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.

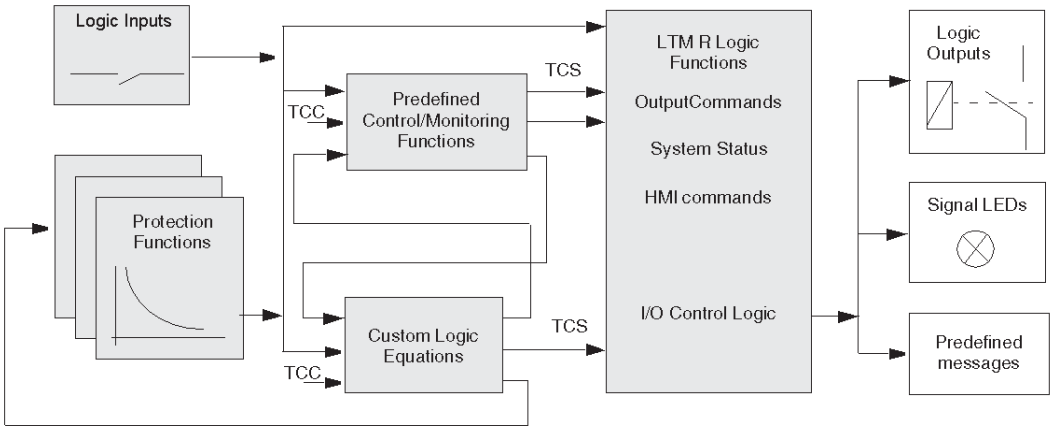
- These functions are predefined and fit the applications most frequently used. They are ready to use and are implemented by simple parameter setting after the LTM R controller has been commissioned.
- The predefined control and monitoring functions can be adapted for particular needs using the custom 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 169)*	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 171)*	Direct-on-line (across-the-line) full-voltage non-reversing motor starting applications
Reverser *(see page 173)*	Direct-on-line (across-the-line) full-voltage reversing motor starting applications
Two-Step *(see page 176)*	Reduced voltage starting motor applications, including: ● Wye-Delta ● Open Transition Primary Resistor ● Open Transition Autotransformer
Two-Speed *(see page 181)*	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 155*.

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 53)* 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

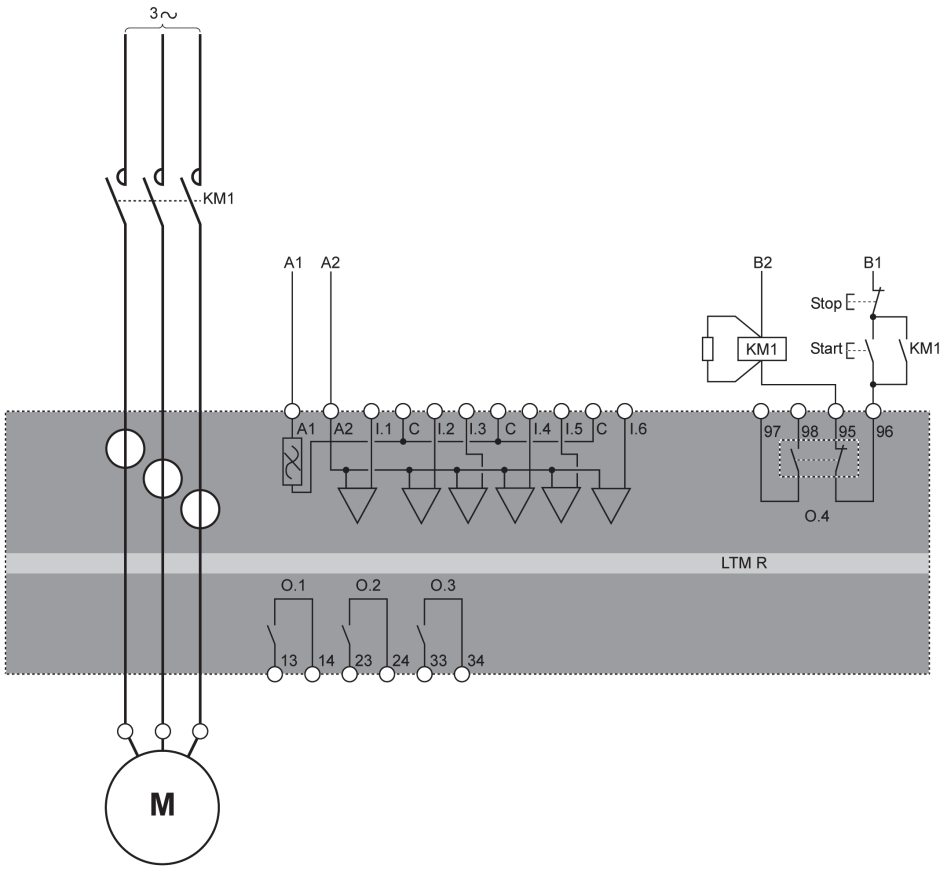
The Overload operating mode includes the following features:

- 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 495*.

For examples of overload operating mode NEMA diagrams, refer to relevant diagrams *Overload Mode Wiring Diagrams, page 514*.

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

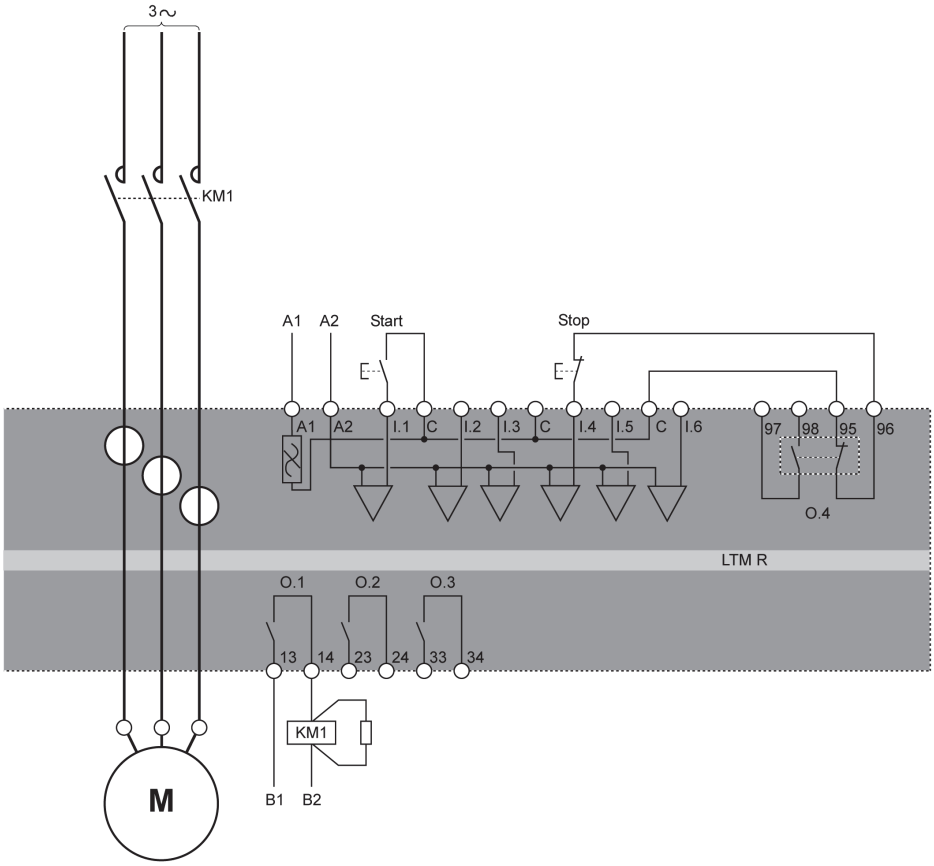
This function includes the following features:

- 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 168* 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 499*.

For examples of independent operating mode NEMA diagrams, refer to relevant diagrams *Independent Mode Wiring Diagrams, page 518*.

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:

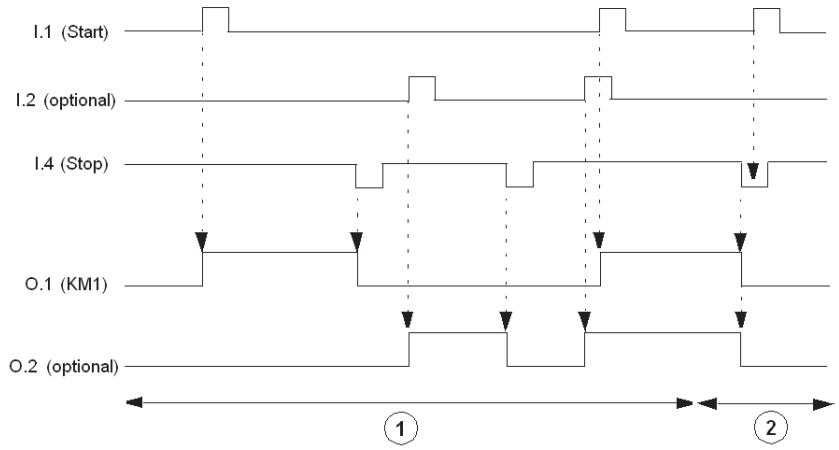
Logic Outputs	Assignment
O.1 (13 and 14)	KM1 contactor control
O.2 (23 and 24)	Controlled by I.2
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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

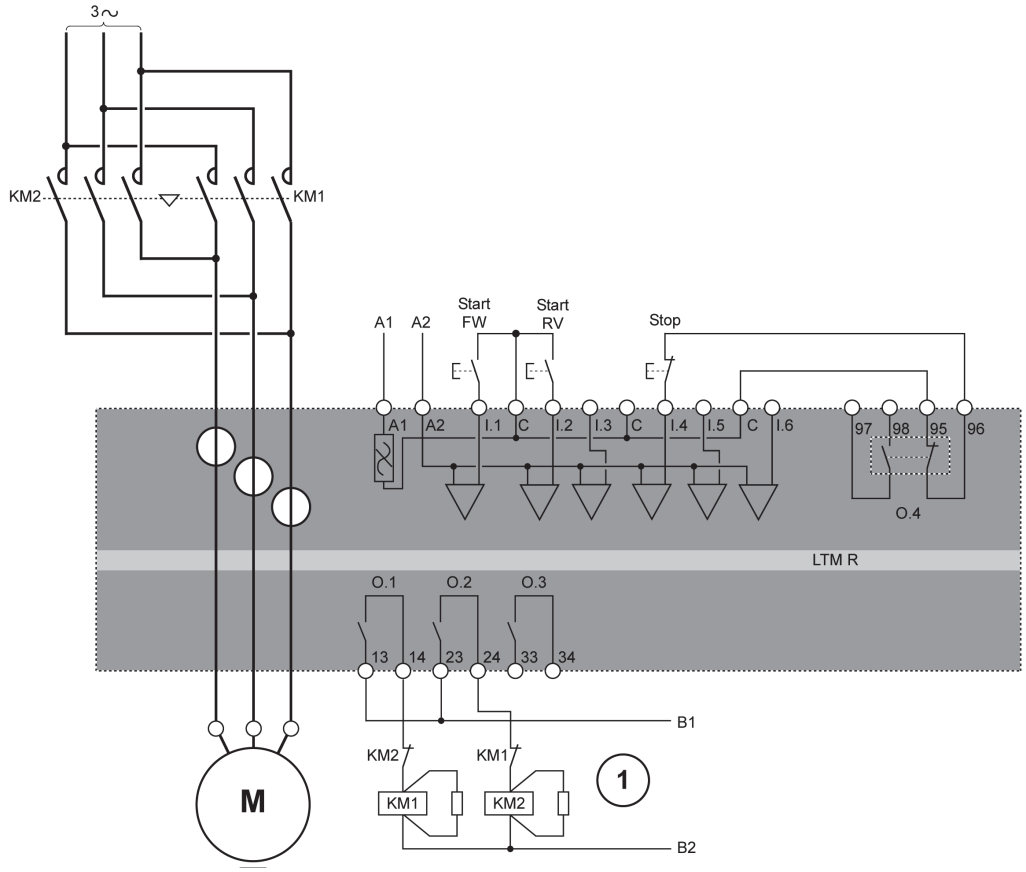
This function includes the following features:

- 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 168* 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 501*.

For examples of reverser operating mode NEMA diagrams, refer to relevant diagrams *Reverser Mode Wiring Diagrams*, *page 520*.

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:

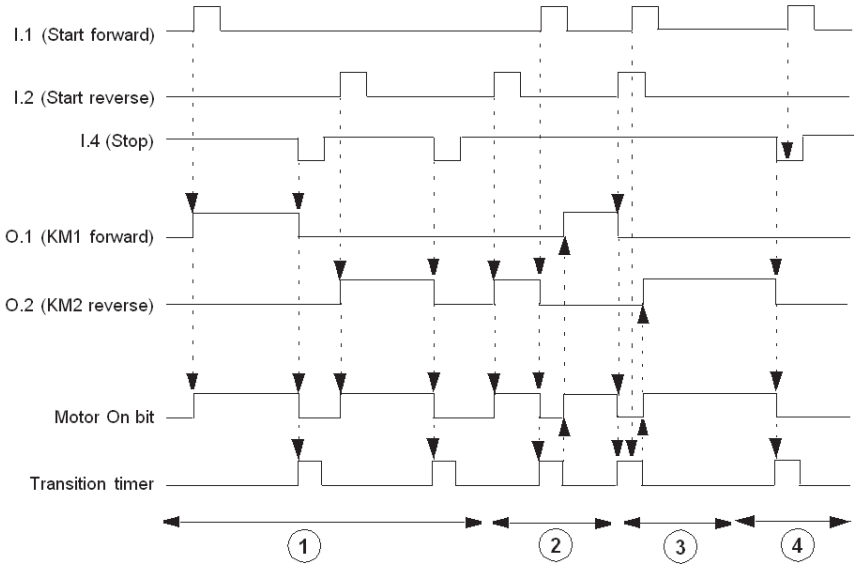
Logic Outputs	Assignment
O.1 (13 and 14)	KM1 contactor control Forward
O.2 (23 and 24)	KM2 contactor control Reverse
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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:

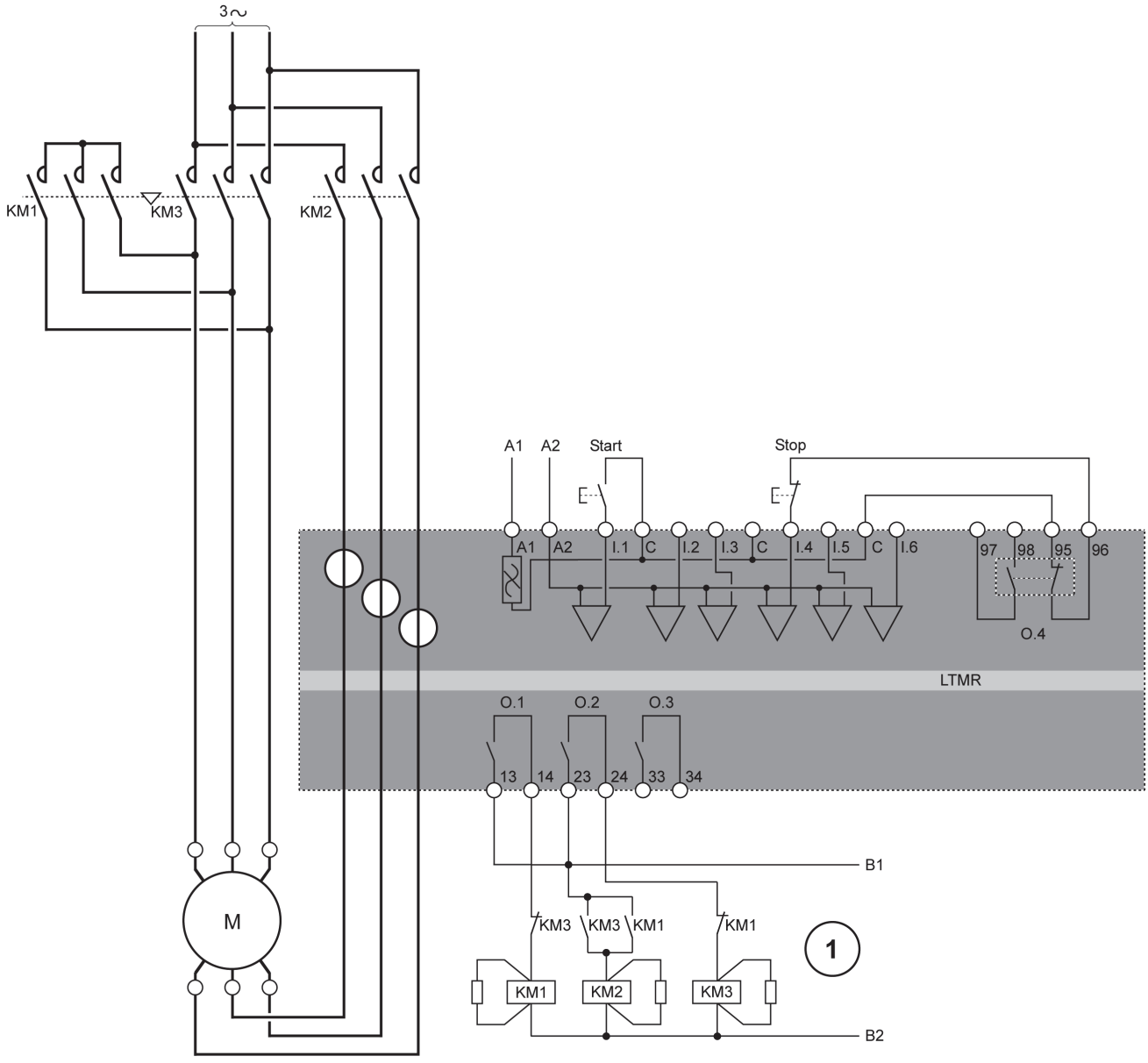
- Accessible in 3 control channels: Terminal Strip, HMI, and Network.
- Two-Step operation settings include:
  - A Motor Step 1 To 2 Timeout that starts when current reaches 10% of FLC min.
  - A Motor Step 1 To 2 Threshold setting.
  - A Motor Transition Timeout setting that starts upon the earlier 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 168* 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.



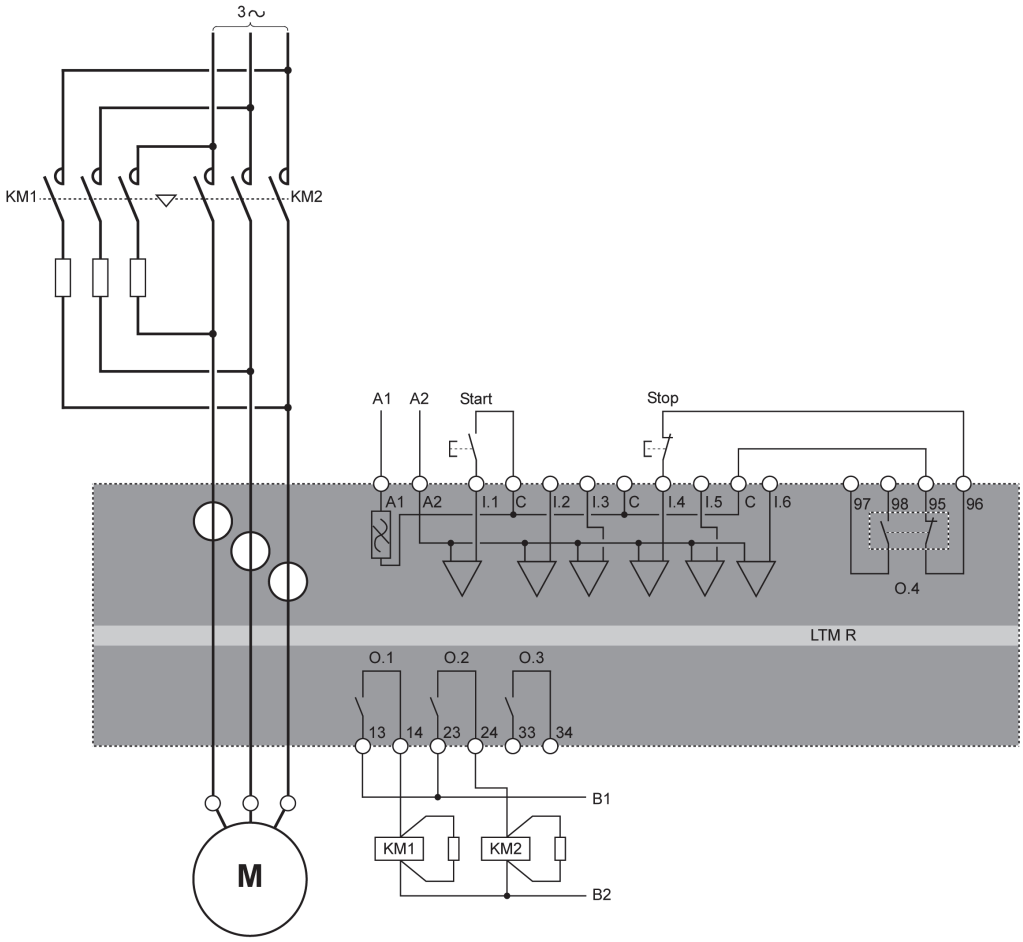
1 The N.C. interlock contacts KM1 and KM3 are not mandatory because the LTM R controller electronically interlocks O.1 and O.2.

For additional examples of two-step Wye-Delta IEC diagrams, refer to relevant diagrams *Two-Step Wye-Delta Mode Wiring Diagrams, page 503*.

For examples of two-step Wye-Delta NEMA diagrams, refer to relevant diagrams *Two-Step Wye-Delta Mode Wiring Diagrams, page 522*.

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.

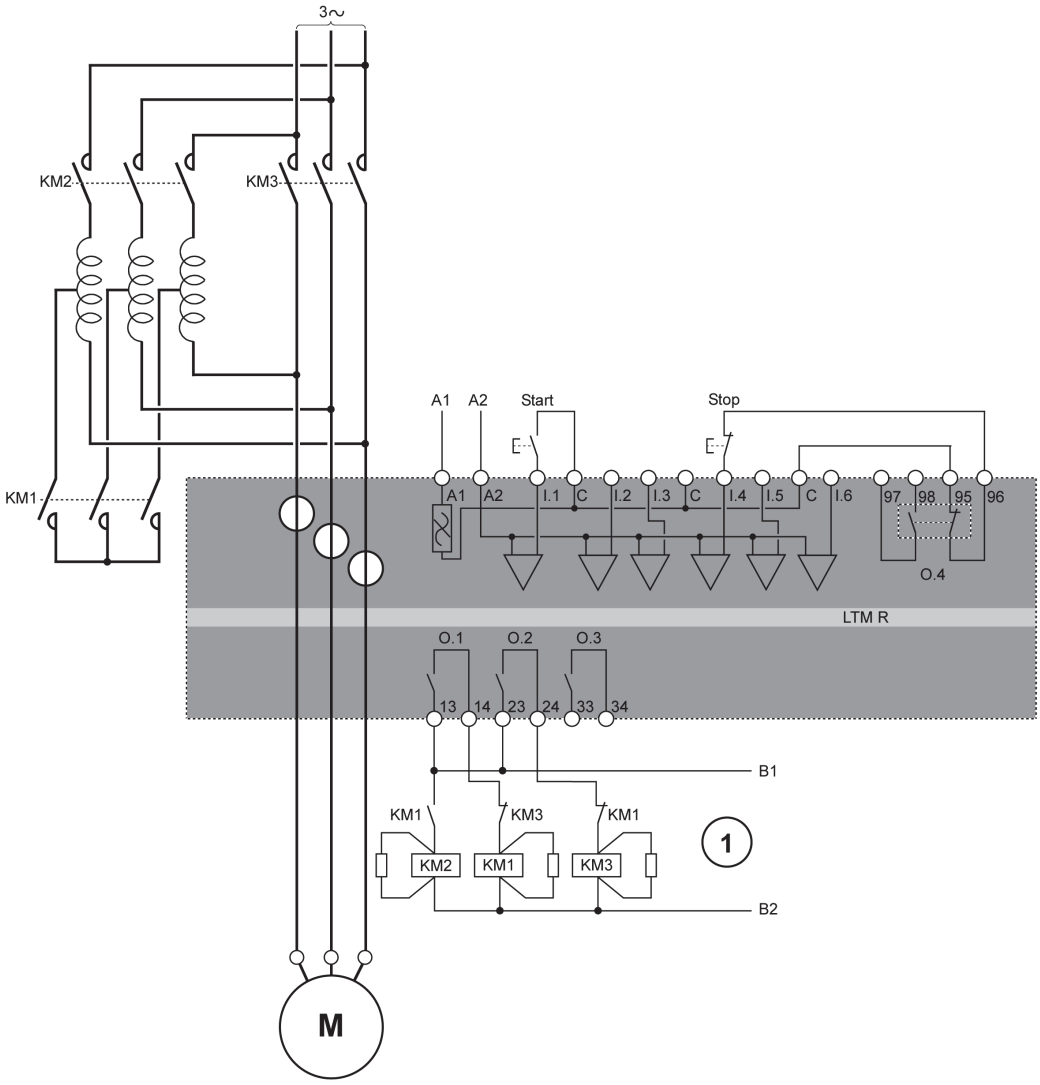


For additional examples of two-step primary resistor IEC diagrams, refer to relevant diagrams *Two-Step Primary Resistor Mode Wiring Diagrams*, *page 505*.

For examples of two-step primary resistor NEMA diagrams, refer to relevant diagrams *Two-Step Primary Resistor Mode Wiring Diagrams*, *page 524*.

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 507*.

For examples of two-step autotransformer NEMA diagrams, refer to relevant diagrams *Two-Step Autotransformer Mode Wiring Diagrams, page 526*.

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:

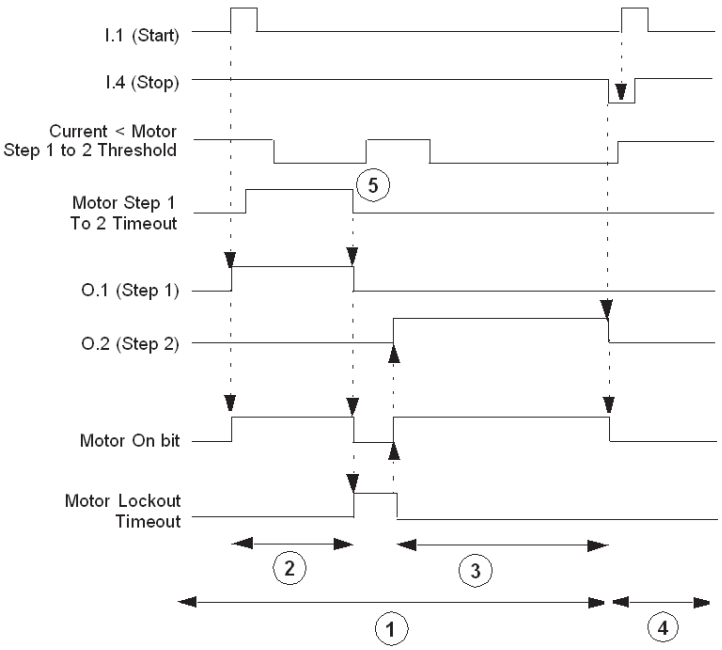
Logic Outputs	Assignment
O.1 (13 and 14)	Step 1 contactor control
O.2 (23 and 24)	Step 2 contactor control
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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:

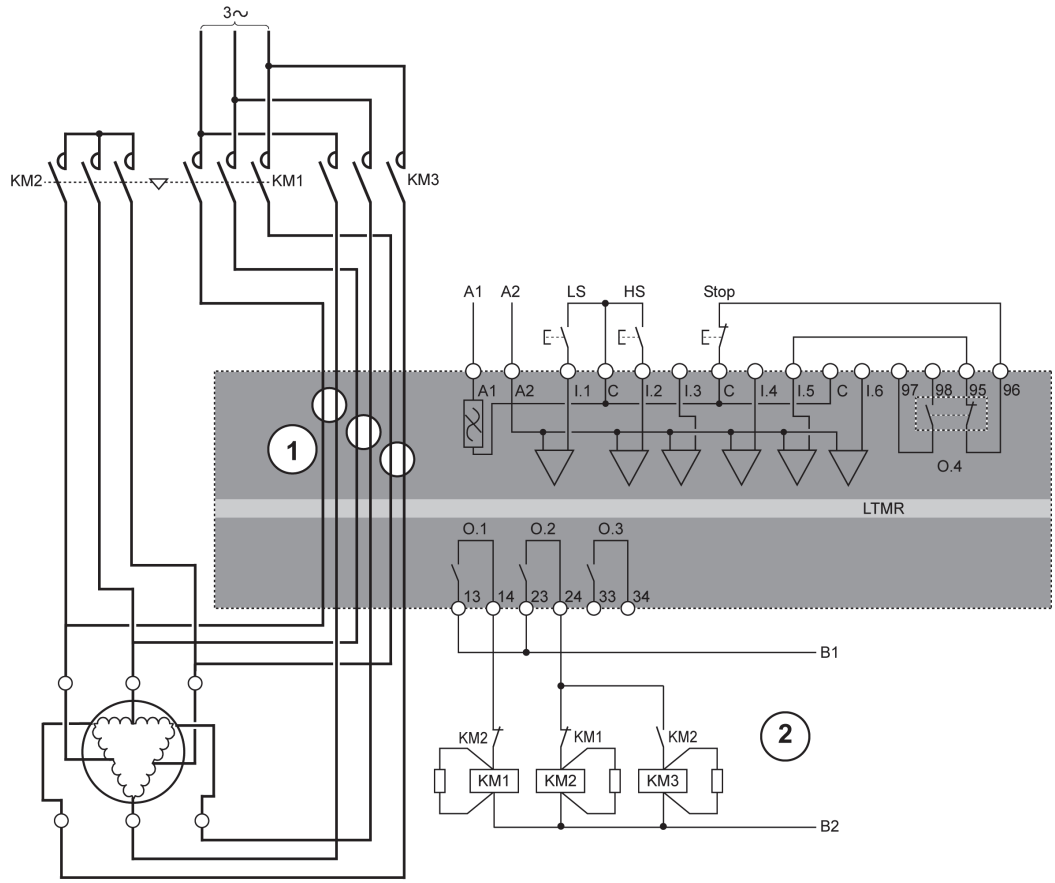
- Accessible in 3 control channels: Terminal Strip, HMI, and Network.
- Firmware interlocking prevents simultaneous activation of O.1 (low speed) and O.2 (high speed) logic outputs.
- 2 measures of FLC:
  - FLC1 (Motor Full Load Current Ratio) at low speed
  - FLC2 (Motor High Speed Full Load Current 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 168* 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.

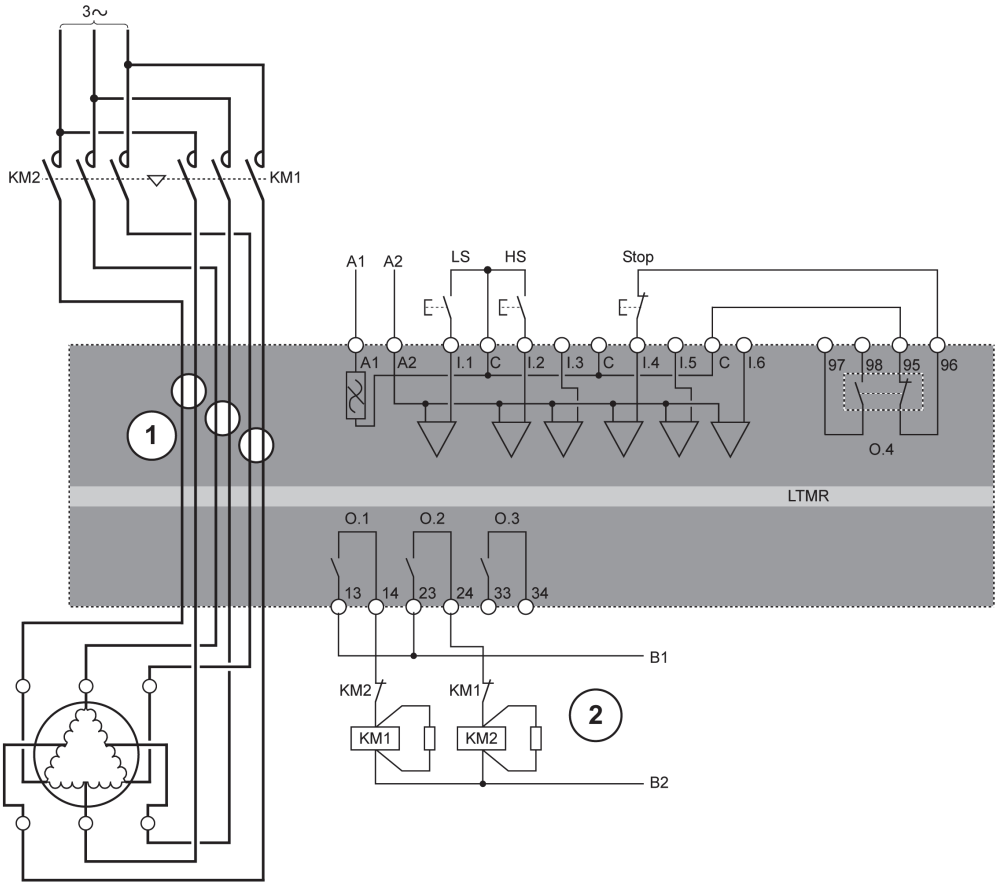
2 The N.C. interlock contacts KM1 and KM2 are not mandatory because the LTM R controller firmware interlocks O.1 and O.2.

For additional examples of two-speed Dahlander IEC diagrams, refer to relevant diagrams *Two-Speed Dahlander Mode Wiring Diagrams, page 509*.

For examples of two-speed Dahlander NEMA diagrams, refer to relevant diagrams *Two-Speed Mode Wiring Diagrams: Single Winding (Consequent Pole), page 528*.

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 511*.

For examples of pole-changing NEMA diagrams, refer to relevant diagrams *Two-Speed Mode Wiring Diagrams: Separate Winding, page 530*.

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:

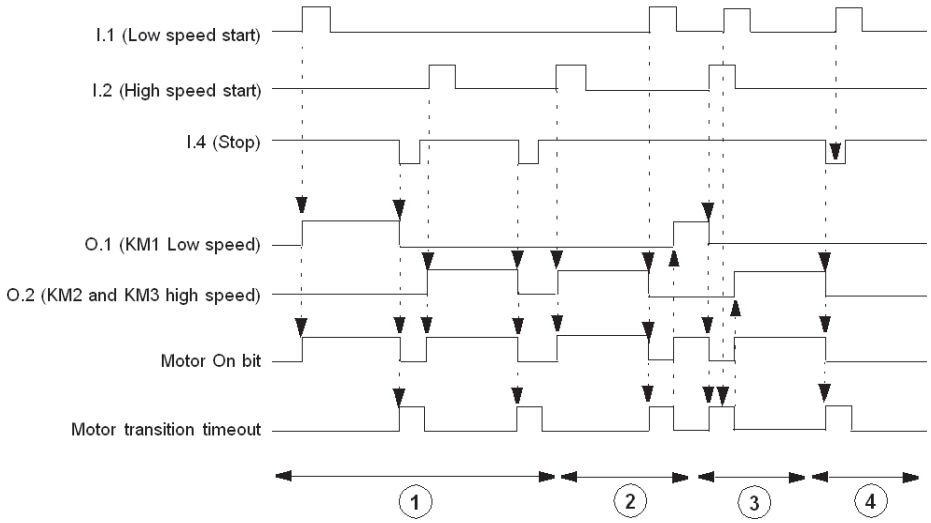
Logic outputs	Assignment
O.1 (13 and 14)	Low speed control
O.2 (23 and 24)	High speed control
O.3 (33 and 34)	Warning signal
O.4 (95, 96, 97, and 98)	Fault signal

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.

Possible Functions with Custom Logic

With custom logic, it is possible to customize the motor operating mode to:

- control the motor through two channels at the same time
- enable/disable protection functions or change the protection level
- customize external detected faults: circuit breaker detected fault, wrong drawer position
- create a commissioning or testing mode and activate all outputs without motor current
- switch to local or remote based on a bit activated by network
- limit the number of starts per hour
- use TeSys T for motors over 1000 A, and return correct calculation of power

Configuration Files

The configuration of the 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.