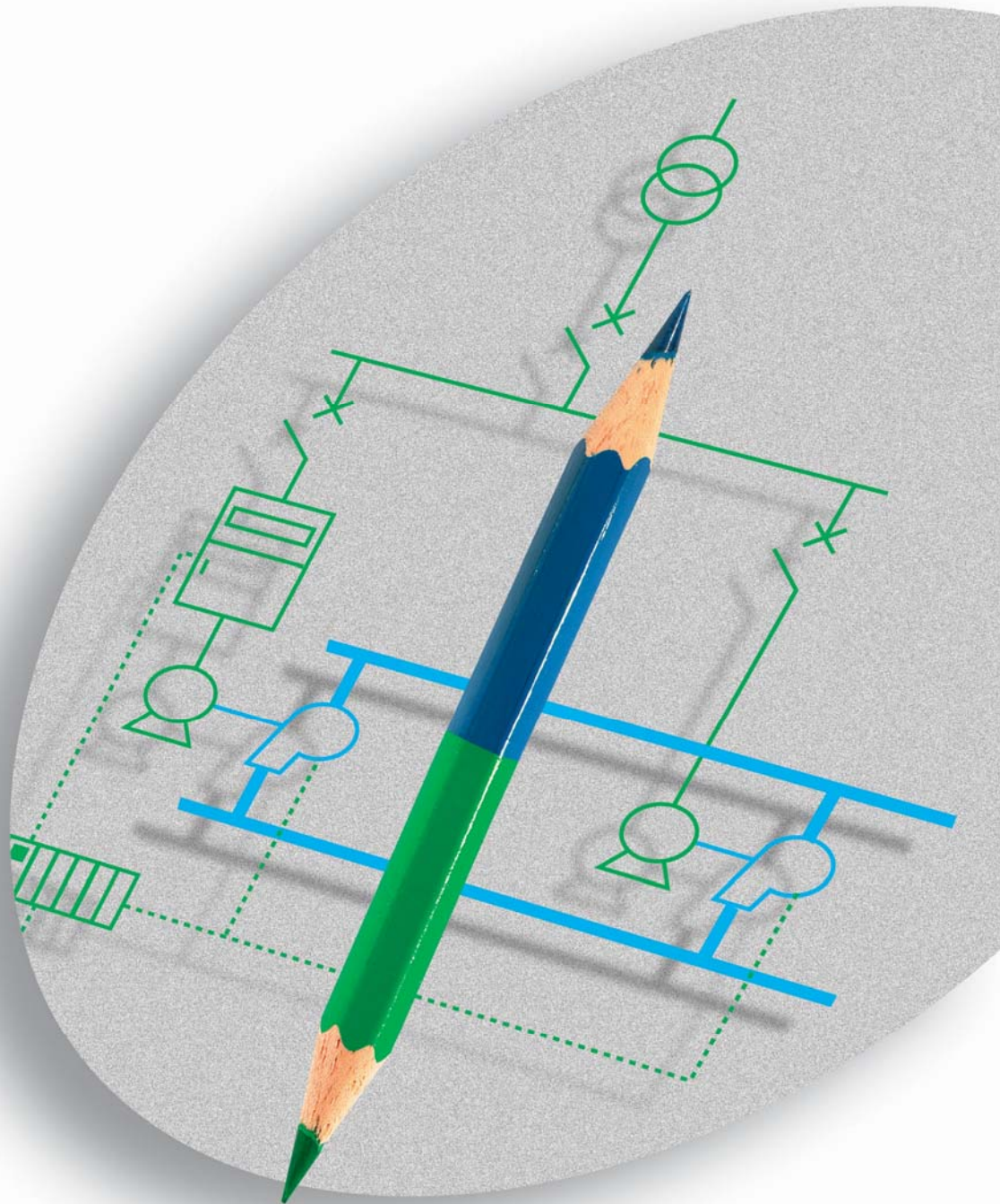


TeSys[®] T

Motor Management System

Technical Leaflet
For Engineer



Merlin Gerin
Square D
Telemecanique

Schneider
 **Electric**
Building a New Electric World

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Chapter 1. Brief Introduction of TeSys® T Motor Management System

1.1 The Offer Provides You...

TeSys® T Motor Management System offers increased protection, control, and monitoring capabilities for single-phase and 3-phase induction motors.

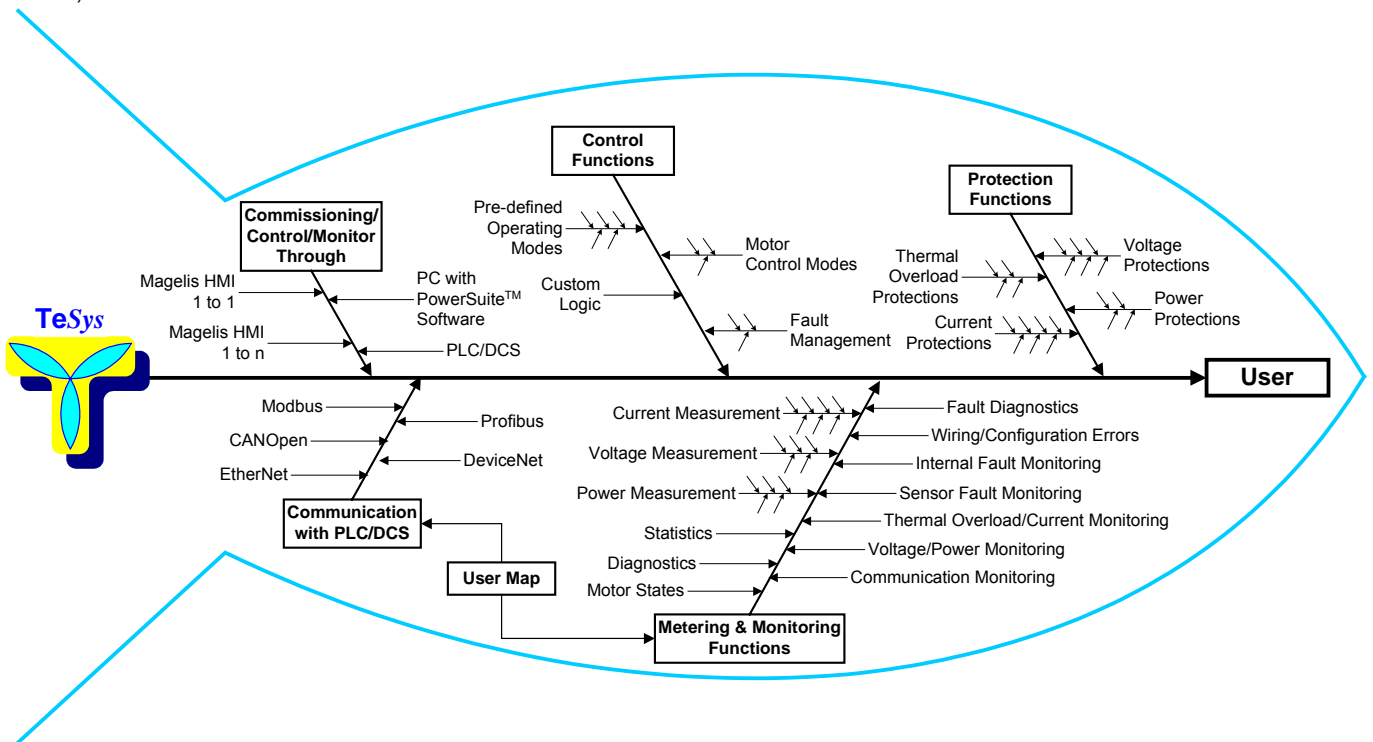
The system is flexible and modular which can be configured to meet the need of applications in industry as well as the needs for integrated protections systems with open communications and global architecture.

More accurate sensors and solid-state full motor protection ensures better utilization of the motor. Complete monitoring functions enable analysis of motor operating conditions and faster reaction 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 continuous improvement of the entire system.

1.2 Overview of the Functionality

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



1.2.1 Control Functions

		Functions	Controller	With Expansion Module
Motor control modes		Local terminal strip	X	X
		Local HMI	X	X
		Network	X	X
Operating mode	Predefined mode	Overload	X	X
		Independent	X	X
		Reverser	X	X
	Custom Logic	Two-step	X	X
		Two-speed	X	X
		User defined logic for operating mode	X	X
Fault Management		Manual reset	X	X
		Automatic reset	X	X
		Remote reset	X	X

1.2.2 Protection Functions

Functions		Controller	With Expansion Module
Thermal based	Thermal overload	X	X
	Motor temperature sensor	X	X
	Current phase imbalance	X	X
	Current phase loss	X	X
	Current phase reversal	X	X
Current based	Long start (locked rotor during start)	X	X
	Jam (locked rotor during run)	X	X
	Undercurrent	X	X
	Overcurrent	X	X
	Ground current	X	X
Voltage based	Rapid cycle lockout	X	X
	Voltage phase imbalance	-	X
	Voltage phase loss	-	X
	Voltage phase reversal	-	X
	Undervoltage	-	X
	Overvoltage	-	X
	Voltage load shedding	-	X
Power based	Underpower	-	X
	Overpower	-	X
	Under power factor	-	X
	Over power factor	-	X

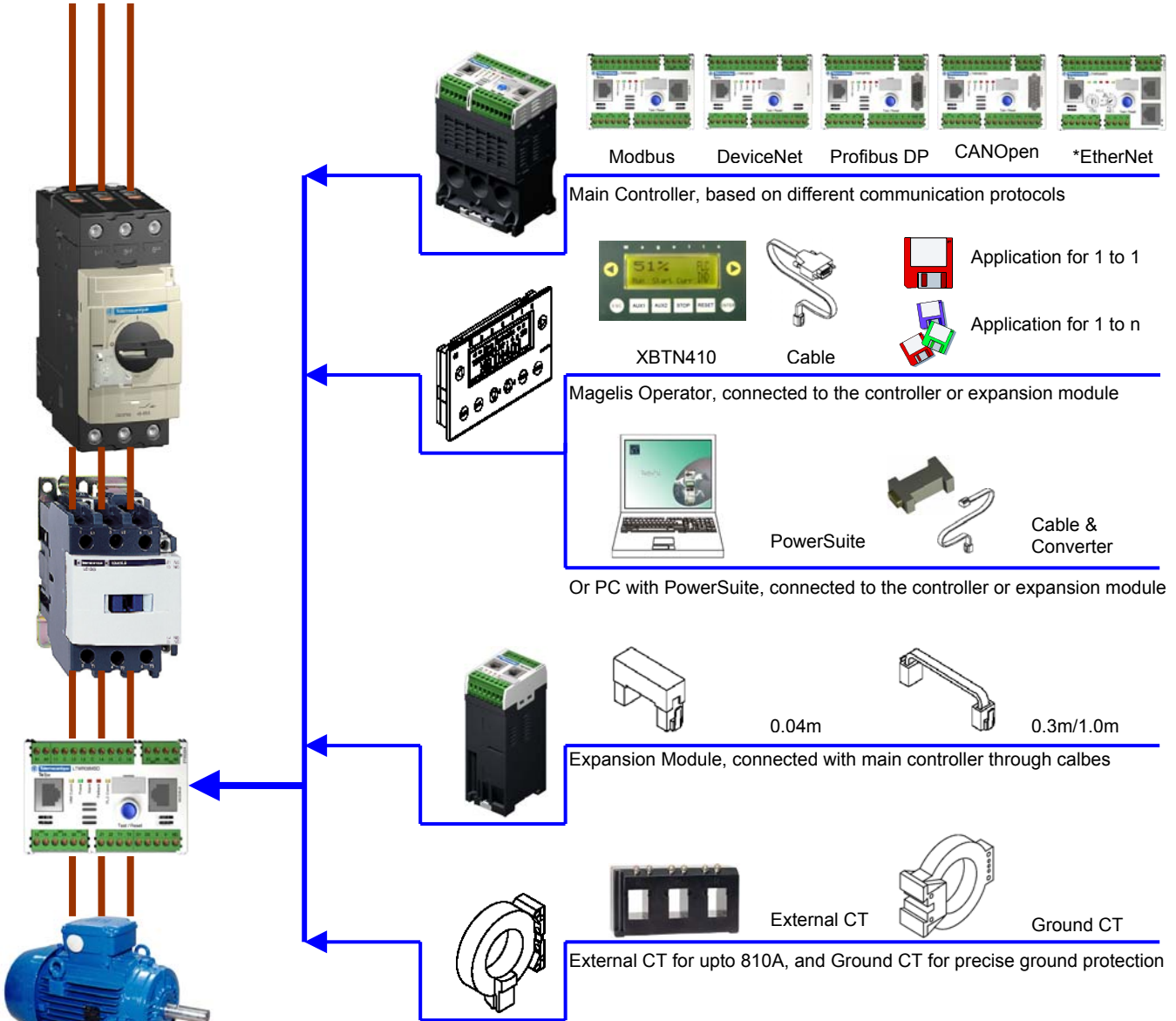
1.2.3 Metering and Monitoring Functions

Metering Functions				Fault Monitoring Functions			
	Function	Controller	With Expansion		Function	Controller	With Expansion
Measurement	Line currents	X	X	Diagnostic	Run Command Check	X	X
	Ground current	X	X		Stop Command Check	X	X
	Average current	X	X		Run Check Back	X	X
	Current phase imbalance	X	X		Stop Check Back	X	X
	Thermal capacity level	X	X		Wiring & configuration errors	PTC connection	X
	Motor temperature sensor	X	X	CT Reversal		X	X
	Frequency	-	X	Voltage Phase Reversal		-	X
	Line to line voltage	-	X	Current Phase Reversal		X	X
	Line voltage imbalance	-	X	Voltage Phase Loss		-	X
	Active power	-	X	Internal	Phase Configuration	X	X
	Reactive power	-	X		Stack Overflow	X	X
	Power factor	-	X		Watchdog	X	X
	Active power consumption	-	X		ROM Checksum	X	X
	Reactive power consumption	-	X		EEROM	X	X
Statistics	Protection fault counts	X	X	CPU	X	X	
	Protection warning counts	X	X	Sensor	Internal Temperature	X	X
	Diagnostic fault counts	X	X		PTC Binary	X	X
	Motor control function counts	X	X		PTC Analog	X	X
Diagnostics	Fault history	X	X	NTC Analog	X	X	
	Internal watchdog faults	X	X	Thermal Overload	Definite Time	X	X
	Controller internal temperature	X	X		Inverse Thermal	X	X
	Temperature sensor connections	X	X	Current	Long Start	X	X
	Current connections	X	X		Jam	X	X
	Voltage connections	-	X		Current Phase Imbalance	X	X
	Control commands (start, stop, run check back and stop check back)	X	X		Current Phase Loss	X	X
Control configuration checksum	X	X	Overcurrent		X	X	
Communication loss	X	X	Undercurrent		X	X	
Motor States	Motor Control States motor start/LO1 starts/LO2 starts	X	X		Voltage	Internal Ground Current	X
	Operating time	X	X	External Ground Current		X	X
	Motor starts per hour	X	X	Overvoltage		-	X
	Last start max current	X	X	Power	Undervoltage	-	X
	Last start time	X	X		Voltage Phase Imbalance	-	X
	Time to trip	X	X		Underpower	-	X
	Comms Loss	Time to reset	X	X	Overpower	-	X
					Under Power Factor	-	X
				Over Power Factor	-	X	
				Comms Loss	PLC to LTM R	X	X
					LTM E to LTM R	-	X

Chapter 2. Components and Selection Guide

2.1 Architecture of the Offer

As mentioned ahead, TeSys T Motor Management System is a modular offer, whose architecture could be described as blow chart:



* Note: Controller with EtherNet port will be launched in the middle of 2007

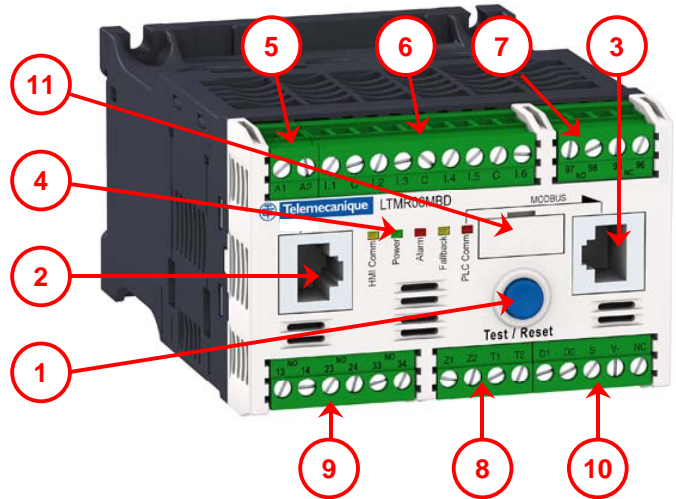
2.2 Description of the main parts

A typical TeSys T Motor Management System is composed by a main controller plus a Human Machine Interface (HMI), which could be a Magelis operator terminal or a PC with PowerSuite™ software; an expansion module may be needed if voltage or power is required to be monitored. And this offer also provides some useful auxiliaries, like external CT, ground CT, temperature sensors..., which will be supplements to the basic functions and increase the capability of the whole system.

2.2.1 LTM R Controller with Modbus Communication Port

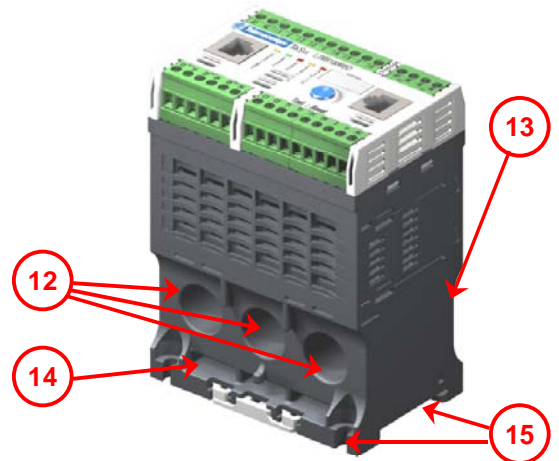
Features of the front panel

- 1 Test/Reset button
- 2 HMI, PC, or expansion module RJ45 port
 - To connect to an expansion module or a PC running PowerSuite™ software or a Magelis XBT410
- 3 PLC RJ45 port
- 4 Status-indicating LEDs
 - HMI Comm - Indicates communication between controller and HMI device, PC, or expansion module
 - Power - Indicates the controller state
 - Alarm - Indicates warning or fault condition
 - Fallback - Indicates communication loss on active control source
 - PLC Comm - Indicates network status
- 5 A1, A2 - Supply voltage input
- 6 Plug-in terminal: control power, logic Input, and common
 - I1 ~ I6 - Logic Input 1 ~ 6, internally powered by the control voltage
 - C - Input common
- 7 Plug-in terminal: double pole/single throw (DPST) relay output
 - 97/98 - normally closed contact
 - 95/96 - normally open contact
- 8 Plug-in terminal: ground fault input and temperature sensor input
 - Z1/Z2 - Connection for external ground fault CT
 - T1/T2 - Connection for embedded motor temperature sensing elements
- 9 Plug-in terminal relay output
 - LO1: 13/14 - normally open contact
 - LO1: 23/24 - normally open contact
 - LO1: 33/34 - normally open contact
- 10 Plug-in terminal: PLC network
 - D1 - Modbus D1 pin
 - D0 - Modbus D2 pin
 - S - Modbus shield pin
 - V- - Modbus common pin
 - NC - Modbus VP pin (not connected)
- 11 Marking tag, removable and changeable



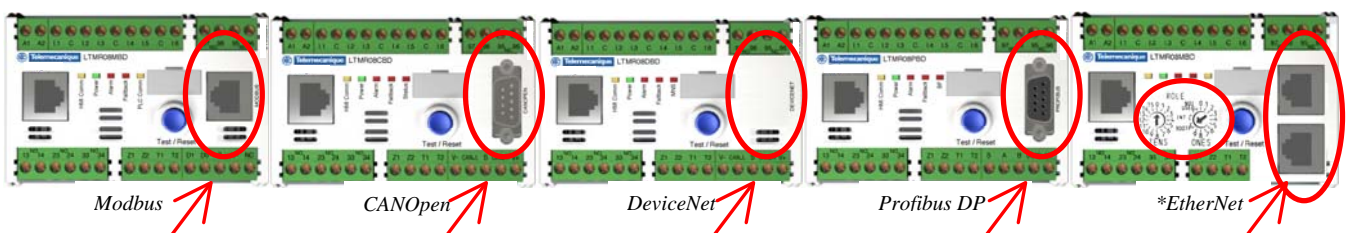
Features from side view

- 12 Embedded 3-phase current transformer, 18mm in diameter
- 13 Side groove to optimize space required for power wiring
- 14 Special CT windows for looping wires
- 15 Both DIN rail mounting and screw mounting accepted



2.2.2 LTM R Controller with Other Communication Ports

Features of the controller with other communication ports are mostly the same (except for EtherNet controller) as that with Modbus communication port, except for the right side on the front panel:

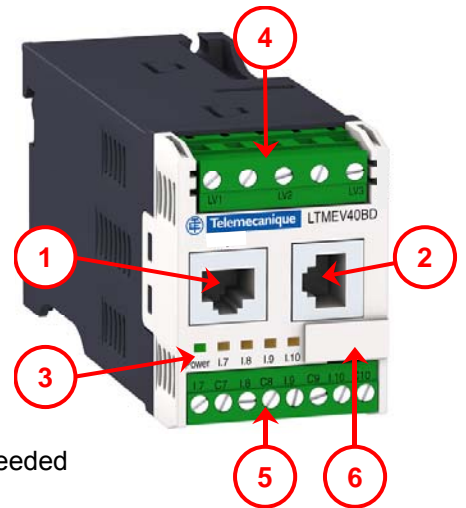


* Note: Controller with EtherNet port will be launched in the middle of 2007

2.2.3 LTM E Expansion Module

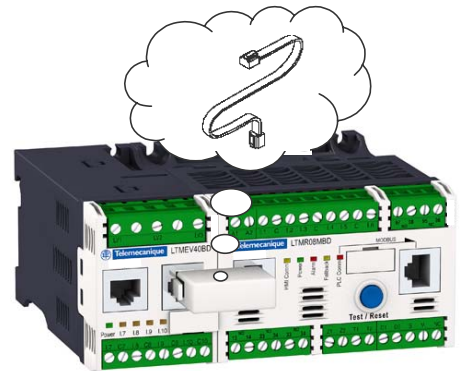
Features of the front panel

- 1 HMI or PC RJ45 Port
 - To connect to a PC running PowerSuite™ software or a Magelis XBTN410
- 2 Controller RJ45port to connect to the LTM R controller
- 3 Status indicating LEDs
 - Power - power/fault status: green, power on with no fault; red, power on with fault; off, no power
 - I.7 ~ I.10 - Logic input I.7 ~ I.10 status: yellow, activated; off, not activated
- 4 Plug-in terminal: voltage inputs
 - L1 ~ L3 - Phase 1 ~ 3 input voltage
- 5 Plug-in terminal: logic inputs and common. All Inputs on Expansion Module are isolated from the main controller inputs and external power needed
 - LI7 ~ LI10 - Logic input 7 ~ 10
 - C7 ~ C10 - Common for LI7 ~ LI10
- 6 Marking tag, removable and changeable



Connection with LTM R controller

LTM E can be connect to LTM R controller with a specified RJ45 cable, whose shape varies with the length



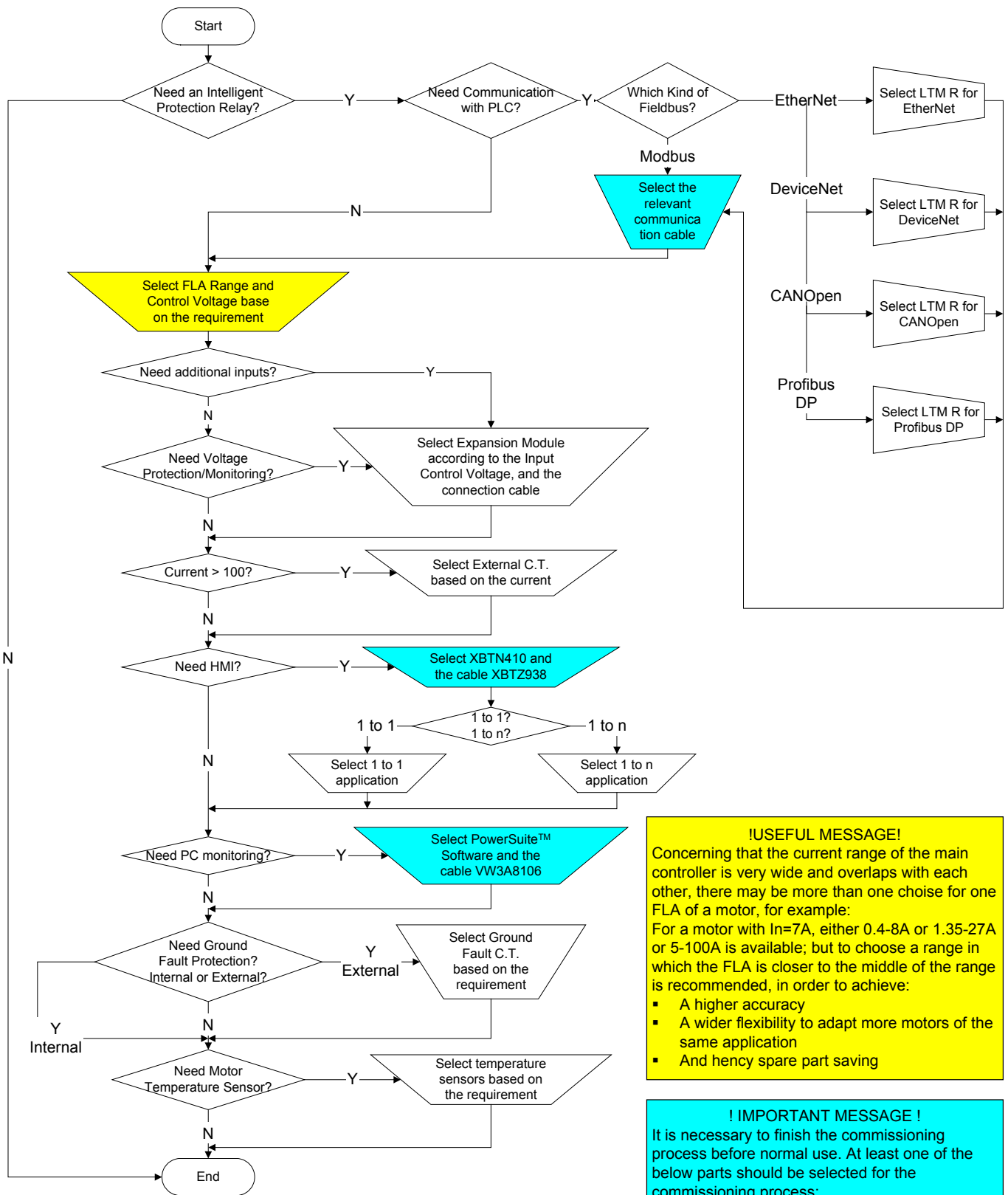
2.2.4 Magelis HMI XBTN410

- 1 LCD displayer
 - 2-line display in the configuration mode, to display the menu and present parameter values
 - 4-line display in the presentation mode, to display the real-time measurement values, or fault/warning information
- 2 8-button Keypad
 - In the configuration mode, to change the configurations
 - In the monitoring mode, to selected useful information for display
 - In the controlling mode, to send command like start/stop
- 3 XBTL1000 software to download 1 to 1 application program or 1 to n application program into the Magelis HMI



2.3 Selection Guide

Requirements of the functionality, or specifications of the system to be designed are most important factors during the selection phases. One can follow the below procedure to make a selection:



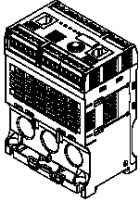









!USEFUL MESSAGE!
 Concerning that the current range of the main controller is very wide and overlaps with each other, there may be more than one choice for one FLA of a motor, for example:
 For a motor with $I_n=7A$, either 0.4-8A or 1.35-27A or 5-100A is available; but to choose a range in which the FLA is closer to the middle of the range is recommended, in order to achieve:

- A higher accuracy
- A wider flexibility to adapt more motors of the same application
- And hency spare part saving

! IMPORTANT MESSAGE !
 It is necessary to finish the commissioning process before normal use. At least one of the below parts should be selected for the commissioning process:

- Magelis HMI XBTN410 and the cable
- PowerSuite software with PC and the cable
- Master network PLC controller, network configuration utility and cables

2.4 References

Picture	Description	Category	Branches		Part Number		
			FLA Range (A)	Control Voltage (V)			
	Main controller	Modbus	0.4 ~ 8	DC 24	LTM R08MBD		
				AC 100 ~ 240	LTM R08MFM		
			1.35 ~ 27	DC 24	LTM R27MBD		
				AC 100 ~ 240	LTM R27MFM		
				Profibus DP	5 ~ 100	DC 24	LTM R100MBD
			AC 100 ~ 240		LTM R100MFM		
		0.4 ~ 8	DC 24		LTM R08PBD		
			AC 100 ~ 240		LTM R08PFM		
				DeviceNet	1.35 ~ 27	DC 24	LTM R27PBD
			AC 100 ~ 240		LTM R27PFM		
		5 ~ 100	DC 24		LTM R100PBD		
			AC 100 ~ 240		LTM R100PFM		
				CANOpen	0.4 ~ 8	DC 24	LTM R08DBD
			AC 100 ~ 240		LTM R08DFM		
		1.35 ~ 27	DC 24		LTM R27DBD		
			AC 100 ~ 240		LTM R27DFM		
				Ethernet	5 ~ 100	DC 24	LTM R100DBD
			AC 100 ~ 240		LTM R100DFM		
		0.4 ~ 8	DC 24		LTM R08CBD		
			AC 100 ~ 240		LTM R08CFM		
		Ethernet	1.35 ~ 27	DC 24	LTM R27CBD		
	AC 100 ~ 240		LTM R27CFM				
5 ~ 100	DC 24		LTM R100CBD				
	AC 100 ~ 240		LTM R100CFM				
		Ethernet	0.4 ~ 8	DC 24	LTM R08EBD		
	AC 100 ~ 240		LTM R08EFM				
1.35 ~ 27	DC 24		LTM R27EBD				
	AC 100 ~ 240		LTM R27EFM				
		Ethernet	5 ~ 100	DC 24	LTM R100EBD		
	AC 100 ~ 240		LTM R100EFM				
			Inputs Control Voltage (V)		Part Number		
	Expansion module		DC 24		LTM EV40BD		
		AC 100 ~ 240		LTM EV40FM			
	Magelis HMI, require 1 to 1 or 1 to n application programs			XBTN410			
	PC with PowerSuite™ software			To be defined			
	External CT, support current sensing up to 810A	TeSys® U CT	Ratio				
				30:1	LUTC0301		
				50:1	LUTC0501		
				100:1	LUTC1001		
				200:1	LUTC2001		
				400:1	LUTC4001		
			800:1	LUTC8001			
		LT6 CT	100:1	LT6CT1001			
			400:1	LT6CT4001			
			800:1	LT6CT8001			
		Square D Starter Size CT	300:5	31102-085			
			600:5	31105-049-50			
900:5	31124-033						
	Ground CT, support ground current detection	TeSys® U CT	Diameter (mm)				
				30	TA30		
				50	PA50		
				80	IA80		
				120	MA120		
				196	SA200		
	Connection cable from the expansion module to main controller	TeSys® T	Length (m)				
				0.04	LTMCC004		
		TeSys® U	0.3	LU9R03			
			1.0	LU9R10			
	Connection cable to Magelis HMI	Magelis	2.5	XBTZ938			
	RS232-485 converter with connection cable	PowerSuite™	1.0	VW3A8106			
	Connection cable to Modbus network	PowerSuite™	0.3	VW3A8306R03			
			1.0	VW3A8306R10			
			3.0	VW3A8306R30			
	Specific terminal for OKKEN panel			To be defined			

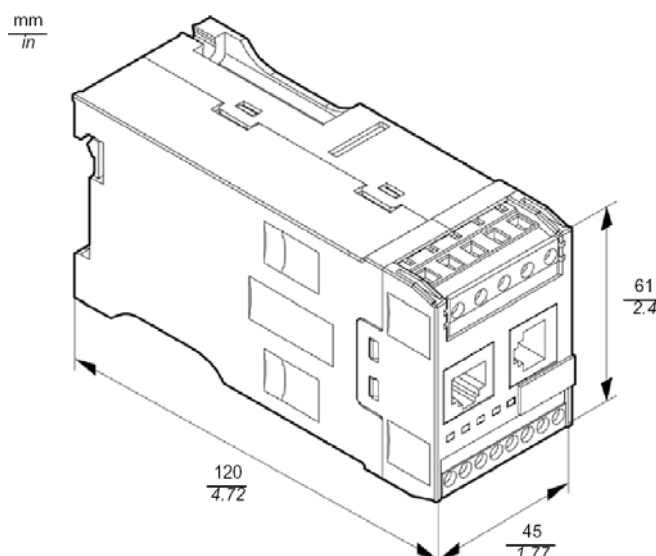
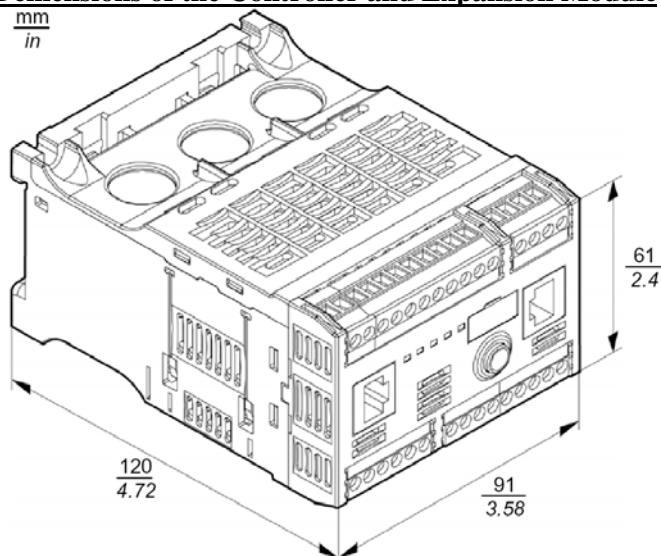
2.5 Technical Specification

Technical Specifications of the Controller						
Certification	UL, CSA, CE, CCC, NOM, GOST, IACSE10					
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	
	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		
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 hr		
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 (14763 ft)		
	without de-rating			2000 m (6561 ft)		
Fire resistance	According to UL 94			V2		
	According to IEC 695-2-1	(Parts supporting live components)		960 °C (1760 °F)		
		(other components)		650 °C (1202 °F)		
Half-sine mechanical shock pulse = 11 ms	According to CEI 60068-2-27 ¹			15 gn		
Resistance to vibration	According to CEI 60068-2-6 ¹		Panel mounted	4 gn		
			DIN rail mounted	1 gn		
Immunity to electrostatic discharge	According to EN61000-4-2		In the air	8 kV level 3		
			On contact	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 EN61000-4-6			10 V rms level 3		
	According to IEC/EN 61000-4-5		Common mode	Differential mode		
Surge immunity	Power lines and relay outputs		4 kV (12 Ω/9 uF)	2 kV (2 Ω/18 uF)		
	24 Vdc inputs and power		1 kV (12 Ω/9 uF)	1 kV (2 Ω/18 uF)		
	100-240 VAC inputs and power		2 kV (12 Ω/9 uF)	1 kV (2 Ω/18 uF)		
	Communication		2 kV (12 Ω/18 uF)	1 kV (2 Ω/18 uF)		
	Temperature sensor (IT1/IT2)		1 kV (42 Ω/0.5 uF)	0.5 kV (42 Ω/0.5 uF)		
1. Without modifying the state of the contacts in the least favorable direction. Controller base and control unit relays.						
Control Voltage		24 V DC		100-240 V AC		
Power consumption	According to IEC/EN 60947-1	TBD		TBD		
Control voltage range	According to IEC/EN 60947-1	TBD		TBD		
Overcurrent protection		24 V fuse 0.5 A gG		100-240 V fuse 0.5 A gG		
Resistance to Microbreaks		3 ms with Phaso power supply		3 ms		
Resistance to voltage dips	According to IEC/EN 61000-4-11	70% of UC min. for 500ms		70% of UC min. for 500ms		
Logic Input I.1 ~ I.6 Characteristics		24V DC		115-230 V AC		
Nominal input Voltage		24 Vdc		100-240 Vac		
Nominal input Current		7 mA		100-240 Vac		
At state 1	Input limit Voltage		15 V maximum		79 V < V < 264 V	
	Input limit Current		2 mA min to 15 mA max.		2 mA min. at 110 Vac to 3mA min. at 220 Vac	
At state 0	Input limit Voltage		5 V maximum		0V < V < 40 V	
	Input limit 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)	
IEC 1131-1 conformity		Type 1		Type 1		
Type of Input		Resistive		Capacitive		
Altitude Derating						
Corrective Factors for altitude	2000m	3000m	3500m	4000m	4500m	
Dielectric Strength Ui	1	0.93	0.87	0.8	0.7	
Max. Operating Temperature	1	0.93	0.92	0.9	0.88	

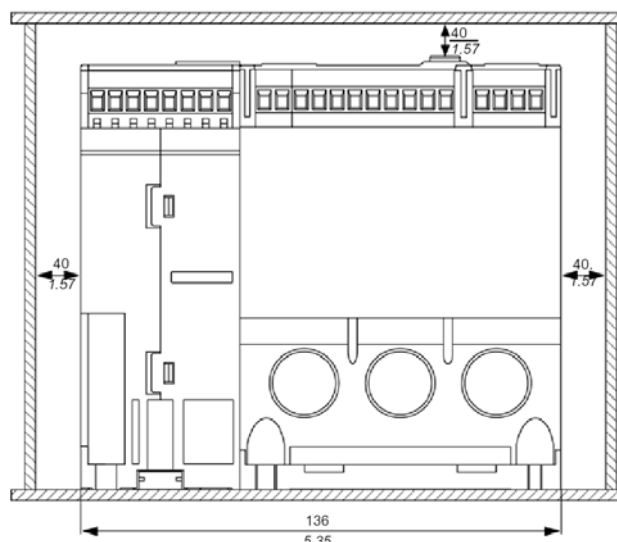
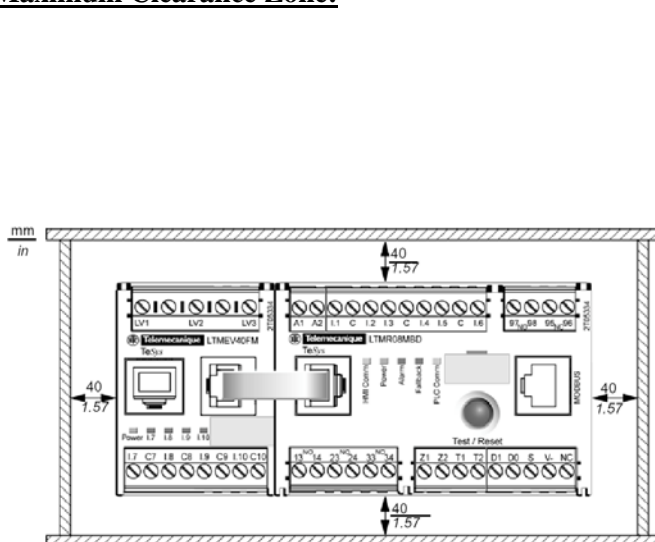
Technical Specifications of the Expansion Module					
Certification	UL, CSA, CE, CCC, NOM, GOST, IACSE10				
Conformity to Standards	IEC/EN 60947-4-1, UL 508 - CSA C22-2, IACSE10				
European community directives	CE marking, satisfies the essential requirements of the low voltage (LV) machinery and electromagnetic compatibility (EMC) directives.				
Rated insulation voltage (Ui)	According to IEC/EN 60947-1	overvoltage category III, degree of pollution: 3	690 V		
	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 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 hr		
Ambient air temperature around the device	Operation ¹	Storage	-40...+80 °C (-40...176 °F)		
		>40 mm (1.57 inches) spacing	-20...+60 °C (-4...140 °F)		
		<40mm (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 (14763 ft)		
	without de-rating		2000 m (6561 ft)		
Fire resistance	According to UL 94		V2		
	According to IEC 695-2-1	(Parts supporting live components) (other components)	960 °C (1760 °F) 650 °C (1202 °F)		
Half-sine mechanical shock pulse = 11 ms	According to CEI 60068-2-27 ²				30 g 3 axis and 6 directions
Resistance to vibration	According to CEI 60068-2-6 ¹	Panel mounted	5 gn		
Immunity to electrostatic discharge	According to EN61000-4-2		In the air	8 kV level 3	
			On contact	6 kV level 3	
Immunity to radiated fields	According to EN61000-4-3		10 V/m level 3		
Immunity to fast transient bursts	According to EN61000-4-4		All circuits	4 kV level 4	
				2 kV level 3	
Immunity to radioelectric fields	According to EN61000-4-6		10 V rms level 3		
	According to IEC/EN 61000-4-5	Common mode	Differential mode		
Surge immunity	100-240 Vac inputs	4 kV (12 Ω)	2 kV (2 Ω)		
	24 V dc inputs	2 kV (12 Ω)	1 kV (2 Ω)		
	Communication	1 kV (12 Ω)			
1. The maximum rated ambient temperature of the expansion module depends on the installation spacing with the controller.					
2. Without modifying the state of the contacts in the least favorable direction. Controller base and control unit relays.					
Logic Input I.7 ~ I.10 Characteristics		24V DC		115-230 V AC	
Nominal input Voltage		24 Vdc		100-240 Vac	
Nominal input Current		7 mA		100-240 Vac	
At state 1	Input limit Voltage	15 V maximum		79 V < V < 264 V	
	Input limit Current	2 mA min to 15 mA max.		2 mA min. at 110 Vac to 3mA min. at 220 Vac	
At state 0	Input limit Voltage	5 V maximum		0V < V < 40 V	
	Input limit 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)	
IEC 1131-1 conformity		Type 1		Type 1	
Type of Input		Resistive		Capacitive	
Altitude Derating					
Corrective Factors for altitude	2000m	3000m	3500m	4000m	4500m
Dielectric Strength Ui	1	0.93	0.87	0.8	0.7
Max. Operating Temperature	1	0.93	0.92	0.9	0.88

2.6 Dimensions and Mechanical Installation

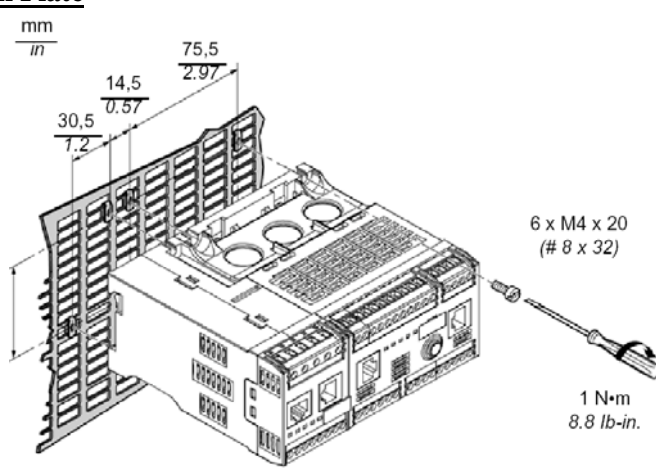
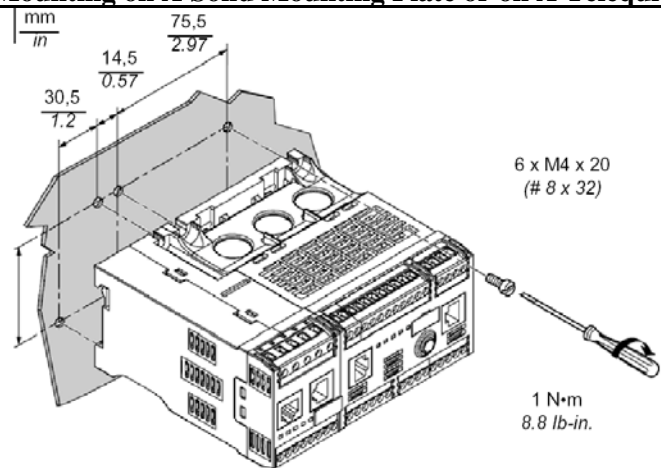
Dimensions of the Controller and Expansion Module



Maximum Clearance Zone:



Mounting on A Solid Mounting Plate or on A Telequick Plate



Chapter 3. Functionality

3.1 Measurements and Motor Protection Functions

As it meters the current, voltage and power, the controller provides motor protection functions. You can configure these motor protection functions to issue alerts indicating 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.

Group	Measurement	Protection				Description
		Functions	Starting State	Running State	With Warning	
Current	Current Imbalance	Current Imbalance	X	X	X	To signal a warning or a fault when the current in any phase differs by more than threshold percentage from the average current in all 3 phases for a threshold time
		Current Loss	X	X	X	To signal a warning or a fault when the current in any phase differs by more than 80% from the average current in all 3 phases for a threshold time
		Current Phase Reversal	X	X		To signal a fault when it detects the current phases of a 3-phase motor are out of sequence, usually indicating a wiring error
	Average Current	Under Current		X	X	To signal a warning or a fault when the 3-phase average current falls and remains below the threshold for a threshold time
		Ground Current	Internal	X	X	X
	External		X	X	X	measuring the current delivered by the secondary of an external ground fault current transformer
	Line Current	Long Start	X			To signal a fault when current continuously exceeds the threshold for the same period of time
		Jam		X	X	To signal a warning or a fault when current in any phase continuously exceeds the threshold for a specified period of time
		Over Current		X	X	To signal a warning or a fault when current in a phase continuously exceeds the threshold for a threshold time
		Rapid Cycle Lockout	X			To protect the motor against harm caused by restarting the motor too quickly after the motor failed to start
T.O.R with Definite time			X	X	To signal a warning or a fault when the maximum phase current continuously exceeds the threshold for a set time delay	
Thermal	Thermal Capacity	T.O.R with Inverse curve	X	X	X	To signal a warning or a fault when utilized thermal capacity continuously exceeds the threshold, based on the motor trip class setting
	Temperature Sensor	Motor Temperature Sensor	X	X	X	To provide protection for motor windings by detecting high temperature conditions that could lead to damage or degradation. Motor Temp Sensor types: PTC Binary, PTC Analog or NTC Analog
Voltage	Line to Line Voltage	Over Voltage	Ready State	X	X	To signal a or a fault when voltage in a phase continuously exceeds the threshold for a specified period of time
		Under Voltage	Ready State	X	X	To signal a or a fault when voltage in a phase falls and remains below the threshold for a threshold time
		Voltage Load Shedding	X	X		The controller provides voltage load shedding, which you can use to deactivate non-critical loads if voltage level is substantially reduced
	Voltage Imbalance	Voltage Imbalance	X	X	X	To signal a warning or a fault when the voltage in any composed phase differs by more than the threshold percentage from the average voltage in all 3 phases for a threshold time
		Voltage Phase Loss	Ready State		X	To signal a warning or a fault when the voltage in any phase differs by more than 40% from the average voltage in all 3 phases for a threshold time
		Voltage Phase Reversal	X	X		To signal a fault when it detects the voltage phases of a 3-phase motor are out of sequence, usually indicating a wiring error
Power	Active Power	Over Power		X	X	To signal a warning or a fault when the active power exceeds the threshold and remains above that threshold for a threshold time
		Under Power		X	X	To signal a warning or a fault when the active power falls and remains below the threshold for a threshold time
	Reactive Power					
	Power Factor	Over Power Factor		X	X	To signal a warning or a fault when the power factor the threshold and remains above that threshold for a threshold time
Under Power Factor			X	X	To signal a warning or a fault when the power factor falls below the threshold and remains below that threshold for a threshold time	
Active Power Consumption						
Reactive Power Consumption						

3.2 Monitoring Functions

3.2.1 Statistics

Protection Faults and Warning Counts

The controller records the total number of faults detected for the all the motor protection functions.

Diagnostic Faults Counts

The controller records the total number of faults detected for all the diagnostic functions.

Motor Control Counts

The controller records the total number of motor control counts.

Fault History

The controller stores details of the last 5 faults detected. Fault N0 is the last fault recorded, fault N1 to fault N4 are the four previous consecutive faults.

3.2.2 Diagnostic Faults

Internal Watchdog Faults

Major faults, in which the controller is unable to reliably execute its own programming, the communication with the controller is not possible and can only attempt to shut down the controller.

And minor faults, in which the controller is unreliable and protection could be compromised. During a minor fault, the controller continues to attempt to monitor status and communications, but will not accept any start commands.

Controller Internal Temperature

The controller measures its internal temperature and records the highest value detected. The controller will indicate a warning or minor fault or major fault condition when the corresponding threshold is exceeded respectively.

Control Commands

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

Current Transformer Connections / Voltage Connections

The controller detects incorrect or conflicting current transformer wiring and will report a fault condition.

Temperature Sensor Connections

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

Controller Configuration Checksum

The controller verifies the software configuration to make sure it has not been accidentally modified, by performing a checksum of the EEPROM and the FLASH memories.

Communication Loss

The LTM R Motor Management Controller monitors the communication with the network port, LTM E Expansion Module, HMI device (XBTN410), and local terminal connection.

3.2.3 Motor States

The controller tracks motor state statistical values memorized by controller, for operational analysis. The controller tracks and records the value detected by the motor control functions.

3.2.4 User Map

In order to improve communication performance and flexibility, a special designed function **User Map** is provided with user map variables, which allows re-mapping of the registers of all actual values and configuration parameters.

3.3 Motor Control Functions

3.3.1 Control Modes and Operating States

Control Modes

The Control Mode defines the device interface that will command controller outputs. Control modes include:

- Local terminal strip, controller outputs are commanded by input devices wired to the input terminals on the front face of the controller
- Local HMI, controller outputs are commanded by an HMI device connected to the controller's Local RJ45 port
- Network, controller outputs are commanded by a network PLC connected to the controller network port

Operating States

The 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's primary operating states are: Ready, Not Ready, Start and Run. Fault and Warning Conditions may occur in any of the motor states. A fault response may change the operating state from Ready to Not Ready.

3.3.2 Operating Modes

The controller is provided with 5 pre-defined operating modes, each of which is designed to meet the requirements of a common application configuration. The pre-defined operating modes are:

- **Overload Mode**
- **Independent Mode**, for FVNR and DOL starter applications
- **Reverser Mode**, for full voltage Reversing starter applications
- **Two-step Mode**, for reduced voltage applications including Wye Delta, Primary Resistor and Autotransformer
- **Two-Speed Mode**, for two speed Pole Changer and Consequent Pole (Dahlander) type motor applications

To see the typical wiring schemes for pre-defined operating modes, please refer to [Chapter 4.2, Application Examples](#).

Other than the pre-defined operating modes, another **Custom Operation Mode** is also provided, in which LTM R controller provides the customer a flexible function – custom logic with which the user can tailor one of the predefined operating modes to include user defined input and output assignments, or to introduce timers, counters, boolean logic (AND, NOT, OR) and math functions to define the desired behavior of the slave motor controller for the specific application.

3.3.3 Fault Management

The setting of the Fault Reset Mode parameter determines how the controller manages faults. The Fault Reset Mode selections include:

- **Manual Reset Mode**, every fault reset command must be performed by on-site personnel. A manual reset will block all reset commands from a remote PLC traveling over the network - even when the Network is the valid control source..
- **Automatic Reset Mode**, permits the controller to automatically reset faults occurring at unmanned installations. Parameters allow the controller to reset the fault and prepare controller for the next intended operation.
- **Remote Reset Mode**, to permit resetting faults from the PLC over a network. This provides centralized monitoring and control of equipment installations. The Control Mode parameter selection determines the available reset methods.

3.4 Commissioning

Commissioning is a pre-process toward the system before using, which includes: initialization of the installed devices, and configuration of controller parameters required to control, protect and monitor the controller, expansion module, and other devices included in the application.

Commissioning could be implemented by 3 means:

- Using the keypad of the Magelis XBTN410 HMI device
- Using a PC running PowerSuite™ software
- Using the network port

Chapter 4. Application Examples

4.1 Supported Application Segments

Supported Machine Segments

The motor management system supports many machine segments including the following:

Machine segment	Examples	
Process and special machine segments	Water	Water treatment (blowers and agitators)
	Metal, Minerals and Mining	Cement
		Glass
		Steel
		Ore-Extraction
	Oil and gas processing	Petrochemical
		Refinery, Offshore Platform
	Microelectronic	
	Pharmaceutical	
	Chemical Industry	Cosmetics
Detergents		
Fertilizers		
Transportation Industry	Paint	
	Automotive transfer lines	
Other industry	Airports	
	Tunnel machines	
	Cranes	
Complex machine segments	Includes highly automated or coordinated machines used in:	Pumping systems
		Paper conversion
		Printing lines
		HVAC

Supported Industries

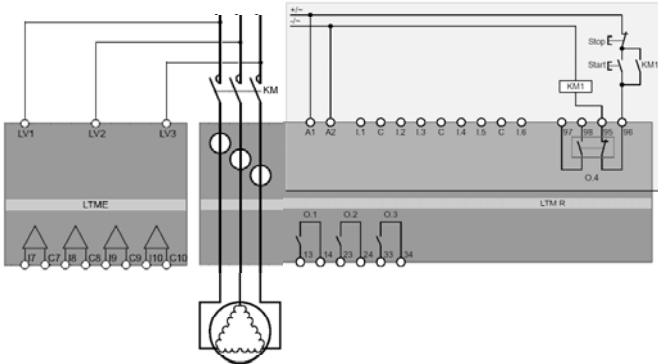
The motor management system supports many industries and associated business sectors including the following:

Industry	Sectors	Application
Building	Office buildings	Control and manage the building facilities: <ul style="list-style-type: none"> ▪ Critical HVAC systems ▪ Water ▪ Air ▪ Gas ▪ Electricity ▪ Steam
	Shopping centers	
	Industrial buildings	
	Ships	
	Hospitals	
	Cultural facilities	
Industry	Airports	<ul style="list-style-type: none"> ▪ Control and monitor pump motors ▪ Ventilation ▪ Control load traction and movements ▪ View status and communicate with machines ▪ Process and communicate the data captured ▪ Remote data management for one or several sites via Internet
	Metal, mineral, and mining: cement, glass, steel, ore-extraction	
	Microelectronic	
	Petrochemical	
	Chemical: pulp and paper industry	
	Pharmaceutical	
Energy and Infrastructure	Food and beverage	<ul style="list-style-type: none"> ▪ Control and monitor pump motors ▪ Ventilation ▪ Remote control of wind turbine ▪ Remote data management for one or several sites via the internet
	Water treatment and transportation	
	Transportation infrastructure for people and freight: airports, road tunnels, subways and tramways	
	Power generation and transport	

4.2 Application Examples

4.2.1 Overload Mode Wiring Diagrams

Monitoring of the motor load where control (start/stop) of the motor load is achieved by a mechanism other than the controller.



Note : The voltage connection for expansion module are recommended to be at the upstream of the contactors, in this way even if the system is in "Ready State", the voltage could also be measured.

Diagram with 3-Wire Local Control

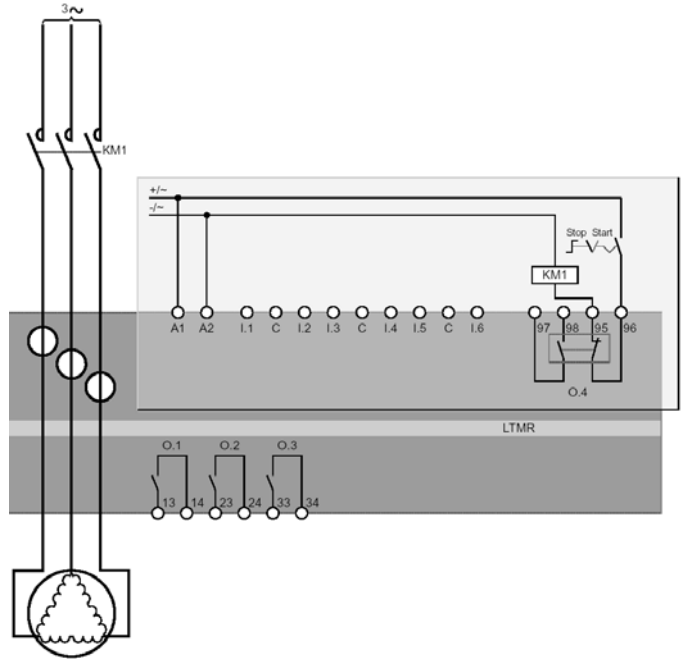


Diagram with 2-Wire Local Control

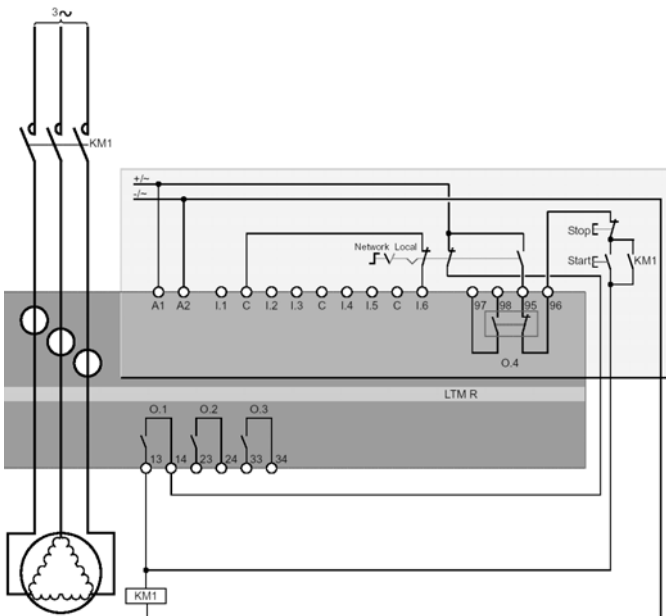


Diagram with 3-Wire Local Control with Network Control Selectable

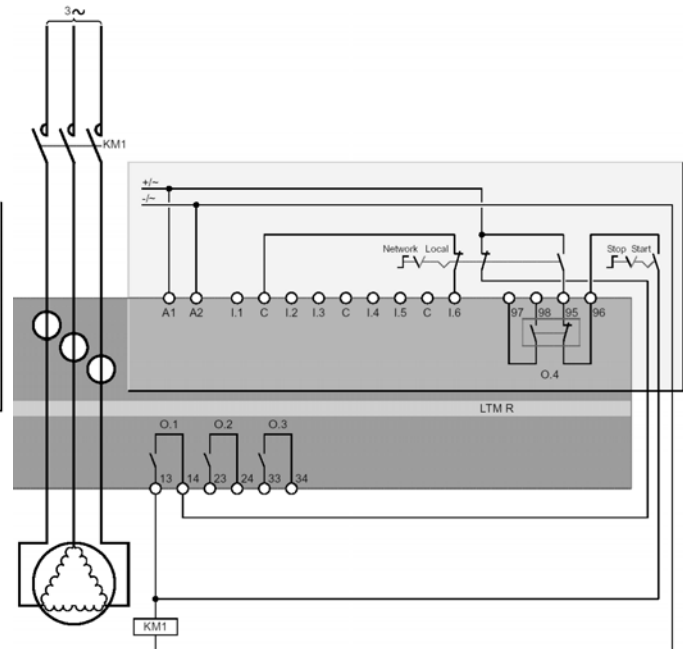


Diagram with 2-Wire Local Control with Network Control Selectable

4.2.2 Independent Mode Wiring Diagrams

Direct-on-line (across-the-line), full-voltage, non-reversing motor starting applications.

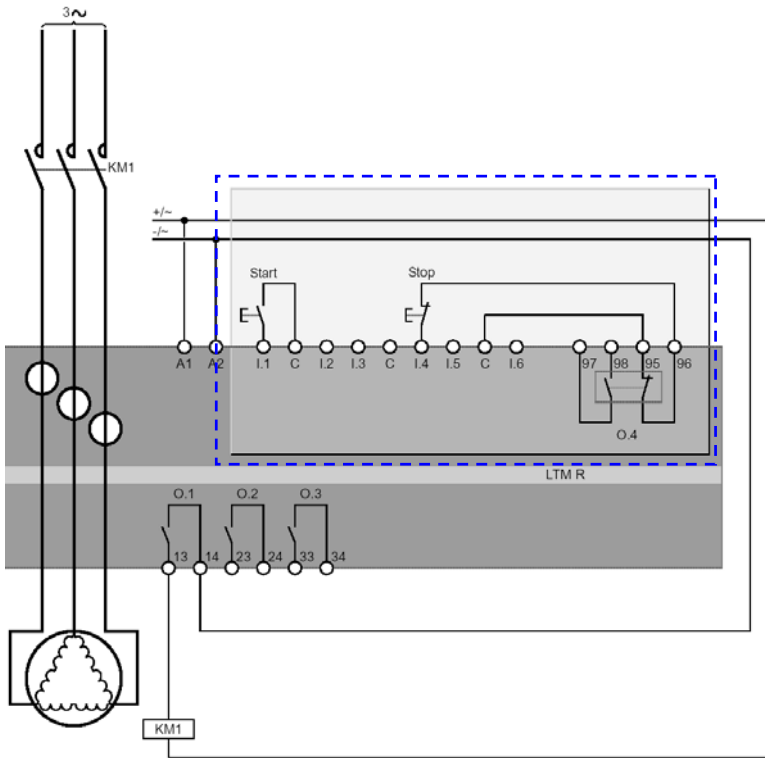


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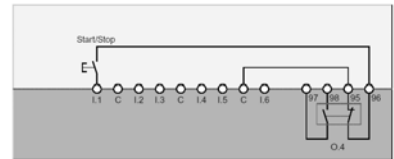


Diagram with 2-Wire Local Control

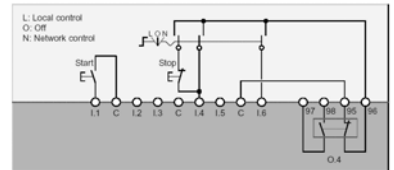


Diagram with 3-Wire Local Control with Network Control Selectable

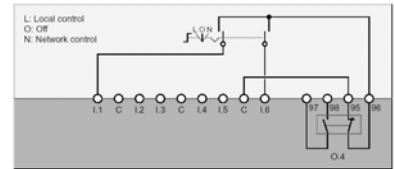


Diagram with 2-Wire Local Control with Network Control Selectable

4.2.3 Reversing Mode Wiring Diagrams

Direct-on-line (across-the-line), full-voltage, reversing motor starting applications.

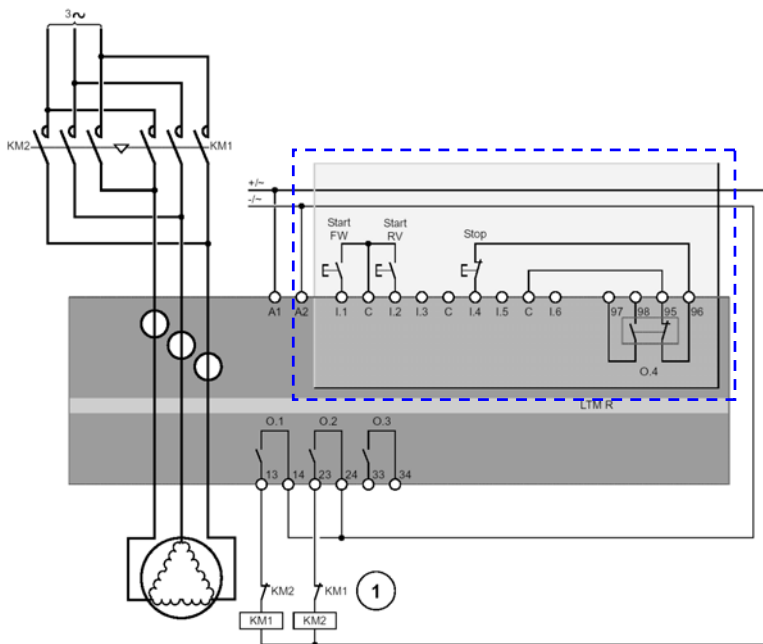


Diagram with 3-Wire Local Control

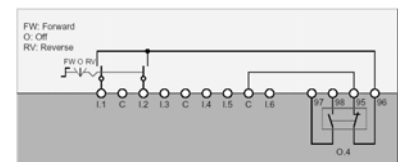


Diagram with 2-Wire Local Control

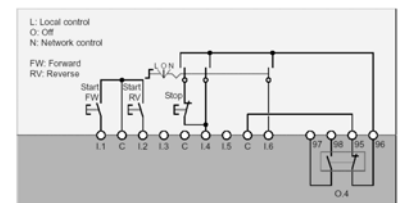


Diagram with 3-Wire Local Control with Network control selectable

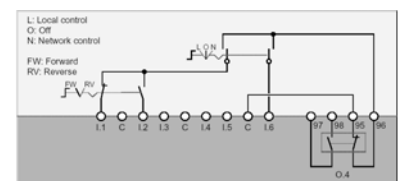
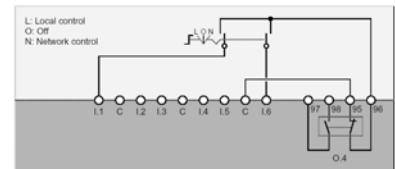
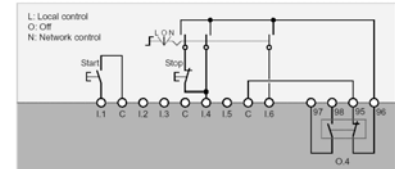
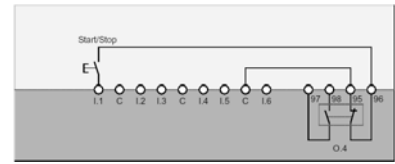
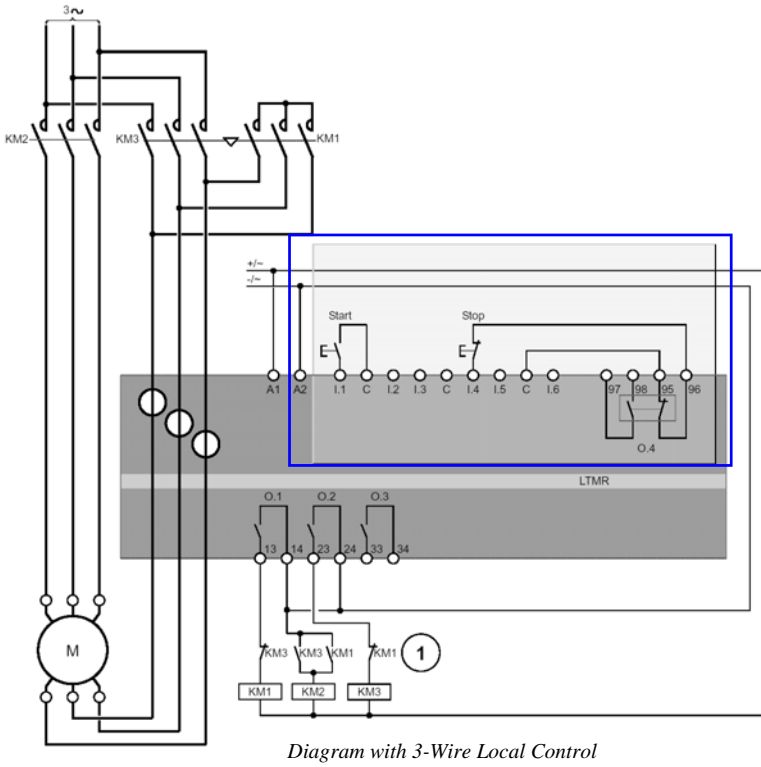


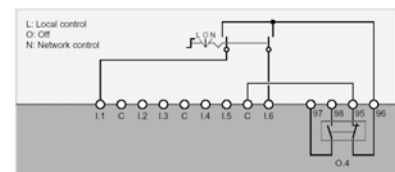
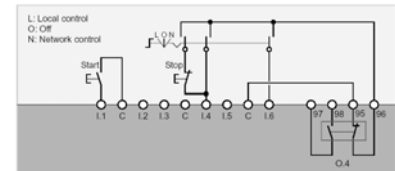
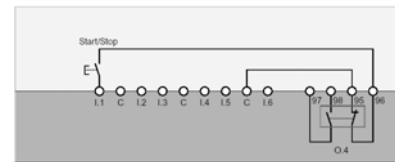
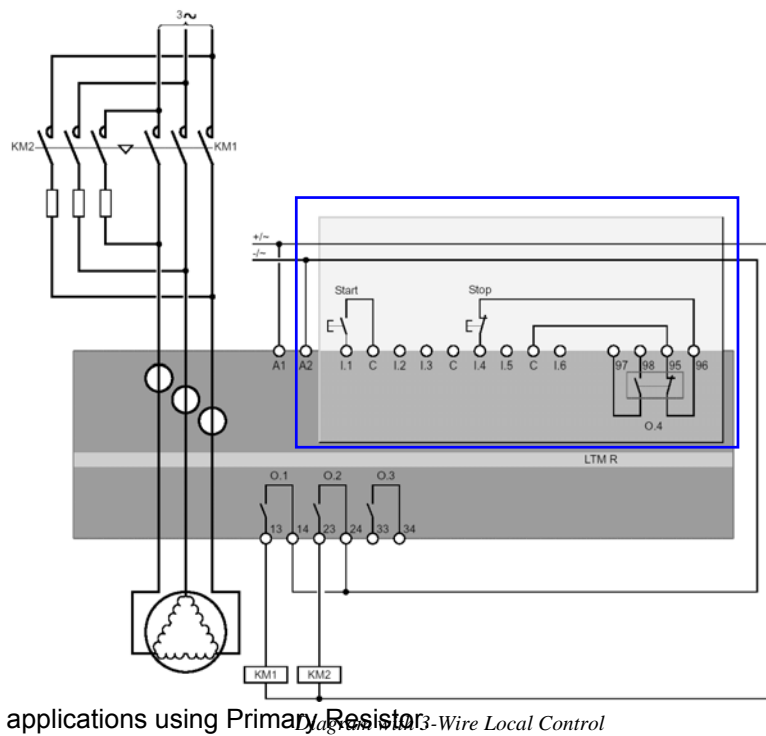
Diagram with 2-Wire Local Control with Network control selectable

4.2.4 Two-Step Wye-Delta Mode Wiring Diagrams

Reduced voltage starting motor applications using Wye-Delta wiring.



4.2.5 Two-Step Primary Resistor Mode Wiring Diagrams



applications using Primary Resistor

Reduced voltage starting motor

4.2.6 Two-Step Autotransformer Mode Wiring Diagrams

Reduced voltage starting motor applications using Autotransformer.

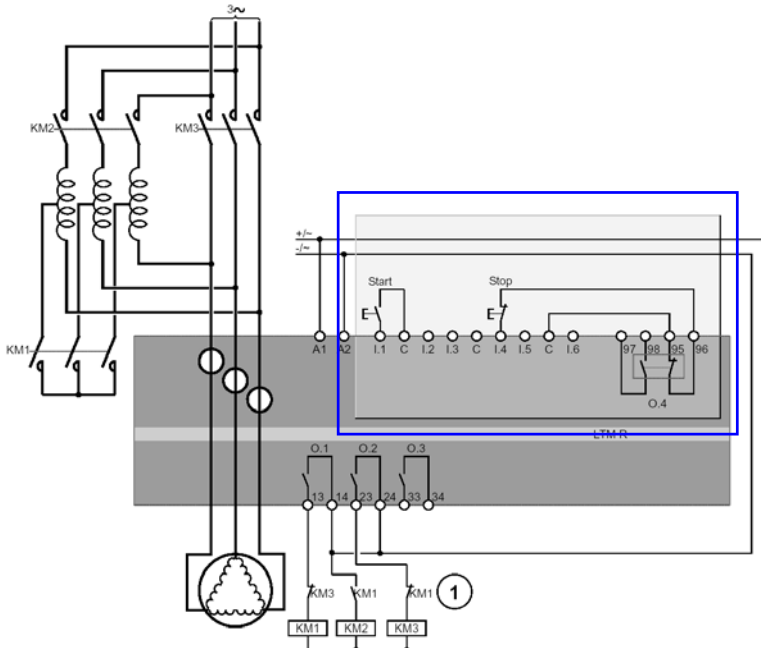


Diagram with 3-Wire Local Control

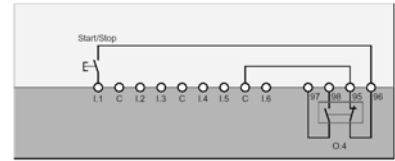


Diagram with 3-Wire Local Control

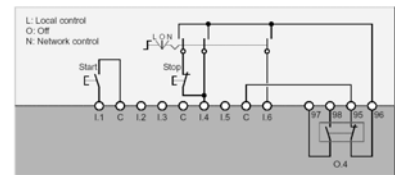


Diagram with 3-Wire Local Control with Network Control Selectable

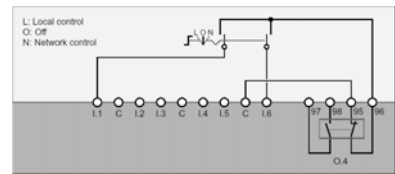


Diagram with 2-Wire Local Control with Network Control Selectable

4.2.7 Two-Speed Dahlander Mode Wiring Diagrams

Two-speed motor applications for motor types, using Dahlander (consequent pole).

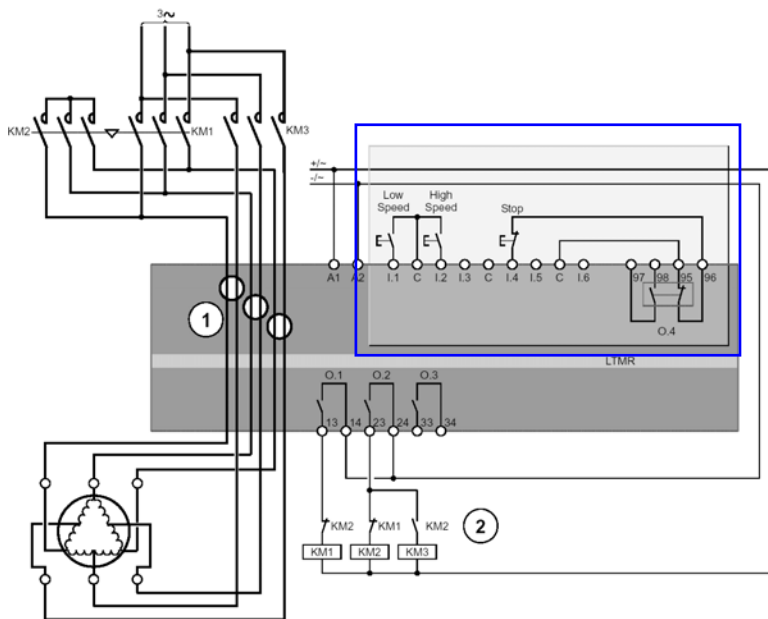


Diagram with 3-Wire Local Control

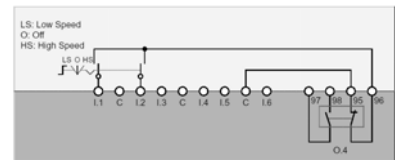


Diagram with 2-Wire Local Control

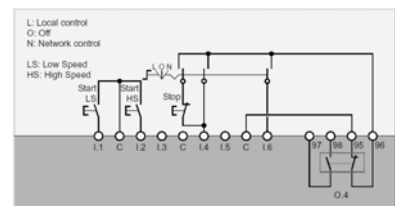


Diagram with 3-Wire Local Control with Network Control Selectable

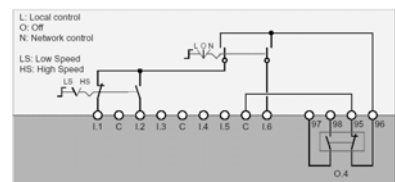


Diagram with 2-Wire Local Control with Network Control Selectable

4.2.8 Two-Speed Pole Changing Mode Wiring Diagrams

Two-speed motor applications for motor types, using Pole Changer.

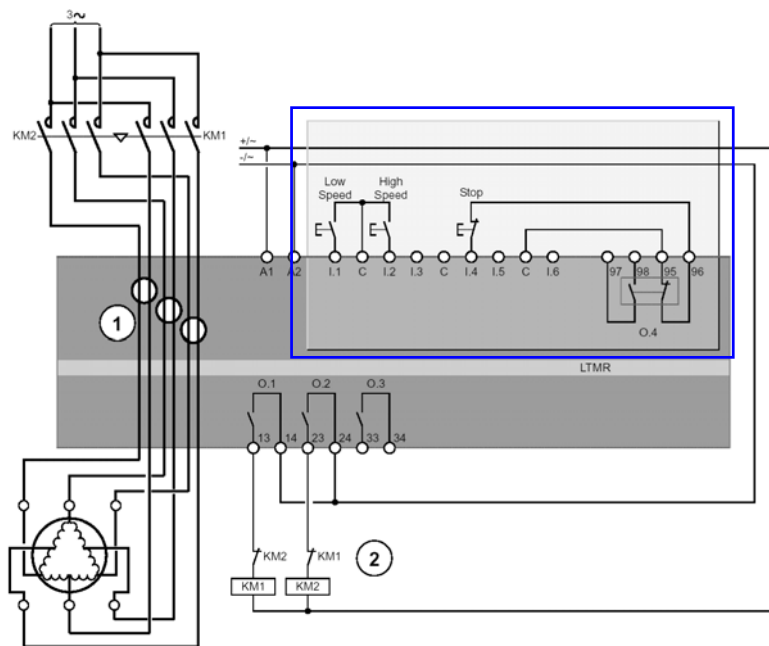


Diagram with 3-Wire Local Control

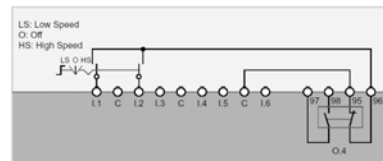


Diagram with 2-Wire Local Control

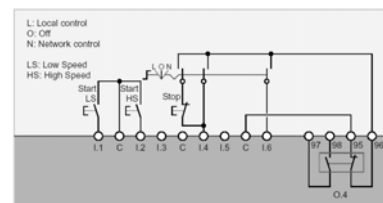


Diagram with 3-Wire Local Control with Network Control Selectable

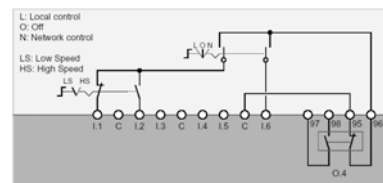


Diagram with 2-Wire Local Control with Network Control Selectable