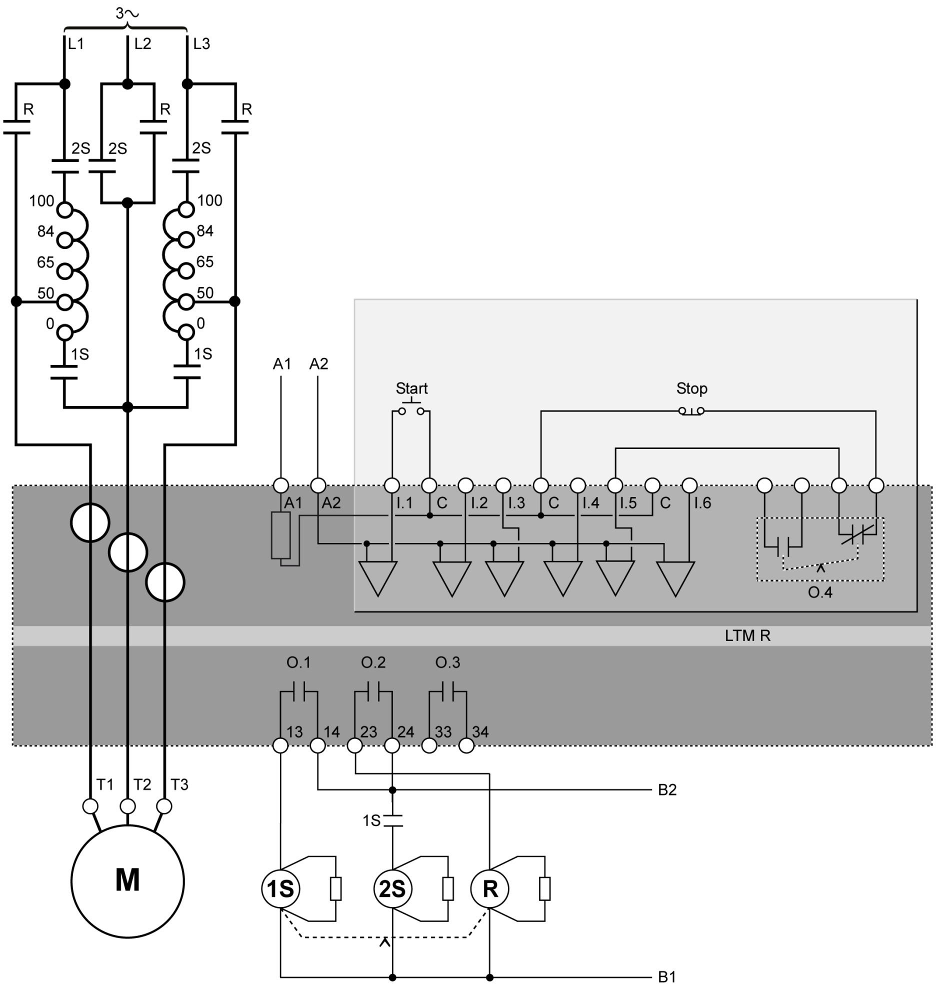


H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Two-Step Autotransformer Mode Wiring Diagrams

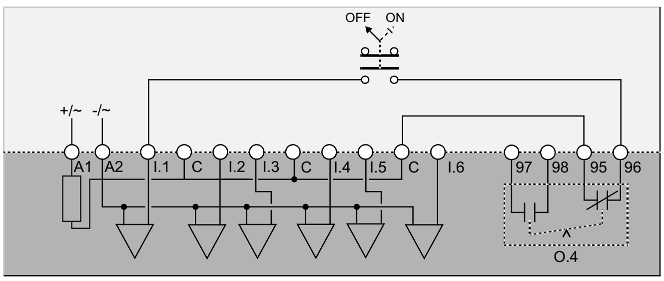
Application Diagram with 3-Wire (Impulse) Terminal Strip Control

The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



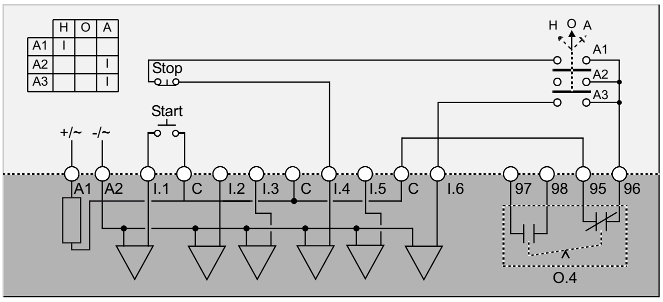
Application Diagram with 2-Wire (Maintained) Terminal Strip Control

The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

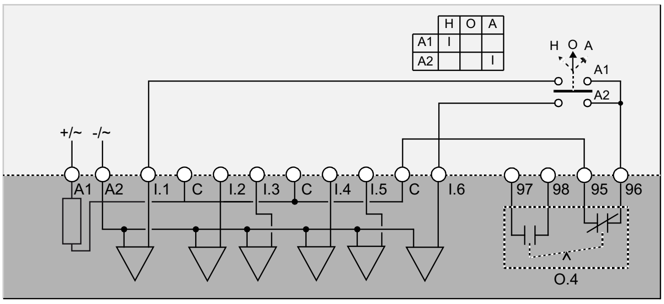
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

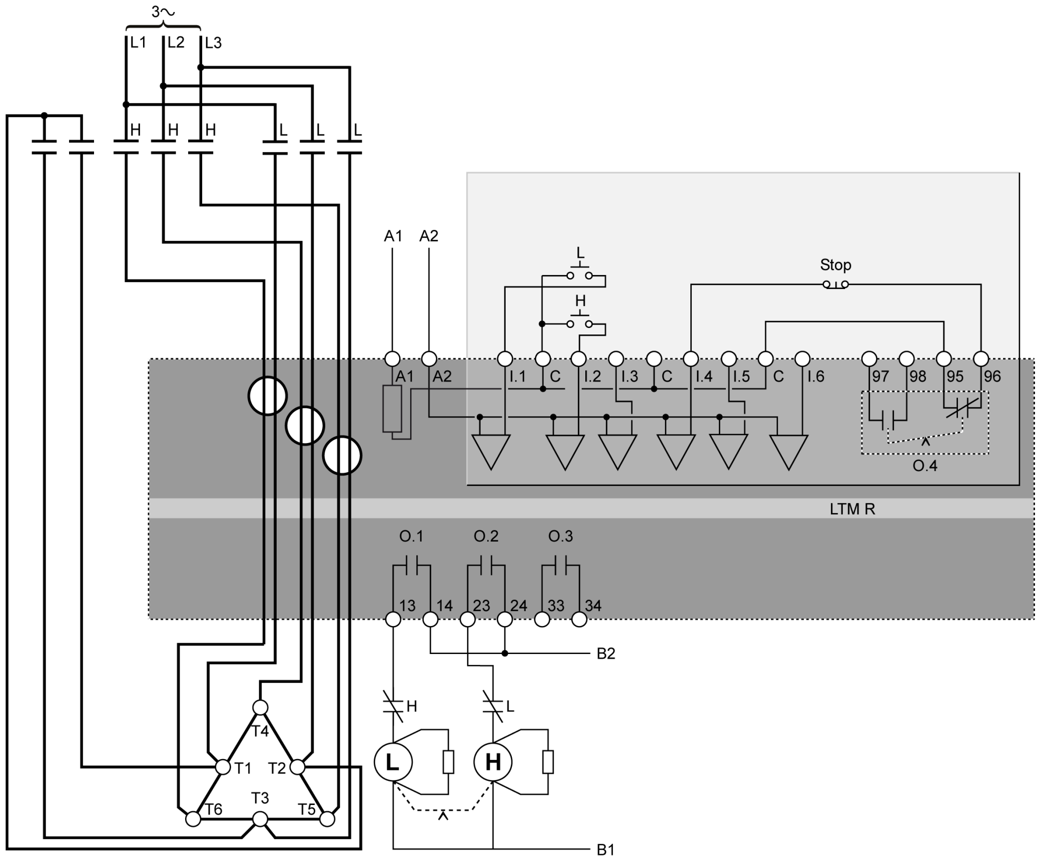


H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Two-Speed Mode Wiring Diagrams: Single Winding (Consequent Pole)

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

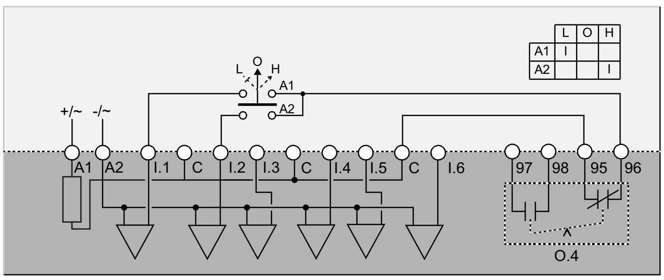
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



L Low
H High

Application Diagram with 2-Wire (Maintained) Terminal Strip Control

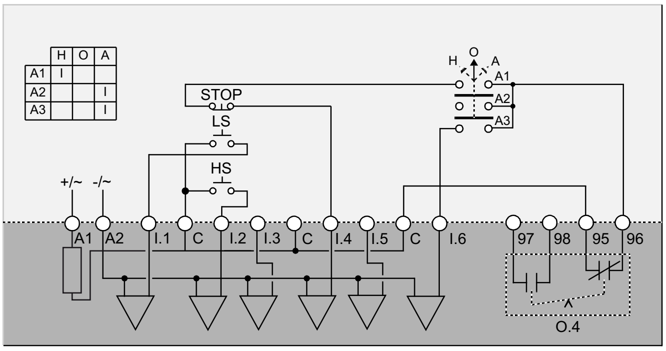
The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



L Low speed
O Off
H High speed

Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

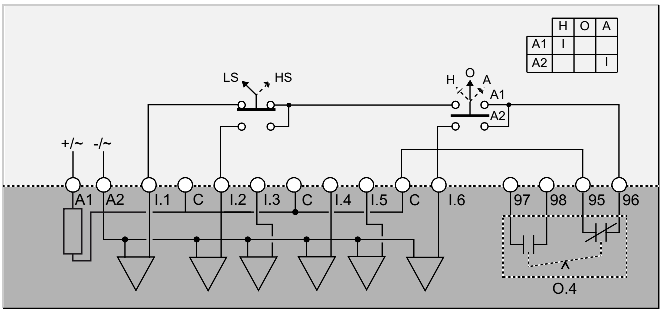
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



LS Low speed
HS High speed
H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:

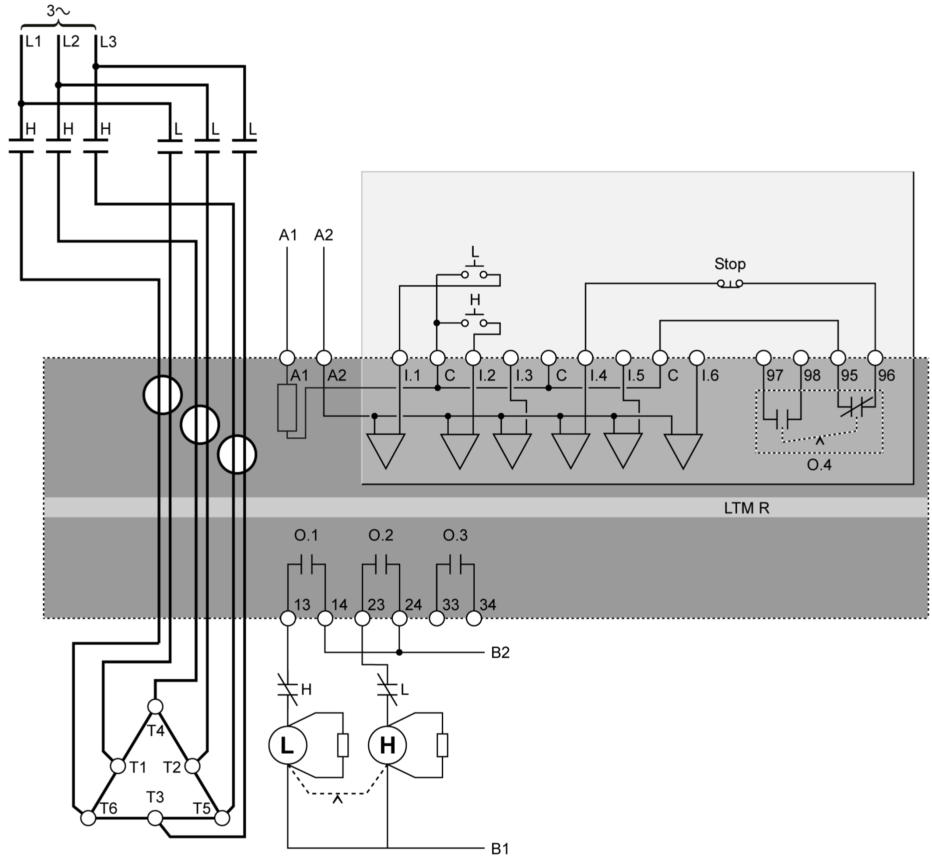


LS Low speed
HS High speed
H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Two-Speed Mode Wiring Diagrams: Separate Winding

Application Diagram with 3-Wire (Impulse) Terminal Strip Control

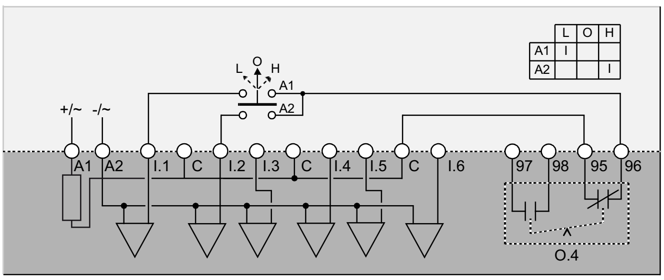
The following application diagram features a 3-wire (impulse) terminal strip control wiring diagram:



L Low
H High

Application Diagram with 2-Wire (Maintained) Terminal Strip Control

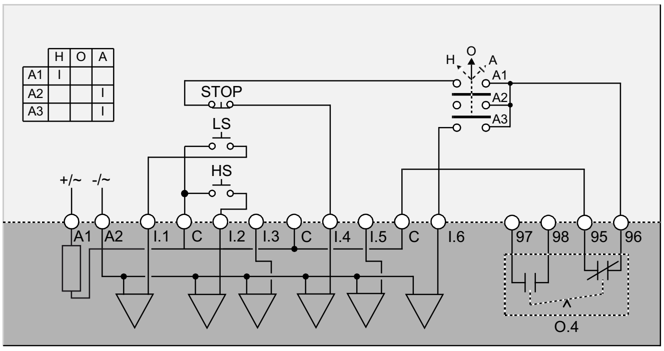
The following application diagram features a 2-wire (maintained) terminal strip control wiring diagram:



L Low speed
O Off
H High speed

Application Diagram with 3-Wire (Impulse) Terminal Strip Control with Network Control Selectable

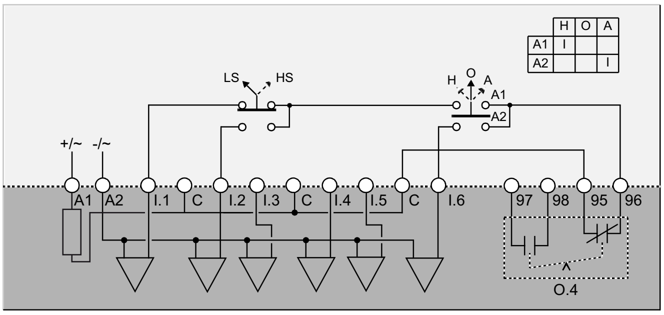
The following application diagram features a 3-wire (impulse) terminal strip control with network control selectable wiring diagram:



LS Low speed
HS High speed
H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Application Diagram with 2-Wire (Maintained) Terminal Strip Control with Network Control Selectable

The following application diagram features a 2-wire (maintained) terminal strip control with network control selectable wiring diagram:



LS Low speed
HS High speed
H Hand (Terminal strip control)
O Off
A Automatic (Network control)

Glossary

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.

FLCmax

Full Load Current Max. Peak current parameter.

H

hysteresis

A value—added to lower limit threshold settings or subtracted from upper limit threshold settings—that retards the response of the LTM R controller before it stops measuring the duration of faults and warnings.

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1639501EN-04

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

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