TECHNICAL INFO

Motor control and protection unit

M10x User Guide

- A reliable, available, simple, safe and powerful low voltage motor control center solution

ABB low voltage MCC with M10x is the intelligent motor control center solution integrating protection, control, monitoring and communication through single M10x, a signature motor management device of ABB low voltage switchgear business.

Main benefits of ABB MCC with M10x

- **Unmatched safety for protection for personnel and plant**
- **Simplicity and high functionality**
- **Integrated communications**
- **Reliable solution proven by years of market experience**
- **Flexibility in a standardized solution**
- **Less spare starter module types**
- **Rapid fault detection and rectification**
- **Easy integrate and access to digital service**
- **Fully integrated into ABB Ability CMES condition monitoring solution**

Contents

01. General

Target group
This manual provides information on the internal parameters of M10x for the purpose of understanding, engineering, testing, system integration or commissioning of the product.

Each chapter consists of brief explanations of the functions, the relevant parameters and the parameter descriptions, along with ranges. Default values of all parameters are listed in appendix: Factory settings for M10x.

Examples and further explanations are provided for user reference in parameterization.

Use of warning, caution, information and tip icon
This publication includes Warning, Caution, and Information icons where appropriate to point out safety related or other important information. It also includes Tip icons to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

	The electrical warning icon indicates the presence of a hazard that could result in electrical shock.
	The warning icon indicates the presence of a hazard that could result in personal injury.
	The caution icon indicates important information or warnings related to the concept discussed in the text. It might indicate the presence of hazard that could result on corruption of software or damage to equipment/property.
	The information icon alerts the reader to pertinent facts and conditions.
	The tip icon indicates advice on, for example, how to design your project or how to use a certain function

Although Warning notices are related to personal injury, and Caution notices are associated with equipment or property damage, it should be understood that the operation of damaged equipment could, under certain operational conditions, result in impaired process performance leading to personal injury or death. It is, therefore, imperative that you comply fully with all Warning and Caution notices.

Terminology

List of terms, acronyms, abbreviations and definitions used in the document:

Abbreviation	Term	Description
	Alarm	Alarm is defined as status transition from any state to abnormal state. Status transition to abnormal state can be data crossing over the pre-defined alarm limit.
DCS	Distributed control system	High level distributed control system
	Local hardwiring	A control access term describing that the M10x accepts its commands from the hardwired inputs when the local control authority is enabled.
PCS	Process control system	High level process control system
	MODBUS	Fieldbus communication protocol
	MODBUS RTU	Fieldbus communication protocol
	PROFIBUS-DP	Fieldbus communication protocol with cyclic data transfer (V0).
	PROFIBUS-DP/V1	Fieldbus communication protocol, extension of PROFIBUS-DP allowing acyclic data transfer and multi master (V1)
PTC	Positive temperature coefficient	PTC thermistors are semiconductor elements with a very high positive temperature coefficient.
RCU	Remote control unit	Local control unit with pushbutton and indicator to operate a device (eg, motor) from field level.
	Remote fieldbus	A control access term describing that the M10x accepts its commands from the fieldbus inputs when the remote control authority is enabled.
RS485		Communication interface standard from EIA (Electronics Industries Association, USA), operating on voltages between 0V and +5V. RS-485 is more noise resistant than RS- 232C, handles data transmission over longer distances, and can drive more receivers.
STP	Shielded twisted pair	A type of cable commonly used for signal transmission.
TOL	Thermal overload protection	Protection against overheated caused by overload
	Trip	A consequence of an alarm activated or an external trip command from another device to stop the motor or trip the circuit breaker.
MCC	Motor control center	Common term for a switchgear used for motor control and protection.
SOE	Sequence of events	A record of events with time stamp.

Related documentation

1TNC 911112	M10x User Guide
1TNC 911507	M10x-P PROFIBUS Protocol Implementation
1TNC 911505	M10x-M Modbus Protocol Implementation
1TNC 911104	MCUSetup User Guide
1TNC928239	M10x Ethernet Module EM01 User Guide

Related System Version

The content of this document is related to M10x products with the following hardware and firmware version release:

	HW	FW
M10x-M 24VDC	2.0	3.5
M10x-M 110VAC	1.0	3.5
M10x-M 240VAC	1.0	3.5
M10x-P 24VDC	3.2	5.4
M10x-P 110VAC	1.0	5.4
M10x-P 240VAC	5.2	5.4
MD21	1.0	2.3
MD31	1.0	1.1
EM01	1.0	1.1

Until further notice, this document is also applicable for future firmware versions other than those listed above.

The described functions are designed but may not be fully implemented in all details. Please refer to the release notes regarding possible restrictions.

Document revision history

Revision	Description of change	Date
D0201	Initial Edition	10/2003
D0202	Product revisions	10/2005
D0203	Revise COM terminals; Revise terminology of control authority. Revise earth fault setting.	10/2007
D0204	Template changed as per BU Guideline.	10/2010
D0205	Released for M10x products with new hardware, suitable for both M10x-M and M10x-P	01/2013
D0206	Feature "Ready to start" is added to DO	07/2013
D0207	Add in Phase sequence protection and more DO functions, modify main switch supervision function.	09/2016
D0208	Add in insertion cycle supervision, external VT setting and Ethernet module EM01	02/2020

New features available in enhanced products (1TNA920xxx)

In comparison with classic products (1TNA911xx)

General features	
1	One single type of integrated CT ranging from 0.24~63A replaces all 6 types of CTs in previous vious products.
2	Products with options for 110VAC or 240VAC power supply and DI types are available in addition to 24VDC option.
3	Additional SOE function in M102 provides event recorder data up to 256 events with time stamp.
4	Products in the same categories are made with the same features and functionalities and are only different in power supply and communication interface from each type. For example, M101's range of products has identical functionalities regardless of different types of power supply and interfaces, such as M101-M 24VDC, M101-P 240VAC, etc.
Physical dimension	
1	Main unit dimension remains the same as previous revision. MDx panel is slightly larger in width and length (both 3mm extra) while cutout dimension remains the same.
Control features	
1	Contactor feeder and contactor feeder/RCU are added into starter types.
2	Two separate start types are available for two-speed starters. NR_2N is for two-speed motor with separate windings while NR_2N Dahlander is for Dahlander connection motor.
3	Control logic in NR_softstarter and REV_softstarter are modified slightly.
4	Control authority feature in M10x-M has been revised to be identical to M10x-P.
Digital inputs and outputs	
1	All DIs in M10x are configurable and also selectable with NO or NC.
2	E-stop, Limit 1, Limit 2, External trip input control definition has been revised.
3	More features are added to DOs.
Protection	
1	Long start protection is available to provide stall protection during motor startup.
2	Options are provided to enable or disable TOL protection during motor startup.
3	PTC short circuit protection and PTC open circuit protection are available.
Communication	
1	Additional communication speeds are available for MODBUS: 38400 bps and 57600 bps.
2	Additonal communication option Modbus TCP is added in.
Measuring and monitoring	
1	Additional running data are monitored such as current phase unbalance, thermistor re-sistor, time to TOL trip, time to TOL reset, startup time, DI status.
2	Phase-to-phase instead of phase-to-neutral voltage is directly measured.
Maintenance	
1	More maintenance features are implemented, including providing number of trips, SOE with time stamp, etc.
Operator panel MDx	
1	MDx is provided as IP54.
2	Color and function of LEDs are selectable.
3	Messages on MD21 are selectable.
4	Multiple languages are supported including , English and Chinese.
5	Parameter setting via MD21 is available.
6	Parameter setting port on MDx is mini USB connector in lieu of USB connector.

02. Product overview

Introduction
M10x is an intelligent motor control and protection device based on current measurement or current measurement and voltage measurement. Installed in and supplied as part of ABB Low Voltage switch-gear MNS®, it is part of a low voltage system family of products that provides customers with an ABB intelligent system solution.

M10x is a microprocessor-based product providing comprehensive but standard features in one device. Standard features simplify maintenance and plant expansion. Each motor starter is equipped with one standard M10x device. With dedicated parameters in each device, M10x provides specific control, moni-toring and protection functions, tailored for various motor applications.

Coupled with the world's most common industrial fieldbus interfaces (PROFIBUS DP and MODBUS), M10x integrates smoothly and efficiently into industrial control and plant management systems. Every individual M10x device can be accessed and interrogated to determine both actual and operating pa-rameters. Fast response time for alarm or trip status makes real time control of a complete process possible. Statistical recording of running hours and number of operations assists with predictive maintenance scheduling.

For AC motor and the operated installations this means:
- Reliable protection
- Maximum utilization
- Continuous supervision
- Flexibility

Structure
- Main unit (with current converter unit)
- Operator panel MD21/MD31

Analogue output (AO) module is available as an optional extension unit.

Main unit
The main unit is constructed with two parts: the electronics of the motor control unit and the integrated CT. Main unit is a one type device with the integrated CT range starting from 0.24 to 63A. For motor ratings larger than 63A, interposing CTs can be selected.
Main unit is designed with a mounting rail fixed to the bottom of the device for easy vertical DIN rail mounting.

Screws and other mounting accessories also provide for vertical and horizontal screw mounting.

Operator panel MD21/MD31
The operator panel is the user interface mounted on the front door or drawer. With control buttons, LED, LCD module (MD21 only), MD21/MD31 provides functions for motor control, supervision and parameter-izing. One operator panel is provided for each main unit upon request.

Analogue Output Module AO11
Analogue output module AO11 is an optional add-on module to main unit, providing one channel 0-20mA or 4-20mA analogue output. Details of AO11 module including how to do the configuration is provided in a separate document, 1TNC 920204 M10x AO Module User Guide.

Ethernet Module EM01
Ethernet module EM01 is the dedicated Modbus TCP interface to M10x. It includes two Ethernet ports and a serial port that support RS-485 communication. Details of EM01 module including how to do the configuration is provided in a separate document, 1TNC 928239 M10x Ethernet Module EM01 User Guide.

M10x material
The enclosure of the M10x is made of polycarbonate. Flammability rating of the material is UL 94 V-0 and material is halogen free.

Color of the enclosure is RAL 7012.

For a detailed description of MD21/MD31, refer to the chapter: Accessories.

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01 M10x and MD21

03. Mounting of M10x

Dimesnions

Basic dimension of M10x
W x H x D=110mm x 140mm x 75mm

Typical installation of M10x
Vertical DIN rail or vertical screw mounting on horizontal plate

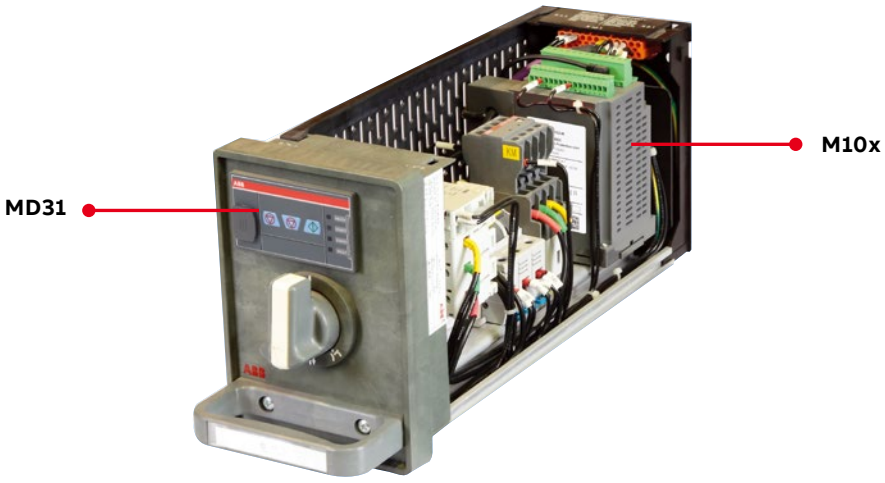
Basic dimension of MD21
W x H x D=91mm x 75mm x 24.3mm

Mounting dimension of MD21
W x H=84mm x 68mm

Basic dimension of MD31
W x H x D=88mm x 50mm x 24.3mm

Mounting dimension of MD31
W x H=84mm x 46mm

For installation details of M10x and MDx, see the related documentation installation manual.



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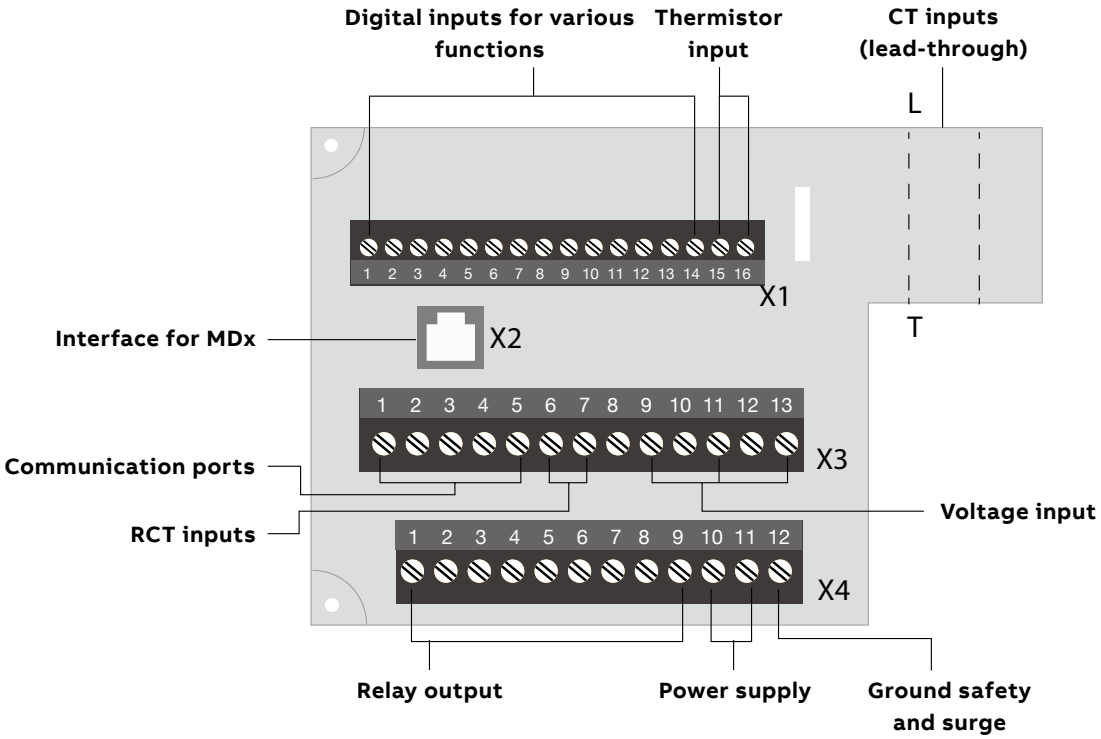
02 M10x in 8E/4 module

Interfaces
Terminal blocks of M10x are located on the top of the main unit for easy access. There are 3 sets of I/O terminal blocks and 1 set of RJ11 connectors as shown.



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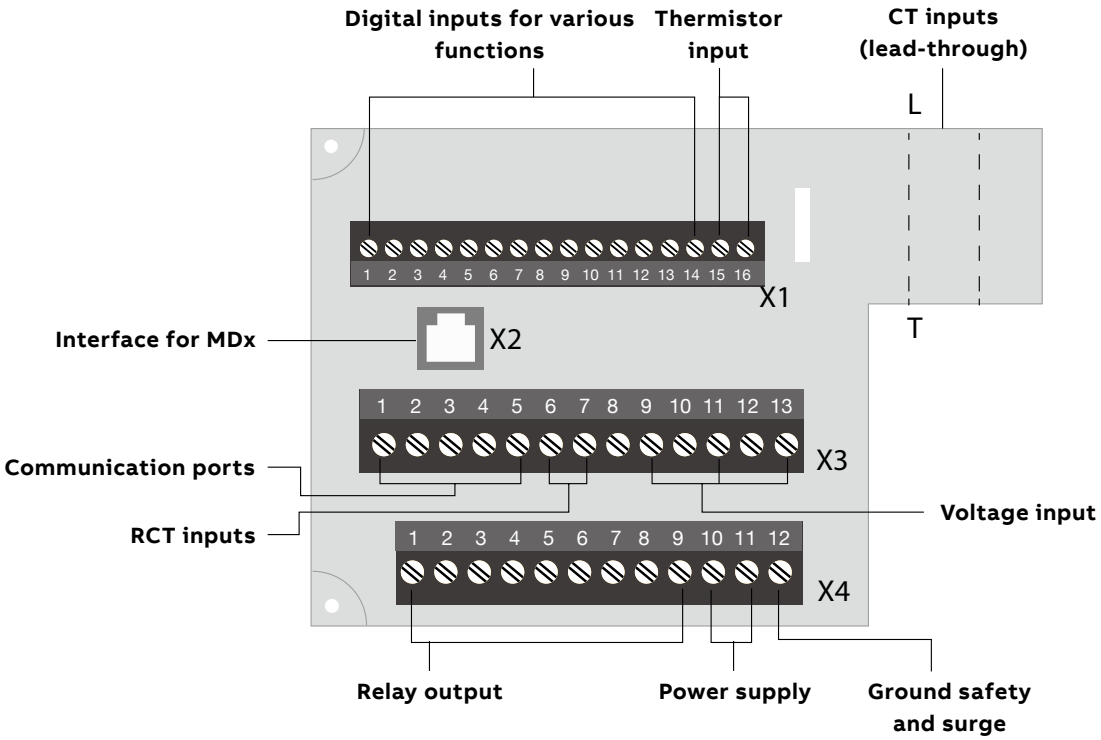
03 Top view terminal layout (24VDC)



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04 Top view terminal layout (110VAC or 240VAC)

Terminal designations

Table 1 Device terminals

Terminal block		Terminal number	Designation... plug/contacts	Remarks
	24VDC type	X1:1...X1:14	Digital input	Cross section 1.5mm²
		X1:15...X1:16	PTC input	
X1	110/240VAC type	X1:1...X1:10	Digital input	Cross section 2.5mm²
		X1:11...X1:12	PTC input	
X2		X2:1...6	Interface for MDx	Cable with RJ11 connector provided
X3		X3:1...5	Fieldbus for external communication	Cross section 2.5mm²
		X3:6,7	RCT input	
		X3:8...13	Voltage input	
X4		X4:1...9	Relay output	Cross section 2.5mm²
		X4:10,11	Power supply	
		X4:12	Ground	
L1-T1; L2-T2; L3-T3		Lead-through	Current measurement	110mm Window

Power supply
Depending on the product type, three types of power supply are available, ie, 24VDC, 110VAC and 240VAC. Power supply of the device should be always derived from an uninterrupted and reliable supply source.

Table 2 Power supply input terminals

Terminal no.	Name	Description
X4:11	24VDC or L	24VDC +, 110VAC or 240VAC
X4:10	GND or N	0VDC or Neutral

Both L-N input and L-L input between X4:10 and X4:11 are applicable For AC type device.

Digital input
M10x 24VDC type has 13 DIs and M10x 110/240VAC type has 9 DIs. Digital inputs are cyclically read.

M10x reads the status of input contacts by measuring the voltage drop on inputs:

Functions of all digital inputs are selectable, and can be assigned to a defined function.

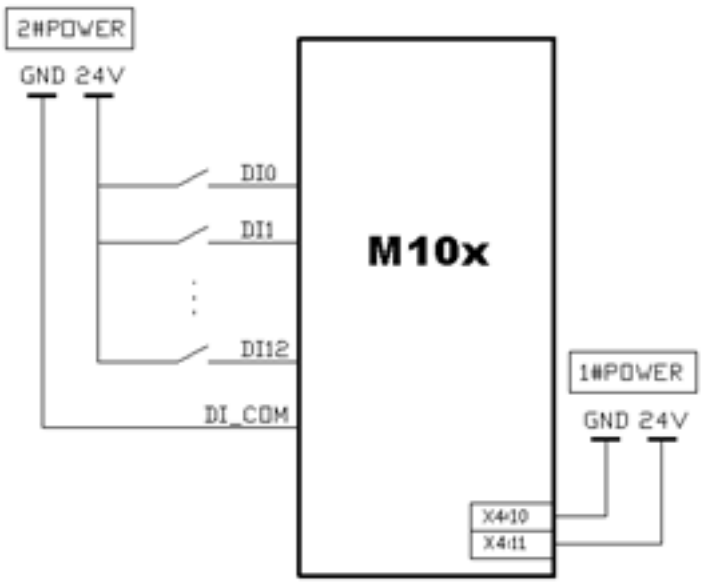
Table 3 Digital inputs with 24VDC supply

Terminal no.	Name	Description
X1:1	DI0	Digital input 0
X1:2	DI1	Digital input 1
X1:3	DI2	Digital input 2
X1:4	DI3	Digital input 3
X1:5	DI4	Digital input 4
X1:6	DI5	Digital input 5
X1:7	DI6	Digital input 6
X1:8	DI7	Digital input 7
X1:9	DI8	Digital input 8
X1:10	DI9	Digital input 9
X1:11	DI10	Digital input 10
X1:12	DI11	Digital input 11
X1:13	DI12	Digital input 12
X1:14	DI_COM	Digital input common terminal

Table 4 Digital inputs with 110/240VAC supply

Terminal no.	Name	Description
X1:1	DI0	Digital input 0
X1:2	DI1	Digital input 1
X1:3	DI2	Digital input 2
X1:4	DI3	Digital input 3
X1:5	DI4	Digital input 4
X1:6	DI5	Digital input 5
X1:7	DI6	Digital input 6
X1:8	DI7	Digital input 7
X1:9	DI8	Digital input 8
X1:10	DI_COM	Digital input common terminal

i) For 24VDC, it is recommended to use separate supply source for power supply and digital inputs, especially in the case that DI signals are taken from the field which is located a long distance from MCCs.



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05 Illustration of DIs wiring to M10x

PTC input (M102 only)
PTC function is only available in M102 series of products. Type A temperature sensor with a characteristic curve according to IEC 60947-8 to follow the temperature of motor winding is used in the device. PTC connector is located on the top of M102 unit, terminal X1.

i) M101 series of products do NOT have PTC function built in.
ii) It is recommended to short terminal X1:15 and X1:16 together to avoid potential external disturbance when this function is not activated.
iii) STP cable is recommended for PTC circuit connections.

—
Table 5-1 PTC input terminals (24VDC type)

Terminal no.	Name	Description
X1:15	PTCA	PTC measurement input A
X1:16	PTCB	PTC measurement input B

—
Table 5-2 PTC input terminals (24VDC type)

Terminal no.	Name	Description
X1:11	PTCA	PTC measurement input A
X1:12	PTCB	PTC measurement input B

Communication interface
Selected by different product types, M10x can be used directly on Modbus RTU, Modbus TCP or PROFIBUS DP networks. Modbus RTU and Profibus are based on physical RS485 layer. Dual RS485 interfaces are provided in MODBUS type of device to support full redundancy network design. M10x is connected to the Ethemet network via its Modbus TCP interface EM01 which is described in a separate product manual 1TNC928239 M10x Ethermet Module Em01 User Guide.

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Table 6 MODBUS dual RS485 interfaces

Terminal no.	Name	Description
X3:1	2B	Serial RS485 B
X3:2	2A	Serial RS485 A
X3:3	SHIELD	485 shield
X3:4	1B	Serial RS485 B
X3:5	1A	Serial RS485 A

—
Table 7 PROFIBUS RS485 interface

Terminal no.	Name	Description
X3:1	5V	Power supply 5V+ for bus terminator
X3:2	B	RS485 B
X3:3	A	RS485 A
X3:4	GND	Power supply GND for bus terminator
X3:5	SHIELD	Shield

Residual current transformer
M10x supports earth fault protection through external residual current transformer (RCT).

—
Table 8 Residual current transformer terminals

Terminal no.	Name	Description
X3:6	Ioa	Residual current transformer input A
X3:7	Iob	Residual current transformer input B

i) Different sizes or types of RCT are available. Refer to M10x ordering guide for details.
ii) It is recommended to short terminals X3:6 and X3:7 to avoid potential external disturbance when RCT is not in use.
iii) It is recommended to use STP cable for RCT circuit connections.

Voltage measurement (M102 only)
Voltage measurement and protections are available in M102 range of products.

Voltage unit is available in M102 only.

—
Table 9 Voltage input terminals

Terminal no.	Name	Description
X3:9	VL3	Phase L3 voltage input
X3:11	VL2	Phase L2 voltage input
X3:13	VL1	Phase L1 voltage input

i) When single phase system is selected, voltage measurement is based on phase L1 - phase L3. Connect L to VL1(X3:13) and neutral to VL3(X3:9).
ii) If PT is selected, according to phase sequence, connect the secondary side of PT to VL1 VL2 VL3.
iii) PT type should be single-phase voltage transformer or Yy0 connection for three-phase voltage transformer.

Current measurement
M10x continuously measures three motor phase currents. The phase current data will be used by the protection functions and is reported to the fieldbus. Phase currents are reported as a value relative to the motor nominal current In.

Current wires are fed through current sensors from either side of the terminal.

In case of single phase application, power cable has to be wired in L-T directly to avoid any measurement errors.

Motor nominal currents above 63A are not measured directly, but instead intermediate current transformer's secondary side is connected through M10x current measurement terminal.

i) When single phase system is selected, current measurement is based on phase L1.
ii) The measurement range of internal CT is from 0.08A to 63A.
iii) In cases of small current measurement (<0.5A), it is highly recommended to increase the primary wiring turns through internal CT in order to avoid nuisance current measurement. Refer to descriptions on ' Internal CT primary winding' in the product manual 'M10x parameter description.

Contactor control output
M10x supports various motor starter types. The control of the contactor by M10x is via internal output relays (CCA, CCB, CCC relays) by the microprocessor.

Internal relays CCA and CCB are hardwire-interlocked to prevent both contactors being closed at the same time.

1) M101 is equipped with CCA and CCB output relays only.
2) For external connecting contactors, spark suppression is necessary for all types of contactors except the AF types to maintain reasonable service life of relays.

—
Table 10 Contactor control terminals

Terminal no.	Name	Description	M101	M102
X4:6	CCLI	Contactor control voltage input	√	√
X4:7	CCA	Contactor control A	√	√
X4:8	CCB	Contactor control B	√	√
X4:9	CCC	Contactor control C		√

Digital output
M10x is also equipped with two sets of auxiliary programmable digital output relays which function according to project specific settings.

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Table 11 Digital output terminals

Terminal no.	Name	Description	M101	M102
X4:1	GR1_A	Programmable relay output 1 (NO+NC)		√
X4:2	GR1_B			
X4:3	GR1_C		√	
X4:4	GR2_A	Programmable relay output 2 (NO)		√
X4:5	GR2_B			

The output status of programmable relays may change in response to different assigned functions.

1) M101 is equipped with only one set of output relay (GR1).

2) For external connecting contactors, spark suppression is necessary for all types of contactors except the AF types to maintain reasonable service life of relays.

Interface for MD21/MD31
M10x is connected with operator panel MD21/MD31 using RJ11 interface.

Ground terminal

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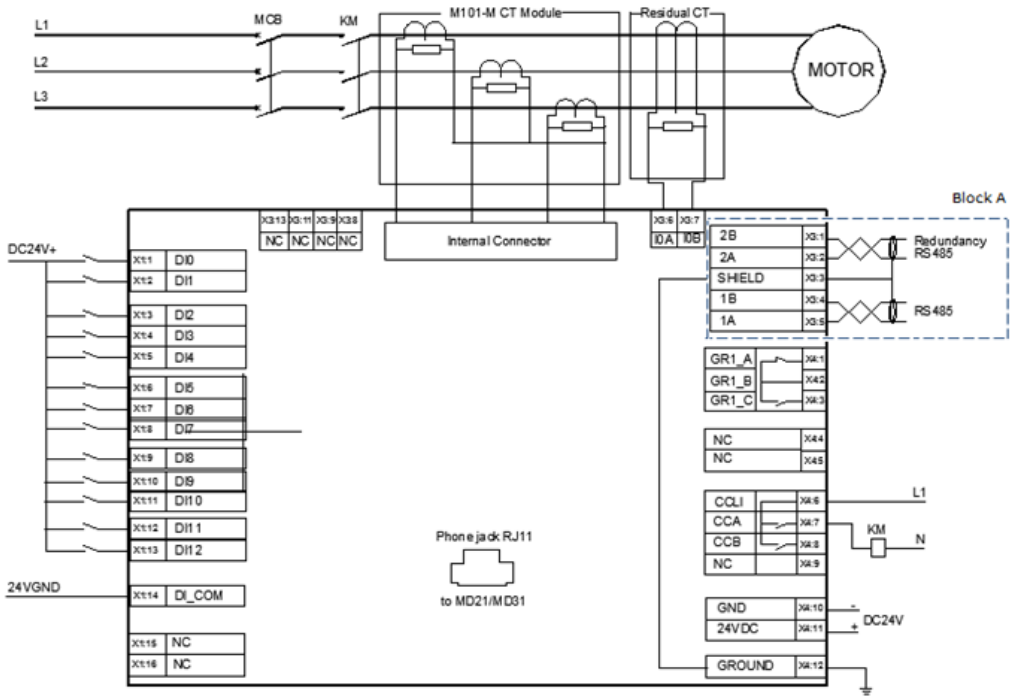
Table 12 Ground terminal

Terminal no.	Name	Description
X4:12	GROUND	Ground safety and surge

This is an additional ground terminal provided for dissipating transient signals and surges. It must be connected by a thick wire or braid to the system ground for reliable operation.

Typical Wiring Digrams
Typical wiring diagrams of different types of M10x are shown in this section.

- M101 24VDC



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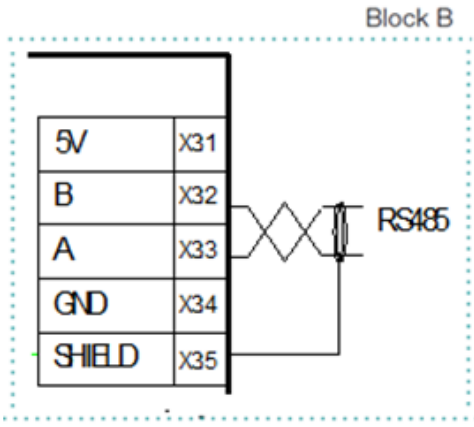
06-1 Typical wiring diagram for M101 (24VDC type)

Note:
1) Block A shows MODBUS dual RS485 interface. For PROFIBUS interface, Block B below should replace Block A.

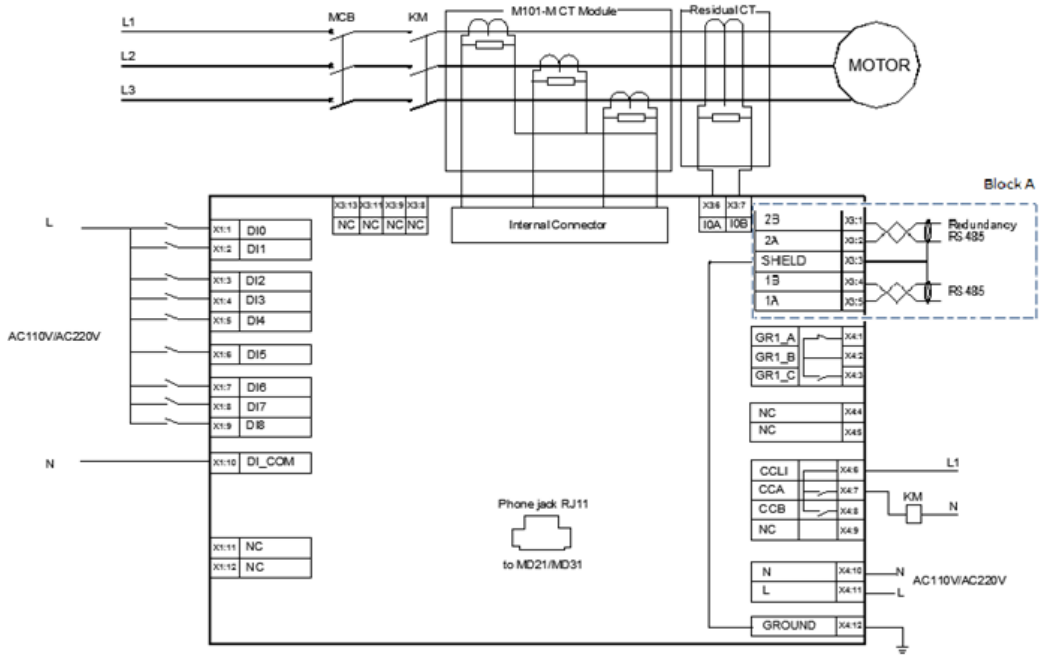


Shield and Ground (X4:12) are connected internal of M10x.

Digital output contacts (GR1_A, GR1_B &GR1_C) as shown are floating NC and NO contacts from the same relay and respond to parameter settings.

Eg. when 'Trip' is set to digital output, NO contact will close under healthy conditions. In the case of power loss, contact status will restore as shown.

- M101 110VAC or 240VAC



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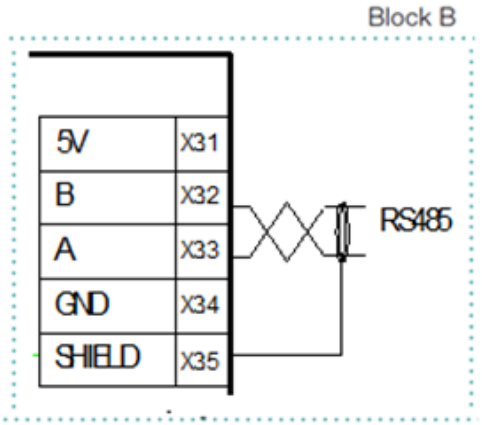
06-2 Typical wiring diagram for M101 (110/240VAC type)

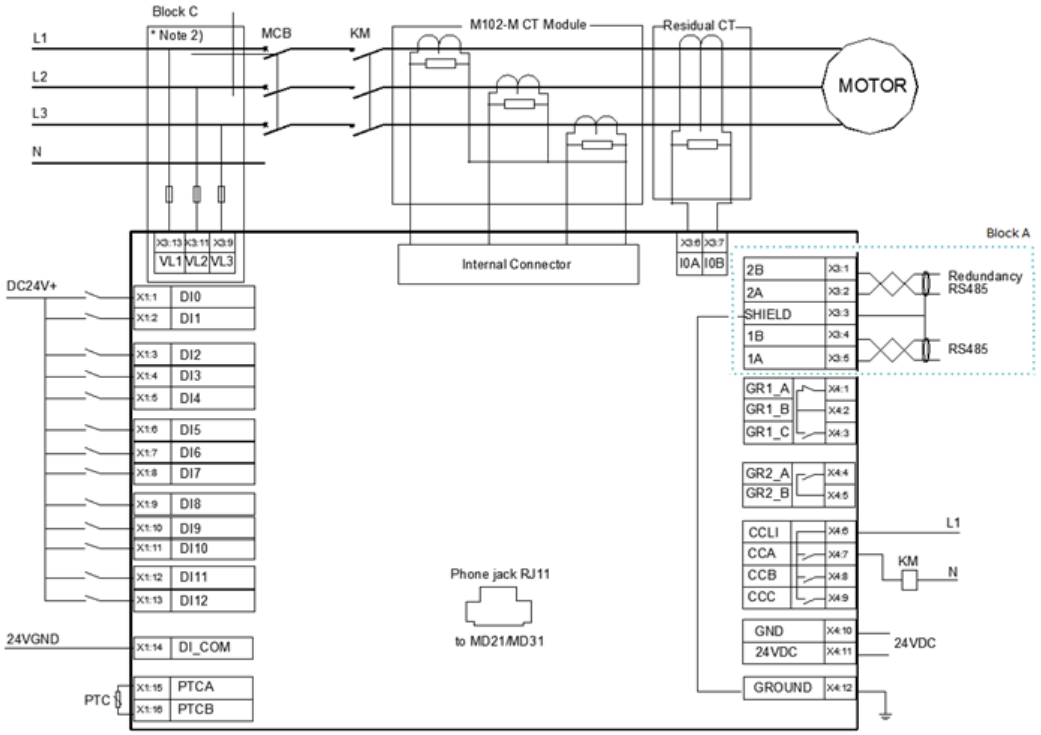
Note:
1) Block A shows MODBUS dual RS485 interface. For PROFIBUS interface, Block B below should replace Block A.
2) 110VAC or 240VAC voltage supply



Shield and Ground (X4:12) are connected inside M10x.

Digital output contacts (GR1_A, GR1_B &GR1_C) as shown are floating NC and NO contacts from the same relay and respond to parameter settings, eg, when Trip is set to digital output, NO contact will close under healthy conditions. In the case of power loss, contact status will restore as shown.

- M102 24VDC



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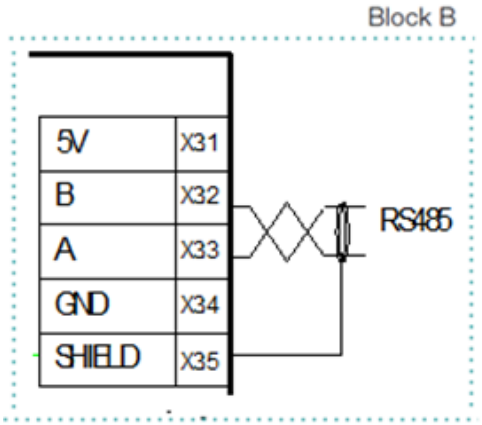
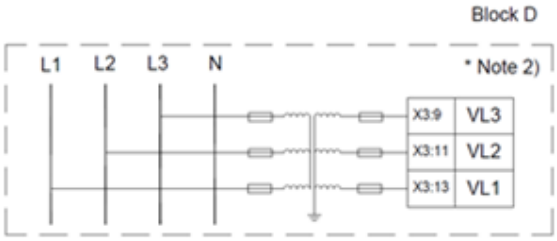
07-1 Typical wiring diagram for M102 (24VDC type)

Note:
1) Block A shows MODBUS dual RS485 interface. For PROFIBUS interface, Block B below should replace Block A.



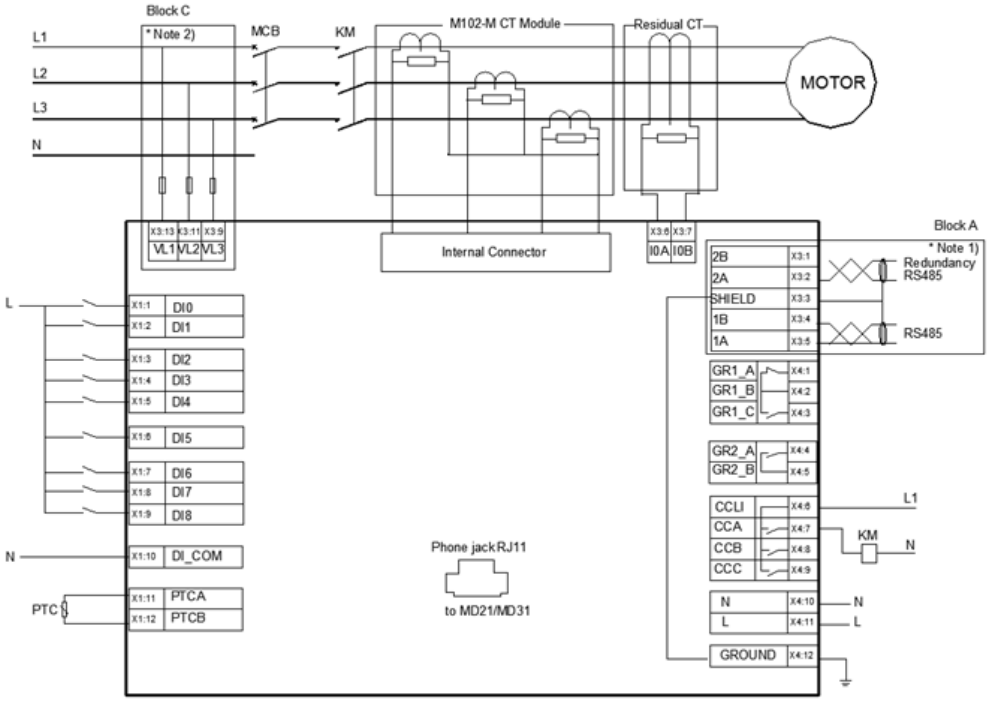
2) Block C shows voltage measurement for 690V and below. For more than 690V system, PT should be used, Block D below should replace Block C.



Shield and Ground (X4:12) are connected internal of M10x.

Digital output contacts (GR1_A, GR1_B &GR1_C) as shown are floating NC and NO contacts from the same relay and respond to parameter settings, eg, when Trip is set to digital output, NO contact will close under healthy conditions. In the case of power loss, contact status will restore as shown.

- M102 110VAC or 240VAC



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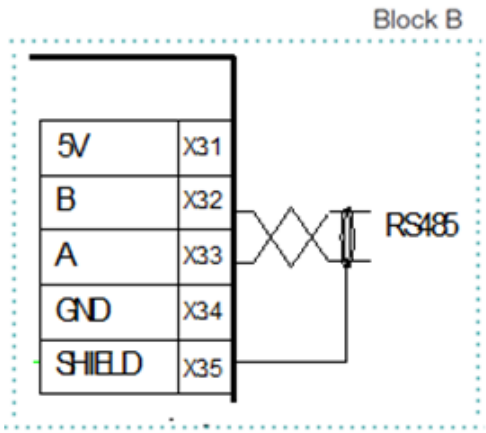
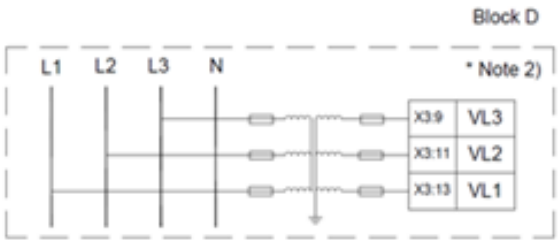
07-2 Typical wiring diagram for M102 (110/240VAC type)

Note:

1) Block A shows MODBUS dual RS485 interface. For PROFIBUS interface, Block B below should replace Block A.



2) Block C shows voltage measurement for 690V and below. For more than 690V system, PT should be used, Block D below should replace Block C.



3) 110VAC or 240VAC power supply.

Shield and Ground (X4:12) are connected inside M10x.

Digital output contacts (GR1_A, GR1_B &GR1_C) as shown are floating NC and NO contacts from the same relay and respond to parameter settings,eg, when Trip is set to digital output, N/O contact will close under healthyconditions. In the case of power loss, contact status will restore as shown.

04. Starter type

M10x offers various kinds of motor starting control modes via the control of relay output. It supervises the operating state of the contactor according to the feedback of auxiliary contact, predefined feedback timeout and current.

The following starting control modes are offered:

Table 13 Starter types supported by M10x

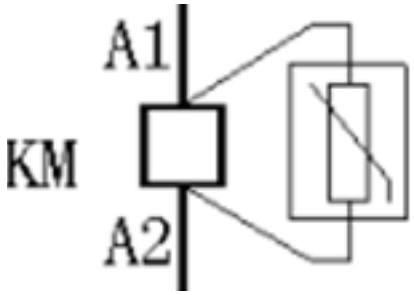
Starter type	M101	M102
NR-DOL	√	√
REV-DOL	√	√
NR-DOL/RCU	√	√
REV-DOL/RCU	√	√
Actuator		√
NR-S/D		√
NR-2N		√
NR-2N Dahlander		√
Autotransformer		√
NR_softstarter		√
REV_softstarter		√
Contactor feeder	√	√
Contactor feeder/RCU	√	√
Feeder	√	√

- NR_DOL: non reversing direct online
- REV_DOL: reversing direct online
- NR_DOL/RCU: non reversing direct online with RCU
- REV_DOL/RCU: reversing direct online with RCU
- Actuator: actuator with limit switch input
- NR_S/D: non reversing star-delta
- NR_2N: two-speed driver for non reversing starter with separate winding
- NR_2N Dahlander: two-speed driver for Dahlander connection
- Autotransformer: autotransformer starter
- NR_softstarter: non reversing softstarter control
- REV_softstarter: reversing softstarter control
- Contactor feeder: contactor controlled feeder
- Contactor feeder/RCU: contactor controlled feeder with RCU
- Feeder: feeder is regarded as a specific starter mode in M10x

Starter type is selected with a dedicated parameter to match the wiring for contactor and motor control circuits.

i) PIN numbers assigned for DIs in below starters are shown as per default settings and are subject to change to meet engineering requirements.

ii) Spark suppression is necessary for all types of connecting contactors except AF types through M10x output relays to maintain reasonable service life of the output relays. Interface relays should also be considered in engineering to increase reasonable service life. Interface relay is recommended to be used for contactor type A75 and above.



—
08 Surge suppressors on contactor coils

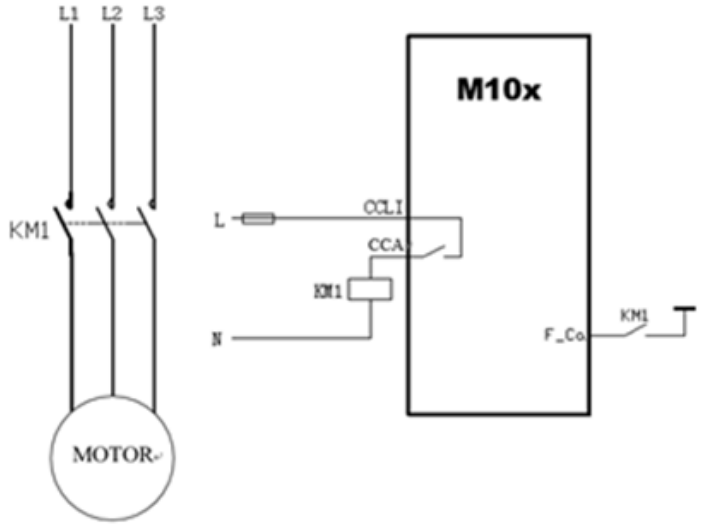
Precautions must be taken in system designs to avoid potential high electromagnetic disturbance which may result in unstable network and malfunction of M10x relays. For example, in applications that variable speed drives are used in a large scale, harmonic filter devices are required in system design to reduce impact to the network.

NR-DOL STARTER
NR_DOL starter is a basic starter type for driving motor in one direction. When start command has been received from fieldbus or local I/O, the contactor control output will be energized and remains in this in condition until stop command has been received or any protection function is activated.

—
Table 14 NR-DOL starter contactor control interface (for M10x)

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
DI6(F_Ca)	X1:7	Contactor control A feedback
DI5(Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example.



—
09 Control circuit for NR-DOL starter (for M10x)

Operating sequence under NR-DOL

- Starting Sequence: Motor is stopped and ready to start → START command (Start 1) received → Internal CCA contact closed and remain closed → Feedback received
- Stopping Sequence: Motor is running → STOP command received → Internal CCA contact open → Feedback received

The completion of an operating sequence is verified by the feedbacks from both internal current measurement (current feedback) and external contactor status checkback (contactor feedback) which is wired through one of the DIs. If an operating sequence fails to complete, depending on actual senario, alarm message may be generated followed by tripping action.

Contactor feedback is an optional feature which can be disabled through parameter. Current feedback of a DOL starter is always on the background to ensure the completion of an expected operation sequence. The feedback time is adjustable.

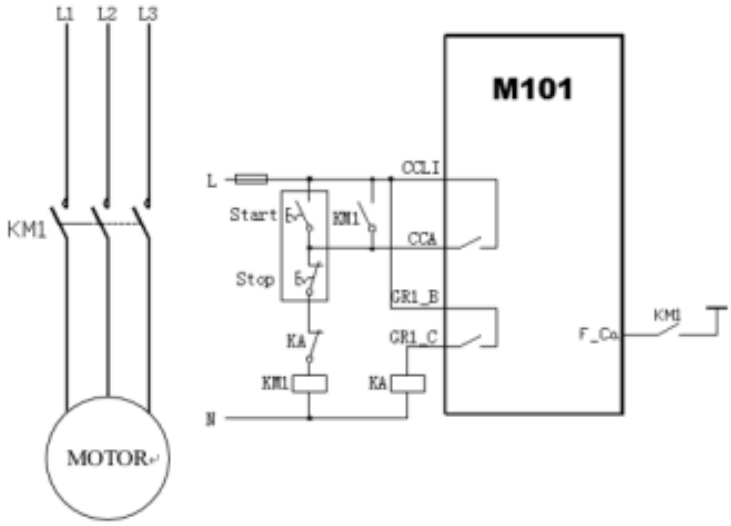
NR-DOL/RCU STARTER

Remote control unit (RCU) is a starter type where contactors are directly controlled by a special RCU switch located near the motor. This allows control of the motor even without the M10x.

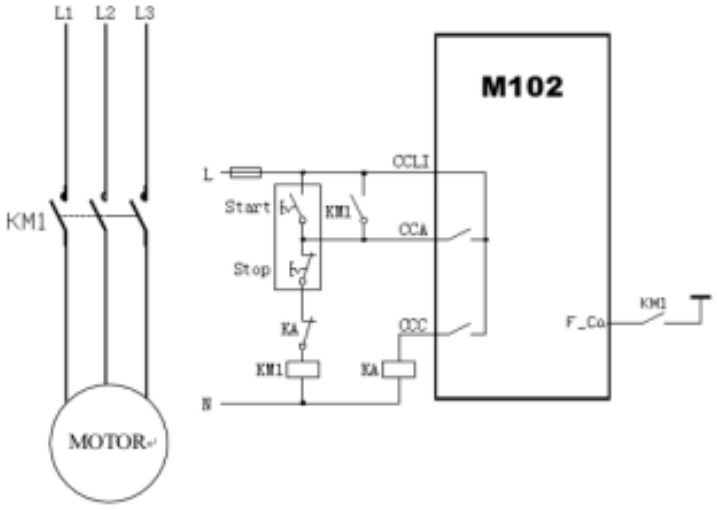
—
Table 15 NR-DOL/RCU starter contactor control interface (for M10x)

Name	Pin	Description	Remarks
CCLI	X4:6	Contactor control voltage input	
CCA	X4:7	Contactor control A	
GR1_C	X4:3	Programmable relay output	Only for M101
CCC	X4:9	Contactor control C	Only for M102
DI6(F_Ca)	X1:7	Contactor control A feedback	
DI5(Loc/R)	X1:6	Local/remote control switch input	

The definition of the terminal X1 in the above list is only an example.



—
10-1 Control circuit for NR-DOL/RCU starter (for M101)



—
10-2 Control circuit for NR-DOL/RCU starter (for M102)

Operating sequence (through M10x only) under NR-DOL/RCU

- Starting Sequence: Motor is stopped and ready to start → START command is received → Internal contact CCA closed and remain closed for 1s → Feedback is received
- Stopping Sequence: Motor is running → STOP command received → internal CCC (M102) or GR1_C(M101) contact closed and remain closed for 1s → Feedback received

When the motor is operated by RCU, the above operating sequence is not applicable. M10x is not part of the operating sequence but still verify the motor state through feedbacks.

The completion of an operating sequence is verified by the feedbacks from both internal current measurement (current feedback) and external contactor status checkback (contactor feedback) which is wired through one of the DIs. If the operating sequence fails to complete, a feedback alarm or a feedback trip occurs.

Contactor feedback is a must parameter and can not be disabled as M10x also requires contactor feedback to sychronize with external RCU control. Current feedback of a DOL-RCU starter is always on the background to ensure the completion of an expected operation sequence and the confirmation of the motor state during RCU control. The feedback time is adjustable.

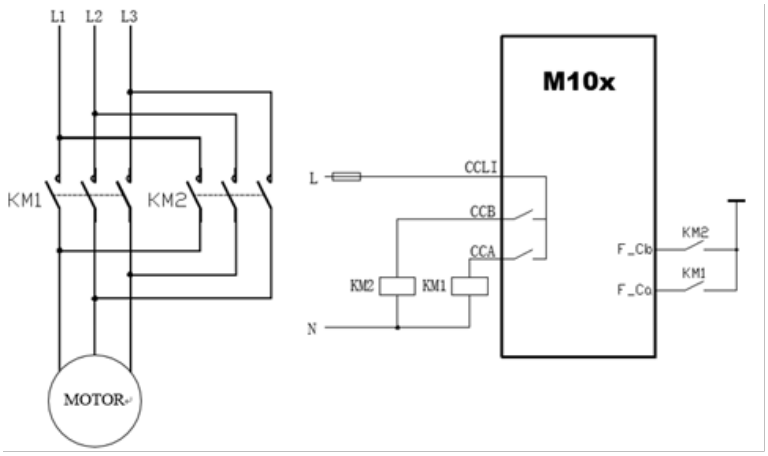
REV-DOL STARTER

REV-DOL uses contactor control output A to control the contactor that drives the motor in direction CW. Correspondingly, contactor control output B is used for direction CCW. When the starting motor to either direction contactor will be energized and is stopped (not energized) by command from fieldbus or local I/O, or active protection function.

Table 16 REV-DOL starter contactor control interface (for M10x)

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
DI6(F_Ca)	X1:7	Contactor control A feedback
DI7(F_Cb)	X1:8	Contactor control B feedback
DI5(Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example.



11 Control circuit for REV-DOL starter (for M10x)

Operating sequence under REV-DOL

- Running foward Sequence: Motor is stopped and ready to run forward → Forward command (Start 1) received → Internal CCA contact closed and remain closed → Feedback received
- Reversing Sequence: Motor is stopped and ready to reverse → Reverse command (Start 2) received → Internal CCB contact close and remain closed → Feedback received
- Stopping Sequence: Motor is running → STOP command received → Internal CCA & CCB contact open → Feedback received

The completion of an operating sequence is verified by the feedbacks from both internal current measurement (current feedback) and external contactor status checkback (contactor feedback) which is wired through one of the DIs. If an operating sequence fails to complete, depending on actual senario, alarm message may be generated followed by tripping action.

Contactor feedback is used for acknowledge the running direction hence can not be disabled through parameter in a REV-DOL starter. Current feedback is always on the background to ensure the completion of an expected operation sequence. The feedback time is adjustable.

Take note of the CT location for the application. CT location should be on the line side of both K1 and K2 to ensure correct current phase sequence reading.

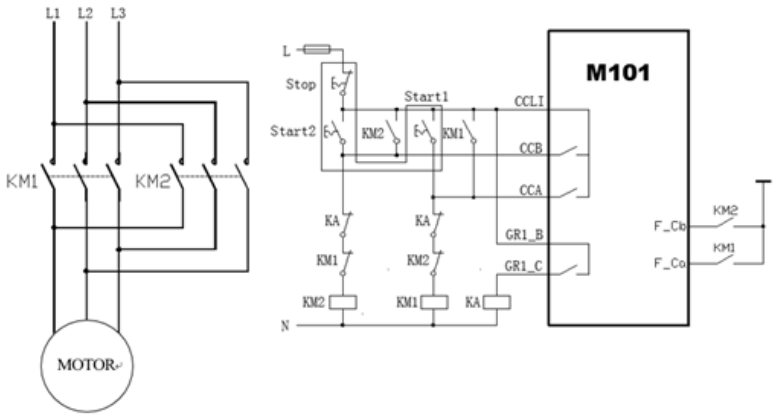
REV-DOL/RCU starter

The functionality of this starter type is the same as the NR-DOL/RCU starter with support for reversing use of motor.

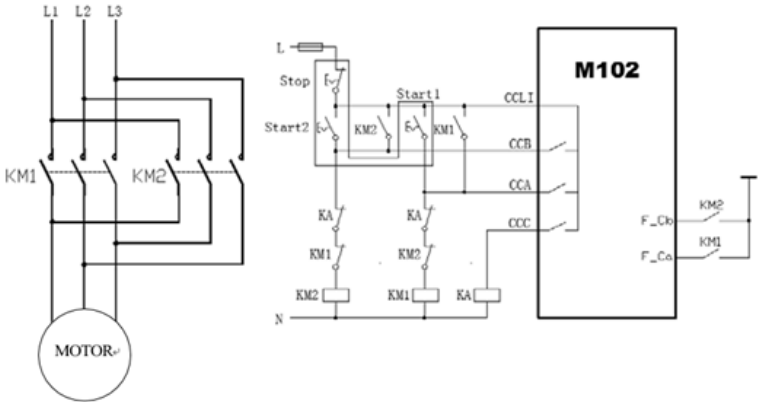
Table 17 REV-DOL starter contactor control interface (for M10x)

Name	Pin	Description	Remarks
CCLI	X4:6	Contactor control voltage input	
CCA	X4:7	Contactor control A	
CCB	X4:8	Contactor control B	
GR1_C	X4:3	Programmable relay output1	Only for M101
CCC	X4:9	Contactor control C	Only for M102
DI6(F_Ca)	X1:7	Contactor control A feedback	
DI7(F_Cb)	X1:8	Contactor control B feedback	
DI5(Loc/R)	X1:6	Local/remote control switch input	

The definition of the terminal X1 in the above list is only an example.



12 Control circuit for REV-DOL/RCU starter (for M101)



—
13 Control circuit for REV-DOL/RCU starter (for M102)

Operating sequence (through M10x only) under REV-DOL/RCU

- Running foward Sequence: Motor is stopped and ready to run forward → Forward command (Start 1) received → Internal CCA contact closed and remain closed for 1s → Feedback received
- Reversing Sequence: Motor is stopped and ready to reverse → Reverse command (Start 2) received → Internal CCB contact close and remain closed for 1s → Feedback received
- Stopping Sequence: Motor is running → STOP command received → internal CCC (M102) or GR1_C(M101) contact closed and remain closed for 1s → Feedback received

When the motor is operated by RCU, the above operating sequence is not applicable. M10x is not part of the operating sequence but still verify the motor state through feedbacks.

The completion of an operating sequence is verified by the feedbacks from both internal current measurement (current feedback) and external contactor status checkback (contactor feedback) which is wired through one of the DIs. If the operating sequence fails to complete, a feedback alarm or a feedback trip occurs.

Contactor feedback is a must parameter and can not be disabled as M10x also requires contactor feedback to sychronize with external RCU control. Current feedback of a RCU starter is always on the background to ensure the completion of an expected operation sequence and the confirmation of the motor state during RCU control. The feedback time is adjustable.

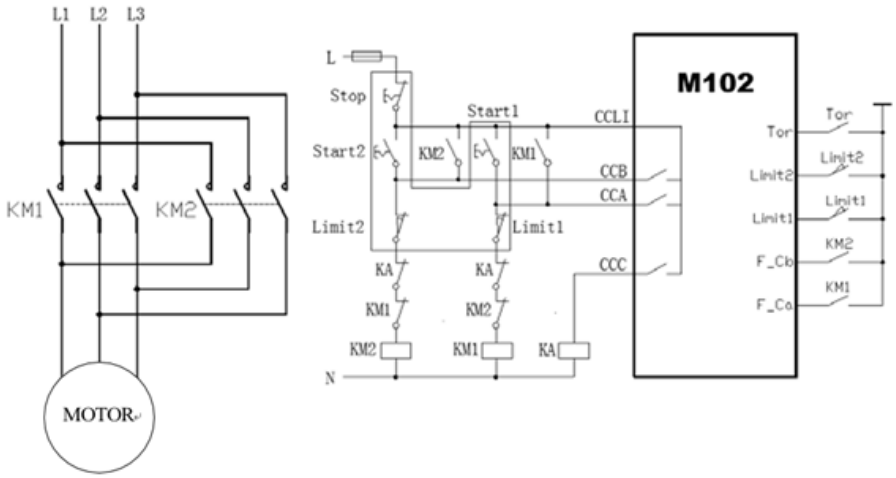
Take note of the CT location for the application. CT location should be on the line side of both K1 and K2 to ensure correct current phase sequence reading.

Actuator starter (M102 only)
This starter type is for controlling valves and actuators by using limit switches

—
Table 18 Actuator starter contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
CCC	X4:9	Contactor control C
DI0 (Limit1)	X1:1	Limit position switch 1 input
DI1 (Limit2)	X1:2	Limit position switch 2 input
DI9 (Torque)	X1:10	Torque switch input
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback
DI5 (Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example.



—
14 Control circuit for actuator starter

Limit switch stops the motor when activated. Additionally, the start command is onlyallowed to reverse direction. Torque switch is selectable by parameterization.

Operating sequence in Actuator
- Motor is stopped & Limit 1&Torque is not triggered → Start1 → CCA closes and remains for 1 second only
- Motor is stopped & Limit 2&Torque is not triggered → Start2 → CCB closes and remains for 1 second only
- Motor is running forward → Limit 1/Stop → CCC closes and remains for 1 second only
- Motor is running reversing → Limit 2/Stop → CCC closes and remains for 1 second only
- Motor is running → Torque → CCC closes

Take note of the CT location for the application. CT location should be on the line side of both K1 and K2 to ensure correct current phase sequence reading.

NR-S/D starter (M102 only)
Motor start current is reduced in star connection to 1/3 of the current in delta connection, with lower torque during the same time.
Star-to-delta starting sequence is based on the presented control logic (Figure 15). The changeover condition is time.

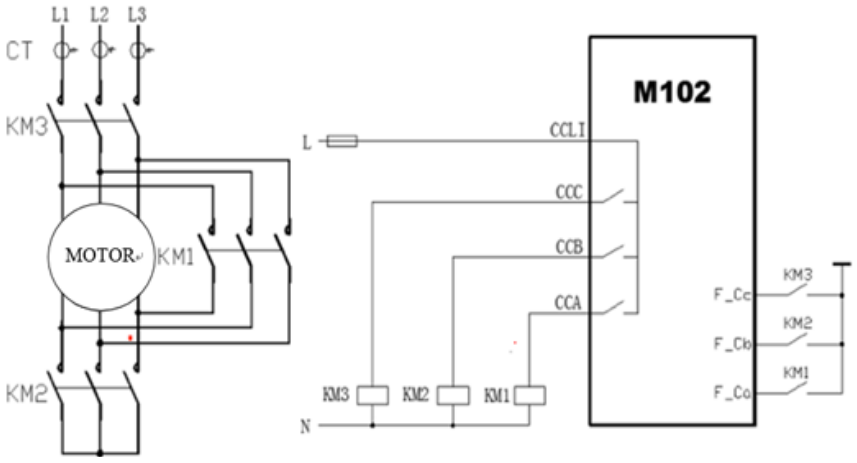
The following guideline is applied for selecting parameter values:

Changeover time < Motor startup time

—
Table 19 NR_S/D starter contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
CCC	X4:9	Contactor control C
DI5 (Loc/R)	X1:6	Local/remote control switch input
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback
DI8 (F_Cc)	X1:9	Contactor control C feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback
DI5 (Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example



—
15 Control circuit for NR-S/D starter

Operating sequence in NR-S/D
- Motor is stopped → Start1 → CCB&CCC close → changeover time → CCB opens & CCA closes
- Motor is running → Stop → CCA&CCB&CCC open

NR-2N starter (M102 Only)
NR-2N uses two contactors to control motor rotation speed; the motor contains separate windings. Rotation speed can be changed “on the fly” without stop command in between. Low speed (start 1) can be changed to high speed (start 2) immediately, and high speed can be changed to low speed after a changeover time.

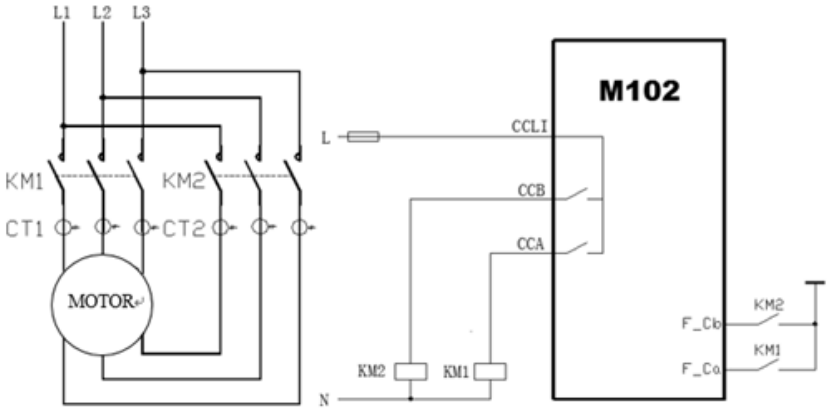
Current measurement for NR-2N uses two external current transformers measuring current from motor main supply. External current transformers can be selected separately for both speeds.

The following guideline is applied for selecting parameter values:

—
Table 20 NR-2N starter contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback
DI5 (Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example.



—
16 Control circuit for NR_2N starter, separate windings

Operating sequence in NR-2N
- Sending command Start1 (low speed N1) to close contactor CCA
- Sending command Start2 (high speed N2) to close contactor CCB
- Contactors are latched
- Stop command opens CCA or CCB

Motor can be controlled with sequences:
- Stop → Start1 → Stop
- Stop → Start2 → Stop
- Stop → Start1 → Start2 → Stop
- Stop → Start2 → Changeover delay → Start1 → Stop

NR-2N Dahlander STARTER (M102 Only)
NR-2N Dahlander uses three contactors to control motor rotation speed where motor is equipped with a three-phase winding. Rotation speed can be changed “on the fly” without stop command in between. Low speed (start 1) can be changed to high speed (start 2) immediately, and high speed can be changed to low speed after a changeover time.

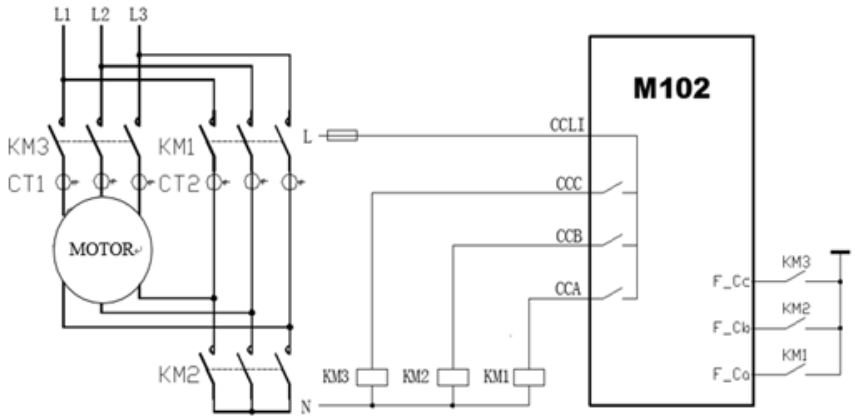
The following guideline is applied for selecting parameter values: Changeover time < Motor startup time

Current measurement for NR-2N Dahlander uses two external current transformers measuring current from motor main supply. External current transformers can be selected separately for both speeds.

—
Table 21 NR-2N Dahlander starter contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
CCC	X4:9	Contactor control C
DI5 (Loc/R)	X1:6	Local/remote control switch input
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback
DI8 (F_Cc)	X1:9	Contactor control C feedback

The definition of the terminal X1 in the above list is only an example.



—
17 Control circuit for NR_2N Dahlander starter

Operating sequence in NR-2N Dahlander
- Sending command Speed1 to close contactor CCA
- Sending command Speed2 to close contactor CCB and CCC
- Contactors are latched
- Sending stop command to open CCA or CCB + CCC

Motor can be controlled with sequences:
- Stop → Start1 → Stop
- Stop → Start2 → Stop
- Stop → Start1 → Start2 → Stop
- Stop → Start2 → Chang over delay → Start1 → Stop

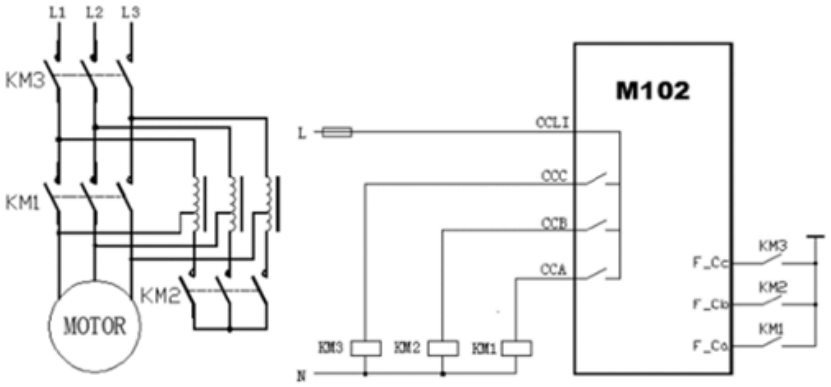
Autotransformer starter (M102 only)
This starter type is used to control the autotransformer unit in order to minimize voltage drop during motor startup. Autotransformer starter with three contactors supports motor starting with reduced voltage, thus providing reduced motor startup current. The starting torque will be reduced accordingly,

The following guideline applies for selecting parameter values: Changeover time < Motor startup time

—
Table 22 Autotransformer starter contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
CCC	X4:9	Contactor control C
DI5 (Loc/R)	X1:6	Local/remote control switch input
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback

The definition of the terminal X1 in the above list is only an example.



—
18 Control circuit for autotransformer starter

Operating sequence in Autotransformer
- Motor is stopped → Start1 → CCB&CCC close → changeover time → CCB opens & CCA closes
- Motor is running → Stop → CCA&CCB & CCC open

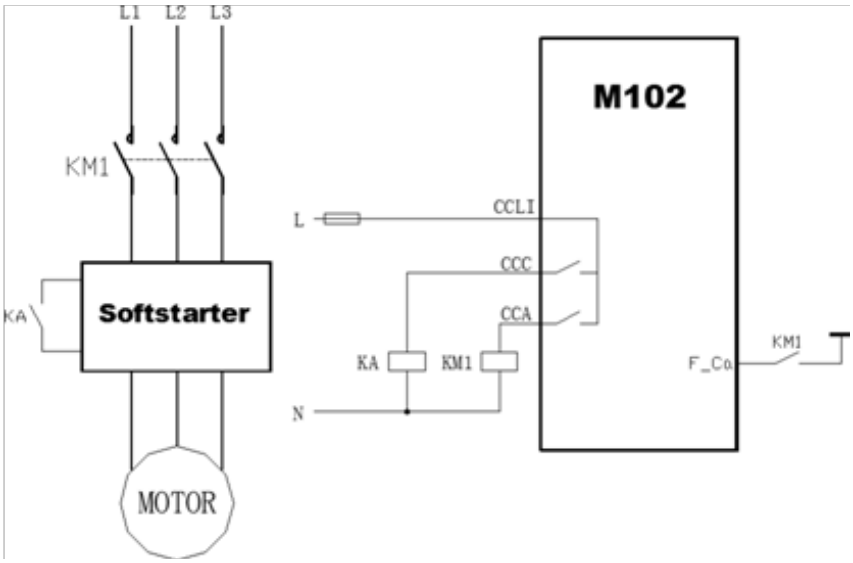
NR-softstarter (M102 only)
Softstarter applications are for controlling the motor accessory softstarter device. M102 gives start and stop commands to the softstarter unit. The softstarter is set for adjusting motor voltage with its own parameters. More information about softstarter can be found in the softstarter manual.

This starter type supports all protection functions during normal running situations. For motor start and stop period, some of the protection functions are disabled by these parameters. Current feedback function is suppressed under soft-starter control.

—
Table 23 NR_softstarter starter contactor control interface.

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCC	X4:9	Contactor control C
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI5 (Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example.



—
19 Control circuit for NR-softstarter

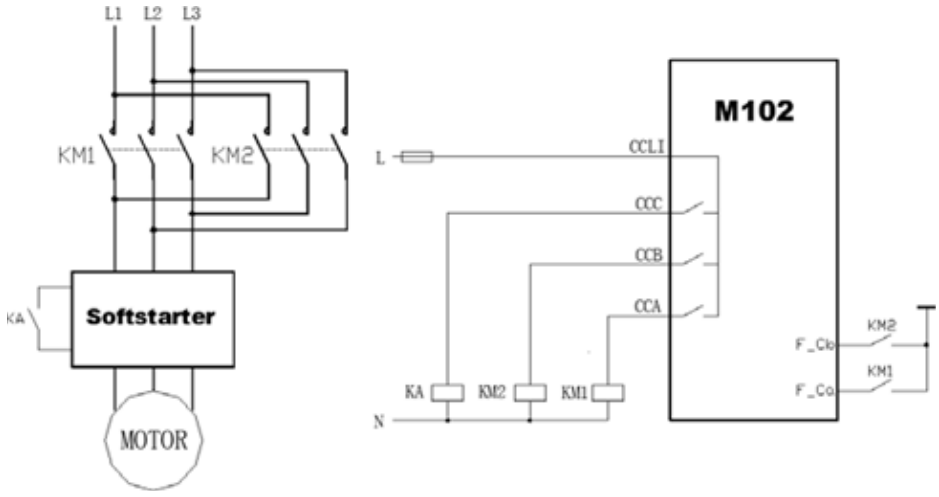
Operating sequence in NR-softstarter
- Motor is stopped → Start1 → CCA closes → CCC closes
- Motor is running → Stop → CCC opens → ramp down time → CCA opens

REV-softstarter (M102 Only)
This starter is of similar functionality as the NR-softstarter starter, with additional function to support reversing the motor.

—
Table 24 REV-softstarter starter contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
CCB	X4:8	Contactor control B
CCC	X4:9	Contactor control C
DI5 (Loc/R)	X1:6	Local/Remote control switch input
DI6 (F_Ca)	X1:7	Contactor control A feedback
DI7 (F_Cb)	X1:8	Contactor control B feedback

The definition of the terminal X1 in the above list is only an example.



—
20 Control circuit for REV-softstarter

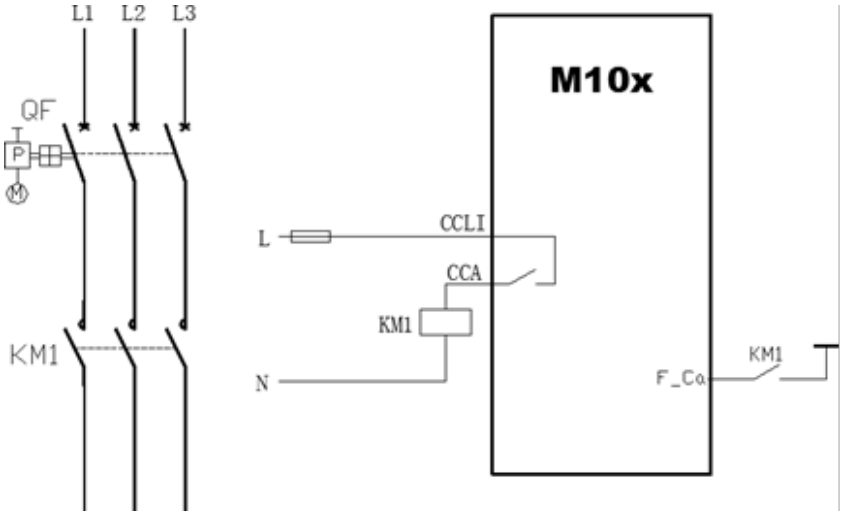
Operating sequence in REV-softstarter
- Motor is stopped → Start1 → CCA closes → CCC closes
- Motor is stopped → Start2 → CCB closes → CCC closes
- Motor is running → Stop → CCC opens → ramp down time → CCA & CCB opens

Contactor feeder
Contactor feeder in M10x is designed for symmetric 3 phase load or single phase load. All measurement, control and protection features which are available to NR-DOL are available to contactor feeder load. Contactor feeder also use contactor feedback to verify the control operating sequence. However current feedback is no longer required for the same verification under contactor feeder control.

—
Table 25 Contactor feeder contactor control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Contactor control A
DI6(F_Ca)	X1:5	Contactor control A feedback
DI5(Loc/R)	X1:6	Local/remote control switch input

The definition of the terminal X1 in the above list is only an example.



—
21 Control circuit for contactor feeder

Operating sequence under Contactor Feeder:
- Starting Sequence: Motor is stopped and ready to start → START command (Start 1) received → Internal CCA contact closed and remain closed → Feedback received
- Stopping Sequence: Motor is running → STOP command received → Internal CCA contact open → Feedback received

The completion of an operating sequence is verified by external contactor status checkback (contactor feedback) which is wired through one of the DIs. If an operating sequence fails to complete, depending on actual senario, alarm message may be generated followed by tripping action.

Contactor feedback is an optional feature which can be disabled through parameter. The feedback time is adjustable.

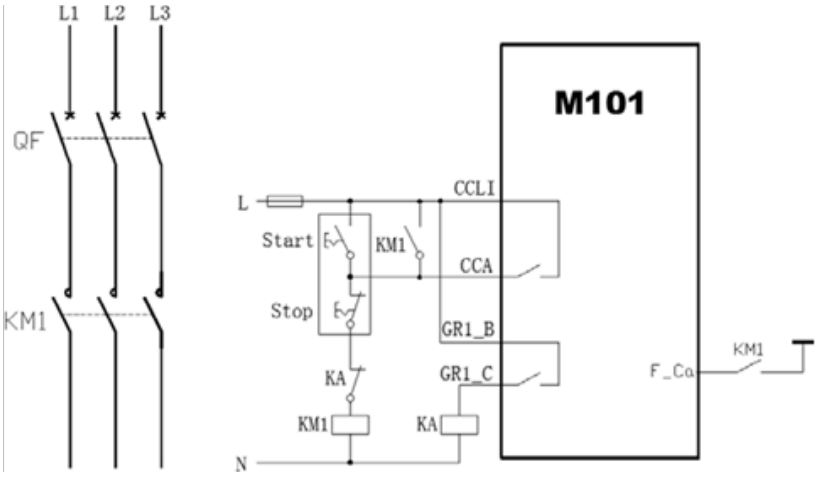
Contactor feeder/RCU
Remote control unit (RCU) is a starter type where contactors are directly controlled by a special RCU switch located near the motor. This allows control of the motor even without the M10x.

Contactor feeder in M10x is designed for symmetric 3 phase load or single phase load. All measurement, control and protection features which are available to NR-DOL/RCU are available to contactor feeder/RCU load. Contactor feeder also use contactor feedback to verify the control operating sequence. However current feedback is no longer required for the same verification under contactor feeder control.

—
Table 26 Contactor feeder/RCU contactor control interface (for M10x)

Name	Pin	Description	Remarks
Contactor	feeder/RCU	contactor	control
CCLI	X4:6	Contactor control voltage input	
CCA	X4:7	Contactor control A	
GR1_C	X4:3	Programmable relay output	Only for M101
CCC	X4:9	Contactor control C	Only for M102
DI6(F_Ca)	X1:7	Contactor control A feedback	
DI5(Loc/R)	X1:6	Local/remote control switch input	
DI5(Loc/R)	X1:6	Local/remote control switch input	

The definition of the terminal X1 in the above list is only an example.



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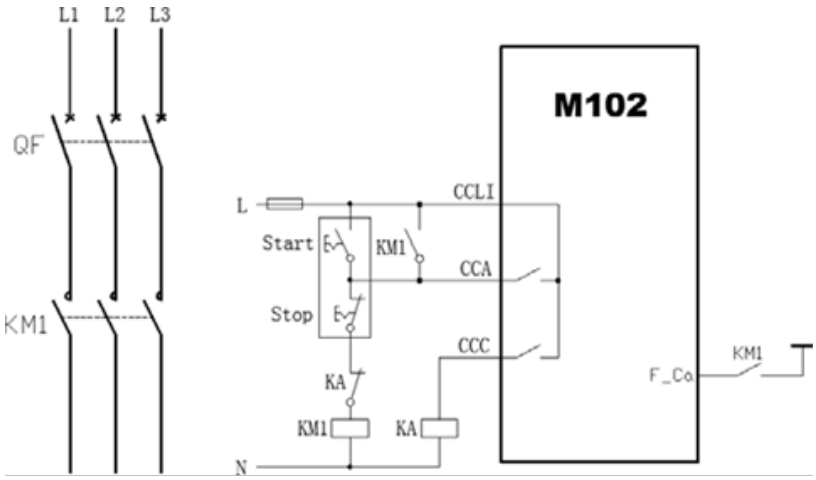
22-1 Control circuit for contactor feeder/RCU (for M101)



—
22-2 Control circuit for contactor feeder/RCU (for M101)

Operating sequence (through M10x only) under Contactor feeder/RCU

- Starting Sequence: Motor is stopped and ready to start → START command is received → Internal contact CCA closed and remain closed for 1s → Feedback is received
- Stopping Sequence: Motor is running → STOP command received → internal CCC (M102) or GR1_C(M101) contact closed and remain closed for 1s → Feedback received

When the motor is operated by RCU, the above operating sequence is not applicable. M10x is not part of the operating sequence but still verify the motor state through feedbacks.

The completion of an operating sequence is verified by external contactor status checkback (contactor feedback) which is wired through one of the DIs. If the operating sequence fails to complete, a feedback alarm or a feedback trip occurs.

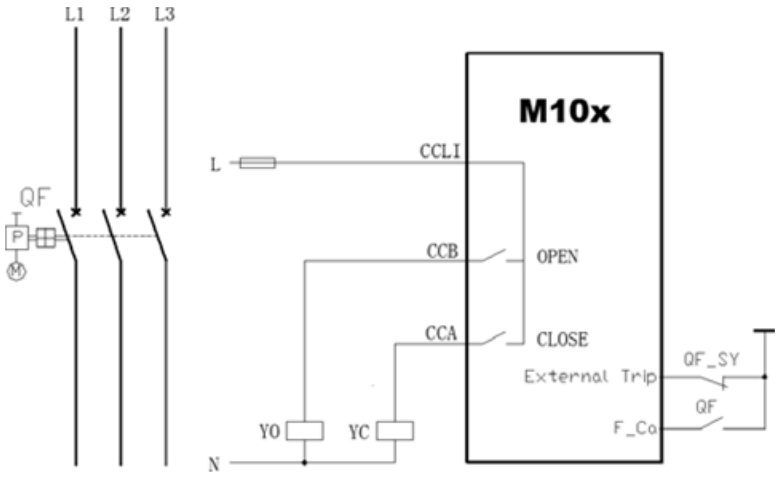
Contactor feedback is a must parameter and can not be disabled in a RCU starter as M10x also requires contactor feedback to sychronize with external RCU control. The feedback time is adjustable.

Feeder
Feeder mode is regarded in M10x as a specific starter type to provide measurement and control functionality. The protection of feeder is not covered in M10x and is normally part of the main circuit breaker. The feeder mode in M10x is designed to provide a complete intelligent solution in MCC plants where the feeder circuits are usually small, but important parts from the MCC plant management point of view.

—
Table 27 Feeder control interface

Name	Pin	Description
CCLI	X4:6	Contactor control voltage input
CCA	X4:7	Control YC /motor drive in MCCB (2 seconds holding)
CCB	X4:8	Control YO/motor drive in MCCB (2 seconds holding)
DI6 (F_Ca)	X1:7	Circuit breaker position aux. feedback
DI9 (External trip input)	X1:10	Circuit breaker trip aux. feedback
DI5 (Loc/R)	X1:6	Local/remote control switch input*

The definition of the terminal X1 in the above list is only an example



—
23 Control circuit for feeder

Feeder application in M10x is limited to certain features. End users need to be informed on these limitations when feeder application is required through M10x.

- **Operating:**
Start 1 command activates contactor output relay CCA for 2 seconds. Start 2 command activates contactor output relay CCB for 2 seconds.

External trip occurs a trip message and will be reset when the signal is inactive.

- **Monitoring:**
Circuit breaker close/open status Circuit breaker trip

- **Protection:**
Motor protection functions are not suitable for feeder application. All protections except earth fault protection in M10x are automatically disabled during parameter setting when feeder type is selected.

- **Measuring:**
Current, voltage are measured by M10x. Power, energy and other parameters related to power factor are NOT correct and should not be referred to.

05. Protection functions

The module provides full protection for motors by supervising three voltage phases, three current phases, earth fault current, PTC sensor, startup time, the state of contactors and the state of the main switch.

Response of protection functions is based on the parameters given by the user. The operation of separate functions is independent, thus protection functions can be active at the same time but the one which indicates the situation first will give a trip for the motor.

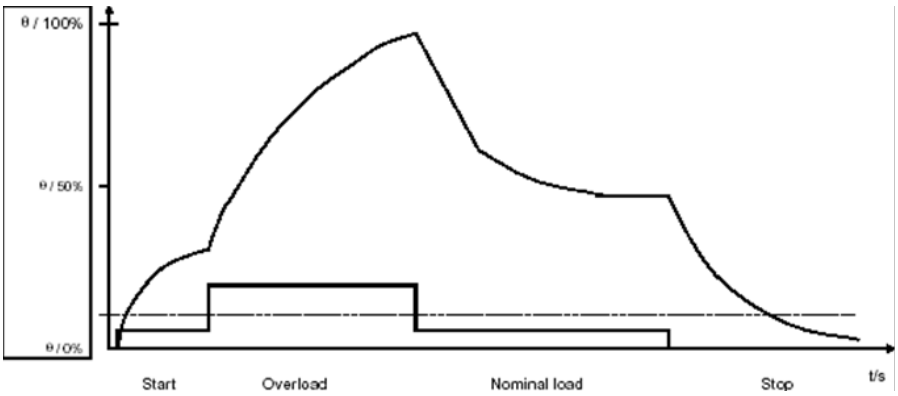
According to the application, all kinds of protection can be enabled, disabled by the upper level system or MCU setup tool, and the protection characteristics can be adjusted. Protection module offers the following protection and supervisory functions:

Table 28 Protection functions in M10x

Protection type	M101	M102
Overload protection	√	√
Stall protection	√	√
Long start protection	√	√
Phase failure protection	√	√
Unbalance protection	√	√
Underload protection	√	√
Noload protection	√	√
Earth fault protection	√	√
PTC protection		√
Undervoltage protection		√
Start limitation protection	√	√
Phase sequence Protection	√	√

Overload protection
Thermal overload protection (TOL) protects the motor against overheating.The motor thermal condition is simulated by a calculation. The result of the calculation is stored in a thermal register and can be reported via operator panel or fieldbus interface.

Calculation is accomplished in a different motor operation conditions, principle presented below. Thermal increase and decrease are simulated by TOL protection function for running and stopped motor.

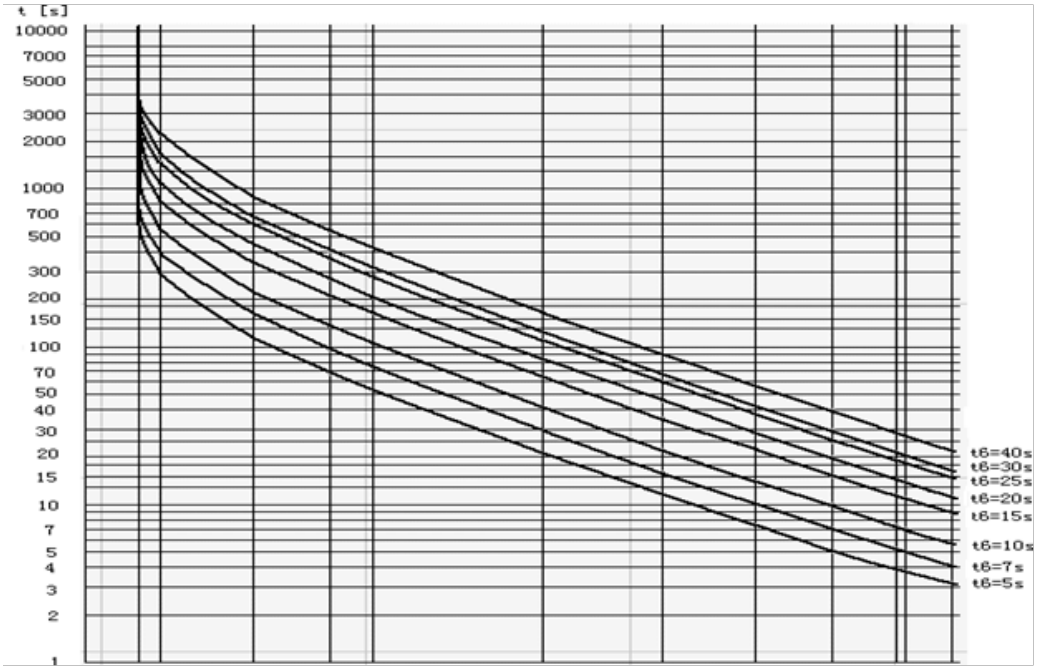


—
24 Principle picture of motor thermal simulation

M10x simulates thermal conditions in the motor for all operating modes (running or stopped). This permits maximum utilization of an installation and assures safe protection of the motor. Thermal overload protection simulation accounts for the temperature rise of both the stator winding and the iron mass of the motor. It gives thorough consideration of the effect of motor overheating due to three-phase unbalance during the simulation calculation of motor thermal overload.

There are two thermal models supported by M10x: standard or EEx e. The standard model makes use of parameters trip class, t6 in thermal overload calculation. The protection of explosion proof three-phase motors with type of protection ‘increased safety’ EEx e is done with two special parameters, the Ia/In ratio (stall/nominal current ratio) and Te time.

The following diagram offers the characteristic curve of overload protection, in which the characteristics are adjusted by changing t6 (trip time for current IL max=6xIn from the cold state).



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25 Trip curve from cold condition

The maximum thermal capacity level is 100%. Maximum level is reached when the motor has been running with a current 6xIn at the time t6 starting from the cold state in ambient temperature 40°C.

Table 29 IEC 60947-4-1 trip class when ambient temperature 40°C, balanced motor current

Trip class	T6
10A	3-7
10	7-12
20	10-25
30	15-38

If motor is in overload condition, i.e. ILmax > 1.14 x TFLC (thermal full load current multiplier reduced by motor ambient temperature), the overload alarm is activated to indicate overload.

In some applications, it is beneficial to be able to bypass the TOL protection momentarily because of the process reasons. The lifetime of the motor will be shortened, but it might the more costly to stop the process.

TOL bypass function is designed for this reason. If a TOL bypass is activated,

- when the motoring is running, the thermal capacity is allowed to rise to 200% before a trip occurs;
- when the motor is already taken off line due to TOL, the motor is ready for an emergency start as long as the thermal level is below 200%.

More details refer to 'TOL bypass' function under digital input functions section.

When Standard thermal model is selected
When EEX e thermal model is selected

—

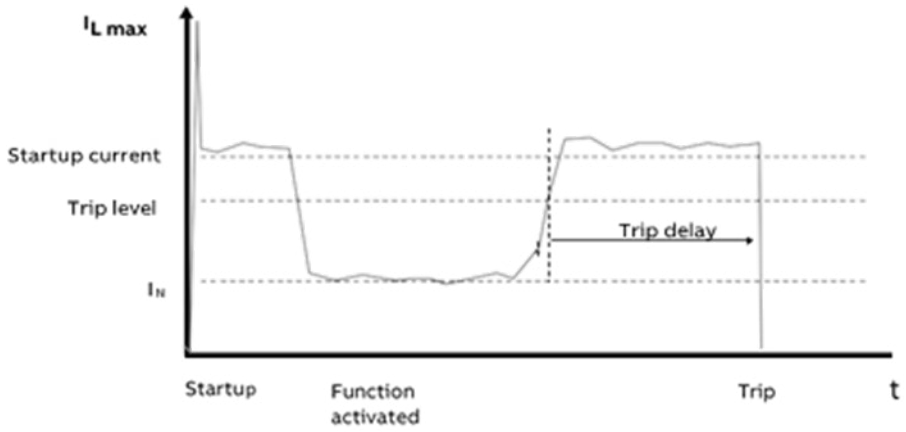
Table 30 TOL protection parameters

Function	
Setting range	0=Disabled 1=Enabled
Default value	Enabled
Step value	1
Disabled during motor startup	
Setting range	0=Enabled during motor startup 1=Disabled during motor startup
Default value	0
Step value	1
Trip reset mode	
Setting range	1=Auto 2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1
Thermal model	
Setting range	0=Standard model 1=EEX e
Default value	0
Step value	1
TOL bypass	
Setting range	0=Disabled 1=Enabled
Default value	Disabled
T6②	
Setting range	3-40sec
Default value	6sec
Step value	1
Cool coefficient	
Setting range	1-10
Default value	4
Step value	1
Ia/In③	
Setting range	1.2-8.0
Default value	5.0
Step value	0.1
Te③	
Setting range	5-40sec
Default value	5sec
Step value	1sec
TOL alarm level	
Setting range	60-100%
Default value	90%
Step value	1%
TOL trip level	
Setting range	60-100%
Default value	100%
Step value	1%
TOL reset level	
Setting range	10-60%
Default value	50%
Step value	1%
Ambient temperature	
Setting range	0-80°C
Default value	40°C
Step value	5°C

Stall protection
Stall protection is used to protect the driven mechanical system from jams and excessive overload. Stall protection function uses Imax as the criterion. There are other parameters to be determined as follow:

—
Table 31 Stall protection parameters

Function	
Setting range	0=Disabled 1=Enabled
Default value	1
Step value	1
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1
Trip level	
Setting range	120-800%
Default value	400%
Step value	10%
Trip delay	
Setting range	0.0-25.0sec
Default value	0.5sec
Step value	0.1sec

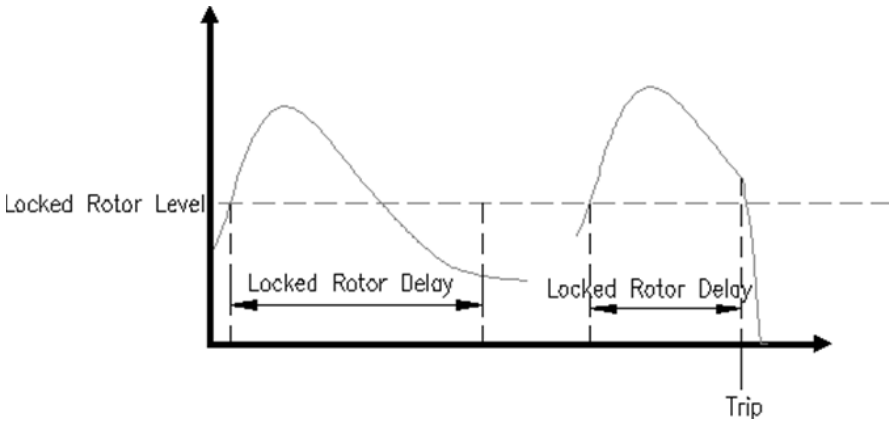


—
26 Stall protection

Stall function activates after motor nominal startup time has elapsed.

The highest measured phase current (ILmax) is compared against the trip level. When ILmax remains over the trip level at a time longer than trip delay, a stall alarm is issued and the contactor tripped.

Long start protection
The long start protection protects motor against locked or stalled rotor in starting state. M10x detects the current after a start command, and signals a fault when current continuously exceeds a separately set threshold of the period of start time.



—
27 Long start protection

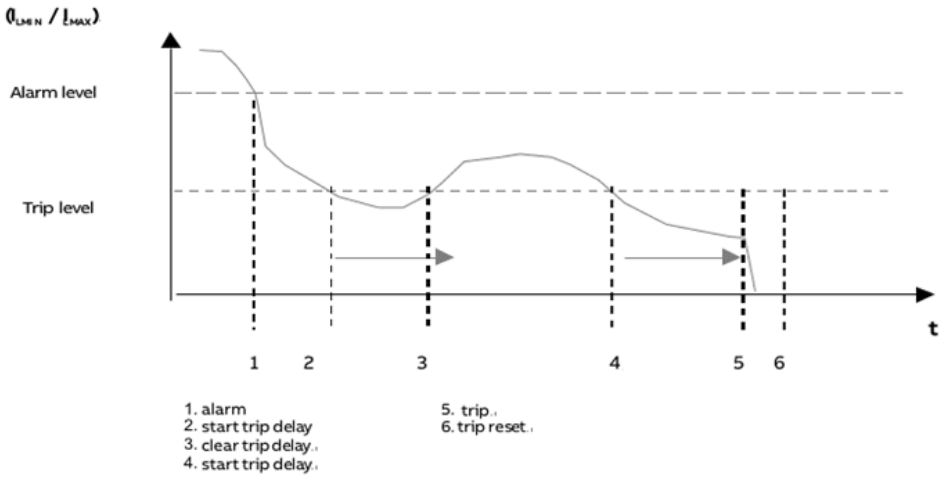
—
Table 32 Long start protection parameters

Function	
Setting range	0=Disabled 1=Enabled
Default value	Disabled
Step value	1
Locked rotor level	
Setting range	120-800%
Default value	120%
Step value	10%
Locked Rotor Delay	
Setting range	0-250sec
Default value	10sec
Step value	1sec
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and Local
Default value	4
Step value	1

Phase failure protection
M10x protects the motor against phase current loss condition. Phase failure protection function uses I_{Lmin}/I_{Lmax} (the ratio of lowest I_{Lmin} and highest measured phase value I_{Lmax}) as the criterion. Function is suppressed by parameters Motor startup time, number of phases and Softstart ramp time.

—
Table 33 Phase failure parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
Trip delay	
Setting range	0-60sec
Default value	10sec
Step value	1s
Alarm level	
Setting range	10-90%
Default value	80%
Step value	1%
Trip level	
Setting range	5-90%
Default value	70%
Step value	1%
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1



—
28 Phase failure protection

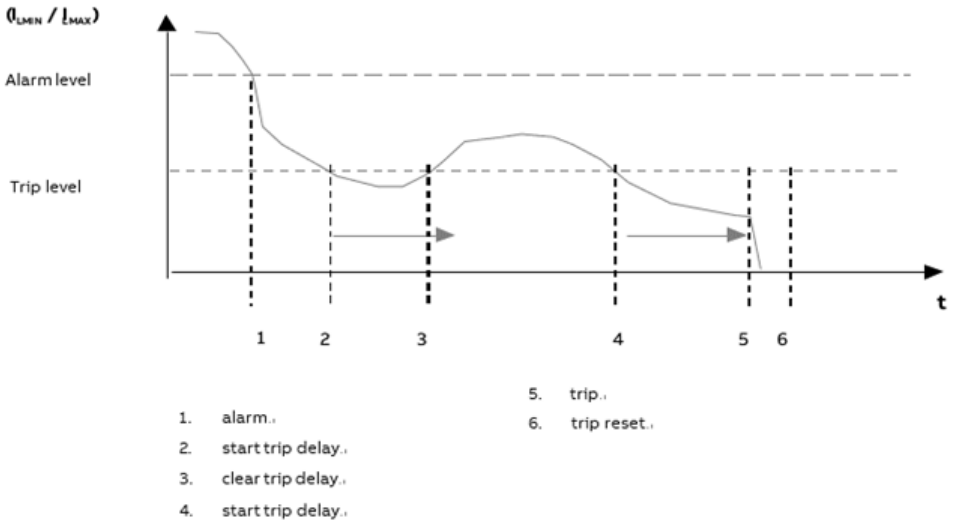
I_{Lmin}/I_{Lmax} is compared against the phase failure alarm level. When I_{Lmin}/I_{Lmax} decreases below the Alarm level, a “Phase failure alarm” alarm is issued.

I_{Lmin}/I_{Lmax} is compared against the phase failure trip level. When I_{Lmin}/I_{Lmax} remains below the trip level at a time longer the trip delay, a “Phase failure trip” alarm is issued and the contactor tripped.

Unbalance protection
M10x protects the motor against unbalance conditions. Unbalance protection function also uses I_{Lmin}/I_{Lmax} as the criterion. Function is suppressed by parameters Motor startup time, Number of phases and Softstart ramp time.

—
Table 34 Unbalance protection parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
Trip delay	
Setting range	0-60sec
Default value	10sec
Step value	1s
Alarm level	
Setting range	50-90%
Default value	90%
Step value	1%
Trip level	
Setting range	5-90%
Default value	85%
Step value	1%
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1



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29 Unbalance protection

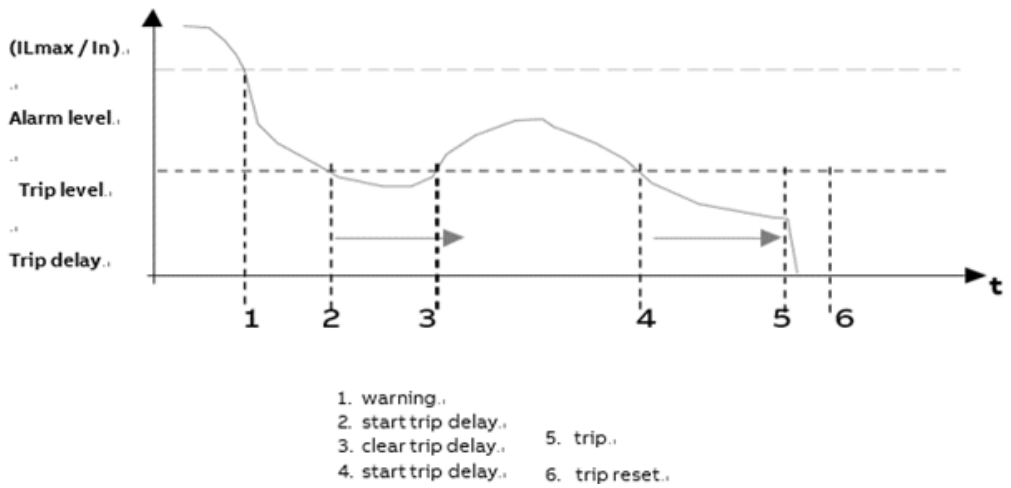
I_{Lmin}/I_{Lmax} is compared against the unbalance alarm level. When I_{Lmin}/I_{Lmax} decreases below the alarm level, an unbalance alarm is issued.

I_{Lmin}/I_{Lmax} is compared against the unbalance trip level. When I_{Lmin}/I_{Lmax} remain below the trip level at a time longer the trip delay, an unbalanced trip alarm is issued and the contactor tripped.

Underload protection
M10x protects the motor against underload conditions. Underload protection function uses I_{Lmax}/In (the ratio of highest measured phase value ILmax and the rated current of the motor In) as the criterion. There are other parameters to be determined, such as alarm level, trip level and trip delay. The protection characteristic are as follows:

—
Table 35 Underload protection parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
Alarm level	
Setting range	20-90%
Default value	30%
Step value	1%
Setting range	
Setting range	5-90%
Default value	20%
Step value	1%
Trip delay	
Setting range	0-1800sec
Default value	10sec
Step value	1sec
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1



—
30 Underload protection

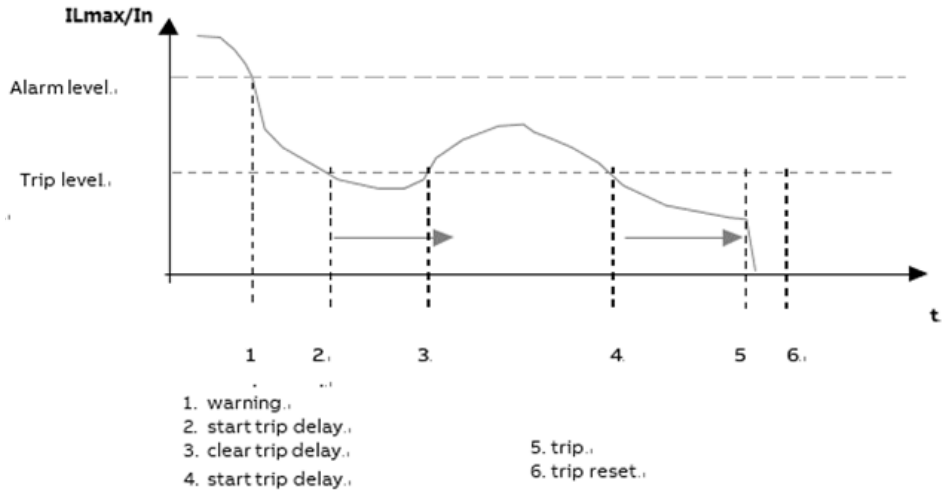
The I_{Lmax}/In is compared against the underload alarm level. When I_{Lmax}/In decreases below the alarm level an underload alarm is issued.

The I_{Lmax}/In is compared against the underload trip level. When I_{Lmax}/In remains below the trip level at a time longer than underload trip delay, an underload trip alarm is issued and the contactor tripped.

Noload protection
M10x protects the motor against no load conditions. Practically, noload protection is the same function as underload protection. The function also uses I_{Lmax}/In as the criterion.

—
Table 36 Noload protection parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
Alarm level	
Setting range	5-50%
Default value	20%
Step value	1%
Trip level	
Setting range	5-50%
Default value	15%
Step value	1%
Trip delay	
Setting range	0-1800sec
Default value	5sec
Step value	1sec
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1



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31 Noload protection

The I_{Lmax} /In is compared against the no load alarm level. When I_{Lmax}/In decreases below the alarm level a noload alarm is issued.

The I_{Lmax}/In is compared against the noload trip level. When I_{Lmax}/In remains below the trip level at a time longer than noload trip delay, a noload trip alarm is issued and the contactor tripped.

Earth fault protection
M10x protects the motor against the earth fault condition with an additional residual current transformer.

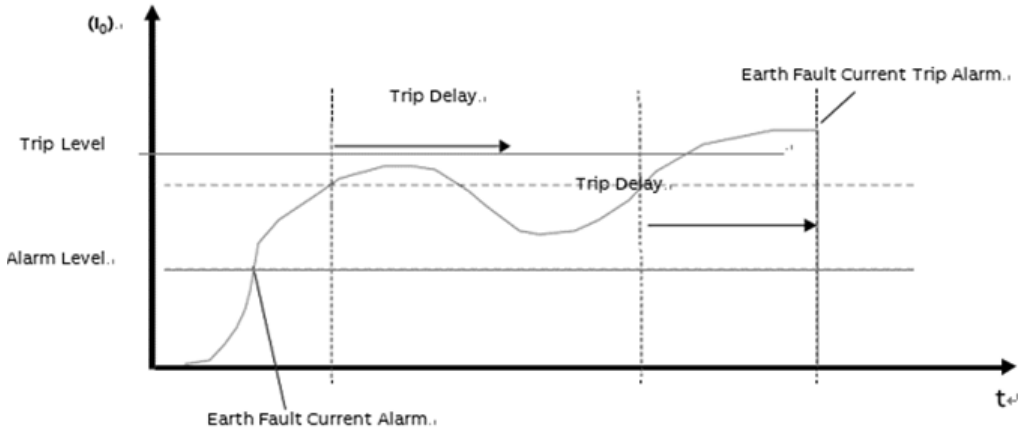
The function is by default suppressed by parameters motor startup time and softstarter ramp up time to avoid nuisance tripping due to harmonics caused by saturation of the current transformers. In some cases, it may need to be switched on during startup in order to meet specific project requirements.

M10x relay is NOT a residual current protection device. This protection is neither intended to be used for pre-emptive isolation supervision nor for personnel protection against electrical shock. For these applications ABB recommends the usage of external protection devices (PRCDs/RCDs).

Earth fault protection uses the following parameters:

Table 37 Earth fault protection parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
Earth fault protection is activated during motor startup time	
Setting range	0=Disabled 1=Enabled
Default value	0
Step value	1
Alarm level	
Setting range	100-3000mA (Earth fault primary = 1A) 500-15000mA (Earth fault primary = 5A)
Default value	500mA
Step value	100mA
Trip level	
Setting range	100-3000mA (Earth fault primary = 1A) 500-15000mA (Earth fault primary = 5A)
Default value	800mA
Step value	100mA
Trip delay	
Setting range	0.1-60.0sec
Default value	10.0sec
Step value	0.1sec
Trip reset mode	
Setting range	2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1



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32 Earth fault protection (I0 = measured earth fault current)

I_0 is compared against the earth fault current fault alarm level. When I_0 exceeds above the alarm level, an earth fault alarm is issued.

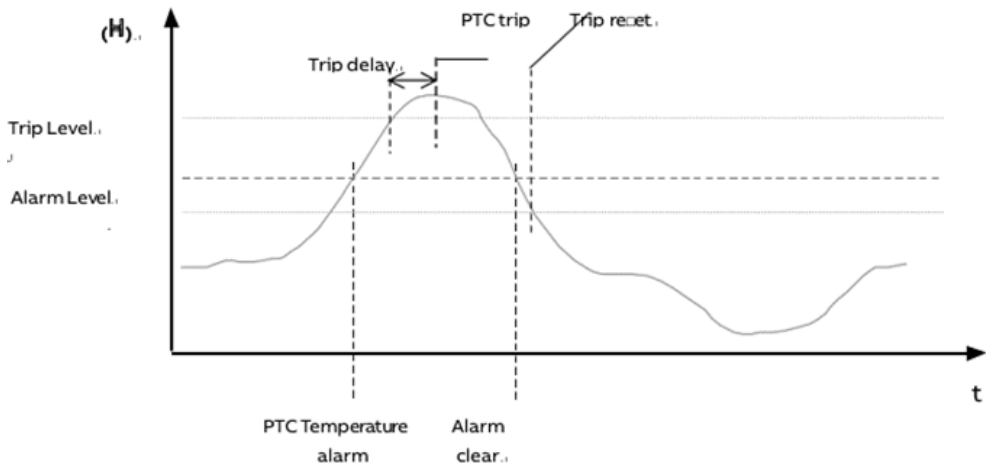
I_0 is compared against the earth fault current trip level. When I_0 remains above the earth fault current Trip level at a time longer than trip delay, an earth fault trip alarm is issued and the contactor tripped.

PTC protection (M102 only)
PTC protection protects the motor against too-high temperature by using PTC-sensor embedded in the stator winding or the bearings. For M102, use a type A temperature sensor with a characteristic curve according to IEC 60947-8.

—
Table 38 PTC protection parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
PTC Alarm level	
Setting range	1000-10000Ω
Default value	1600Ω
Step value	1Ω
PTC trip level	
Setting range	1000-10000Ω
Default value	3600Ω
Step value	1Ω
PTC trip delay	
Setting range	1-1800sec
Default value	1sec
Step value	1sec

Function	
PTC reset level	
Setting range	100-10000Ω
Default value	1600Ω
Step value	1Ω
PTC trip reset mode	
Setting range	1=Auto 2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1
PTC short circuit alarm level	
Setting range	0-250Ω
Default value	10 Ω
Step value	1 Ω



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33 PTC protection

The resistance of PTC input is compared against the alarm level. When resistance of PTC input exceeds above the alarm level, a PTC alarm message is issued.

The resistance of the PTC input is compared against the trip level. When resistance of PTC input is above the trip level PTC trip alarm is issued and the contactor tripped.

After PTC trip is executed, the resistance of PTC input is compared against the PTC reset level. When resistance of PTC input decreases below the reset level, the PTC protection function executes the function set by PTC reset mode.

M10x provides short circuit and open circuit detection for the temperature sensing element. Short circuit alarm level is settable, and open circuit alarm level is fixed. When the resistance of PTC input falls below short circuit alarm level, a PTC short circuit alarm message is issued.

When the resistance of PTC input exceeds 12kΩ, a PTC open circuit alarm message is issued.

Short circuit and open circuit detection threshold have no fault time delay. The short circuit and open circuit protection is enabled when PTC protection is enabled, and cannot be disabled.

If the measured resistance is over 20kΩ, thermistor resistor will display, 20kΩ.

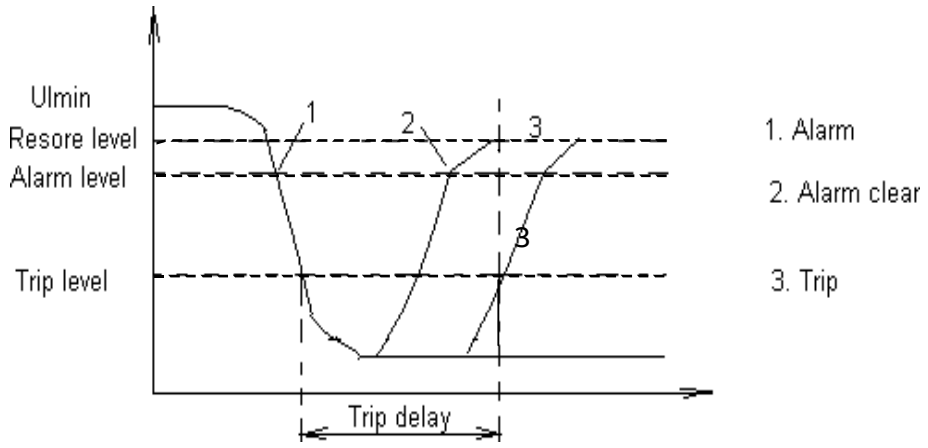
The distance between PTC sensors and M10x PTC measuring inputs cannot exceed the following to be able to maintain reasonable reading:

Cross section	Length
2.5mm²	2x250m
1.5mm²	2x150m
0.5mm²	2x50m

Undervoltage protection (M102 Only)
M102 protects the motor against undervoltage conditions such as voltage dip.

The undervoltage protection function uses ULmin as the criterion. There are other parameters to be determined, such as alarm level, trip level and trip delay, and reset voltage level. The protection characteristic is as follows:

If “main switch” is dectected on ‘powered off’ position, undervoltage alarm/tip function is suppressed to avoid unnecessary annunciation



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34 Undervoltage protection

The lowest measured main line voltage (Ulmin) is compared against the undervoltage alarm level. When Ulmin decreases below the undervoltage alarm level, an undervoltage alarm is issued.

The lowest measured main line voltage (Ulmin) is compared against the undervoltage trip level and voltage restore level. When Ulmin recovers above undervoltage restore level before trip delay expires and motor continues running. If Ulmin remains below the restore level at a time longer than trip delay, undervoltage trip is issued and contactor will be opened.

When autorestart function is active, undervoltage trip delay will be same as maximum power down time automatically.

Table 39 Undervoltage protection parameters

Function	
Setting range	0=Disabled 1=Enabled 3=Alarm only
Default value	Disabled
Step value	1
Alarm level	
Setting range	50-100%
Default value	80%
Step value	1%
Trip level	
Setting range	30-100%
Default value	65%
Step value	1%
Trip delay	
Setting range	0.2-5.0sec
Default value	1.0sec
Step value	0.1sec
Reset level	
Setting range	50-100%
Default value	90%
Step value	1%
Trip reset mode	
Setting range	1=Auto 2=Local 3=Remote 4=Remote and local
Default value	4
Step value	1

Start limitation
Start limitation helps to protect the motor and also the process against excess number of starts in a given interval. When the number of starts is reached and the motor is switched off, a new start is prevented. The time interval, starts from the first start. After the elapse of the time interval, the counter is reset to the preset value. The permissible motor starts per hour can be obtained from the manufacturer's motor and apparatus data sheet. However, the minimum waiting time between two starts must be observed.

The parameterization of the protection function can be the number of starts per time interval or the time between two consecutive starts. In the first case, the user must wait after the trip for the reset to take place before making a start.

If motor data specifies the number of starts during a certain time span, this function can be used to supervise the number of starts. In some other cases, the process may require a motor start number, which the protection can provide.

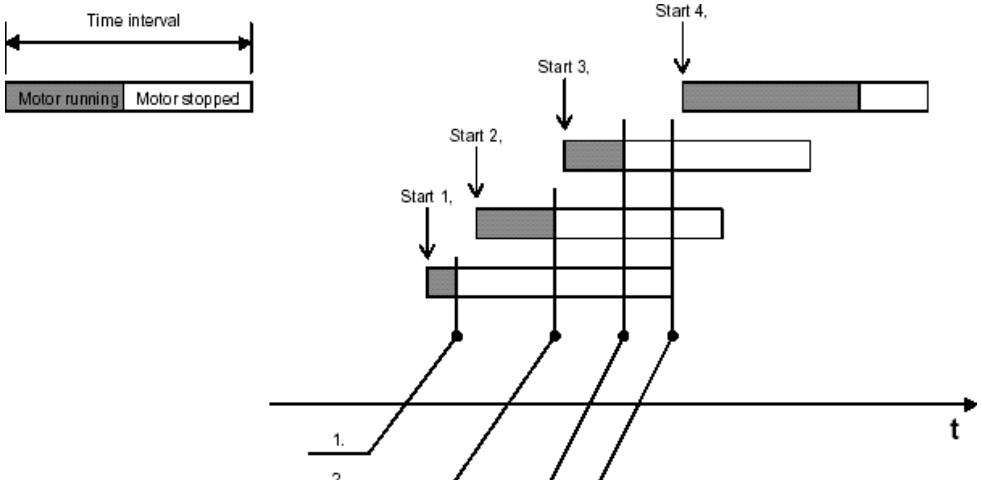
Functionality is presented in the following example. The next Figure 35 illustrates the start limitation protection with 3 starts allowed.

1) Normal situation, after stop command motor can be started normally, start 2. Every start activates an internal timer for the time defined by time interval parameter. The number of active timers are reviewed after every stop command and compared to value of number of starts parameter. Stop command can be implemented during active or elapsed timer.

2) Two timers are still active, thus stop command generates alarm message start limitation alarm and one more start, Start 3 is allowed.

3) The 3rd start has been executed. A contactor trip and trip message start limitation trip alarm will follow when motor is stopped while there are two active timers, starting from Start 1.

4) Trip can be automatically reset when the first timer from Start 1 is finished. Motor start is possible when all pending trips are reset. Supervision continues with a new timer from Start 4.



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35 Start limitation protection

Table 40 Start limitation parameters Phase sequence protection

Function	
Setting range	0=Disable 1=Enable
Default value	Disabled
Step value	1
Time interval	
Setting range	1-600min
Default value	1min
Step value	1
Number of starts	
Setting range	2-100
Default value	2
Step value	1

M10x protects the motor against connection in wrong phase sequence. Before motor startup, M10x detects the phase sequence of voltage continuously and after startup M10x will detect the phase sequence of current. The definition of correct phase sequence:

- Voltage: L1, L2, L3
- Current: Ia, Ib, Ic

If enable phase sequence protection, when M10x detects the voltage or current is different from the definition M10x will release a phase sequence trip signal.

Table 41a Phase sequence protection parameters Autorestart function (M102 Only)

Function Enable/Disable	
Setting range	0=Disable 1=Enable
Default value	Disabled
Step value	1
Trip Reset Mode	
Setting range	2=Local 3=Remote 4=Remote&Local
Default value	4
Step value	1

The line voltage (UL1L3) is supervised continuously. It is possible to automatically restart the motor after momentary power loss. Two alternative models of auto restart function are provided in M102: standard and enhanced.

If “main switch” is dectected on ‘powered off’ position, undervoltage alarm/tip function is suppressed to avoid unnecessary annunciation

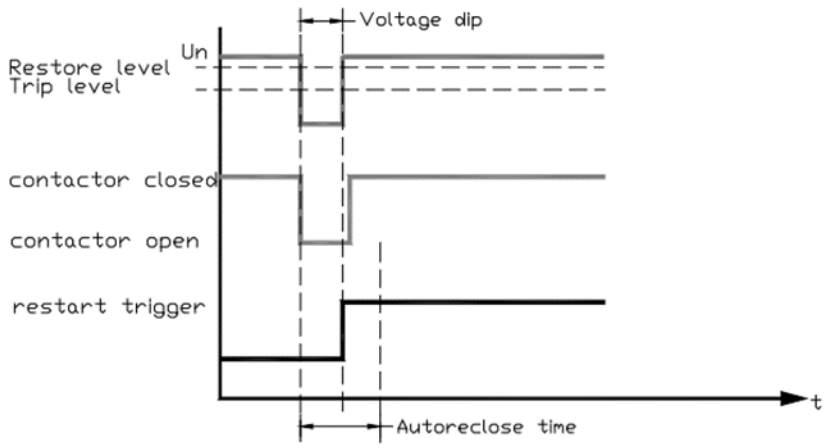
M101 does not have the autorestart function.

—
Table 41 Auto restart function parameters

Function	
Setting range	0=Disabled 1=Enabled
Default value	Disabled
Step value	1
Function mode	
Setting range	0=standard 1=enhanced
Default value	0
Step value	1
Maximum autoreclose time	
Setting range	0-5000msec
Default value	200msec
Step value	100msec
Maximum powerdown time	
Setting range	0-1200sec
Default value	5sec
Step value	0.1sec
Staggered start delay	
Setting range	0-1200sec
Default value	5sec
Step value	0.1sec

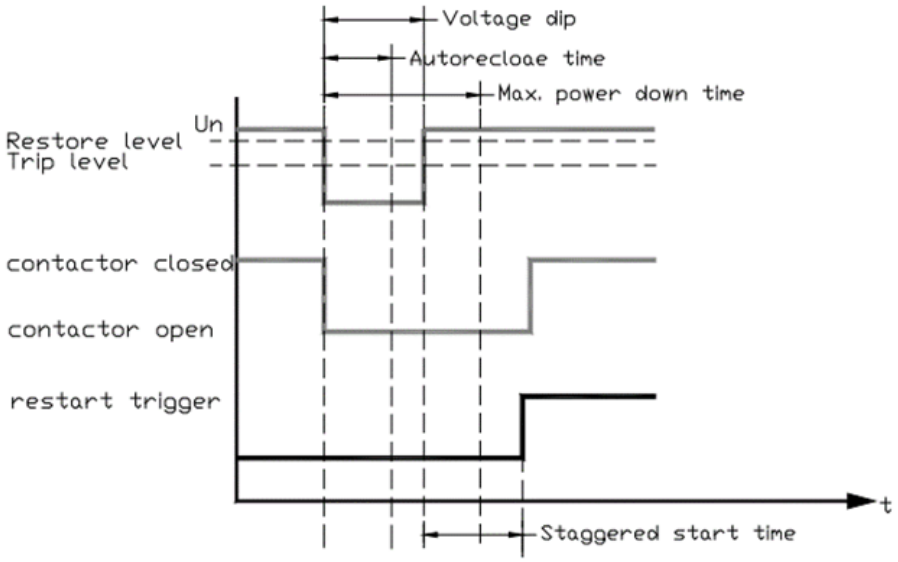
Autorestart function (standard)
In standard mode, the reaction of the auto restart function depends on the length of the voltage dip. The following cases show the different reactions of M102 in different voltage dip situations

Case 1: Voltage dip< autoreclose time.



—
36 Autorestart (Voltage dip< autoreclose time)

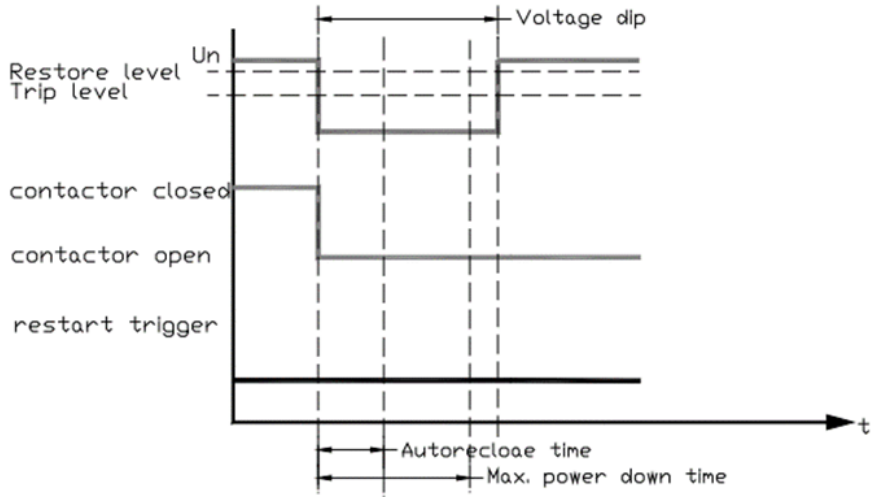
Case 2: Autoreclose time<voltage dip< Maximum powerdown time.



—
37 Autorestart (autoreclose time<voltage dip< Maximum powerdown time)

If power is restored after autoreclose time but before maximum powerdown time, motor will be restarted after the staggered start delay time.

Case 3: Voltage dip> Maximum powerdown time.



—
38 Restart (Voltage dip> Maximum powerdown time)

If supply voltage remains below restore level long enough and exceeds maximum powerdown time, no automatic restart will be initiated.

Autorestart function (enhanced)
If the voltage dip is more serious, the enhanced autorestart function can be applied.

In the enhanced mode, the reaction of the autorestart function not only depends on the length of the voltage dip, but also the number of voltage dips within a short period of time.

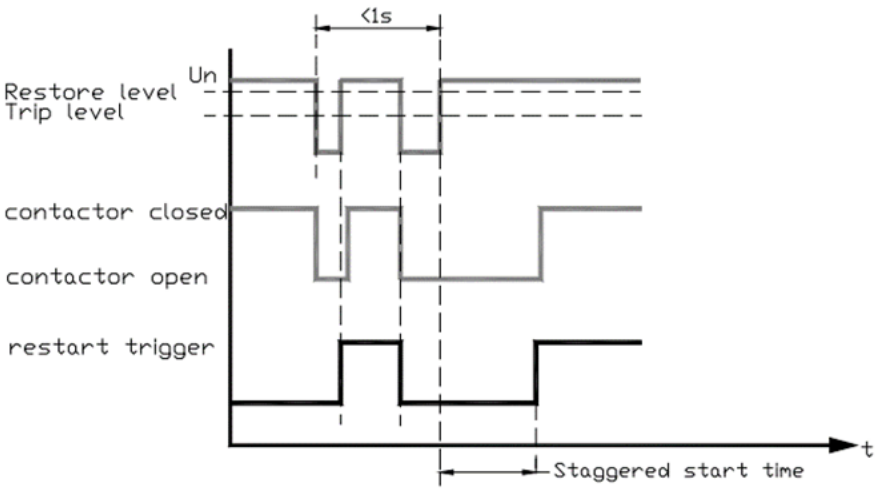
The following cases show the different reactions of M102 in different voltage dip situations:

Case 1: Voltage dip< autoreclose time Identical to Case1 of standard mode

Case 2: autoreclose time<voltage dip< Maximum powerdown time Identical to Case2 of standard mode

Case 3: Voltage dip> Maximum powerdown time Identical to Case3 of standard mode

Case 4: 2xdip<200ms within 1sec



—
39 Restart (2xdip<200ms within 1sec)

If the interval between two voltage dips (length less than 200ms) is less than 1 sec, automatic delay restart is triggered after second voltage restore.

Failsafe functionality
M10x failsafe function supervises the network interface and connection to the remote devices controlling the motor/starter equipmen. Remote devices have to refresh certain M10x network input variables to indicate that the control is operating normally and the network interface is in good condition.

If a loss of communications for 5-25sec is detected, the failsafe activates with the parameterized function as follows:

- No operation
- Start motor direction 1
- Start motor direction 2
- Stop motor

Additionally, control access to motor will be switched to/remain in local control (hardwire control) and MD control while ignoring previous control access settings. When the communication is restored, the control access will recover to the original setting.

Main switch status protection functionality

Main Switch Supervision function is the function base on MNS module handle design. It strengthens the safety operation of MNS system by monitoring main switch status along with test switch status via digital inputs (DIs) under different motor states.

When both main switch status and test switch status are hardwired and assigned through DIs to enable main switch supervision function.

Motor Status	**Main Switch**			**Test Switch*** **		**Both Main Switch and Test Switch are ON**
	ON -> OFF	OFF -> ON	ON	ON -> OFF	OFF -> ON	
Running with load	MSS Trip*	--	CFB Trip**	Stop	Stop	MSS Trip*
Running without load	MSS trip*	Stop	Normal	Stop	Stop	MSS Trip*
Stop	Normal	Normal	Normal	Normal	Normal	MSS Trip*

Notes:
*** M10x trips the motor with message 'Main Switch Status'**
**** M10x trips the motor with message 'Current feedback trip'**
***** When Test switch is ON, a "T" symbol shows on top right corner of MD21 screen**

Main Switch Status function independent of test switch if the latter is not wired in and monitored. When the DI is assigned as 'Main Switch Status', M10x monitors main switch ON/OFF status via the DI. In addition, the following function is provided.

If "main switch" is dectected on 'powered off' position, undervoltage alarm/tip function is suppressed to avoid unnecessary annunciation

	Main Switch	
Motor Status	ON -> OFF	OFF -> ON
Running with load	MSS Trip*	--
Stop	Normal	Normal

Notes:
*** M10x trips the motor with message 'Main Switch Status'!**

Test Switch function independent of main switch status if the latter is not wired in and monitored. When the DI is assigned as 'test switch', M10x monitors if the module handle is in test position. Aligned with MNS module handle design, under test position means that the control circuit is powered up while the power circuit being disconnected so that the control functions testing can be conducted. Once 'test' position is detected through the DI, M10x switches off current and voltage based protection functions regardless the protection settings. A 'T' symbol is displayed on MD panel when 'test' position is detected. Once 'test' position is off, all protections restore automatically.

	Test Switch		
Motor Status	**ON**	**ON -> OFF**	**OFF -> ON**
Running with load	CFB Trip*	Stop	Stop
Running without load	Normal	Stop	Stop
Stop	Normal	Normal	Normal

Notes:
**** M10x trips the motor with message 'Current feedback trip'**
***** When Test switch is ON, a "T" symbol shows on top right corner of MD21 screen**

Soft Test Switch is the function available through selecting the parameter to simulate module in test position. Similar as 'Test Switch' function, when 'Soft Test Switch' parameter is selected, M10x switches off current and voltage based protection functions regardless the protection settings. A 'T' symbol is displayed on MD panel when soft test switch is selected.

06. Control Access

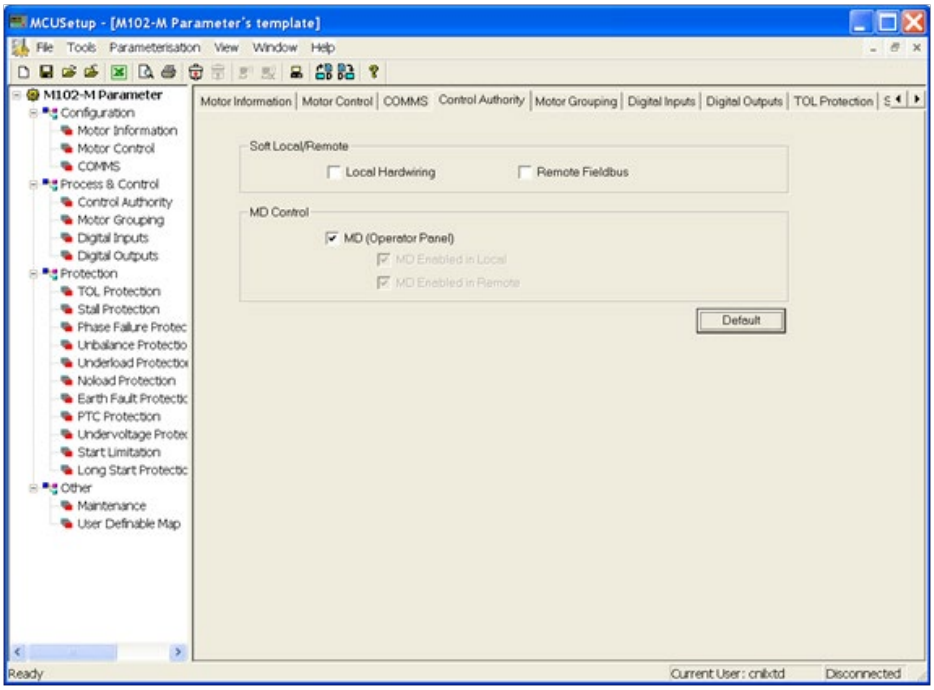
Control authority
M10x control authority is the term describing the privileges allowing motor control operation through M10x. It is also a setting parameter in M10x to define which control access group has privileges to operate the motor via M10x.

Control access
There are three control access groups defined in M10x:

- Local hardwiring: M10x accepts its start1/start2/stop commands from the hardwired inputs
- Remote fieldbus: M10x accepts its start1/start2/stop commands from a PLC or higher control system via fieldbus, ie, MODBUS or PROFIBUS.
- MDx control: M10x accepts its start1/start2/stop commands from operator panel MDx located on the front panel of each starter unit on switchgear.

Assign control authority
There are several means in M10x to assign control authority and decide which control access group has control privileges.

- Parameter setting:
Select the access group from parameter setting window (Fig. 40). This is the most direct option where control access is defined by parameterization software.



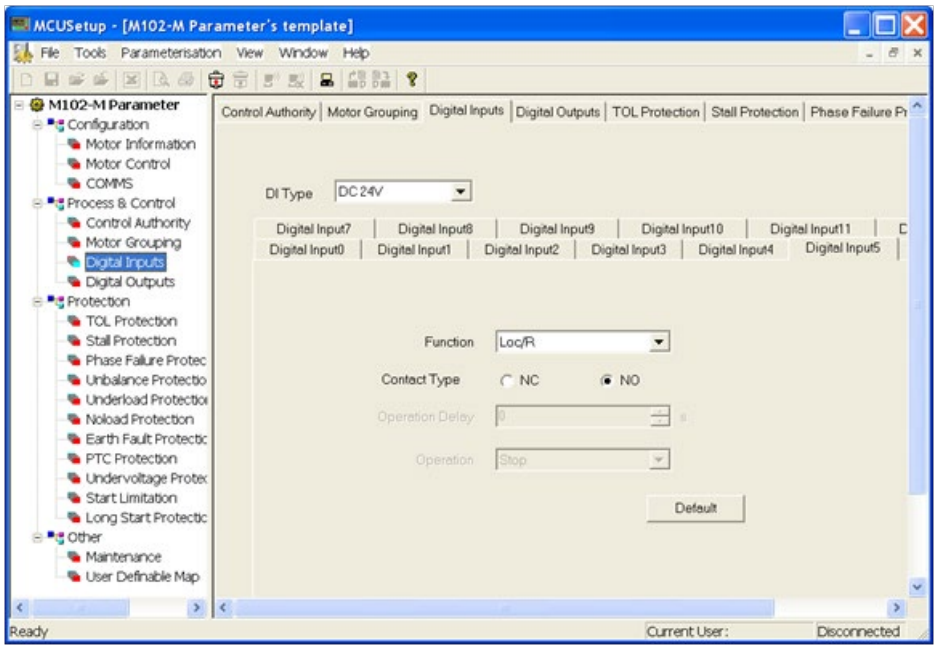
—
40 Parameter setting of local/remote of control authority

Multi-control access group is supported!

1) For M10x-P, only when Profibus option is not selected and no DI is assigned Loc/R, Soft Local/Remote could be selected.

2) If Soft Local/Remote is selected, Profibus option is not available.

• Local/remote selector switch
M10x supports hardwired local remote selector switch function which allows selecting control access groups via hardwired inputs. To enable this function, one of the digital inputs has to be defined as ‘Loc/R’ in M10x (Fig. 41).



—
41 Assign local/remote function to digital input

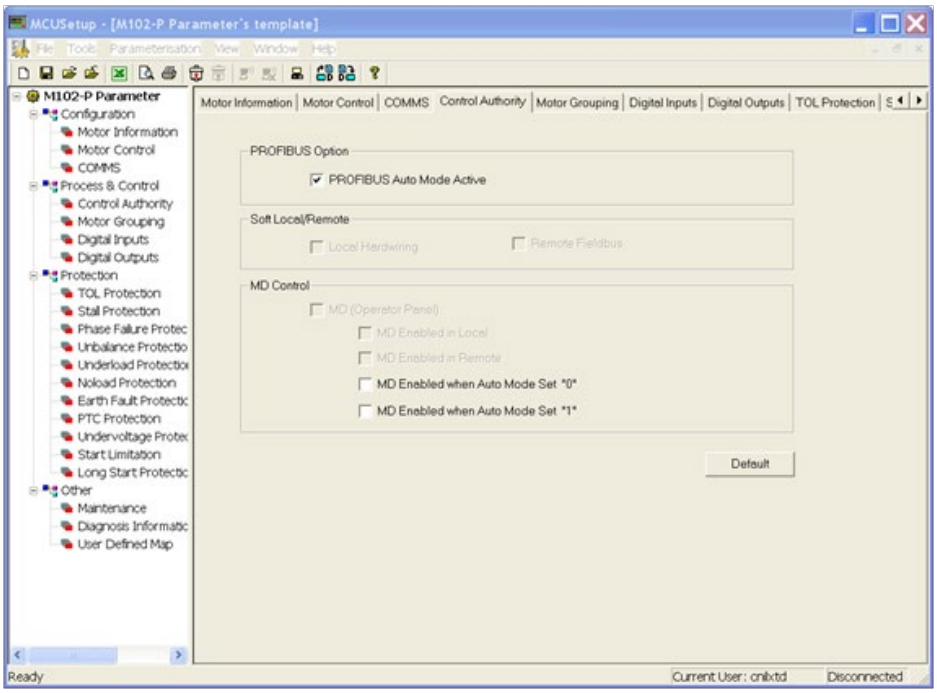
Local/remote selector switch will then define if control access goes to local (local hardwired) or remote (remote fieldbus). This function does not include the selection of operator panel MDx control which is independent of either Local or Remote and has to be further defined in this case.

	Control authority			
Loc/R selector switch input	**Local hardwiring**	**Remote fieldbus**	**MDx enabled in local**	**MDx enabled in remote**
False (open input)	Disabled	Enabled	Disabled	Enabled
True (close input)	Enabled	Disabled	Enabled	Disabled

Local/Remote selector switch

When “Loc/R” is enabled in one of the digital inputs, only “MD control” is available.

Profibus option (M10x-P only):
M10x supports superior control system to select control access groups via fieldbus command. To enable this function, Profibus Auto Mode Active has to be selected (Fig42).



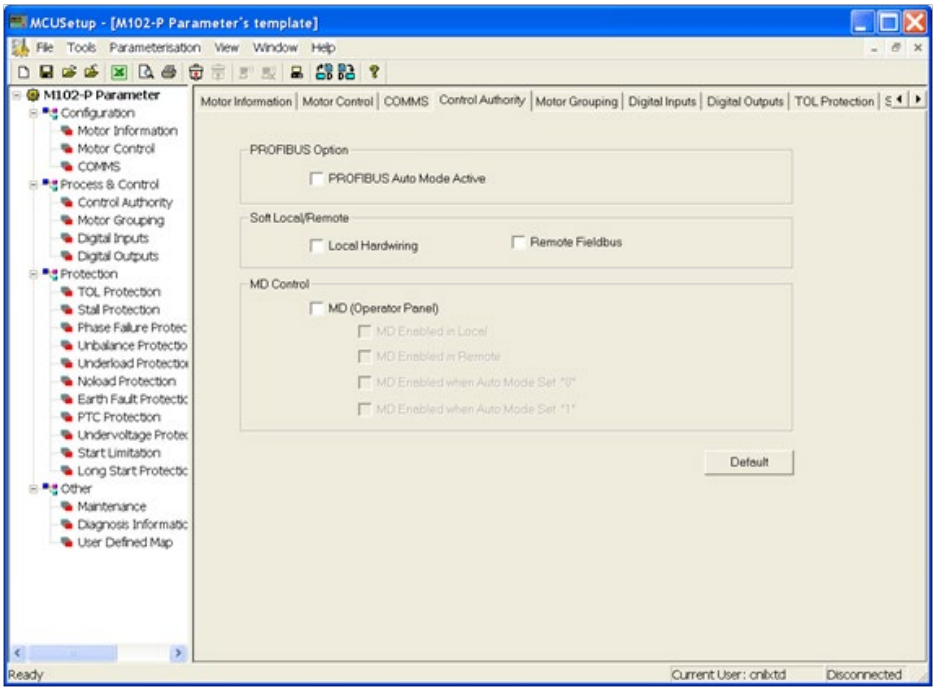
—
42 Enable PROFIBUS option

1) Only when soft local/remote is not selected and no DI is assigned Loc/R, Profibus option can be selected.

2) If Profibus option is selected, control mode is not available.

MD control aurthority setting
The selection of MD control authority is independent of the selection of local/remote control authority.

- Parameter Setting



—
43 MD Control

Select the access group from parameter setting window (Fig 43). This is the most direct option where control access is defined by parameterization software. Meanwhile, option of MD control is defined in this case by Loc/R Selector Switch Input and Profibus Option.

	MD Control			
Loc/R selector switch input	**MD enabled in local**	**MD enabled in remote**	**MD enabled when Auto mode set "0"**	**MD enabled when Auto mode set "1"**
Loc/R selector Switch input	Available	Available	Not available	Not available
Profibus option enabled	Not available	Not available	Available	Available

- Hardwired input

Use external selector switch to select MD control. As in the local/remote selector switch function, one of the digital inputs must be defined as MD control to enable the function.

When "Loc/R" is enabled in one of the digital inputs, control access group options under the control authority tab are limited to MD only, just as when MDx control is enabled, the MD control access option under the control authority tab is grayed out.

In other words, hardwired selection has privileges over parameter setting selection in terms of assigning control authority.

07. Configurable I/Os

Digital inputs
There are 13 separate 24VDC programmable digital inputs (DIs) or 9 separate 110VAC or 230VAC DIs in M10x. These digital inputs can be assigned one of the functions listed below.

- **NOP**

No special operation for the NOP function, only for checking digital input status. This input can be used for status transfer for digital input, and works in level check mode.

- **Start1/Start2**

Local hardwiring start control. To activate the function, control access should be assigned to 'local'. Start 1 is used for start control in one direction starters. It is also used for forward start control in reversing starter control and low speed start in 2 speed starter. Start 2 is used for reverse start in reversing starter control and high speed in 2 speed starter control. Local start control works on edge trigger, i.e. 0->1 or 1->0.

- Stop

Local hardwiring stop control. To activate the function, control access should be assigned to 'local'. Stop control works on either edge trigger (0->1 or 1->0) or level trigger (continuous 1 or 0).

- Limit1/Limit2

This function is used for applications where limit switches are installed. When the input is activated, motor stops and read for starting from different direction.
Limit1 is usually used for stopping the motor from running forward (CW); Limit2 is used for reversing. (CCW).

Limit switch input works on level trigger, i.e. continuous 1 or 0.

- **Process interlock1**

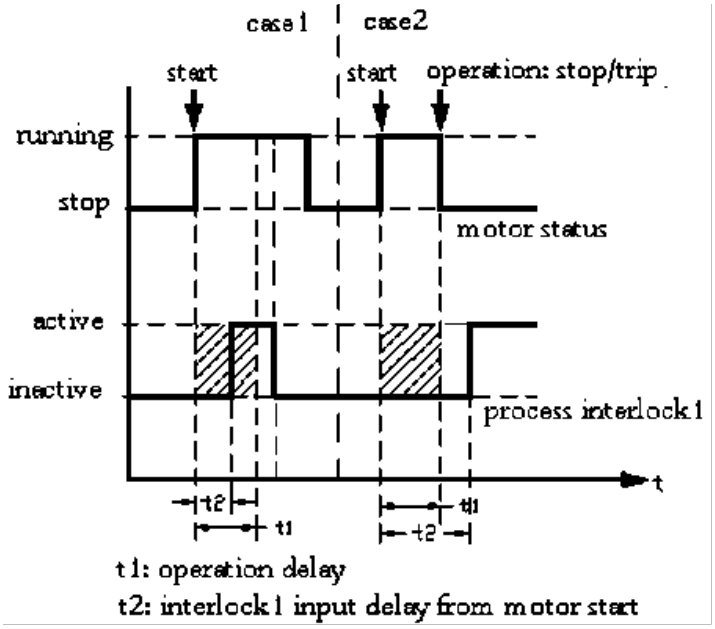
The process interlock1 function is used to provide time dependent trip/alarm/stop features based on a switch input. This function is used together with OPERATION DELAY and OPERATION parameters.

If the hard-wiring signal comes from the field or other remote source external of the switchboard, it is recommended to wire through an interposing relay internal of the starter before wired to digital inputs of M10x relay, 110/240VAC type in particular.

The OPERATION DELAY parameter sets the amount of time that the process interlock1 switch can remain inactive on the occurrence of a motor start. If the switch remains inactive for longer than this time, a trip/stop will occur. If there is valid active process interlock1 input detected in the defined operation delay, motor will keep running. After the operation delay time, the inactive status of process interlock1 input will not affect the running of motor. If the OPERATION DELAY parameter is set to 0, the process interlock1 switch must be active while motor is started, which means motor start will not be allowed if the input is inactive.

The OPERATION parameter determines whether process interlock1 feature is a trip (reset required in order to restart the motor), a stop (no reset required) or an alarm.

This input works in level check mode.



—
44 Process interlock1

Case 1: When t1>t2, motor can run normally.

Case 2: When t1<t2, a trip or stop will be performed according to the predefined operation.

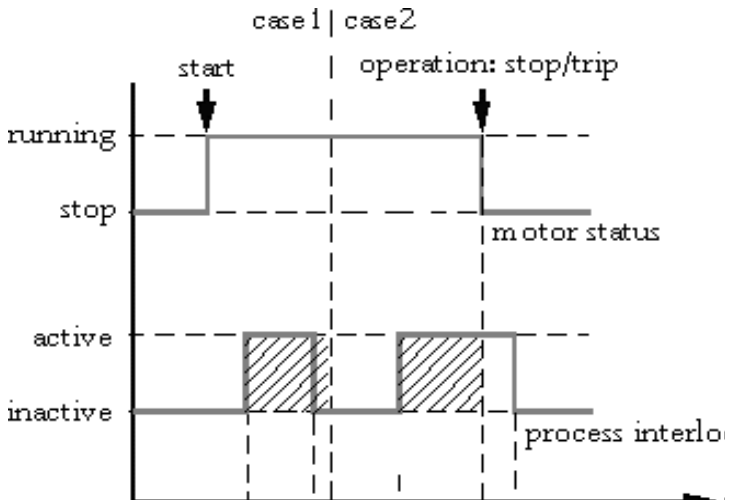
If the signal is detected active, the trip will be reset automatically.

• **Process interlock2**
Process interlock2 function is used to provide time dependent trip/alarm/stop features based on a switch input. This function is used together with OPERATION DELAY and OPERATION parameters.

The OPERATION DELAY parameter sets the amount of time that the process interlock2 switch can be remain active when motor is in running. If the switch remains active for longer than this time, a trip/stop will occur. If the OPERATION DELAY parameter is set to 0, than the process interlock2 switch must be inactive while motor is started, which means motor start will not be allowed if the input is active.

The OPERATION parameter determines whether process interlock feature is a trip (reset required in order to restart the motor), a stop (no reset required) or an alarm.

This input works in level check mode



—
45 Process interlock2

Case 1: when t1>t2, motor can run normally.

Case 2: when t1<t2, a trip or stop will be performed according to the predefined operation.

If the signal is detected active, the trip will be reset automatically.

• **Emergency stop**
This input is used for the emergency stop device. When the input is active, the motor will be stopped/tripped and cannot be restarted until the input is inactive. This function is used together with OPERATION parameters.

OPERATION: This parameter determines whether the emergency stop feature is a trip (reset required in order to restart the motor) or a stop (no reset required).

Emergency stop function is not used for functional safety.

• **PLC control 1 & PLC control 2**
'PLC control 1' & 'PLC control 2' determine jogging control through the digital input. When DI detects an active signal, the motor will run continuously on one direction or at one speed until the inactive signal in detected to stop the motor.

'PLC control 1' is designed for start/stop forward control (CW) or first speed control in two speed starters.

'PLC control 2' is designed for start/stop reverse control (CCW) or second speed control in two speed starters.

To enabled PLC control function (jogging control), local control access has to be enabled.

- **Trip reset**

The input is used to reset a trip. This input works in edge triggering mode.

- Torque switch

This input is used to check the status of torque switch used for actuator starter. When the input is different from normal state, M10x will release all contactor control relays to stop the motor. This input works in level check mode.

- **F_CA**

The F_CA input is the feedback detection signal of contactor control relay CCA. This input works in level check mode.

- **F_CB**

The F_CB input is the feedback detection signal of contactor control relay CCB. This input works in level check mode.

- **F_CC**

The F_CC input is the feedback detection signal of contactor control relay CCC. This input works in level check mode.

- **Loc/R**

The Loc/R input is local/remote control switch input.

For M10x, if the Loc/R input is active, the control authority will be local hardwiring. If the Loc/R input is inactive, the control authority will be remote fieldbus.
This input works in level check mode.

- **Main Switch Supervision**

When ‘main switch status‘ input is selected, main switch protection function will be enabled. Refer to the description of main switch protection function.
This input works in level check mode.

- **External trip**

The input is used for tripping motor from external triggers. For example, a trip signal from short circuit protection device. The input requires to be reset after external trip, either from local or from remote. The input works on level trigger, i.e. continuous '0" or "1".

In feeder mode, ‘External trip’ function only occurs a message and details refer to ‘Feeder’ chapter on page 38.

- **TOL Bypass**

When DI is defined as ‘TOL Bypass’, the input is used to decide when to activate or deactivate ‘TOL Bypass Function’.

TOL bypass function is the function that allow TOL tripping level rise temporarily to 200% when it is activated. That is, when TOL bypass function is activated, a motor is allowed to continue running until thermal capacity level reaches 200% without tripping on TOL and a motor tripped on TOL is allowed to be restarted immediately in case of emergency, regardless the thermal level.

To activate TOL bypass function, the parameter ‘TOL bypass” is required to be enabled. The operation of TOL bypass function is from a special "TOL Bypass " command either through local control signals (via digital input hard-wiring) or given by fieldbus.

If the command comes from local control DIs, depending on the DI setting, a continuous "0" or "1" activate the TOL bypass function. A reserve signal de- activate the function.

If the command comes from PROFIBUS, a continuous "1" from PROFIBUS activate the function until a '0" is received.

If the command comes from MODBUS, an "activate TOL bypass" command activate the function and a 'de-activate TOL bypass' command deactivate the function.

A sequence of activating and deactivating a TOL bypass function via DI is described as following,

- Select parameter ‘TOL bypass’ under TOL protection section if the motor is expected to be run exceeding 100% thermal level in case of emergency;
- Wire a ‘TOL bypass’ control switch to the DI and define the DI as ‘TOL bypass’;
- Switch on motor and run normally;
- In case of emergency, activate TOL bypass function through the DI and increase the TOL level;
- After the emergency situation, de-activate the function through DI to recover TOL protection.

TOL bypass function increases thermal capacity level and can cause equipment overheating and fire. The function must be limited to applications where temporarily thermal increase or immediate restart are vital.

- **MD control**

MD control is used to decide whether the control command from MD is active or not. When one of the digital inputs is assigned as MD control, the control authority of MD will not be changed via parameterization but depend on the input status of the DI. If the input status is active, motor can be controlled via MD and vice versa.

- **Digital Input Types**

—

Table 42 Operation character of digital inputs

Trigger mode	Contactor type	Function	Description
Edge triggering	NO, NC	Start1	If the input status is different than the setting, the function will be active.
		Start2	
		Stop*	
		Trip reset	
		PLC control1	
		PLC control2	
Level triggering	NO, NC	Process interlock1	If the input status is the same as the setting, the function will be active.
		Emergency stop	If the input status is different than the setting, the function will be active.
		Torque switch	
		Process interlock2	
		MD control	
		Test switch	
		External trip	
		Stop *	
		TOL Bypass	
		NOP	Only detects the input status.

* Stop input can be edge trigger type or level trigger type.

Followed functions only can be assigned once at a parameterization:
Limit1,Limit2, PLC control1, PLC control2, F_CA, F_CB, F_CC, Loc/R, Main switch status, MD control.

Digital outputs
The M101 range of products is equipped with one set of programmable digital outputs while the M102 range of products comes with two sets. These outputs can be assigned any of the following functions:

- **Energize on motor start delay:**
Provides a delayed energization of relay when motor is started.

- **De-energize on motor stop delay:**
Provides a delayed de-energization of relay when motor is stopped.

- **Fieldbus control:**
The relay can be energized or de-energized via the serial port.

- **DI9 status(only for 24VDC DIs):**
The relay will be energized while the DI9 switch is closed.

- **DI10 status(only for 24VDC DIs):**
The relay will be energized while the DI10 switch is closed.

- **DI11 status(only for 24VDC DIs):**
The relay will be energized while the DI11 switch is closed.

- **DI0 status(only for 110VAC or 240VAC DIs):**
The relay will be energized while the DI0 switch is closed.

- **DI1 status(only for 110VAC or 240VAC DIs):**
The relay will be energized while the DI1 switch is closed.

- **DI2 status(only for 110VAC or 240VAC DIs):**
The relay will be energized while the DI2 switch is closed.

- **Trips:**
This is a general trip indication function which include the trips initiated across different motor states, i.e. motor running, stopped and at fault. The relay is activated when a trip occurs while motor is running. The relay is also activated to the faults which are detected during motor stopped, e.g. undervoltage happens while motor is stopped or an external trip (through DI) which is received during motor stopped. The relay remains activated while motor is at fault and will not recovered until the trip source is removed. The relay is configurable as energized type or de-energized type.

- **Specific trip function:**
The output can be assigned with specific trip function including TOL, Earth fault trip, Stalled rotor trip, Phase failure trip. Phase unbalance trip, Under-load trip, No-load trip, PTC trip, Under-voltage trip, Start limitation trip, Long start trip, Phase sequence trip.

- **Alarms:**
This is a general alarm function. The relay is energized or de-energized whenever an alarm occurs.

- **Specific alarm function:**
The output can be assigned with specific alarm function including TOL, Earth fault alarm, over-load alarm, Phase failure alarm. Phase unbalance alarm, Under-load alarm, No-load Alarm, PTC alarm, PTC short circuit alarm, PTC open circuit alarm, Under-voltage alarm, Start limitation alarm, Under-voltage alarm, Auto-reclose alarm.

- **Watchdog output:**
M10x has an internal hardware watchdog supervising the behavior of the microprocessor software. Digital output can be used as signaling output relay for indicating the status of the unit's internal watchdog.

- **Communication failure:**
When a failure occurs, the relay can be set to energized or de-energized via parameterization.

- **Contactor welded:**
When contactor welded occurs, the relay can be set to energized or de- energized via parameterization.

- **RCU mode (M101 only):**
This definition is assigned to the programmable output when NR DOL/RCU, REV DOL/RCU or contactor feeder/RCU is selected as the motor start mode. The relay output serves the same function of de-energizing the contactor coil as CCC output in M102.

- **Local_remote output:**
The relay is energized when the control authority is remote only. The relay will be de-energized when the control authority is local.

- **Ready to start:**
The relay will energized when the module is not at fault, not running and ready for a start.

08. Maintenance

M10x provides maintenance for the motor by supervising running hours and start numbers.

Functionality of maintenance functions is based on the parameters given by user. Functions operate independently so that maintenance functions can be active and alarms can be given at the same time.

Number of starts
M10x counts number of starts. For each operation cycle, M10x updates the number of operating cycles in a memory map. When the start number alarm level is exceeded, M10x issues an alarm.

Motor running time
M10x counts motors running hours. When the running hours limit is crossed, M10x issues a “running time” alarm.

Insertion cycles supervision
M10x gets the value of insertion cycles via counting control power cycles. When times of Insertion cycles exceeds alarm level, M10x issues an alarm.

M10x also provides other maintenance information on the motor to expedite user reporting.

Number of trips
M10x counts number of trips and updates them in a memory map.

Parameter change counter
M10x counts times of parameter change and updates them in a memory map.

SOE
M102 provides event recorder data for up to 256 events with time stamp.

09. Metering and monitoring

Metering, Monitoring and Reporting functions
M10x provides an extensive range of motor operation supervisory functions. Supervisory data are transmitted via the fieldbus to the upper level system for centralized management and are optionally directly displayed on the operator panel MD21 if installed on the front of the motor starter module.

Table 43 Monitoring and metering by M10x

Metering and monitoring	M101	M102
Power information		
Current L1,L2,L3 (A)	√	√
Current L1,L2,L3 (%)1	√	√
Current unbalance (%)2	√	√
Thermal capacity (%)	√	√
Power factor	-	√
Line voltages (V)	-	√
Frequency (Hz)	-	√
Earth fault current (A)	√	√
Active power (kW)	-	√
Apparent power (kVA)	-	√
Energy (kWh)	-	√
Thermistor resistor (ohm)	-	√
Time to TOL trip	√	√
Time to TOL reset	√	√
Actual startup time	√	√
Motor status		
Motor status	√	√
DI status	√	√
Diagnosis		
Alarm/trip for each function	√	√
Maintenance		
Motor running hours	√	√
Motor stop time	√	√
Number of starts	√	√
Number of trips	√	√
Number of insertion cycles	√	√
Parameter change counter	√	√
Pre trip phase A/B/C current	√	√
Pre trip earth fault current	√	√
SOE		√

1) Current% measured current compares with nominal current. For example, Current% of L1 = I_{L1} / In*100%

2) Current unbalance measured the maximum difference between current and average current with average current. The formula is : Iave=(I_{L1}+I_{L2}+I_{L3})/3

   Current Unbalance = max I_{L1}- I_{ave} , I_{L2}- I_{ave} , I_{L3}- I_{ave})/ I_{ave} *100%

3) If phase current measured is below 5% of nominal current, 0 amp is displayed.

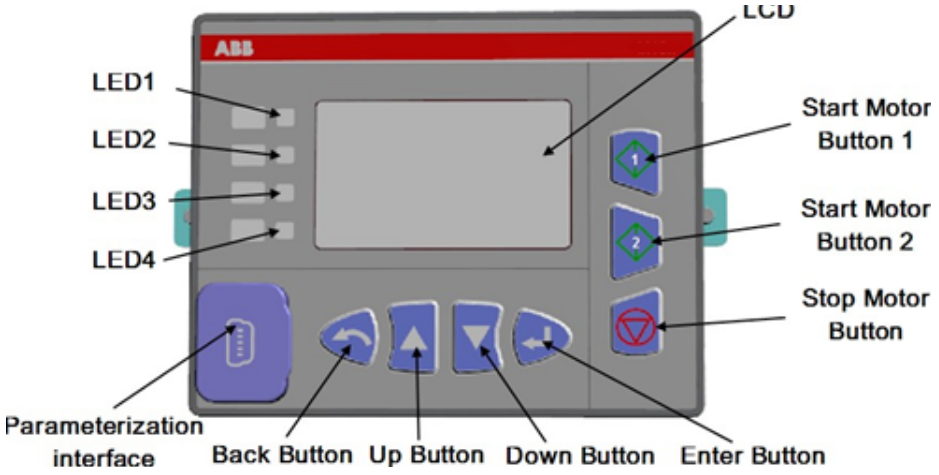
4) Power factor measurement in M102 is based on phase A (L1). Some monitoring parameters, such as active power, apparent power, energy, are calculated based on the measurement.

MD21/MD31 operator panel

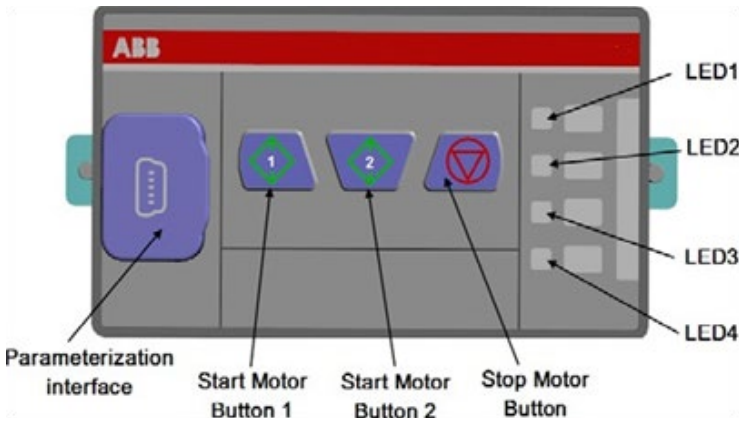
Overview

M10x devices provide operator panels as optional accessories for local operation and setting parameters for individual motor starters. There are two types of operator panels available: MD21 and MD31. MD21 is equipped with control buttons, LED indicators and LCD display. MD31 is more compact in size with control buttons and LED indicators only. Both operator panel types are equipped with communication port (mini USB connector) in the front for remote parameterizing via engineering station.

The operator panel is connected to the main M10x device via RJ11 interface (RS485 port), located on the back of the panel.



—
46 MD21 operator panel



—
47 MD31 operator panel

LED indicators

Four sets of LEDs are available on the front of the MDx panel. LED1 is a single green color, while the other three are dual colors. All four sets are configurable with the functions listed below:

—

Table 44 LED configuration

LEDs	Configurable color	Configurable functions
LED1		Ready(default), Running, Stop, Fault, Ready to Start, Start1, Start2, DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9iii, DI10iii, DI11iii, DI12iii
LED2	(default)	Ready, Running, Stop, Fault, Ready to Start, Start1(default), Start2, DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9iii, DI10iii, DI11iii, DI12iii
LED3	(default)	Ready, Running, Stop, Fault, Ready to Start, Start1, Start2(default) , DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9iii, DI10iii, DI11iii, DI12iii
LED4	(default)	Ready, Running, Stop, Fault(default), Ready to Start, Start1, Start2, DI0, DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8, DI9iii, DI10iii, DI11iii, DI12iii

—

Table 45-1 LED indicator function definition

LED functions	Meaning of the function
Ready	M10x unit is powered up and ready for operation
Start1	Motor is running CW/N1
Start2	Motor is running CCW/N2
Running	Motor is running CW/N1 or CCW/N2 or feeder is closed
Stop	Motor is stopped or feeder is open
Ready to Start	Motor is ready to start, ie, there is no active internal or external trip, motor is not under emergency stop state (if defined) and Main Switch is ON (if defined) or TEST position (if defined)
Fault	Motor is in fault
DIx iii	The status of DIx

—

Table 45-2 LED indicator message

LED Status	Explanation
On	Assigned function is activated
Wink	Alarm active or device is initializing
Off	Inactive or off power *ii)

(i) If MDx is under parameterization with parametering cable plugged in or scrolling through setting menus, all LEDs in the front panel wink at the same time.

(ii) DI9~DI12 are only active for M10x 24VDC type.

(iii) Additional label of LED should be prepared, if LED is not assigned to default function.

Control buttons

MD21 provides 7 buttons and MD31 provides 3. User can control motor via buttons on MD21 and MD31. User can also control motor, monitor and pa-rameterize via buttons on MD21.

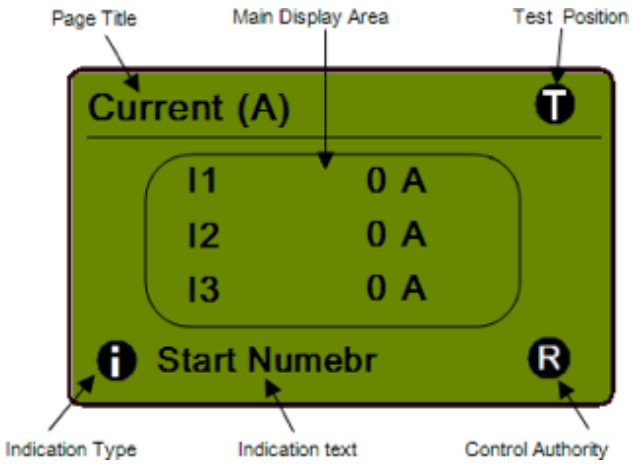
—

Table 46 MD21/31 Button Icons

Button	Function	Remark
	Start 1 button, to start motor CW/N1	
	Start 2 button, to start motor CCW/N2	
	Stop button, to stop motor	Also used to reset fault trip
	Enter button, to enter selected menu	Only in MD21
	Down button, to show next messages or menus	Only in MD21
	Up button, to show past messages or menus	Only in MD21
	Back button, to exit selected menu or go back one step.	Only in MD21

Monitoring value display

After power on, MD21 initially enters monitoring values display stage, during which all values, alarms, trips and control authority can be displayed.



—

48 View of monitoring value display windowl

- Page title: At the top of the LCD to show the tag name.
- Main display area: Main display area to display process data.
- Indication type: At the left side of the bottom of the LCD to show the type of the indication (alarm/trip).
- Indication text: Following Indication type to show the detail alarm/trip message
- Control authority: show control access

Table 47 Description of icons displayed on MD21

Icon	Meaning
	Alarm
	Trip
	Local control is active
	Remote control is active
	Test Position On
	01, highlighted, DI1* status is closed
	02, not highlighted, DI2* status is open

The number stands for the port of DI. Status of each DI is available on MD21.

Displaying parameters

MD21 supports up to 13 running parameter windows/pages. Users are free to choose any or all of the parameters to be shown on MD panel and mask out unwanted information.

User can navigate through displaying pages by pressing up or down button.

Page no.	Page title	M101	M102
1	Current (A)	√	√
2	Current (%)	√	√
3	Line Voltage	-	√
4	Power related (include power, apparent power, power factor)	-	√
5	Thermal capacity	√	√
6	Frequency	-	√
7	Energy	-	√
8	Ground current	√	√
9	PTC	-	√
10	Time to TOL trip/reset	√	√
11	DI status	√	√
12	Startup time	√	√
13	Current unbalance	√	√

i) Enter button is NOT active when scrolling through running parameter windows.
ii) Table 48 shows the actual sequence of displaying pages on MD21.

Alarm message
Alarm message will come up on the bottom of the display window as shown in Fig. 48 with indication icon whenever an alarm is active. Possible alarm messages include the following:

TOL	Insert cycle	Phase failure
Phase unbalance	Underload	Noload
Earth fault	PTC *	Undervoltage *
Autoreclose *	Feedback	Welded contactor
PTC short circuit*	PTC open circuit*	Start limitation
Serial communication	Running time	Start number
Watchdog	Ready to trip reset	DI
Insert cycle		

*** M102 only.**
Follow section“fault messages and trouble shoot” for the explanation of individual message and suggested trouble shoot.

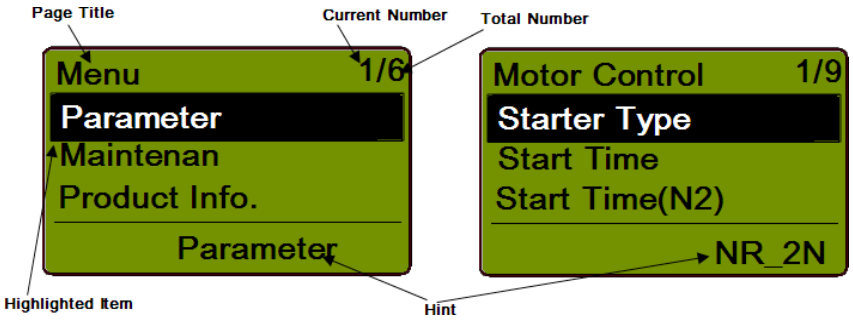
Trip message
Trip message will come up on the bottom of the display window as shown in Fig. 48 with indication icon whenever a trip is active. Possible trip messages include the following,

TOL	Stalled rotor	Phase failure
Phase unbalance	Underload	Noload
Earth fault	PTC *	Undervoltage *
Feedback	Serial communication failure	Start limitation
Feeder trip	Long start	Emergency stop
External trip	DI	Current feedback
Main switch off	Phase sequence	

Follow Follow section“fault messages and trouble shoot” for the explanation of individual message and suggested trouble shoot.

***M102 only.**
“Trips” function is not only the indicator after a motor is tripped but also indicate that a mo-tor is ready to trip before tripping or during motor stopped. e.g. an undervoltage or external trip (via DI) can activate the ‘Trips’ function while the motor is stopped.

The menu trees
Press the back button at monitoring value display window to enter the main configuration menu.



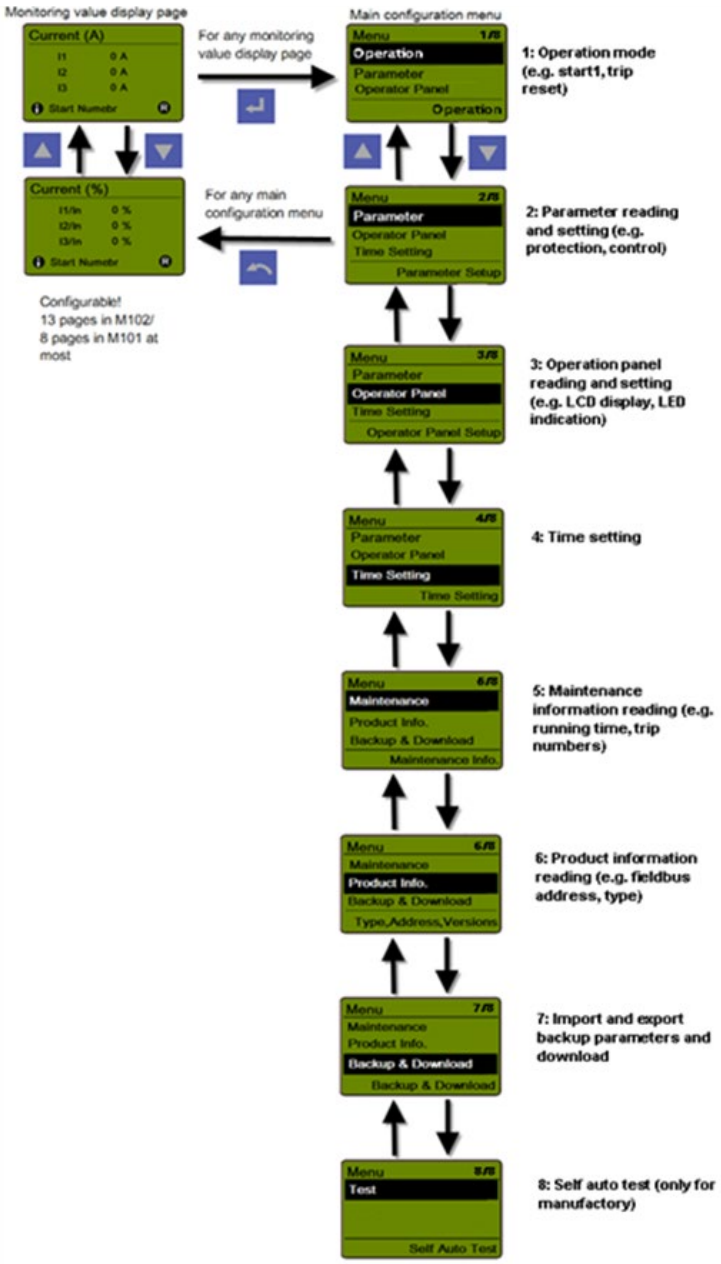
—
49 View of menu

Press the back button at the main configuration menu to enter running parameter window.

- Page title: At the top of the LCD to show the tag name or submenu table.
- Highlighted item: The current active menu item.
- Current number: At the right of the top of the LCD to show the number of the current selected menu item.
- Total number: At the right of the top of the LCD to show total menu item numbers in the current page.
- Hints: At the bottom of the LCD to describe the current highlighted item or the related value of the highlighted item.

Press up/down button, can move the highlight to previous/next items. Press enter button to enter next level of menu.

Press back button to go back to previous level of menu.



50 View of main configuration menu tree

Password protection from MD panel
Password protection can be activated on MD21 panel to avoid unauthorized operations from switch-board front.

The operations which can be password protected include start, stop, trip reset, alarms. The password protection may also be activated for acknowledging trip messages only when necessary.

Only one set of password is required for all operations and parameter settings/changes. The password should be reset and managed by the end users according to individual plant management policy. The initiate password is "1111".

1) Password protection function is related to the operations via MD21 panel only! In case op-erations are from hardwiring or fieldbus, they are not bonded by this feature.

Activate password protection function:

Pressing  button > Select 'Operator panel'>

'StartPwOn' – select 'On' to turn on password for 'start' control

"StopPwOn'- select 'On' to turn on password for 'stop'control

"TripAlarmPwOn'- select 'On' to turn on password for 'trip reset' and acknowledging alarm/trip mes-sages.

Operating Start/stop with password
Option 1: Press start1/2/stop button, MD21 will prompt up password window. Once the correct pass-word is entered, press again 'start1/2/stop" to initiate the operation. Fail to press 'start1/2/ stop' but-ton within 30 seconds after entering the password will bring up password window again.
Option 2: Go to the main menu and select "Operation "Select desired operation from the list.

If motor is tripped, start/stop command will be latched. That means password window will not prompt up when start/stop command is given via MD21.

Operating Trip Reset with password
Step 1: Activate 'TripAlarmPwOn' on MD21.
Step 2: Select trip reset mode parameter as 'local' or 'local &remote' via MD21 panel

If reset mode is set to 'remote', trip reset with password is not available.

Step 3: When motor trips, trip message comes up on MD21, "fault' LED switches ON. There are two possibilities to reset the trip message:
a) Press stop button, then "reset trip?" message comes up.
b) Press back button to enter setting menu. Select 'Operations' > 'Reset Trip' to enter "reset trip?" window.
Step 4: Press enter button at 'reset trip?' window.
Step 5: Enter the password. If password is correct, M10x will execute trip reset command. If password is wrong, MD21 will go back to "reset trip?" message following 'Invalid password' message.

If the cause of trip is removed, trip will be reset. If the cause of trip persists, 'Remove the cause before reset' message comes up with no further response. It goes back to trip message win-dow after 3s.

In case that 'TripAlarmPwOn function' is activated, password input is always needed for every trip reset function

Acknowledge Alarm message with/without password
When there is an alarm, alarm message comes up on MD21, "fault' LED flashing. The alarm message displayed is a real time message and disappear when the cause of the alarm is removed. Users may refer to SOE list for history alarms.

When an alarm or multiple alarms are present but not critical to the process, it is also possible to sup-press the alarms temporally after acknowledging the alarm with or without password protection. Once the alarm is acknowledged, a '*" mark is removed from the message description while the message remains on the alarms list until the cause is removed. The LED stops flashing after all the alarms are acknowledged but remains ON after acknowledgement.

Acknowledge with password

Step 1: Activate 'TripAlarmPwOn' on MD21.

Step 2: Select 'Operations' > 'Alarm Acknowledge' to prompt a password window.

Step 3: Enter the password. If password is correct, all active alarms are listed. If password is wrong, MD21 will go back to previous menu following 'Invalid password' message.

Step 4: Select the alarm to be acknowledged via up/down button, then press enter button to acknowledge the message.

Acknowledge without password

Skip step 1 above and select 'Alarm Acknowledge' will display active alarms without asking for password. Then carry on from Step4.

Operation

Within this submenu, start/stop can be triggered, trip can be reset, and alarm can be acknowledged. Below table shows the organization of the different parameter masks in the menu tree.

—

Table 48 Menu tree of operation

Level 1	Level 2
Operation	Trip Reset
	Alarm Acknowledge
	Start1
	Start2
	Stop

Parameter

Within this submenu, all motor related parameters can be configured. Table 49 shows the organization of the different parameter masks in the menu tree.

For more details about parameters, please refer to the document: M10x parameter descrip-tion.

—
Table 49 Menu tree of parameter

Level 1	Level 2	Level 3	Level 4	Level 5
Parameter	Protection	TOL[2]		Function
				Disabled duration stop[9]
				Reset mode[9]
				Thermal mode[9]
				TOL bypass[9+10]
				T6[9+10]
				Cool coe.[9]
				Te[9+11]
				Ia/In[9+11]
				Alarm level[9]
				Trip level[9]
				Reset level[9]
				Ambient temperature[9]
		Stall[2]		Function
				Reset mode[9]
				Trip level[9]
				Trip delay[9]
		Phase failure[2]		Function
				Reset mode[9]
				Alarm level9+12
				Trip level[9]
				Trip delay[9]
		Unbalance[2]		Function
				Reset mode[9]
				Alarm level[9+12]
				Trip level[9]
				Trip delay[9]
		Underload[2]		Function
				Reset mode[9]
				Alarm level[9+12]
				Trip level[9]
				Trip delay[9]
		Long stop[2]		Function
				Reset mode[9]
				Alarm level[9+12]
				Trip level[9]
				Trip delay[9]
		Earth fault		Function
				Enabled duration stop[9+12]
				Reset mode[9]
				Alarm level[9+12]
				Trip level[9]
				Trip delay[9]

Level 1	Level 2	Level 3	Level 4	Level 5
Parameter[1]	Protection	PTC[2+3]		Function
				Reset mode[9]
				Alarm level9[+12]
				Trip level[9]
				Trip delay[9]
				Reset level[9]
				SC Alarm level[9+12]
		UV&AR[2+3]		Function
				Reset mode[9]
			Autorestop[9]	Function
				Mode[9]
				MAT[9]
				MPDT[9]
				Delay[9]
				Alarm level[9+12]
				Trip level[9]
				Trip delay[9]
				Reset level[9]
		Stop limit		Function
				Mode[9]
				Interval[9]
				Stop number[9]
		Long stop[2]		Function
				Reset mode[9]
				Rotor level[9]
				Rotor delay[9]
		Phase Sequence		Function
				Reset Mode[9]
		Motor Control		Stoper type
				Stop time[14]
				Stop time (N2)[6]
				Change over[15]
				Ramp up[16]
				Ramp down[16]
				Earth fault primary[17]
				Internal CT
				Communication failure delay
				Fail safe[18]
				Feedback
				Feedback timeout[7]
				Soft test switch
				External CT used
				External CT1 primary[20]
				External CT2 primary[20+6]

Level 1	Level 2	Level 3	Level 4	Level 5
Parameter[1]	Control	Motor Control	External CT secondary[20]	
		Control authority	Profibus option[19]	Auto mode active
		Soft local/ remote[19]	Soft local/ remote[19]	L hardwiring
				R fieldbus
		MD control[19]	MD control[19]	MD operator panel
				MD in local
				MD in remote
				MD in auto Mode[0]
				MD in auto Mode[1]
		Grouping	Function	
			Direction[9]	
			Group number[9]	
			Stop delay[9]	
			Stop delay[9]	
	Communication	MODBUSRTU[4]	Address	
			Parity	
			Redundancy	
			Baud rate	
		PROFIBUSDPV[15]	Address	
			Mode	
			Block DP	
	Motor info		Motor type	
			Voltage[3]	
			Frequency	
			Rated power	
			In	
			In (N2)[6]	
	DI		Type	
		DI0 ~DI12 (24VDC) or DI0-DI8 (110V or 240VAC)	Function	
			Contact type	
			Delay[21]	
			Operation[22]	
	DO	DO[1]	Function	
			Delay	
			Principle	
		DO[23]	Function	
			Delay	
			Principle	
	Maintenance	Running hour	Function	
			Alarm level[9]	
		Stop number	Function	
			Alarm Level[9]	

Note:
Items with marks will only display when they meet corresponding conditions shown below.

1: MD21 is connected with M10x.
2: Stoper type is NOT set to be Feeder.
3: MD21 is connected to M102.
4: MD21 is connected to M10x-M.
5: MD21 is connected to M10x-P.
6: Stoper type is set to be NR_2N|NR_2N Dahlander.
7: Feedback function set as "Enabled".
8: Backup parameter has ever been performed at least once.
9: Related Function is set to be On.
10: TOL Thermal mode is set to be Standard.
11: TOL Thermal mode is set to be EExe.
12: Related Function is set to be Alarm only.
13: MD21 is connected to M101.
14: Stoper type is NOT set to be NR_softstoper|REV_softstoper.
15: Stoper type is set to be NR_S_ D|NR_2N| Dahlander|Autotransformer.
16: Stoper type is set to be NR_softstoper| REV_softstoper.
17: Earth fault Function is set to be “On|Alarm only.
18: “Comm. F Delay” is NOT set to be “255”.
19: Details refer to Control Authority chapter.
20: Ex CT Used is set to be Yes.

Operator panel
Within this submenu, LCD display and LED indication can be configured. Table 50 shows the organiza-tion of the different parameter masks in the menu tree.

For more details about parameters, please refer to the document: M10x Parameter Description.

*** M102 only.**

Table 50 Menu tree of operator panel

Level 1	Level 3	Level 2	Level 4
Operation	LCD display	Current (A)	
		Current (%)	
		Line voltage[1]	
		Power related[1]	
		Thermal capacity	
		Frequency[1]	
		Energy[1]	
		Ground current	
		PTC[1]	
		Time to TOL trip/reset	
		DI status	
		Stopup time	
		Current unbalance	
	LED indication	LED1	Function
			Color
		LED2	Function
			Color
		LED3	Function
			Color
		LED4	Function
			Color
	Language		
	TripAlarmPwOn		
	StopPwOn		
	StopPwOn		
	Password setup		

Time setting
Within this submenu, actual time can be configured. Table 51 shows the organization of the different parameter masks in the menu tree.

—
Table 51 Menu tree of time setting

Level 1	Level 2
Time setting	Year
	Month
	Day
	Hour
	Minute
	Second
	Week

Maintenance
Within this submenu, all motor related maintenance can be configured. Table 52 shows the organization of the different parameter masks in the menu tree.

—
Table 52 Menu tree of maintenance

Level 1	Level 2
Maintenance	SOE*
	Running time
	Start time
	Stop number
	Stop number
	Trip number
	Last trip current(%)
	Last trip current(A)
	Last trip EF current
	Insertion cycle
	Parameter change counter

*** M102 only.**

Product information
Within this submenu, information of M10x and MD21 can be read. Table 53 shows the organization of the different parameter masks in the menu tree.

Table 53 Menu tree of product information

Level 1	Level 2
Product information	Fieldbus address
	Type of M10x
	Firm version of M10x
	Firm version of MD

Backup and download
The backup feature is for reading parameters from the M10x device and creating a backup file in the MD panel. The download feature is for downloading backup files from MD panel to M10x device.

This feature is easy to operate onsite, and is quite useful when similar parameters are required for sev-eral M10x devices.

Table 54 shows the organization of the different parameter masks in the menu tree.

Table 54 Menu tree of backup and download

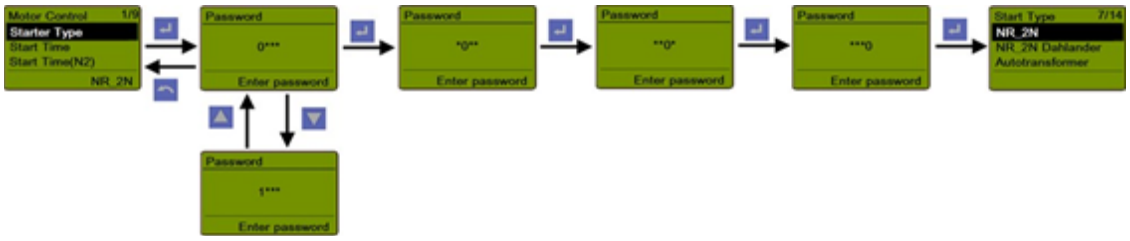
Level 1	Level 2
Backup and download	Backup parameter
	Download backup1

1) The download backup option is not available until the backup parameter function has been executed.
2) Remember to change slave address after copying parameters from other devices to avoid communication problems.

Backup parameter: Saves current parameter to backup register in MD21. Download backup: Downloads the parameter in backup register into M10x.

Test
Select this submenu, M10x will conduct a self-diagnosis to health check hardware circuits, firmware programs and operation functions.

Adjusting parameters
Select the item at the last parameter level and press enter. A password window will appear. Input the correct password to enter the parameter adjusting window.



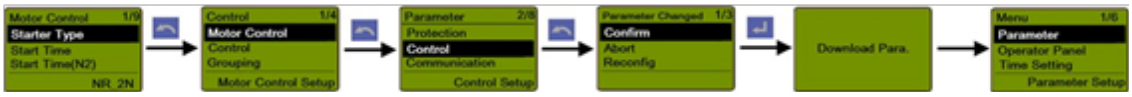
—
51 Process of entering parameter adjusting window

Default password is 1111.

It is recommended to change the default password after first login.

There are two types of parameter adjusting window: numerical value adjusting, and option selecting.

When finished, press the back button to return to the confirmation window. Select confirm and press enter to download the new parameter to the M10x.



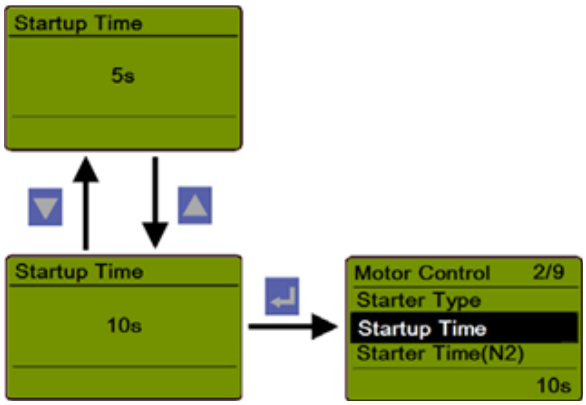
—
52-1 Confirm parameter adjustment

The slave address can be revised and downloaded to M10x via MD21.

Adjust a numerical value
This type of window allows a numerical value to be specified within given limits. Pressing up/ down buttons will increase/decrease the digit. Once the value is set, press enter to acknowledge.

i) The information of given limits of parameters is provided in the document: M10x Parameter Description.
ii) Continuing to press the up/down button to change the speed of increase/decrease.
iii) When the value reaches the limit, it will automatically count backwards even if the same button is pressed.

The following example shows how to set the stopup time to 10sec:



—
52-2 Example of numerical value adjusting

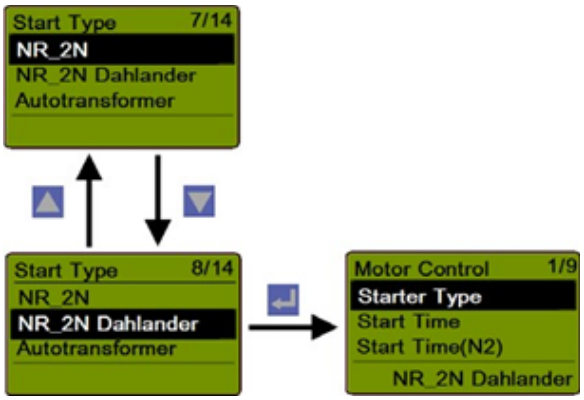
Stop editing the value by pressing the up button. When it reaches 10, press enter.

Select an option from a list
This type of window allows an item to be selected from a given list of options. With the up/down keys you can scroll through the list. The highlighted selection shows current position within the list. Press enter to confirm, then press back to exit.

Pressing the back button exits the dialog and discards the selection.

i) The details of given options of parameters can be found in the document: M10x Parameter Description.

The following example shows how to set the starter type as NR_2N Dahlander:



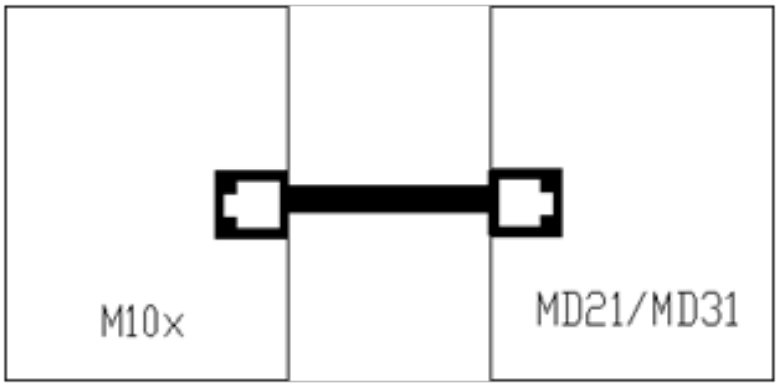
—
53 Example of options selecting

Parameterization port
The parameterization port on MD panel is a mini USB type of interface. Once this port is connected with parametering cable, the communication between M10x main device and MD panel is temporarily stopped with a parameterizing status message shown on LCD. No operation is allowed during parame-terizing.

M10x parameters can be uploaded and downloaded from the parameterization device via the interface.

Remember to cover up the mini USB port after parameterization is finished.

Connection
Operator panel is connected to the X2 terminal on M10x via RJ11 interface. The connection shown below includes power supply and communication.



—
54-1 Connection between M10x and MDx

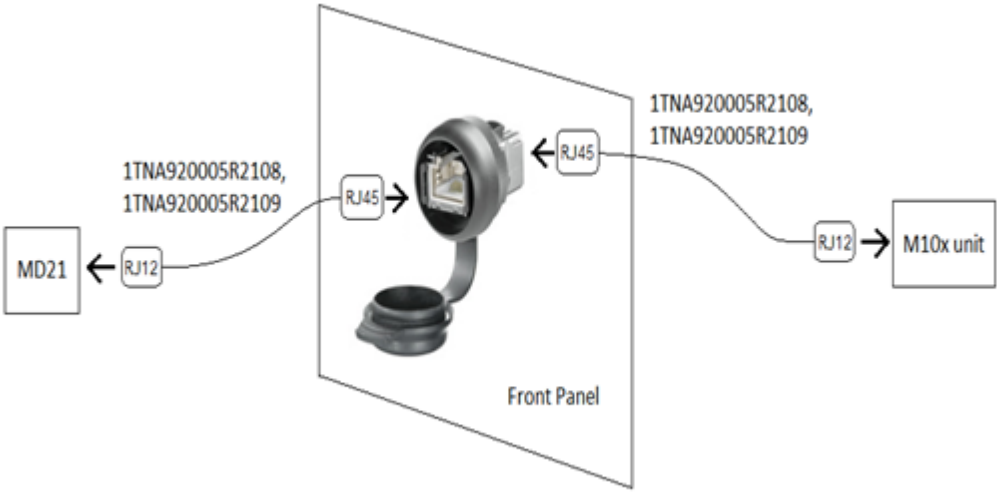
Remember to cover up the mini USB port after parameterization is finished.

If MD21 cannot receive information from M10x, a No Comm. message will appear on the LCD display.

If MD21 receives incorrect information from M10x, a comm. Error message will appear on the LCD display.

MDx adaptor
MDx adaptor is the adaptor kit which is designed to connect M10x main unit to an external MDx control panel. MDx adaptor kit include a compact IP65 socket which is to be installed on the front panel of the each starter and a couple of connection cables. The connection between M10x and MDx is shown in Fig50-2. Details of ordering, please refer to M10x ordering guide.

The connection between M10x and MDx is shown in Fig50-2.



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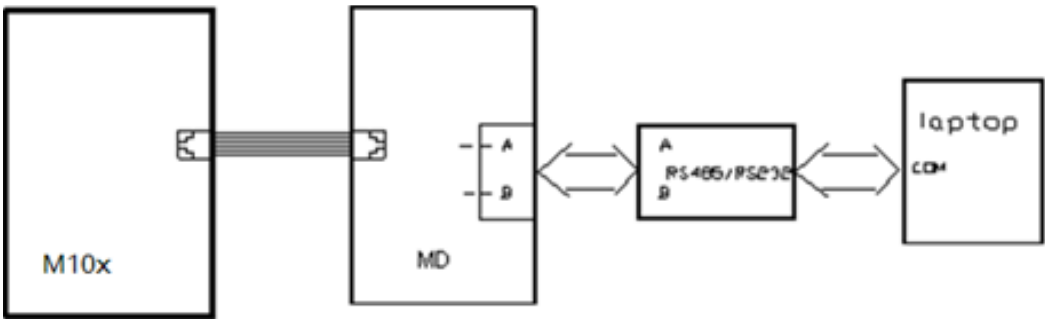
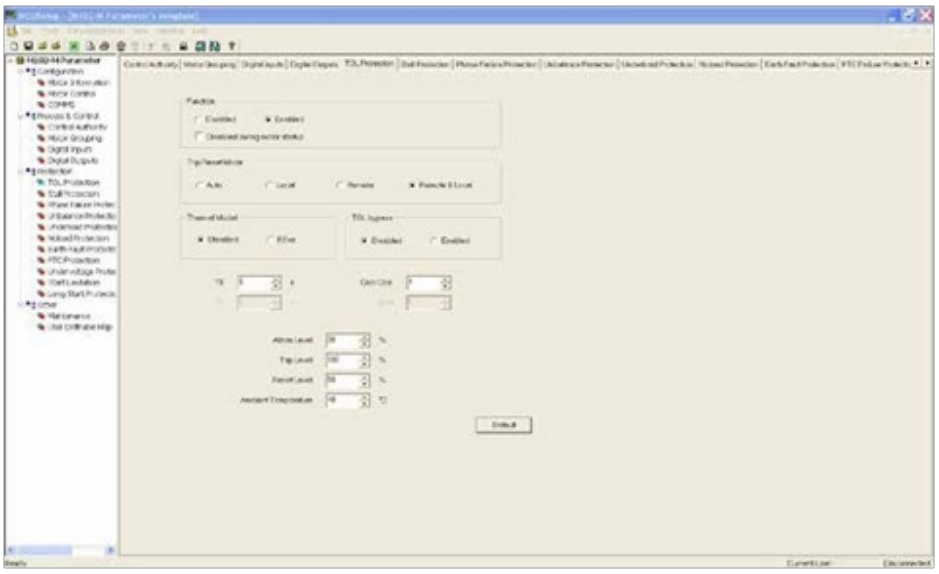
54-2 Connection between M10x and MDx

Parameterization software: MCUSetup
MCUSetup software is used to set parameters. It exchanges data with M10x via RS485.



—
55 Parameterization interface



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56 MCUSetup window

The parameterization software includes the following functions:

- Edit parameters
- Export parameter to a file
- Import parameter from a file
- Update M10x's parameters
- Download M10x's parameters
- Read M10x's parameters
- User management

The parameterization software can run on all of the following PC operation systems: Windows 2000, Windows XP, Win 7 and Win 8 and Win10.

For more information on how to set parameters with MCUSetup software, please refer to separate document: MCUSetup User Guide.

10. Communication interface

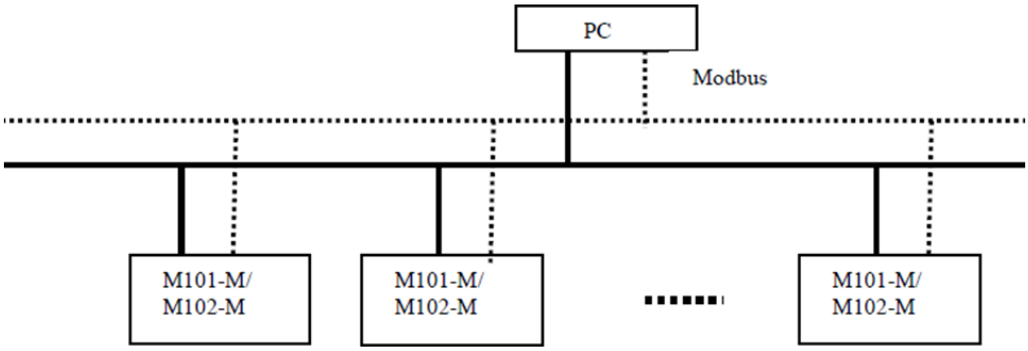
Overview
M10x supports three types of communication protocol: MODBUS RTU, PROFIBUS DP and MODBUS TCP.

MODBUS RTU
The physical fieldbus interface in M10x-M is RS485. There are two identical RS485 interfaces for redun-dant design. All functions are supported via RS485, eg, parameterization, control, supervisions, etc.

The M10x-M implements a subset of the Modicon MODBUS RTU serial communication standard. MODBUS is a single master/multiple slave type of protocol suitable for a multi-drop configuration as provided by RS485 hardware. The M10x-M is always a MODBUS slave, and cannot be programmed as a master. Commonly, computers or PLCs serve as masters.

Both monitoring and control are possible using read and write register commands. Other commands are supported to provide additional functions.

- **RS485 interface cable**
All devices are connected in bus structure. In one segment, up to 32 modules can be connected. At the beginning and the end of one segment, the cable is terminated with a resistor. The maximum length depends on cable type and baud rate.



—
57 Network connection of M10x-M

• **Function description**
The following functions are supported by the M10x-M:

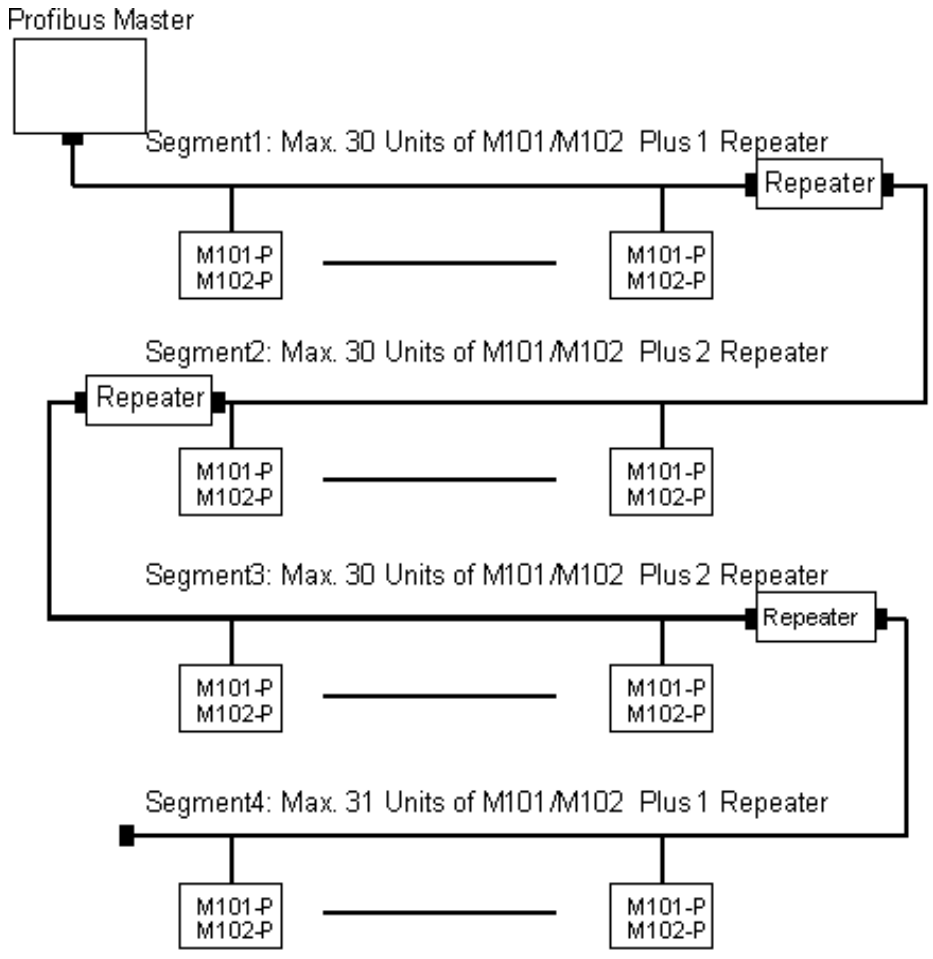
- FUNCTION CODE 02 - Read settings and actual values
- FUNCTION CODE 03 - Read settings and actual values
- FUNCTION CODE 04 - Read settings and actual values
- FUNCTION CODE 05 - Execute operation
- FUNCTION CODE 06 - Store single setting
- FUNCTION CODE 08 – Loop back test
- FUNCTION CODE 10 - Store multiple settings

For more details on the M10x MODBUS, refer to M10x-M MODBUS Protocol Implementation.

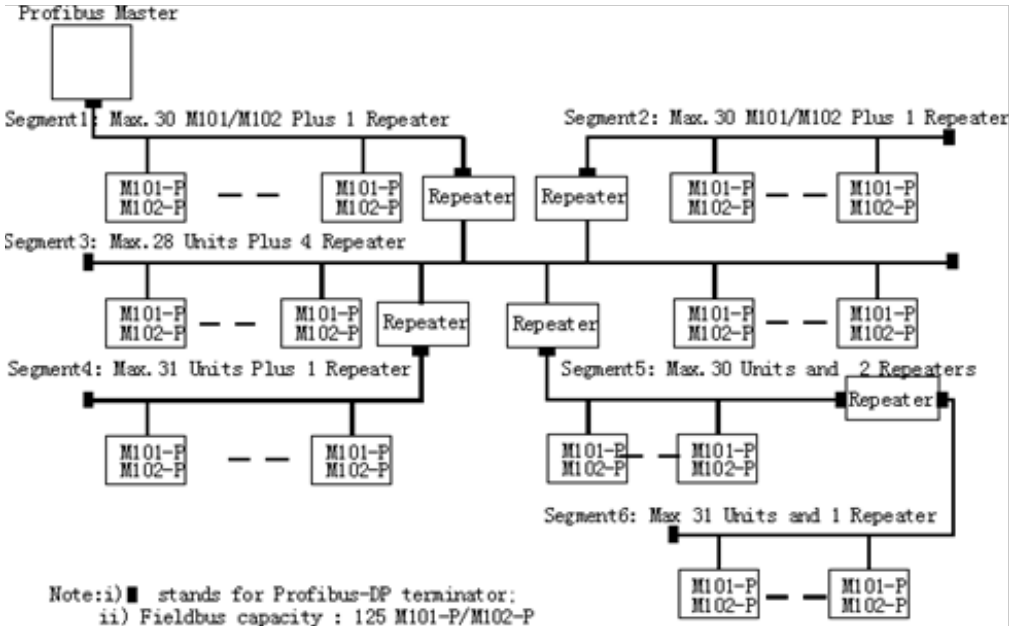
PROFIBUS DP
The M10x implements a subset of the PROFIBUS DPV1 serial communication standard. PROFIBUS is a multiple master/multiple slave type of protocol suitable for a multi-drop configuration as provided by RS485 hardware. M10x always acts as PROFIBUS-DP slave in the network. Usually, computers or PLCs act as masters in the network.

The physical interface used from the M10x is RS485. All functions are supported via RS485 interfaces, eg, parameterization, control, supervisions, etc.

Both bus network and tree network are supported by M10x PROFIBUS installation. Two network types are illustrated below:



—
58-1 Bus (line) network



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58-2 Tree network

• **PROFIBUS interface wiring**
All devices are connected in bus structure or tree structure. Up to 32 nodes can be connected in one segment. The cable is terminated with a resistor at both ends of each segment. The maximum length of the cable depends on cable type and baud rate.

For more detailed information, please consult with PROFIBUS organization or the manufacturer.

• **PROFIBUS DP description**
PROFIBUS-DP is a distributed I/O system that enables the master to use a large number of peripheral modules and field devices. The data transfer is mainly cyclic: the master reads the input information from the slaves and sends the output information back to the slaves. PROFIBUS-DPV1 is an extension of the DP protocol. Additionally, it allows the acyclic exchange of data between master station and slave station.

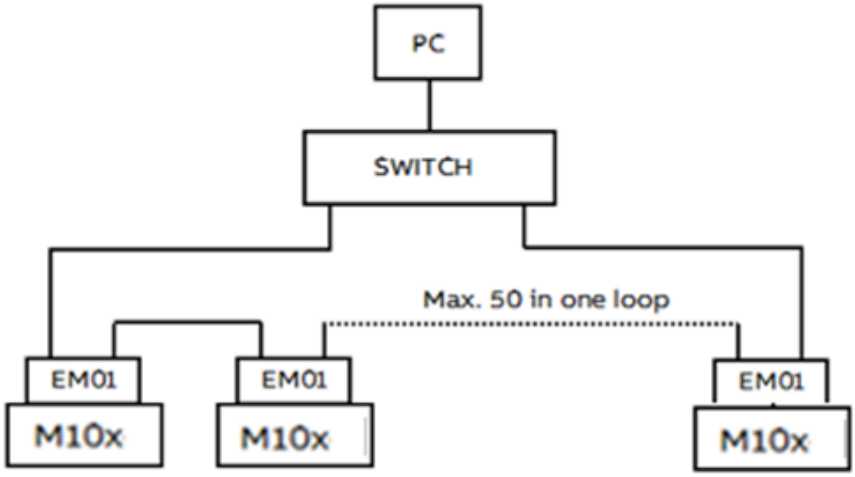
The services of the PROFIBUS data link layer (Layer 2) are used by PROFIBUS-DP through service access Points (SAPs). Precisely defined functions are assigned to individual SAPs. For further information on SAPs, refer to the PROFIBUS master manual.

The following SAPs are supported by the M10x:
- SAP47 – acyclic read/write of MSAC_C2, abort
- SAP48 – acyclic read/write of MSAC_C2, abort
- SAP49 – initiate req of MSAC_C2
- SAP51 – acyclical read/write of MSAC_C1
- SAP56 – read input
- SAP57 – read output
- SAP58 – global control command
- SAP59 – read configuration data
- SAP60 – read diagnosis data
- SAP61 – initial parameters
- SAP62 – check the configuration data

For more information on PROFIBUS implementation in M10x, please refer to M10x-P PROFIBUS protocol implementation.

MODBUS TCP
The M10xis connected to Modbus TCP network via its ethenet interface EM01. Following figure illus-trates to the M10x Ethernet network with EM01 interface

For detail information, please refer to EM01 User Guide.



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59 M10x connected to Ethernet network

- **Function Description**

The following functions are supported in EM01 Modbus/TCP Implementation:

- FUNCTION CODE 02H - Read Actual Values
- FUNCTION CODE 03H - Read Parameters and Actual Values
- FUNCTION CODE 04H - Read Parameters and Actual Values
- FUNCTION CODE 05H - Execute Operation
- FUNCTION CODE 06H - Store Single parameter
- FUNCTION CODE 10H - Store Multiple parameters

11. Paraterization

Overview
M10x relays can be configured with MD21 or MD31 operator panel keypad, via MCUSetup software, and through fieldbus if the communication network is available.

Parameterization via MD21
Most parameters can be set or changed through the MD21 operator panel keypad. For details of the parameters menu structure, please refer to the chapter: MD21/ MD31 Operator Panel.

Parameterization via MCUSetup software
Users can complete parameter settings by connecting a computer with installed MCUSetup software to MD21 or MD31 with a mini USB-pin physical interface.

Parameterization via fieldbus
M10x parameters are listed in the memory map. The user can parameterize M10x-M by MODBUS RTU protocol and M10x-P by DPV1 protocol. For detailed information, refer to the M10x-M MODBUS Protocol Implementation and M10x-P PROFIBUS Protocol Implementation.

M10x parameters
M10x Parameters are listed together with explanations, possible ranges and default values in a separate document: M10x Parameter Description.

12. Fault Messages and Trouble Shoots

Self-diagnosis feature
M10x has built in self-diagnosis program to actively health check the internal hardware circuits and software programs. The 'test' function through MD21 panel can also activate the health checking pro-gram on request.

- **Watchdog**

A hardware watchdog is designed to supervise the health checking program. In case any hardware or software failure is detected by the program, a reset is triggerred from the watchdog to restart the program. In the meantime, a watchdog alarm message is generated.

A watchdog alarm is a warning of one time health check failure. The cause of the faulure may be temporary due to external disturbance/EMC environment and may not necessarily be severe. However once a wathdog alarm message occurs, it is necessary to be closely monitored. If the wathdog alarm is trigger frequently, a follow-up service and maintainace shall be scheduled shortly..

In case of severe hardware or firmware failure, the relay will no longer be resettable and required to be replaced immediately.

The wathdog can be configured to one of the digital output relays and monitored through hardwiring.

- **Test**

Selecting TEST option under the main menu of MD21 panel activates a comprehensive helath checking of M10x and MD21 including hardware circuits, firmware programs and operation functions.

Fault messages and trouble shoots

Condition	Description	Possible Cause	Suggested Action
Thermal Capacity Alarm	Motor is about to be stopped. the motor thermal level reaches thermal capacity level alarm level	The motor is under thermal overload condition. Unacceptable heating-up of motor windings.	Check the process conditions:> If it is extereme starting conditions, high overload or intermittent operation; Check the motor condition:> Cooling problem, ambient temperature too high; mechnical problem; Check the thermal model relevant parameters: the Ie setting, T6 time and ambient temperature setting, the thermal level setting etc.
Overload Alarm	Motor is about to be stopped. The motor is in overload condition, i.e. measured current ILmax > 1.14 x TFLC (thermal full load current multiplier reduced by motor ambient temperature)	The motor is in overload condition	Check the process conditions; Check motor load; Check parameter settings.
Phase Failure Alarm	Motor is about to be stopped. The maximum imblance current of any phase reaches the phase failure alarm level.	Phase failure in motor phase currents generally occurs because of pitted contacts in the contactor or SCPD, imbalance in the mains supply, loose connections, blown fuse, and faults within the motor.	Check for blown fuse Check for pitted contacts in contactor or SCPD Check for loose connection on power supply Check the motor connection

Condition	Description	Possible Cause	Suggested Action
Phase unbalance Alarm	Motor is about to be stopped. The maximum imblance current of any phase reaches the unbalance alarm level.	phase unbalance in motor phase currents generally occurs because of pitted contacts in the contactor or SCPD, imbalance in the mains supply, loose connections, blown fuse, and faults within the motor.	Check for pitted contacts in contactor or SCPD Check for loose connection on power supply Check the motor connection
Underload Alarm	Motor is about to be stopped. The highest of the measured phase currents is below the alarm level.	Motor current is below the alarm setting; motor running idle, dry running pump, conveyer belt broken; fan with no air flow	Check motor load and motor / process conditions. Check parameter settings.
Noload Alarm	Motor is about to be stopped. The highest of the measured phase currents is below the alarm level.	Motor current is below the alarm setting; motor running idle, dry running pump, conveyer belt broken; fan with no air flow	Check motor load and motor process conditions. Check parameter settings.
Earth Fault Alarm	Motor is about to be stopped. Residual current for cable(s), motor and connection box above alarm level . Measured Earth Fault Current exceeds above the Alarm level	Insulation problems for cable(s), motor and connection box or reduced insulation strength due to extreme ambient conditions.	Check parameter settings. Check Earthing system. Check motor or connected load.
PTC Alarm *	Motor is about to be stopped. The resistance corresponding to the high temperature at one or more of the thermistors exceeds alarm level	Excessive temperature rise in the windings and reaches alarm level	Check motor evviroment and load condition
Undervoltage Alarm *	Motor is about to be stopped. The lowest of the measured voltages is below the alarm level.	Voltage dip below the alarm level	Check parameter settings. Check main supply
Autoreclose Alarm *	Motor is about to restart after the voltage dip	Voltage dip is measured and the autorestart function is active	N/A
Feedback Alarm	Motor is about to be stopped. Contactor feedback or current feeddback is not as expected.	Contactor feedback is not detected or the current is not measured during motor starting or running.	Check for loose connection of contactor feedback Check for contactor control Check motor load and motor process condition
Welded Contactor Alarm	Motor is stopped. Contactor feedback is not as expected.	Contactor welded fault	Check parameter settings.Check contactorsCheck motor
PTC short circuit *	The resistance of PTC input is lower than the alarm level	PTC short circuit	Check parameter settings. Check PTC wiring between motor and relay
PTC open circuit *	The resistance of PTC input exceeds 12kΩ	PTC open circuit	Check parameter settings. Check PTC wiring between motor and relay
Start limitation Alarm	Motor is about to be stopped and one more start is allowed	motor starts too frequent	Check parameter settings.
Serial Communication Alarm	Before the permitted time delay elapse, M10x considers loss of communication	communication interruption between m10x and upper control system	Check parameter settings. Check network interface
Running time Alarm	The Running timer exceeds the preset running time alarm level	This helps to lubricate and maintain the bearings of the motor within the correct service interval.	Check parameter settings. Check motor
Start number Alarm	The start counter exceeds the set value of cycles in preset start number alarm level	This help in carrying out preventive maintenance of power contacts.	Check parameter settings. Check contactors

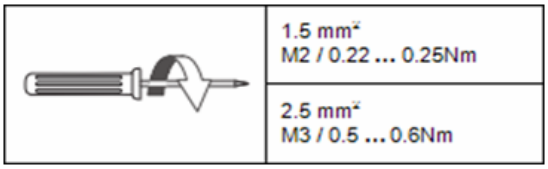
Condition	Description	Possible Cause	Suggested Action
DIx Alarm	Motor is about to stop if the DIx changes status from healthy to unhealthy during running ; Motor is prevented from starting if the DIx input is unhealthy.	The process interlock1 switch remain inactive on the occurrence of a motor start or the process interlock2 switch remain active when motor is in running.	Check DI settings on process interlock. Check DIx wirings
Watchdog Alarm	Internal hardware watchdog activated	Hardware fault or internal programme running fault (if it is a temporary fault, it is recoverable after power cyclying).	Check if it is recoverable (by cycling the power) Change hardware if it is not recoverable
No Comm	The communication between MDx display and M10x main unit is interrupted or M10x simply stops functioning.	Physical connection is damaged between MDx display and M10x. M10x is no longer in working mode.	Check if the cable connection is in good condition; Check if MDx or M10x relay is in working condition (by swapping with spares)
TOL Trip	Motor is stopped. The motor thermal level reaches thermal capacity trip level	The motor is under thermal overload condition. Unacceptable heating-up of motor windings.	Check the process conditions:> If it is extereme starting conditions, high overload or intermittent operation. Check the motor condition:> Cooling problem, ambient temperature too high; mechnical problem; Check the thermal model relevant parameters:> Check the Ie setting, T6 time and ambient temperature setting, the thermal level setting etc.
Stalled rotor Trip	Motor is stopped. The highest of the measured phase currents remains above the trip level for a trip delay time	The driven mechanical system from jams and excessive overloads	Check parameter settings. Check motor connected load and process condition.
Phase Failure Trip	Motor is stopped. the ratio between the lowest phase current to the highest phase current (ILMIN / ILMAX) from the measured currents of all three phases is below the trip level	Phase failure in motor phase currents generally occurs because of pitted contacts in the contactor or SCPD, imbalance in the mains supply, loose connections, blown fuse, and faults within the motor.	Check for blown fuse Check for pitted contacts in contactor or SCPD Check for loose connection on power supply Check the motor connection
Phase unbalance Trip	Motor is stopped. the ratio between the lowest phase current to the highest phase current (ILMIN / ILMAX) from the measured currents of all three phases is below the trip level.	Phase failure in motor phase currents generally occurs because of pitted contacts in the contactor or SCPD, imbalance in the mains supply, loose connections, blown fuse, and faults within the motor.	Check for blown fuse Check for pitted contacts in contactor or SCPD Check for loose connection on power supply Check the motor connection
Underload Trip	Motor is stopped.The highest of the measured phase currents is below the trip level.	Motor current is below the alarm setting; motor running idle, dry running pump, conveyer beltbroken; fan with no air flow	Check motor load and motor / process conditions. Check parameter settings.
Noload Trip	Motor is stopped. The highest of the measured phase currents is below the trip level.	Motor current is below the alarm setting; motor running idle, dry running pump, conveyer belt broken; fan with no air flow	Check motor load and motor process conditions. Check parameter settings.
Earth fault Trip	Motor is stopped. Residual current for cable(s), motor and connection box above trip level.	Insulation problems for cable(s), motor and connection box or reduced insulation strength due to extreme ambient conditions. Consider whether starpoint of IT-networks may have moved.	Check parameter settings. Check Earthing system. Check motor or connected load.
PTC Trip *	Motor is stopped. The resistance corresponding to the high temperature at one or more of the thermistors exceeds trip level	Excessive temperature rise in the windings	Check parameter settings. Check PTC input Check motor

Condition	Description	Possible Cause	Suggested Action
Undervoltage Trip *	Motor is about to be stopped. The lowest of the measured voltages is below the trip level.	Voltage dip below the trip level	Check parameter settings. Check main line voltage
Contactor Feedback Trip	Motor is stopped. Contactor feedback is not as expected.	Contactor feedback fault	Check for loose connection of contactor feedback Check for contactor control Check motor load and motor process condition
Serial Communication Trip	After the permitted time delay elapse, M10x considers loss of communication and activates failsafe	communication interruption between m10x and upper control system	Check parameter settings.(change the setting to "255" will disable the communication supervision); Check network interface
Start limitation Trip	Motor is stopped and a new start is prevented.	The motor starts too frequent and the number of starts in a given interval is reached start limitation	Check parameter settings.
DIx Trip	Motor is tripped because the DIx changes status from healthy to unhealthy during running ; Motor is prevented from starting because the DIx input is unhealthy.	The process interlock1 switch remain inactive on the occurrence of a motor start or the process interlock2 switch remain active when motor is in running.	Check DI settings on process interlock. Check DIx wirings
Long start Trip	Motor is stopped. After a start signal, when the measured phase currents remain above the set value for a locked rotor delay time during the startup time	motor locked or stalled in start state and signals a fault when current continuously exceeds a separately set threshold after a start command for the same period of time.	Check parameter settings. Check motor or connected load.
Feeder trip	Motor is stopped because of external trip input of feeder starter type.	The input is defined as ‘external trip’, M10x will trip the motor after a high input is detected.	Check parameter settings. Check Digtal input wiring.
Emergency stop trip	Motor is stopped because of emergency stop input.	The input is defined as ‘emergency stop’, M102 will stop or trip the motor after a high input is detected.	Check parameter settings. Check Digtal input wiring.
External Trip	Motor is stopped because of external trip input.	The input is defined as ‘external trip’, M10x will trip the motor after a high input is detected.	heck parameter settings. Check Digtal input wiring.
Main switch off trip	Motor is stopped because of main switch input.	The input is defined as ‘Main switch status’, M10x will trip the motor after a low input is detected.	Check parameter settings. Check Digtal input wiring.
Current feedback trip	Motor is stopped. Current feedback is not as expected.	Current is not measured during motor starting or running. Or current is measured while starter is detected in test position.	Check parameter settings if 'soft test' is enabled. Check motor connected load and process condition.

13. Appendix A: Technical data

Technical data

Main circuit			
Rated operation voltage (U_e)	up to 400/690VAC		
Rated insulation voltage (U_i)	690VAC		
Rated impulse withstand voltage (U_{imp})	6KV, overvoltage category II in IT network, Category III in other networks.		
Degree of pollution	3		
Rated operation current (I_e)	0.24-63A		
Rated frequency	50/60Hz		
Control circuit			
Rated operational voltage (U_e)	24V DC ,110 or 240 VAC		
Rated insulation voltage (U_i)	-250VAC		
Rate impulse withstand voltage	4kV for AC circuit		
Rated operational current (I_e)			
Contactor control relay output (CCA,CCB,CCC) Digital output	2A /24VDC(DC-13) 4A/120VAC(AC-15) 2A/240VAC(AC-15)		
Rated frequency	50/60 Hz		
Response timing accuracy			
TOL protection	5% of tolerance of tripping time		
Stall protection	200 ~ 350ms		
Earth fault protection	-30~+30ms		
PTC protection	400 ~ 500ms		
Others	0 ~ 150ms		
Power supply			
Rated operational voltage (U_e)	24VDC , 110 or 240VAC		
Voltage operation range	85%-110% Ue		
Power consumption			
	24VDC	110VAC	240VAC
Typical	5W	6VA	12VA
Maximum	8W		
Maximum inrush current *	600ma		
igital input (DC)			
Number of digital inputs	13 with one common connection		
Logic 1	15…30V		
Logic 0	0…5V		
Digital input (AC)			
Number of digital inputs	9 with one common connection		
Logic 1	110VAC type, 79…110V	240VAC type, 164…240V	
Logic 0	110VAC type, 0…20V	240VAC type, 0…40V	

Fieldbus interface		
Protocol	PROFIBUS-DP/MODBUS RTU	
Baud rate	PROFIBUS DP 9.6kbps/19.2kbps/45.45kbps/93.75Kbps/187.5Kbps/500Kbps/1.5Mbps MODBUS RTU 1200/4800/9600/19200/38400/57600 bps	
Fieldbus capacity	32 nodes per segment	
Degree of protection		
M10x	IP20	
MD21/MD31	IP54 from module front	
Environmental conditions		
Storage	-40 ~ +85°C	
Normal operation	24VDC type	-10 ~ +60°C
	110/240VAC type	Vertical mounting: -10 ~ +60°C Horizontal mounting: -10 ~ +55°C
Humidity	15% up to 95% without dew	
Derating accepted operating altitude	4500m	
Without derating operating altitude	2000m	
EMC environment	Equipment in the system complies with EMC requirement of CE/CCC certificate. Power supply system complies with IEC61000-2-1, IEC61000-2-2, especially the system in which VSD/frequency converters are used.	
Metering accuracy		
Phase current	Range: 0.4-8 × phase CT primary amps Accuracy: ±2% or ±0.01A, whichever is greater	
Earth fault current	Full scale: 1.2 × RCT nominal current Accuracy: ±2% RCT primary	
Line voltage (M102 only)	Voltage measurement range: 100V - 690V Accuracy: ±2%	
Power (only for M102)	Accuracy: ±5% or ±0.1kW, whichever is greater	
Thermistor input (only for M102)	Sensor type: positive temperature coefficient PTC RHOT=100-10,000 Ω Accuracy: ±2% or 10Ω which is greater	
Installation		
Mounting	MCU	On TS35 DIN rail
		With 3 screws ST4.2 (tightening torque 4.5Nm)
		With 2 screws (tightening torque 0.1Nm)
Mounting position (MCU)	Vertical	(DIN and screw)
	Horizontal	(screw only)
Dimension	MCU	110mm X 140mm X 75mm
	MD21	91mm X 75mm X 24.3mm
	MD31	88mm X 50mm X 24.3mm
Wiring size	Terminal X1	DC type 1.5mm²
		AC type 2.5mm²
	Terminal X3	2.5mm²
	Terminal X4	2.5mm²
Tightening torque		

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Standards

Low voltage switchgears		
IEC60947-1	Low voltage switchgear and control gear" Part1: General rules	
IEC60947-4-1	Low voltage switchgear and control gear" Part4: Contactors and motor-stopers, Section one- Electromechanical contactors and motor- stopers	
EMC		
Electrostatic discharge	IEC61000-4-2,	Level 3
Electromagnetic field immunity	IEC61000-4-3,	Level 3
Electrical fast transient/burst immunity	IEC61000-4-4	Power supply, Level 4 Others, Level 3
Surge immunity	IEC61000-4-5,	Level 3
Conducted disturbance immunity	IEC61000-4-6,	Level 3
Radiated disturbance	EN55011/CISPR 11,	Class A

Note

ABB Connect

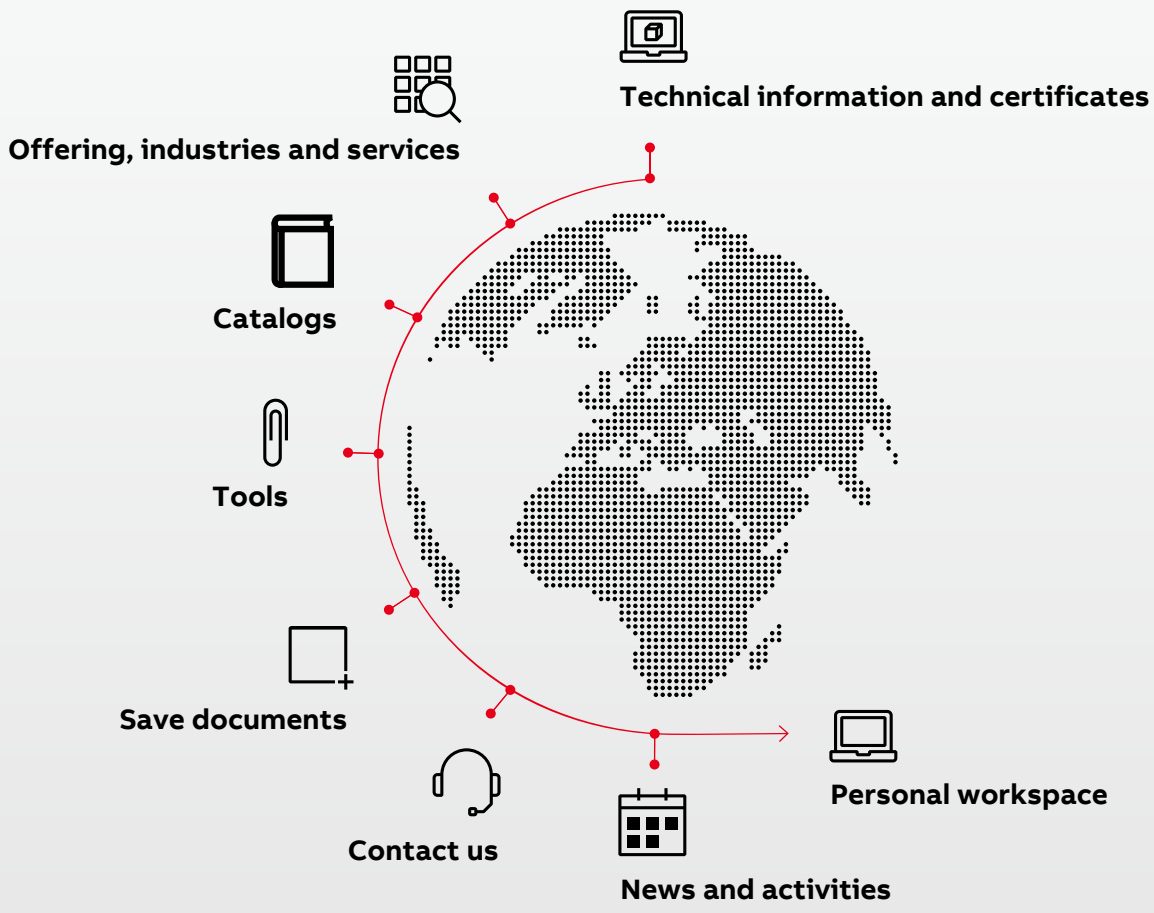
The digital assistant for all your electrification needs

ABB Connect helps you to find product information and stay connected to the latest news and tools. It’s a digital assistant that enables customers to connect to the broadest range of electrification solutions in one place.

- Easy to find what you need by search
- Get all information about our products, applications, selection guides, installation manuals, service, certificates, and engineering tools, etc.
- Saving documents locally, updating automatically.
- Receive your expected massages
- Online customer service

You can use ABB Connect on iOS, Android and Windows 10 device

Scanning QR code
to enter ABB Connect



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