



MNS with M10x

Intelligent motor management

Power and productivity
for a better world™



This guide is intended to be used along with the following brochures:

MNS System Guide

Publication no. 1TGC902030B0202 containing details on ABB MNS Low Voltage Switchgear design

MNS Safety Aspects

Publication no. 1TGC900009B0201 containing details on plant and personnel safety assured by MNS design

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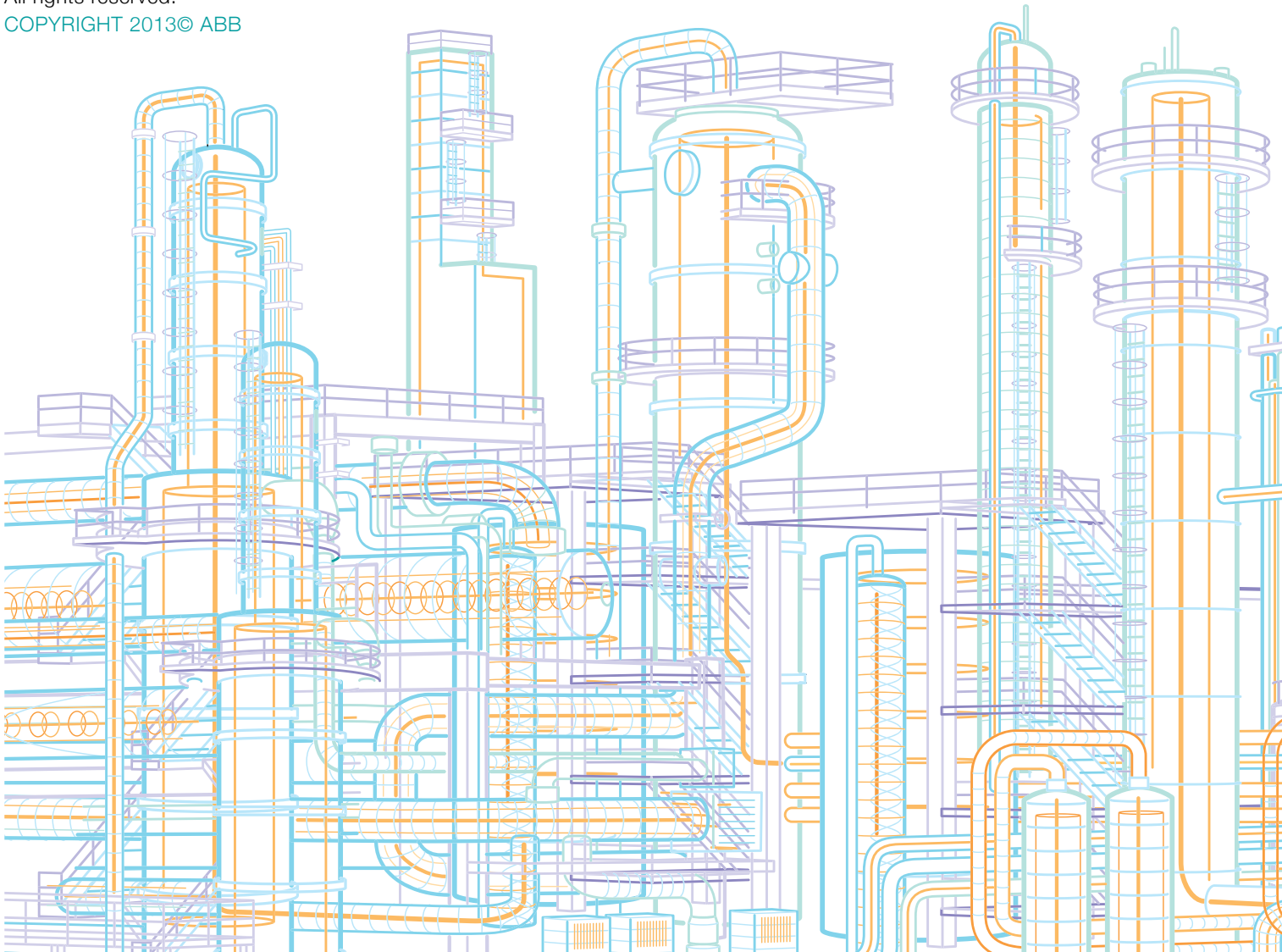
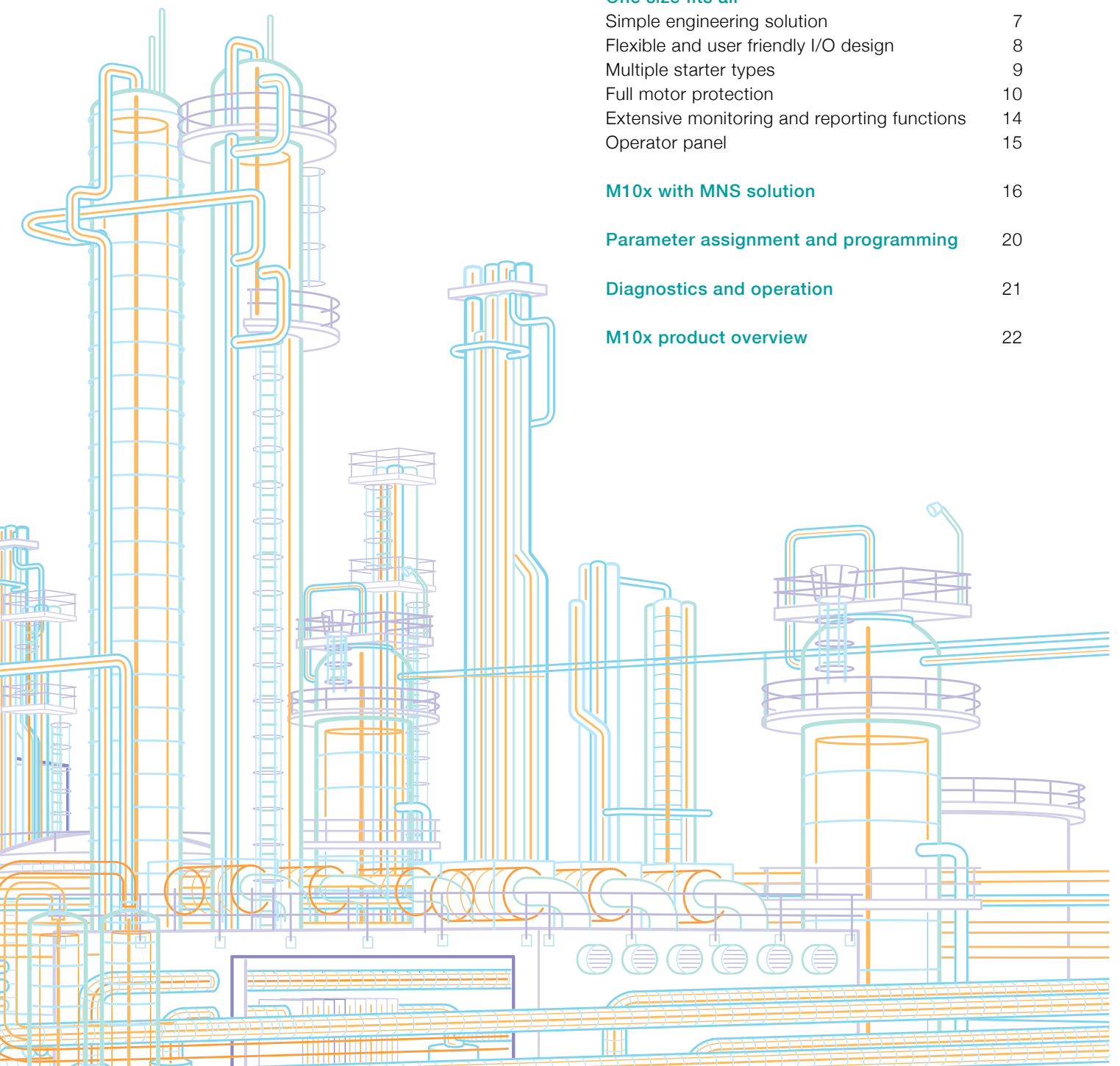


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MNS with M10x motor management



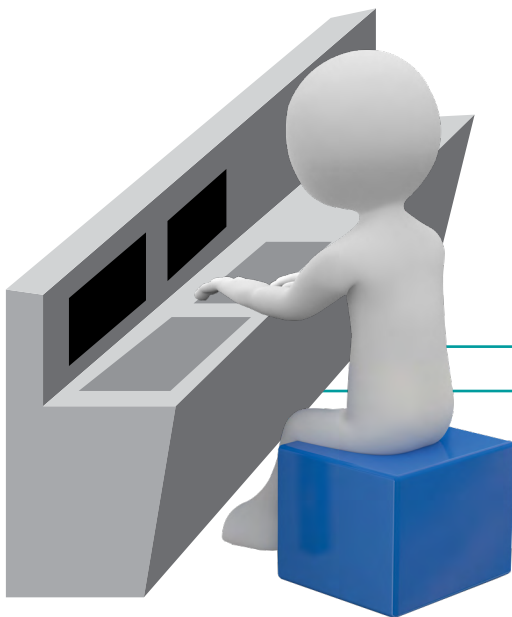
M10x is a microprocessor-based intelligent motor management system that provides users with complete and specialized low voltage motor control, protection and monitoring.

Its splendid, all-in-one functionality, robust communication and commercially economical qualities make M10x a trademark ABB intelligent motor controller. It has been chosen and delivered for many projects worldwide, especially in the Middle East and Asia where the most reliable and proven solutions are demanded. It is no surprise that M10x has become the number one choice of customers and end users.

Making the right decisions at the right time

M10x is an intelligent system, based on ABB's low voltage switchgear MNS. This system offers superior protection, control and monitoring that supports a fully user-optimized approach to motor management.

M10x collects all relevant information from the process involved, including timely alarms, enabling plant operators to make the right decisions based on precise, real-time process conditions.



Profibus DP or Modbus RTU

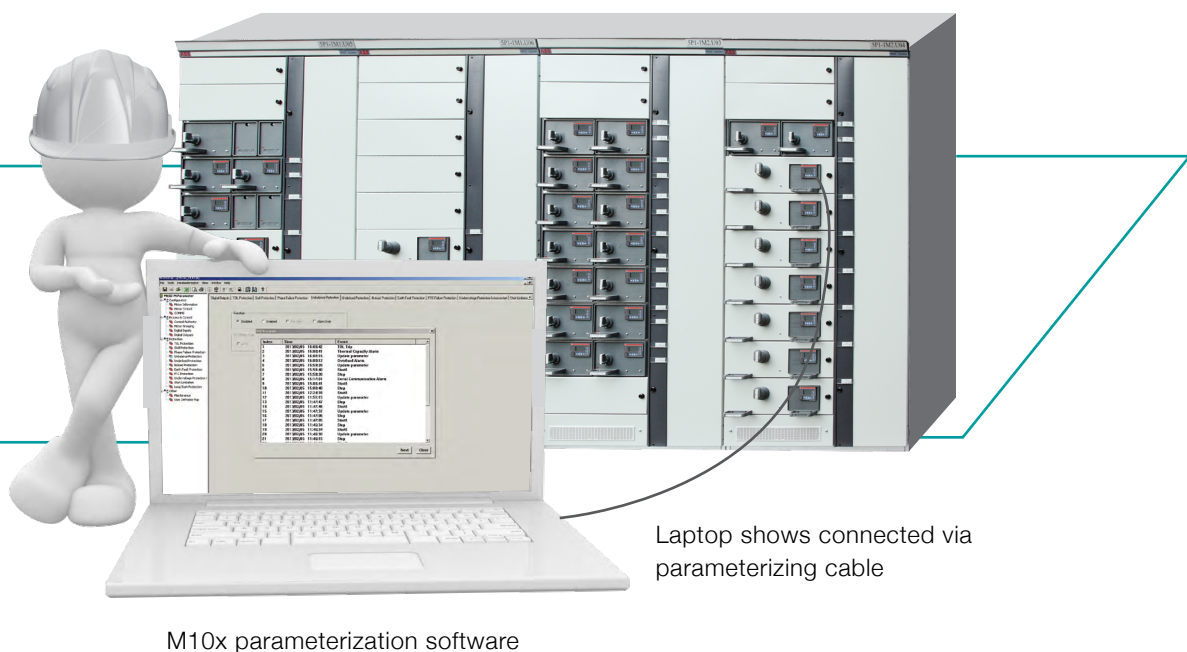
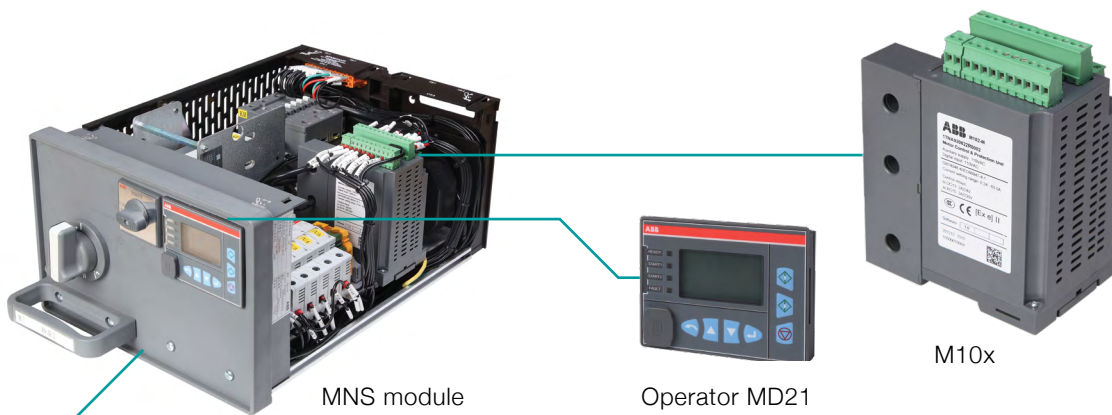
Process control system,
Energy management system,
Emergency shut down system

Increasing plant availability

M10x significantly increases plant availability by enabling preventive action. Its data quality goes far beyond conventional motor protection systems. Its remote control technology may be used by the engineering team, and provides highly-detailed system analysis for need-based maintenance.

Flawlessly integrated communications

M10x provides typical low voltage energy distribution and motor control center communications vertically to process control systems, and horizontally across engineering and maintenance stations. Configurable in a simplex or dual-redundant manner, M10x is flexible to meet a wide range of customer requirements.



A world of experience



With nearly ten years of exposure to the market, M10x has a large installed base in many industries. From mines deep underground to power plants, paper mills and factories on the surface, M10x has a global reputation for reliability and ease-of-use.

Mining and minerals

- Easy operation, highly flexible process control and supervision
- Comprehensive motor protection, including earth fault
- Multiple configurable digital inputs/outputs for monitoring and control

Water industry

- Pump control and protections
- Plant automation support, from starters to feeders
- Reliable network support with dual communication interfaces

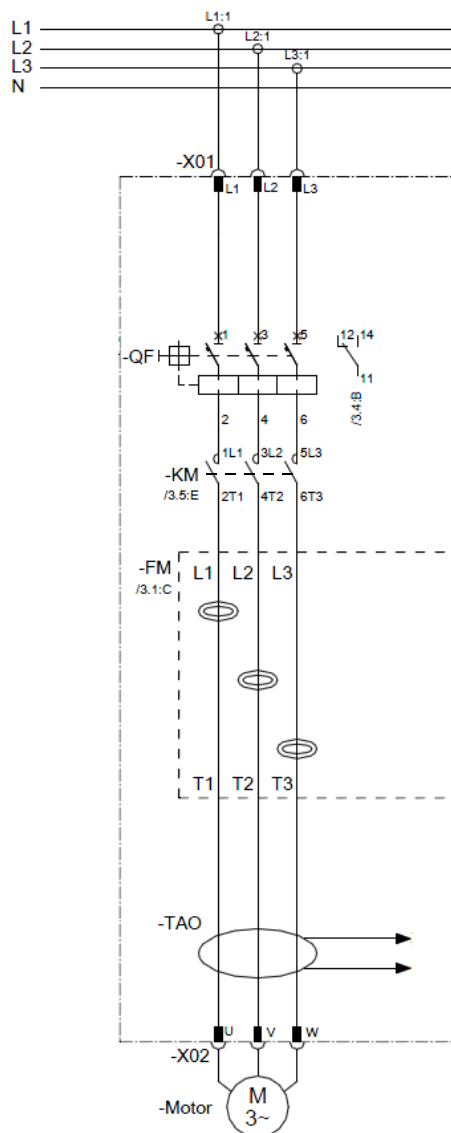
COG

- Complete monitoring and control of processes
- Built-in undervoltage monitoring and protection
- Advanced auto-restart function

One size fits all

Simple engineering solution

A single, uniquely equipped device, M10x can be customized through its software to perform all of the varied tasks customers require.



Operator Panel MDx

MD21 (LCD panel)

Control, monitor, parameterization



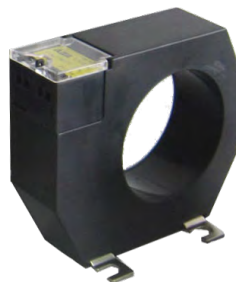
MD31

Control & indication



One Size Product

- Control, protection, monitoring & communication in one device
- Multiple choice of power supply i.e., 24VDC, 110VAC & 240VAC
- One type of integrated CT ranging from 0.24-63A (External CT is required for 63A above)
- One physical size regardless of different M10x variants

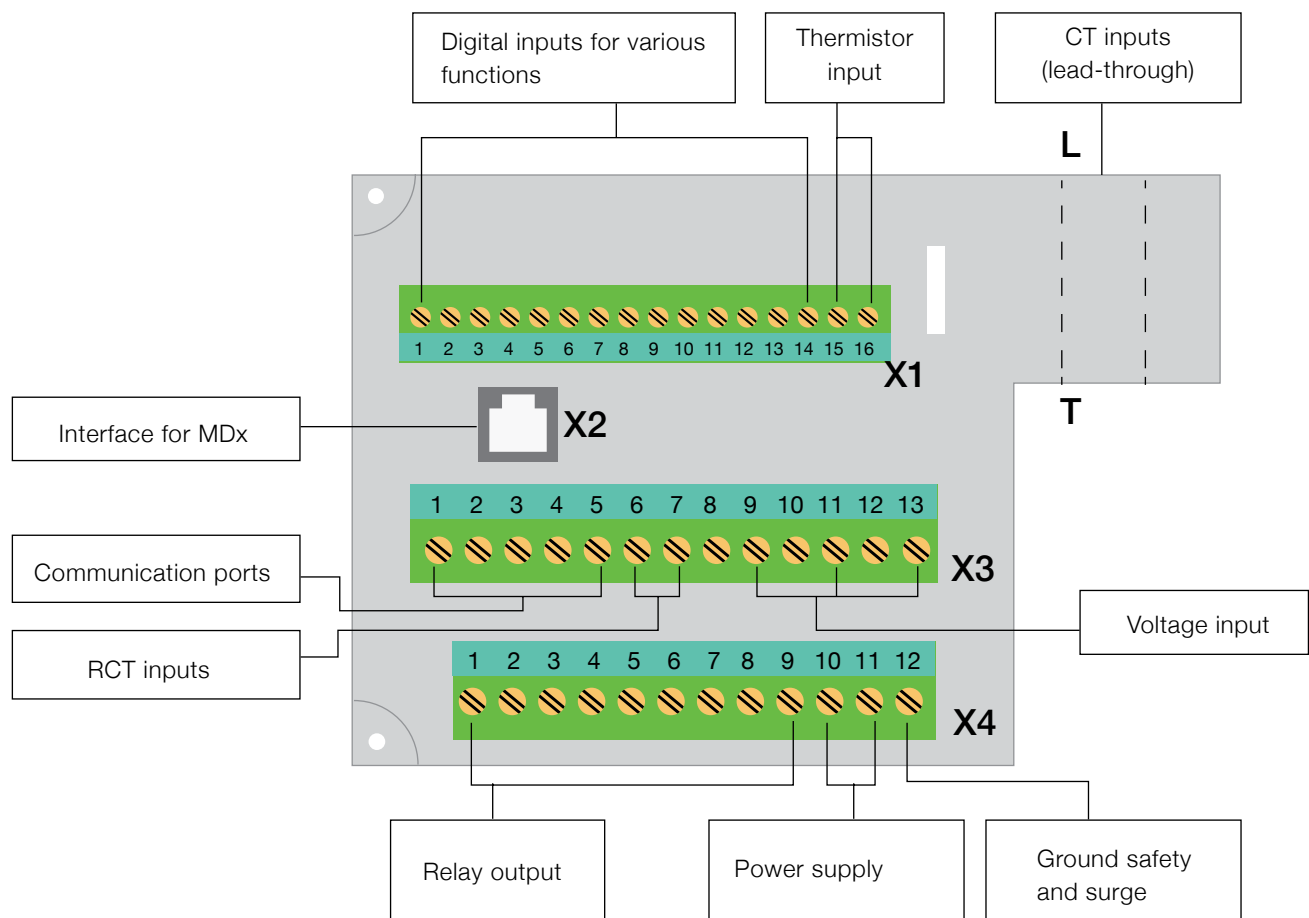


Current Transformer

RCT

Earth fault current CT

Flexible and user friendly I/O design



Note:

Different product types may have different quantities of I/Os. Please refer to product user manual for details.

M10x supports up to 13 digital inputs and 5 digital outputs in one single device. All inputs and outputs are configurable to suit different applications.



Multiple starter types

M10x relays provide a full range of functionalities for motor monitoring, control and protection.

M10x offers a variety of motor start modes via parameterization, and supervises the operating state of the contactor through the feedback of the auxiliary contact of the contactor. The control authority of the motor includes local control and remote control.

All necessary motor starting control modes are integrated in the device. To select a desired starting control mode, simply click on the setup interface of the M10x motor control unit.

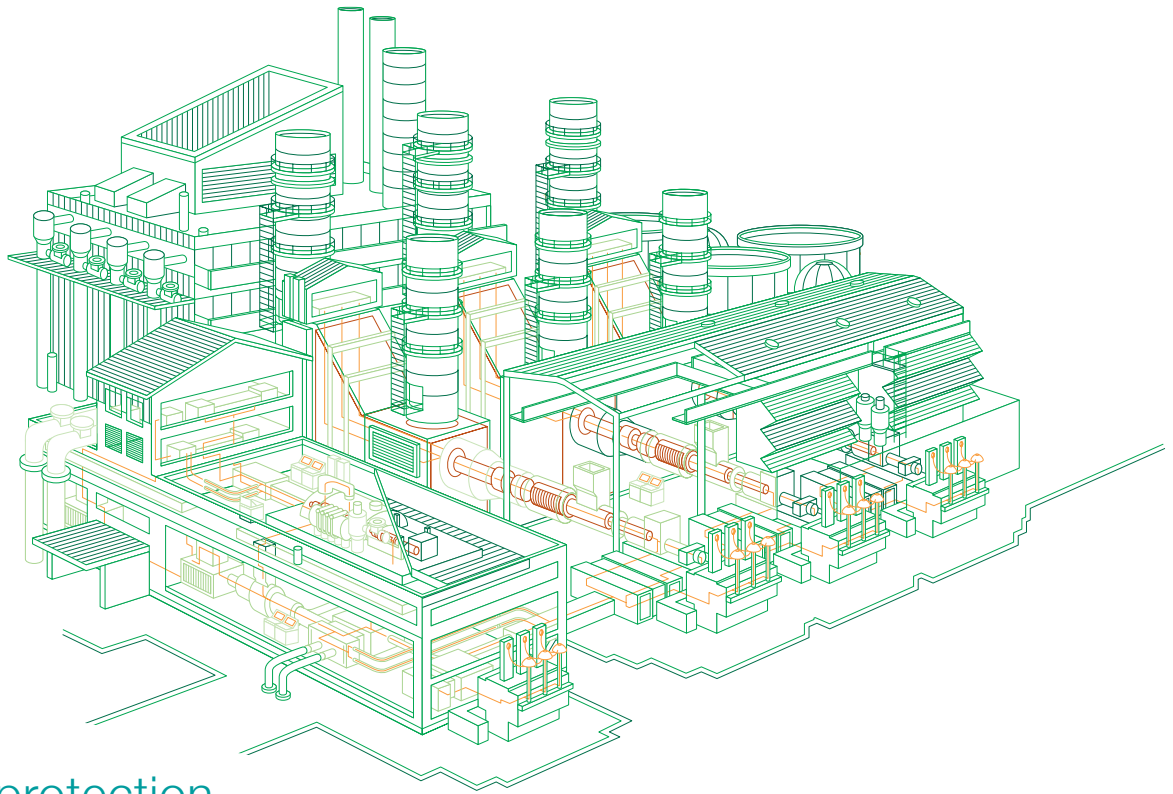
Start Modes	M101	M102
Non-reversing direct online NR-DOL	■	■
NR-DOL with RCU function	■	■
Reversing direct online REV-DOL	■	■
REV-DOL with RCU function	■	■
Actuator (e.g., valve or damper control)		■
Start / Delta starter		■
2 speed starter with separate windings		■
Autotransformer		■
NR-Softstarter		■
REV-Softstarter		■
Feeder (motor operated)	■	■
Dahlander starter		■
Contactor feeder	■	■
Contactor feeder with RCU function	■	■

Remarks:

RCU: RCU is an option to control the contactor by bypassing the M10x.

Actuator: Starter type is based on reversing direct on line starters where limit switch inputs are used to stop the motor in some necessary cases like valves, dampers, actuators etc.

Feeder: Feeder mode is listed as a specific start mode in M10x to serve for circuit controlling and supervising for motor operated MCCB feeder.

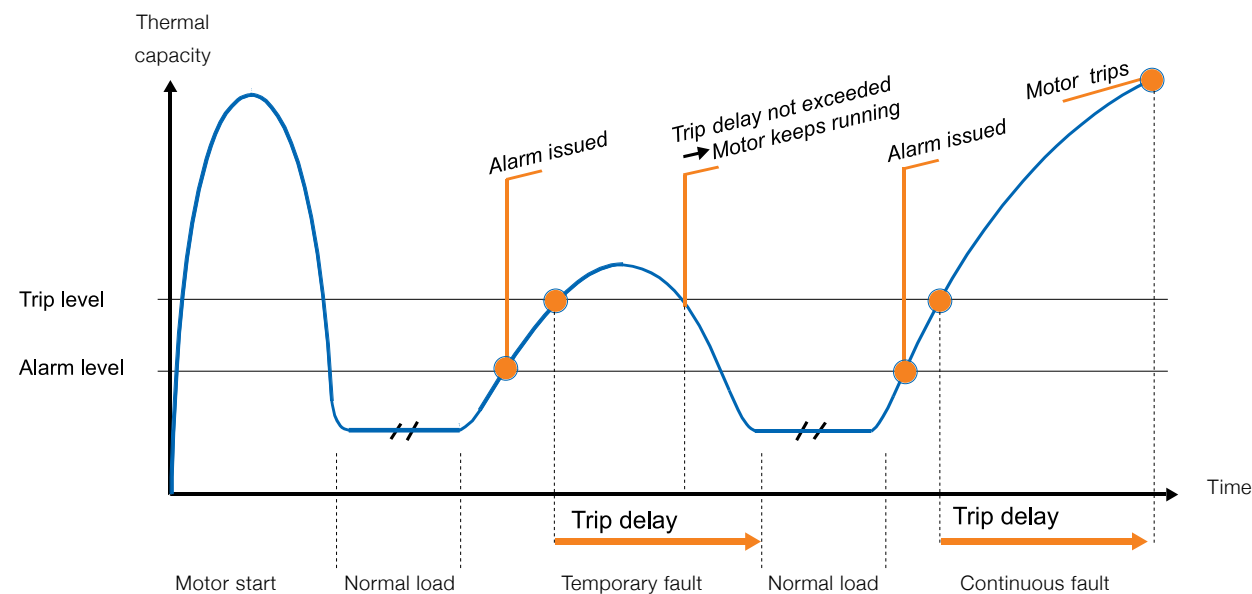


Full motor protection

M10x devices provide full motor protection. Full motor protection means timely and accurate protection by continuously collecting and keeping track of information on all operating states during the course of motor operations, providing fault alarm and protection action (protection trip) and setting action delay times, to safeguard motors and smooth production. Via serial communication, real-time information of process motors is reported upward to plant control systems, providing the basis for process analysis and management optimization. Prior to any possible major fault in the equipment, a limit-exceeding alarm will alert the administrator in a timely manner to take corrective actions to prevent unnecessary shutdown. This provision maximizes the

operating efficiency of the equipment. When the preset alarm level is reached, the 'alarm' message is generated and reported. As soon as the preset trip level is crossed, a timer is activated and the count down to motor tripping starts. The time duration for count down is set according to the 'trip delay' parameter. The count down continues as long as the fault exists. The motor eventually trips out when the setting delay time runs out. If the fault is corrected before the countdown reaches 0, the timer is reset and switched off - no trip will follow. In any of the above cases, the event message is generated. In addition to this, operating data such as 'time to trip' and 'time to reset' can be collected and reported via fieldbus.

Alarm level, trip level and trip delay, illustrated



Alarm and trip data set according to motor manufacturer's specification and process needs

M10x motor protection has the following features:

- All protection functions are implemented with the microprocessor built in the device and configurable
- The desired protection function can be easily selected with the parametering software
- The protection function can be set as alarm and trip, alarm only, or trip only
- Trip reset modes can be configured as any of the following by preset of trip reset modes

The reset modes are different in various protection functions:

- Automatic reset
- Remote reset
- Local reset
- Local & remote reset

Motor protection functions	Description	M101	M102
Long start protection	Protects the motor against locked or stalled rotor in start state.	▪	▪
TOL protection	Tracks and calculates the thermal capacity of the motor in operation to protect the motor against overheating.	▪	▪
TOL EEx e	The EEx e protection takes into consideration the stall/nominal current ratio and the maximum motor temperature allowed by the environment class definition. It belongs to start limitation	▪	▪
Start limitation protection	Limits the number of starts during a time interval. Number of starts and time interval are parameter settings.	▪	▪
Phase failure protection	Uses the minimum/maximum line current ratio as the criterion for enabling the phase failure protection function.	▪	▪
Phase unbalance protection	Unbalance can be caused by pitted contacts, faulty motor, loose connections, etc. The difference between the minimum and maximum phase currents is compared against the set parameters. Reverse phase protection not supported for the IEEE standard.	▪	▪
Stall protection	Protects against stall, the highest measured phase current to compare against the set parameters, activates only after motor start-up time is complete.	▪	▪
Undervoltage protection	Protects the motor against undervoltage condition (voltage drop or loss).		▪
Autorestart	Available in standard and enhanced models.		▪
Underload protection	Uses the highest measured phase current to compare against set parameters.	▪	▪
No load protection	Similar to underload but with different set levels and messages. No load uses the highest measured phase current to compare against the set parameters.	▪	▪
Earth fault protection	Protects the motor against the earth fault condition with an additional residual current transformer with adjustable trip level and time delay.	▪	▪
Motor temperature protection (PTC)	Protects against too high temperature by using PTC sensors. The resistance values are compared against the set levels.		▪
Motor temperature protection using PTC relay	Monitors motor winding temperatures from PTC sensors against preset values using an additional thermistor relay.	▪	▪
Motor temperature protection using RTD relay	Monitors motor winding temperatures from PT 100 sensors against preset values, options are available for single or triple channel monitoring.	▪	▪

Thermal overload protection

Thermal overload (TOL) protection keeps track of and calculates the thermal capacity of the motor in operation to protect the motor against overheating, which may shorten the service life of the motor or damage it. In addition, the thermal memory function of the TOL protection is particularly important in case frequent starting is required.

The TOL protection has a thermal memory function, which protects the motor from startup in an overheated condition. The M10x unit simulates the thermal conditions in all operating states of the motor to maximize the use of the motor on the premises for safe operation. The TOL protection takes into consideration the temperature rise of the motor rotors and stators, as well as the impact of the three-phase unbalance on the overheated motor. When the 'restart' command is issued before the temperature drops to the pre-set restart level after a 'TOL Trip', the M10x device will then suppress the command and the motor will not be restarted.

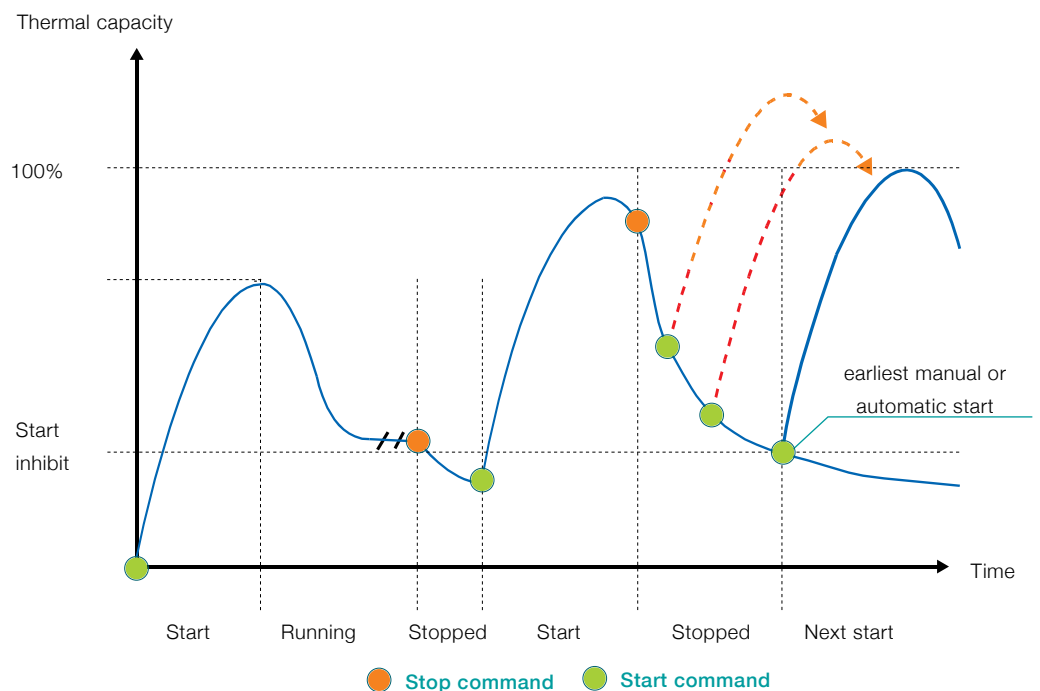
TOL protection

The trip level, alarm level and reset level can all be adjusted by setting the parameters or altering constant values.

TOL EEx e protection

EEx e protection takes into consideration the stall/nominal current ratio and the maximum motor temperature allowed by the environment class definition. Relevant data of EEx e motor is provided by motor manufacturer to direct programming into the M10x device without additional calculation.

Thermal overload protection, illustrated



Thermal capacity must be below "Start inhibit" to allow a motor start.

Earth fault protection

The earth fault protection function protects the motor against the earth fault condition with an additional residual current transformer. When the earth fault current exceeds the preset trip level, delayed trip or instantaneous trip is triggered. A torodial current transformer is required for this function. Earth fault protection in M10x can be set to active or inactive during motor start up period.

ABB LNG series residual current transformer is employed as earth fault protection input of M10x.

ABB LNG is available in four different diameter dimensions: $\phi 35$, $\phi 70$, $\phi 105$ and $\phi 185$.

- 1A or 5A current can be selected, depending on the setting range of the earth fault current of the protected system.
- Shielded twisted pair should be used between outputs of LNG CT and terminals of M10x.

Spec	Primary side input (A)	Secondary side output (V)	Secondary
LNG35 1A	1	1	35
LNG35 5A	5	1	35
LNG70 1A	1	1	70
LNG70 5A	5	1	70
LNG105 1A	1	1	105
LNG105 5A	5	1	105
LNG185 1A	1	1	185
LNG185 5A	5	1	185



LNG CT

Undervoltage protection (M102 only)

The undervoltage protection function is enabled when the voltage of the main circuit drops below the set value. To enable the undervoltage protection function, other parameters must be set, such as the alarm level, the trip level and the trip delay. The protection action is delayed trip.

Undervoltage and autorestart (M102 only)

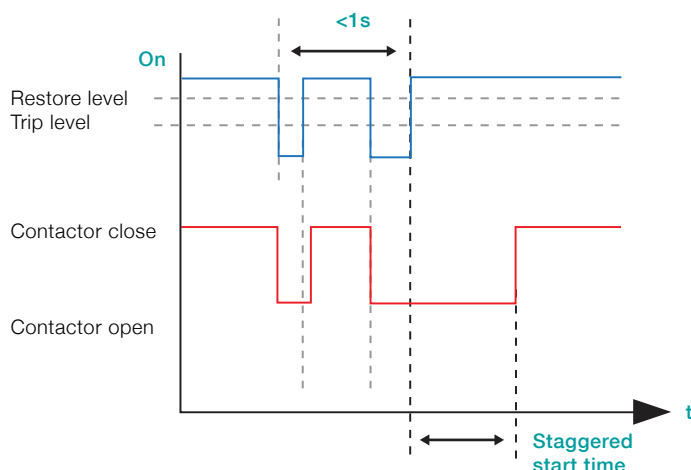
Following a sudden voltage dip, M102 can restart the motor in different modes, depending on the specific circumstances in which the voltage is restored. There are three cases of auto restart:

- The voltage is restored within the autoreclose time (presetting required), the motor will be restarted immediately.
- If the voltage is restored after the autoreclose time (presetting required) but before the maximum undervoltage time (presetting required), the M102 device will restart the motor in its staggered sequence; in other words, the motor will be restarted after the staggered start delay (adjustable) expires.
- If the voltage is restored after the maximum undervoltage time (presetting required), M102 will not execute restart; in other words, the auto restart function of the motor will be suspended.

Two alternative modes of auto restart function are integrated in M102: standard and enhanced. The standard mode applies to the above 3 cases; the enhanced mode, in addition to the functions available in the standard mode, applies to a fourth case:

- If the interval between two voltage dips is less than 1 second and neither voltage dip has exceeded 200ms, M102 will restart the motor in the staggered sequence; in other words, the motor will be restarted after the staggered starting delay (adjustable) expires.

The auto restart function can effectively protect the motor against the disturbance caused by the instantaneous voltage dip.



For other motor protections please refer to product user manual.

Extensive monitoring and reporting functions

M10x provides an extensive range of motor operation supervisory functions. Supervisory data are transmitted via the field bus 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.

Monitoring and reporting		M101	M102	Description
Motor Running Data	Motor status	■	■	Start1, Start2, Stop, Alarm, Trip
	Three phase current	■	■	Relative value or actual value (only in MD21)
	Line voltage*		■	Actual value of phase-phase voltage
	Power related*		■	Include power, apparent power, power factor
	Thermal capacity	■	■	Thermal capacity of motor
	Frequency*		■	Frequency of power system
	Energy*		■	Energy consumed by motor
	Ground current	■	■	Ground current
	PTC		■	the value of PTC resistor
	Time to TOL trip	■	■	Time to trip triggered by TOL protection
	Time to TOL reset	■	■	Time to reset after TOL trip
	DI status	■	■	The status of each DI
	Startup time	■	■	Actual startup time of motor
	Current unbalance	■	■	Current unbalance between three phase current
Maintenance and Service Data	SOE*		■	256 SOE with time stamp
	Running time	■	■	Running Time
	Stop time	■	■	Stop time
	Start number	■	■	Start number
	Stop number	■	■	Stop number
	Trip number	■	■	Trip number
	Last trip current	■	■	Three phase current of last trip
Diagnosis Data	Cause of alarm	■	■	TOL, overload, stall, Phase failure, Phase unbalance, Underload, Noload, Earth fault, PTC*, Under voltage*, Autoreclose*, Contactor feedback, Welded contactor, PTC short circuit*, Start limitation, Serial communication, Running time, Start number, Watchdog, Ready to trip reset, Dlx
	Cause of trip	■	■	TOL, stall rotor, phase failure, Phase unbalance, Underload, Noload, Earth Fault, PTC*, Under voltage*, Contactor feedback, Start limitation, Serial communication, Feeder trip, Long start, Emergency stop, External trip, Dlx

Note: 1) The parameters marked (*) are only for M102.

Communication

The M10x motor control unit has serial communication interfaces based on EIA-485 (RS-485) standard.

The following protocols are supported:

- PROFIBUS DP V1 communications (up to 1.5Mbps)
- Modbus RTU communication (Redundancy up to 57.6kbps)

Operator panel

M10x can optionally be equipped with an operator panel MDx1, which is used to display the status of the motor. Motor control is possible through predefined pushbuttons A mini USB physical connection port is available on the operator panel for parameterization via service laptop and software.

The basic type MD31 provides 4 LED indicators that are function configurable and has pushbuttons for operation.

The operator panel MD21 integrates the functions of measurement and maintenance display, LED indicators (configurable function) and has pushbuttons for operation and parameterization as well as fault monitoring functions.



MD21

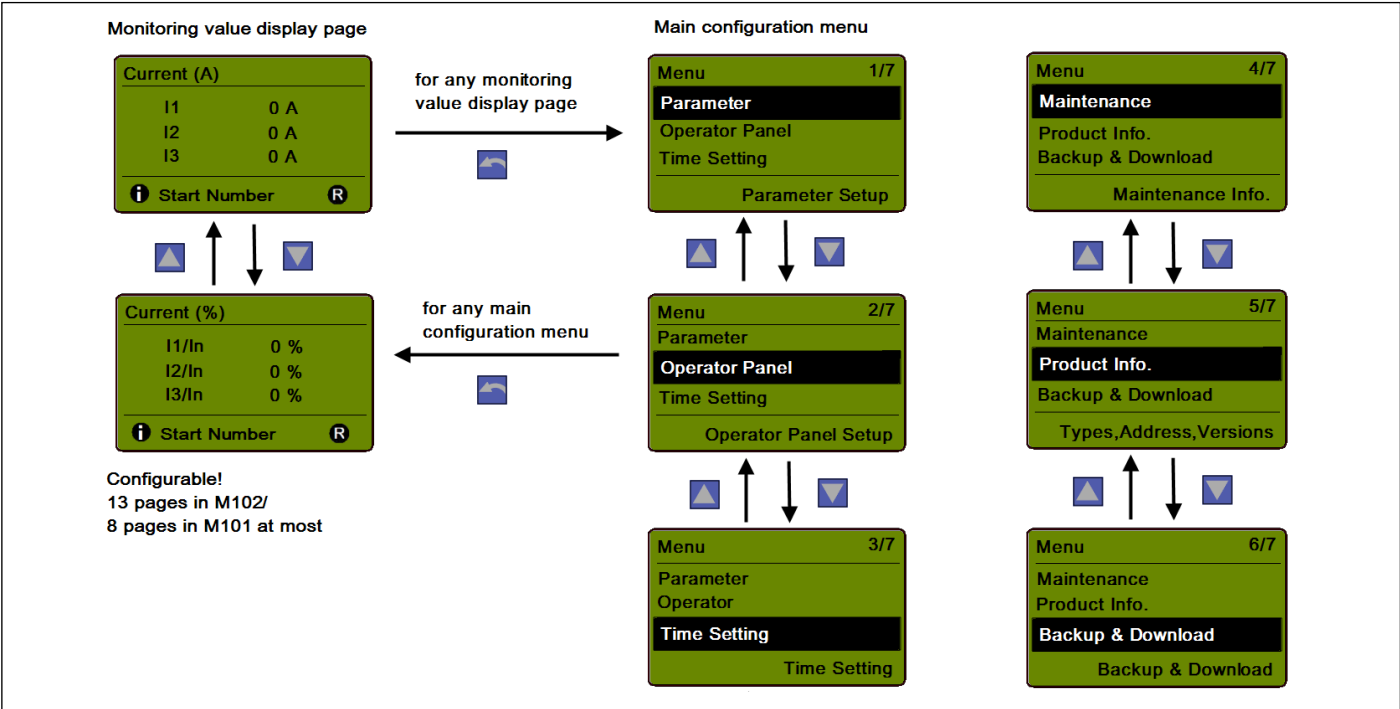


MD31

MD21 and MD31 panels can be used for both M101 and M102 devices.

Start modes	MD21	MD31	Description
Control buttons	▪	▪	Start1, Start2, Stop
Navigating buttons	▪		Page up, Page down, Enter, Exit buttons for navigating and parametering
LED indicators	▪	▪	Configurable function as Power, Ready, Start1, Start2, Running, Stop, Fault, DLx
Parameterization interface	▪	▪	mini USB port
LCD window	▪		Motor running data *, Maintenance data *, Diagnosis information *, Product information, Setting parameters

* Parameters including motor running data, maintenance data and diagnosis data which are listed on the table under ' Extensive monitoring and reporting functions' can be read on MD21



M10x with MNS solution

Product portfolio

MNS replaces traditional overcurrent protection devices with standalone protection and control relays engineered directly into the switchgear modules. This makes MNS uniquely equipped to serve a broad range of applications. The benefits for EPCs and end users are clear:

- Full-spectrum protection and control functions
- Flexible function change during design stage
- More plant data due to more measurement input
- Industry standard communications for seamless control system integration

Simple, yet highly functional

M10x is a solid feature and functionality device that offers simple-to-advanced motor protection and control functions.

- Multiple motor control and protection functions
- Local control panel for simple control and monitoring
- Motor starter and load feeder (with motor MCCB) monitoring and control
- Additional I/Os for hardwired interlock and basic control functions

Flexibility in a standardized solution

MNS with M10x is an intelligent switchgear solution based on the proven MNS.

- Standardized solution with simplified schematics
- Single front, back-to-back or duplex switchgear arrangement
- Plug-in or withdrawable modules, even when combined in one vertical section
- Easy to modify existing switchgear by replacing modules



Seamless system integration

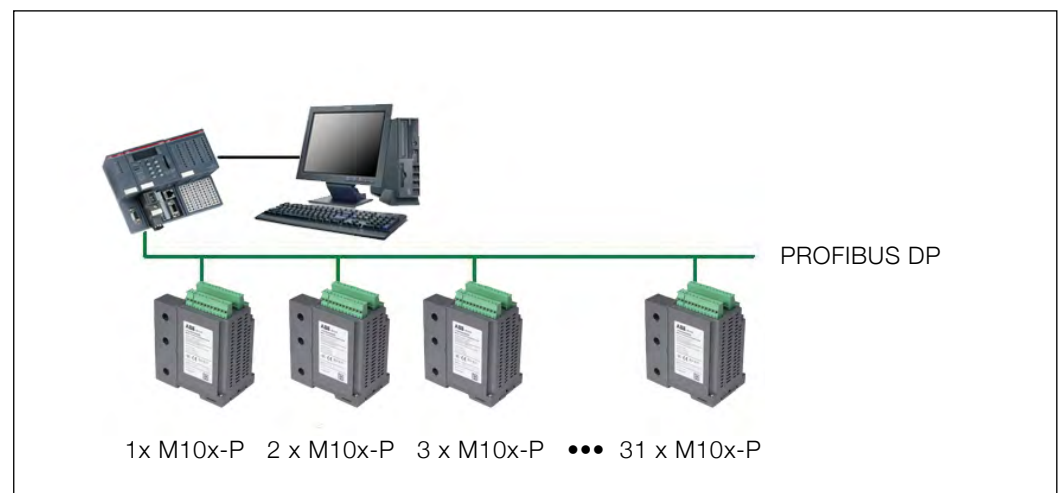
M10x is connected to the upper level process control and management system.

Communication occurs through a port on the device, that supports the following protocols:

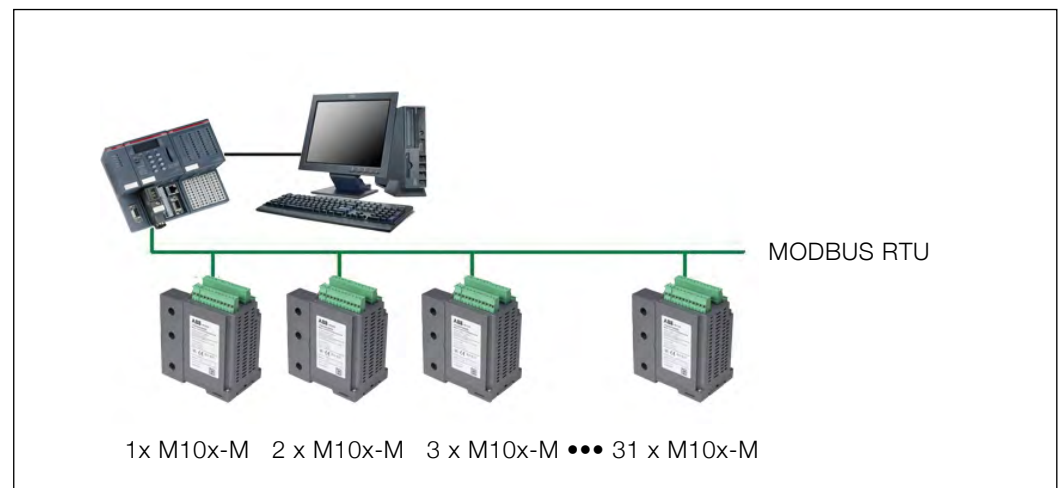
- PROFIBUS DP communications
- Modbus RTU communication

Other serial protocols can be achieved by using a protocol converter.

PROFIBUS communication



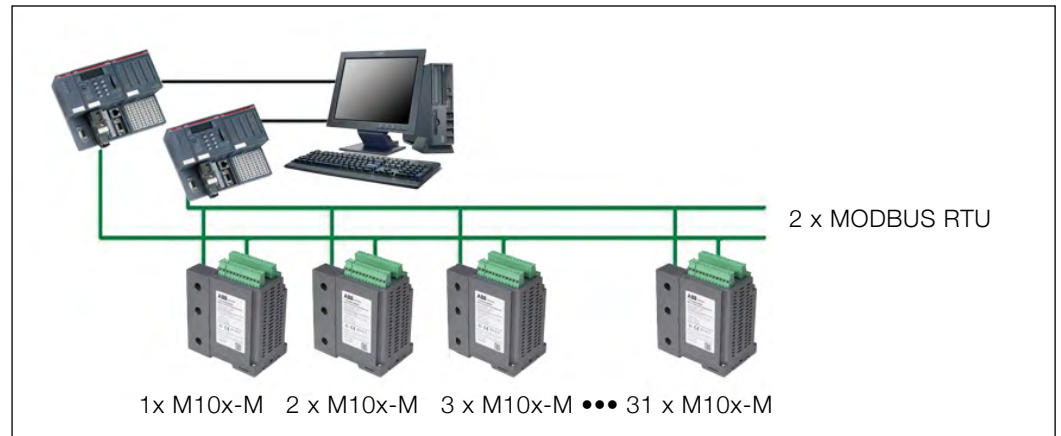
Modbus communication



Redundant communication

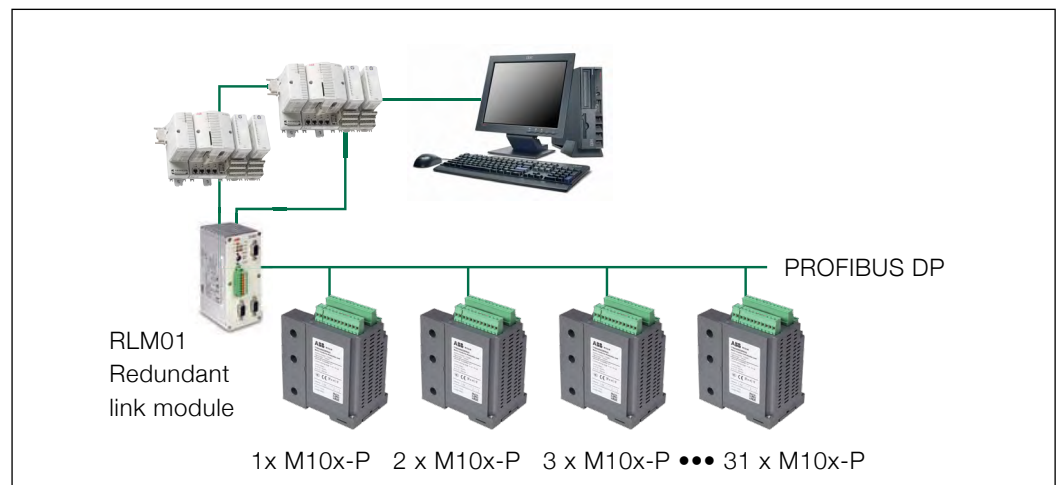
M10x provides redundant connectivity provides higher availability in serial communication applications.

Modbus communication (redundant)



Modbus RTU, makes direct redundant serial communication possible. The M10x-M provides two identical RS-485 interfaces on the same device. Two Modbus RTU cables are connected throughout the switchgear assembly to each M10x-M. Both Modbus ports use the same communication parameters (address, speed, etc.). For example, this allows the M10x-M to be connected to two communication lines to the upper-level process control system, or alternatively connect one line to the process control and the other to the management system.

PROFIBUS communication (redundant)



With PROFIBUS DP, redundant communication to a process control system can be provided through a redundant link module RLM01. Inside the switchgear assembly, the PROFIBUS DP cable connection is single, while the connection to the upper-level process control system through the RLM01 module is provided as a redundant interface.

M10x in MNS design

M10x installation

M10x and the operator panel MDx are individually mounted and electrically connected to each other via the connection cable.

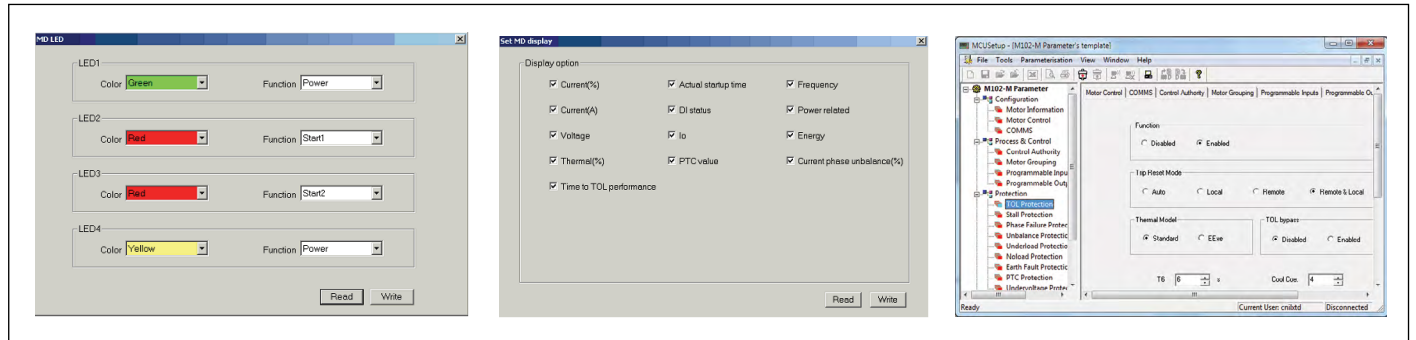
Compact size makes it possible to install M10x in the smallest size as the 8E/4 module of ABB's MNS switchboard. Minimum installation space in MNS is the same or smaller as required for traditional protection with thermal relays. (For details, refer to MNS brochure.)

The MDx operator panel is designed to be flush-mounted on the front or door of the MNS module. The following minimum mounting space requirements apply for MNS modules when used with the MDx operator panel:

Minimum mounting space	MD21	MD31
MNS 8E/2	■	
MNS 8E/4		■



Parameter assignment and programming

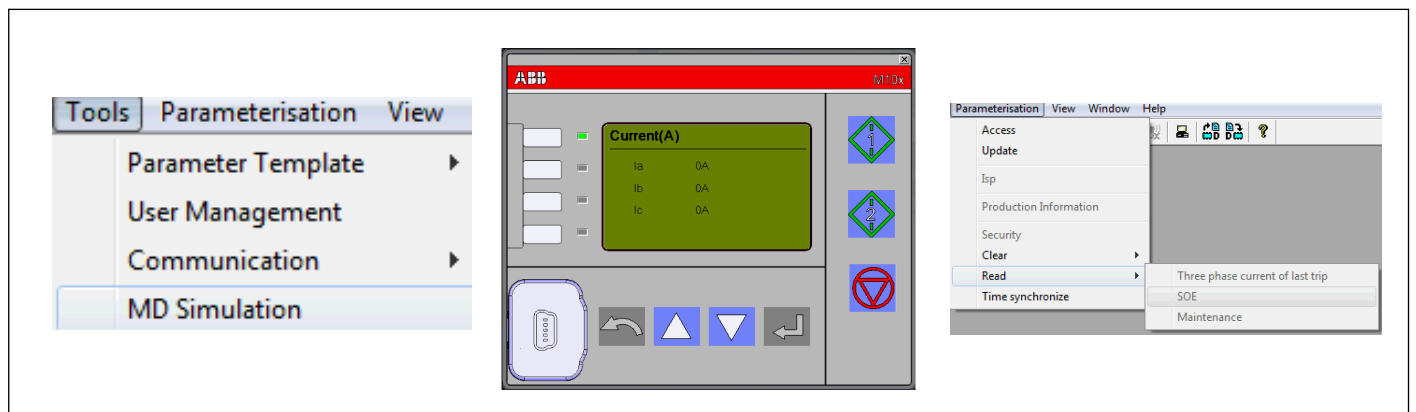


MNS setup software for parameterization and configuration of M10x is user-friendly and MS Windows-based. Parameter setting is carried out via a dedicated parameter cable connecting the M10x to the MDx1 panel mounted on the front of the motor starter module. Software allows for the parameterization of all functions of the M10x types.

Simple setup windows make parameter setting easy to understand and follow. Import and export setting functions offer a choice of managing setting files on or offline. For plants that require different access levels for security reasons, up to three levels of user groups can be defined as assigned under the user management menu.

MCUSetup

MCUSetup can show the operation data and control via MD simulation tools, while the software collects service data from the motor.



Diagnostics and operation

Alternatively, M10x can be equipped with an operator panel MDx for displaying the motor's operating, diagnostic and service data. Predefined pushbuttons can control the motor. In addition, MCUSetup software provides diagnostics and operation.

Operating data

Motor status
Current (A)
Current (%)
Line voltage*
Power related* (include power, apparent power, power factor)
Thermal capacity
Frequency
Energy*
Ground current
PTC resistor*
Time to TOL trip/reset
DI status
Startup time
Current unbalance

*Available only in M102

Diagnostic data

Alarm message

Possible alarm causes:

Thermal capacity	Overload	Phase failure
Phase unbalance	Underload	Noload
Earth fault	PTC*	Undervoltage
Auto reclose*	Contactors feedback	Welded contactor
PTC short circuit*	PTC open circuit*	Start limitation
Serial communication	Running time	Start number
Watchdog	Ready to trip reset	Dlx

*available only in M102

Trip message

Possible trip causes:

TOL	Stalled rotor	Phase failure
Phase unbalance	Underload	Noload
Earth fault	PTC*	Undervoltage*
Contactors feedback	Serial communication failure	Start limitation
Feeder trip	Long start	Emergency stop
MCCB trip	Dlx	External trip

*Available only in M102

Service data

SOE*
Running time
Stop time
Start number
Stop number
Trip number
Last trip current

*Available only in M102

M10x product overview



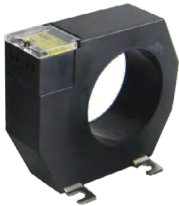
Product type	
Function options	M101-Simplified type, current based unit, limited range of protection functions
	M102-Advanced type, current and voltage based unit, full range of protection functions
Supply voltage options	24VDC, 110VAC, 240VAC
Fieldbus options	Modbus RTU, PROFIBUS DP

Main unit M10x

Power circuit	
Rated operation voltage (Ue)	up to 400/690VAC 346/600VAC(UL)
Rated insulation voltage (Ui)	690VAC 600VAC(UL)
Rated frequency	50/60Hz
Motor current rating (Ie)	0.08-63A (integrated CT) For 63A above, external CT is required.
Starter coordination	Refer to product coordination table
Control circuit	
Rated operational voltage (Ue)	24V DC, 110 or 240VAC
Rated operational current (Ie) for contactor control relay output	2A/24VDC (DC-13), 240VAC (AC-15)
Trip rating	115% of TFLC

Inputs and outputs	
Digital inputs (configurable)	13 inputs (DC) or 9 inputs (AC)
PTC input	1 channel PTC input (M102 only)
RCT (earth fault CT input)	1 channel RCT input
Digital outputs	5 outputs (M102) or 3 outputs (M101)

Power supply	
Supply voltage	24V DC, 110 or 240VAC
Power consumption	4.5W 24VDC
	6VA 110VAC
	12VA 240VAC



Operator panel

The operator panel is the user interface mounted on the module front or door, used for local monitoring, control and parameterization

MD21	With LCD display, can be used to set up parameters through keypad
MD31	Without LCD display, can not be used to set up parameters via keypad

Residual current CT

Special CT, closed window type

Primary	1A or 5A
Window diameter	35mm, 70mm, 105mm, 185mm

External KORC CT

KORC series CTs are 3-phase CTs. It is required when motor rating is > 63A. Linear type is normally selected for motor protection.

Secondary output	1A or 5A
Window size	28.5mm x 21mm for each phase

Analog Output module

AO11 provides one channel 0-20 mA or 4-20 mA current loop output. The monitored parameters in M10x can be configured and converted to analogue signals through MCUSetup software.

Power circuit

Rated operational voltage (Ue)	24VDC, 110~240VAC
Voltage operation range	85%-110% Ue
Power consumption	1W max

AO character

Accuracy*	±0.5% of full range (20mA)
Analog output	1 channel 4-20mA/0-20mA
Max load resistance	500Ω

* This accuracy is NOT include the measurement error of M10x.

Parameter setup software

Parameter setup software for M10x is MCUSetup software. It is provided along with M10x product free of charge. MCUSetup software is running under Windows 2000, Windows XP, Windows 7 & 8 environment.

Parametering cable set

This is a special connection cable for parametering. It is with USB connector in one end to connect onto PC and mini USB connector on the other end for MDx connection. Converter is built in the cable.

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