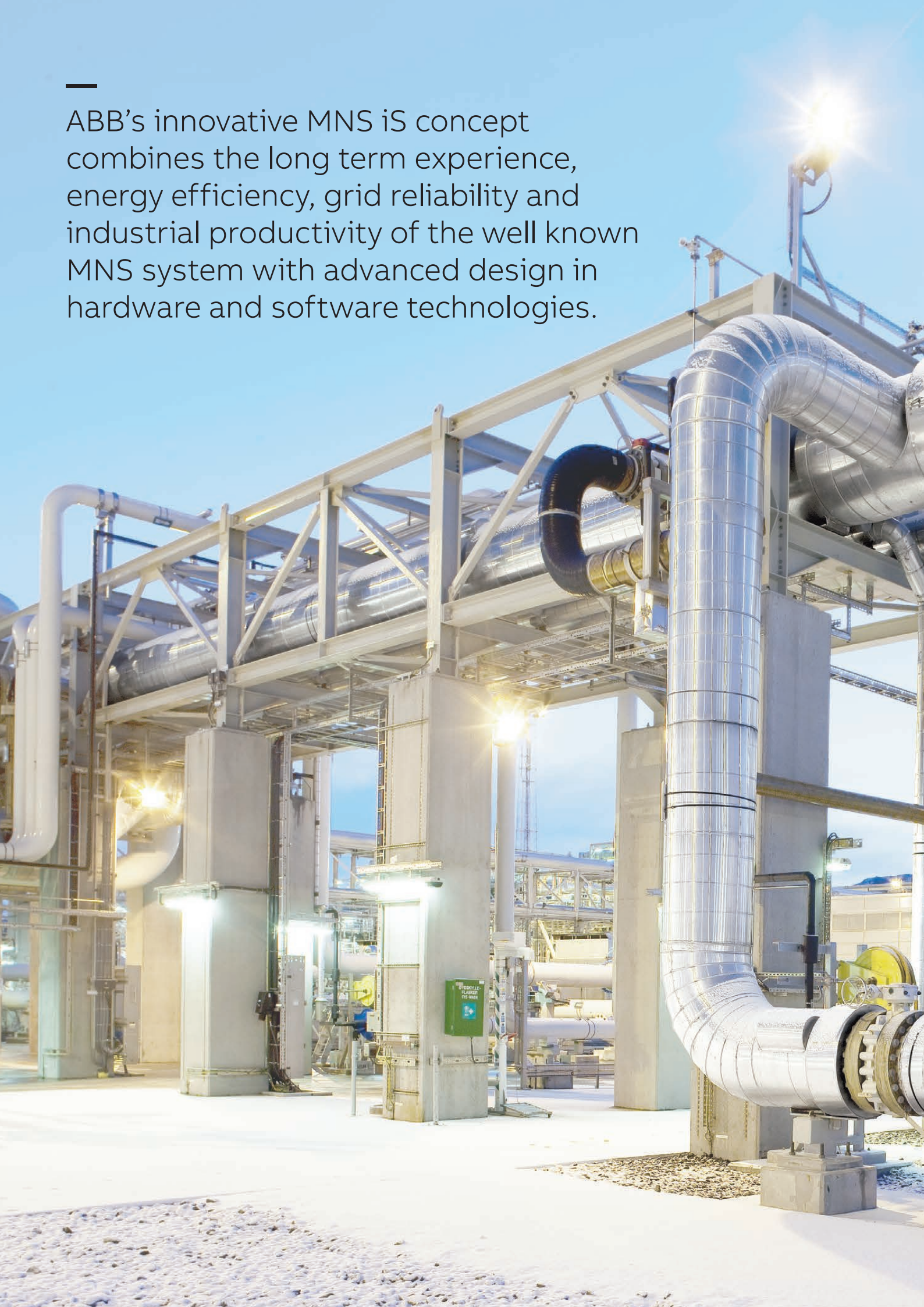
MNS iS motor control center
System guide

Table of contents

ABB’s innovative MNS iS concept combines the long term experience, energy efficiency, grid reliability and industrial productivity of the well known MNS system with advanced design in hardware and software technologies.



MNS iS system overview
MNS iS – Value inside

High protection and safety
MNS iS and its clear segregation of power and control compartments offers highest personal, system and supervision safety possibilities.

Standardization
Maximum simplicity due to standardized power modules – fully assembled and ready to use for a wide range of motor starter and energy distribution modules.

Lower lifecycle costs
These are defined in three ways; less downtime, less fault finding and less inventory.

Information variety
MNS iS offers latest HMI technology, remote management, innovative plug and produce technology and real time plant condition monitoring.

Complete solution
ABB offers the possibility to provide an all in one solution when MNS iS is used in conjunction with other power and automation technologies from ABB.

Pro-active maintenance
MNS iS with Condition Monitoring indicates conditions before a failure occurs, enabling pro-active maintenance possibilities.

User friendliness
MNS iS provides integrated user tasks, like module supervision, lifecycle management, contact temperature supervision and power loss supervision.

Less engineering complexity
MNS iS is the easiest way to plan, engineer and manage a low voltage switchgear system.

Project implementation
MNS iS helps you to reduce your project costs by offering a shorter project duration due to high standardization and reduced engineering.

MNS iS system overview
MNS iS – Innovative design

MNS iS retains the best of MNS technology and evolves it into the next level of operational handling benefits for customers' low voltage motor control center applications.

The distinct elements in MNS iS are:

Power and control part operational safety
Physically separated and independent operational handling of power and control parts.

Standard power modules
Fully assembled, ready to use and offered for a wide range of motor starter and energy distribution modules.

Flexible control modules
Scalable for basic to complex motor starter types, protection functions and field input/output signal requirements.

Integrated control schematics
All starter level interlocking scheme between control and power module is built in.
No hardwiring or input/output assignment required. The control schematic is reduced to assigning field I/O signal contacts only.

Measurement variables
Selectable temperature, current and voltage measurement for various protection needs for both motor and the switchgear itself. No traditional transformers are utilized for any measurements.

Information distribution as required
Industry standard communication interfaces, such as Profibus DP, ProfiNet, Modbus RTU, Modbus TCP and OPC are available, enabling site wide distribution of information (operator, maintenance, management).

System accessibility with 'off the shelf' web browser based devices
With an inbuilt web server functionality, the user can select any web browser based device to interrogate the system.

User friendliness
Self supervision of module location, module type, power rating and automatic installation onto the communication network.

MNS iS system overview
Function module concept

MNS iS motor control center solution delivers all the functions for control, protection and monitoring of the motors and motor starters using software and hardware modules for the specific tasks. Right information is provided to the right people at the right time.

Hardware modules are designed to fulfill desired tasks (power module containing electrical parts e.g. to isolate power, control module containing software applications etc. to control a motor). System functions are provided as functional modules to be downloaded to the control module. Only required functions are downloaded while others are available as options.

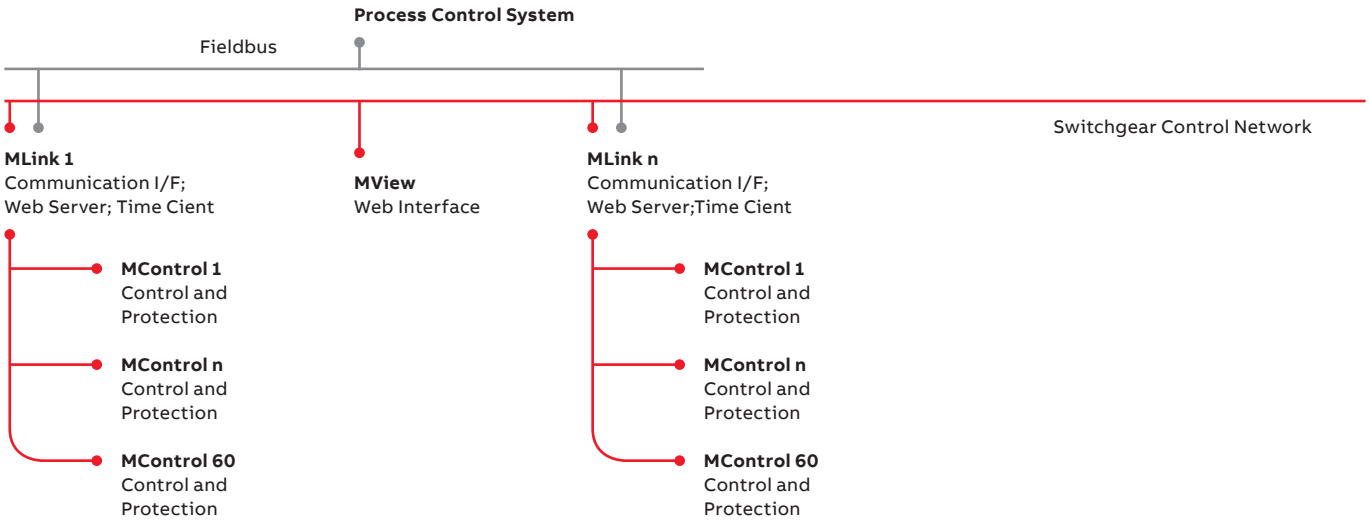
System functionality may be enhanced at any time without the requirement for additional hardware or wiring.

Time synchronization with a time server in the plant or locally in the switchboard allows accurate time stamps of alarms and events collected in the control module.

Module and location supervision are available as a standard. These functions ensure the corresponding power and control modules are installed to the correct location for the particular motor/feeder application.

Maintenance functions are an integral part of the system. Asset monitors measuring system performance data (e.g. outgoing line temperature, number of insertions) allow scheduling of maintenance activities only if they are really required.

The flexibility of the system allows modifications by a simple “plug and produce” concept. Exchanging the modules or changing the parameter settings is easily achieved by using system inherent functions and tools.



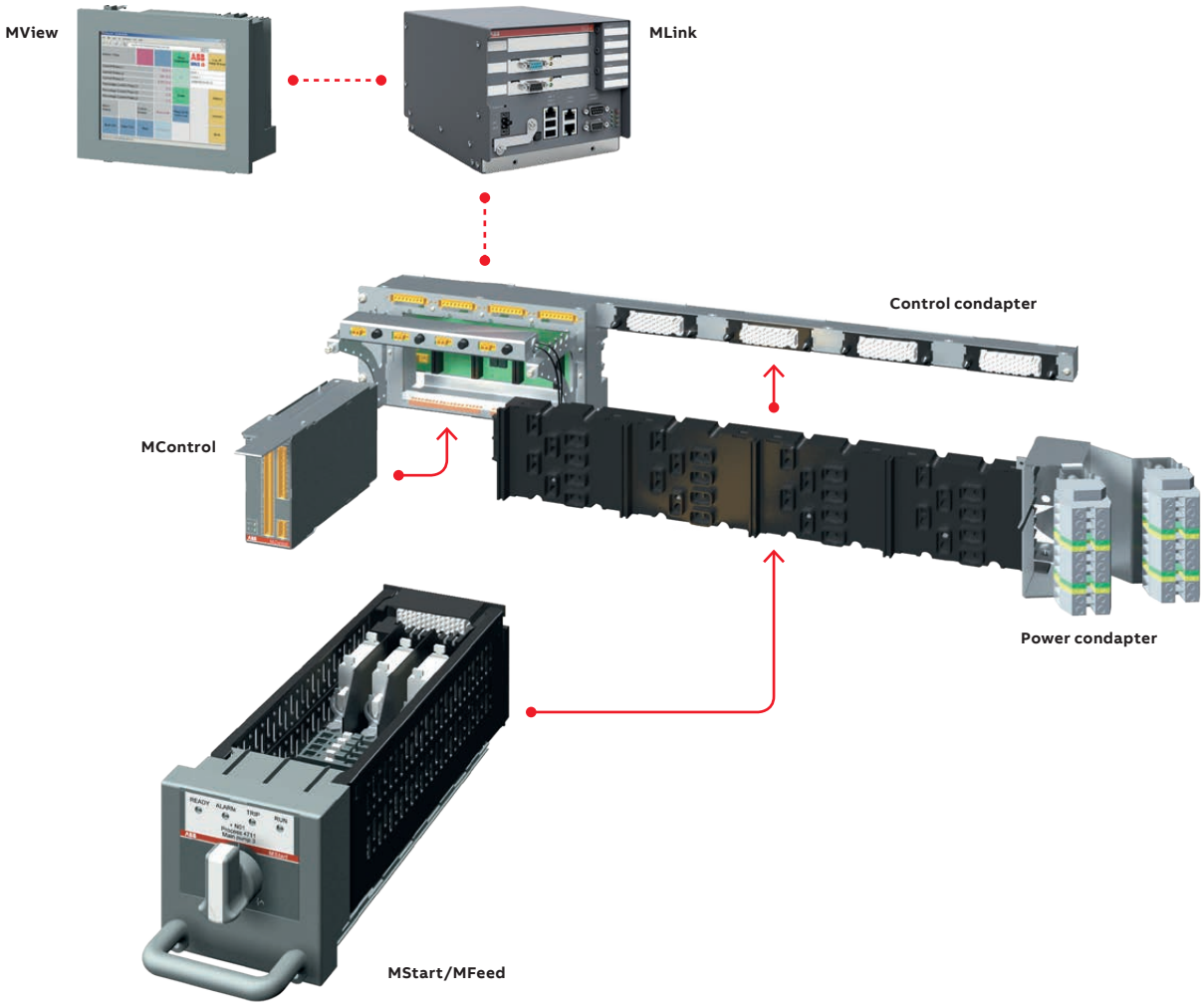
MNS iS system overview
Components overview

The power module MStart/MFeed comprises:
- The electrical isolator.
- The short circuit protection device (fuses or circuit breaker).
- Contactor and any electrical control equipment and status indication.
- The sensor module (measuring the electrical values, which are then available to the process via the MControl module).

The integrated motor controller module MControl (located in the control compartment) comprises:
- The processor performing all the protection, control functions and monitoring functions. It exchanges information with the MStart/MFeed via an internal bus.
- I/O interface modules providing an interface to external components for control, protection and indication.

The interface module MLink serves as the gateway to higher level systems which communicate via the internal bus to all MControl modules.

A local human system interface MView is available to monitor the MNS iS status and display information on each connected motor/feeder.



MNS iS design aspects
Switchboard construction

MNS iS as part of the ABB low voltage switchgear solution uses the well proven ABB MNS standard design aspects. MNS aspects described in this section are fully applicable to MNS iS.

MNS system is a verified low voltage switchgear design in accordance with IEC 61439 series and IEC 61641.

The consistent application of the modular principle both in electrical and mechanical design as well as the use of standardized components allows its flexible and compact design. Depending on operating and environmental conditions different design levels are offered.

Notable system advantages with regard to design aspects:

- Optimum personal protection
- Design verified by testing
- Arc fault containment acc. criteria 1-7
- High operational reliability and availability
- Earthquake-, vibration- and shock-proof designs are available
- Maintenance-free busbar construction
- Simple retrofitting procedures
- Compact, space-saving design
- Easy project and detail engineering through standardised components

MNS iS design aspects
Functional compartments and segregation

The switchboard is divided into vertical and horizontal compartments thus separating different functional areas.

As a standard, power cabling and control wiring are strictly separated within MNS iS. The switchboard is structured as follows:

1. **Equipment compartment**
   All equipment, including the standard motor starter modules (MStart) in withdrawable design, is situated therein. The compartment can be divided in horizontal and vertical sub-compartments.

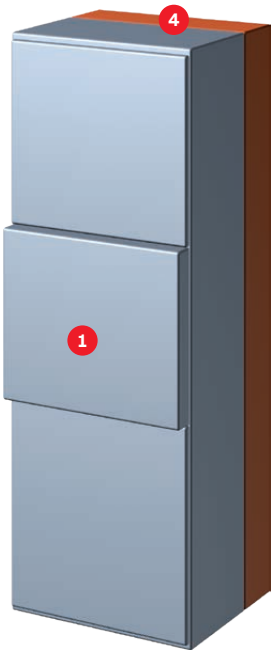
2. **Control cable compartment**
   Contains the motor control devices (MControl), control cables and terminals.

3. **Power cable compartment**
   Contains power cables and connection units.

4. **Busbar compartment**
   Contains the MNS main busbar system and distribution bars. The distribution bars are embedded in the multifunction separation wall (MFW) which is located between the equipment compartment and the busbar compartment.

System highlights

- Functional areas are separated from each other in accordance with IEC 61439 series.
- Power cables are fully separated from the control and communication cables, thus avoiding electromagnetic interferences.
- Different access rights to cable compartments can be granted using different key locks.



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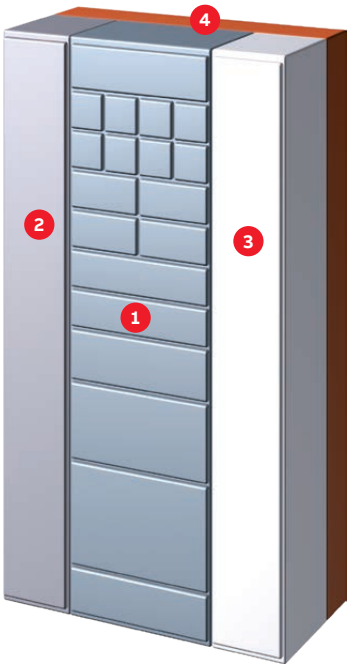
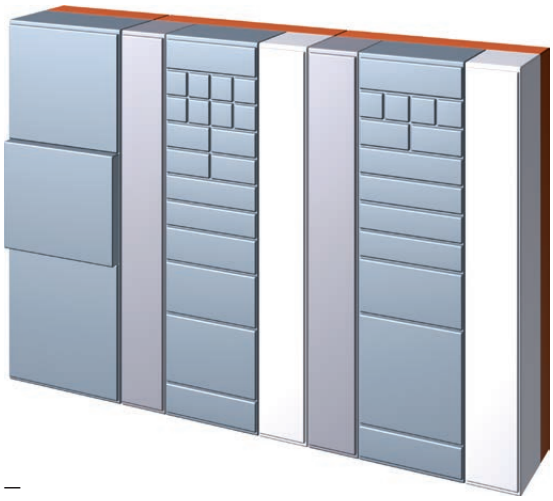


— MCC

MNS iS design aspects
Switchboard arrangements

MNS iS cubicles can be arranged as follows:
- In standard execution (back-to-wall)
- Back-to-back
- Duplex

For switchgear dimensions, see **Technical Data** section.



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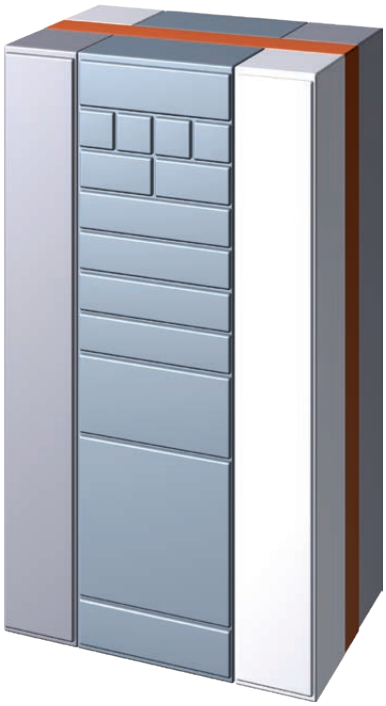
Standard (Back-to-wall)



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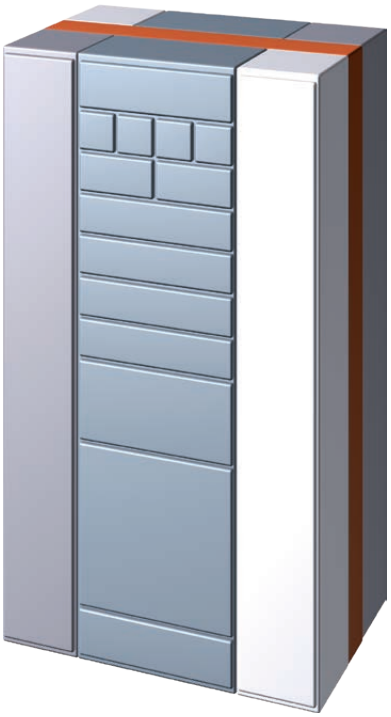
Back-to-back



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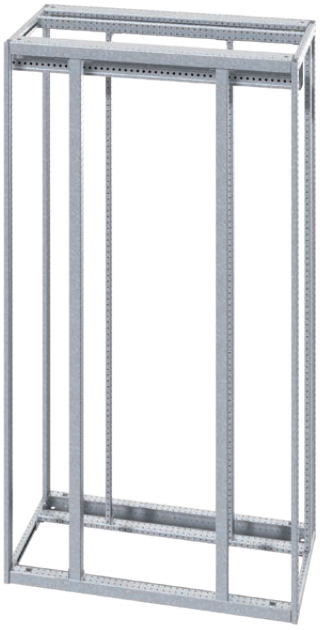
Duplex (common busbar compartment)

MNS iS design aspects Frame construction

The basic elements of the MNS iS frame construction are “C” shaped steel profiles with a 25 mm hole pitch according to DIN 43660. This 25 mm equals the dimension of 1E used in MNS to define the area usage within the switchgear.

Each cubicle is precision constructed by bolting horizontal and vertical profiles together, to form a rigid modular structure. The assembly is maintenance free as a result of the construction method utilizing a combination of thread locking ESLOK screws with bolted pressure plates and thread forming screws.

The profiles are galvanic protected (Zn or AL/Zn) against corrosion.



MNS iS Design Aspects Enclosure

MNS iS switchboard enclosure is made of sheet steel protected by galvanic coating and powder coating for maximum durability.

The fixing of the enclosure with respect to doors, roof plates, rear and side walls is achieved with thread forming screws. Final construction varies depending upon the required degree of protection.

In accordance with the general safety philosophy followed with MNS iS, each compartment and sub-compartment which requires access for commissioning, operation or maintenance, has its own door.

MNS iS design aspects
Cable compartments

Access to components such as electronic protection relays within standard switchgear is usually not possible if the module is energized.

As an innovative design attribute MNS iS switchgear provides separate compartments, one for power cables on the right hand and another for control cables on the left hand. The two cable compartments can be provided with different key locks in order to assure specific access rights.

Cable compartment separation is available as an option up to Form 4, as shown below.

Control cable compartment
The control cables have their own control cable compartment completely segregated from the power compartment.

This control compartment houses the scalable motor control units MControl and serial communications bus cables.

The control wiring can enter from the top or bottom as required for the project.

Power cable compartment
MNS iS motor/feeder cables are housed in their own power cable compartment completely isolated from any control equipment or wiring. The cubicle arrangements are configured suitable for front cable access.

The power cable compartment can be provided with cable entry from the top or bottom of the cubicle.

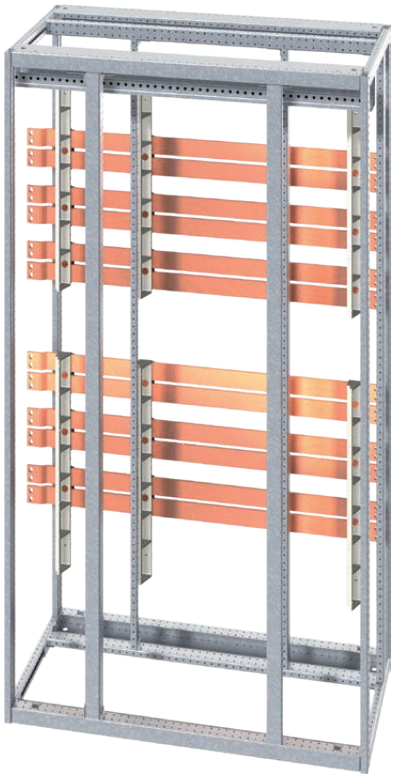
MNS iS design aspects
Busbar systems

Main busbars
The MNS main busbar system is arranged in the rear of the switchgear. This assures a maximum distance from the busbars to the operator and maintenance staff. The main busbar system is fully separated from the equipment compartment as well as from the cable compartments.

The busbar system is a maintenance free construction as a result of utilizing thread locking ESLOK screws together with conical spring washers.

This technology remains relatively unchanged since the introduction of MNS, and has been extensively supplied into the most demanding industries.

The busbar system and all associated parts are manufactured from copper in accordance with DIN 40500. Options are available for silver plating and/or fully insulated solution utilizing heat shrinkable sleeving.



Protective earth and neutral bars
As a standard, protective earth and neutral bars run horizontally in the front of the switchboard just above the base. The PE bar is fastened to the frame to assure electrical continuity. Inside the power cable compartment they run vertically, located on the front right hand side of the compartment.

For applications where a 50% or 100% neutral size is required due to unbalance or harmonic distortion as well as for 4 pole switching, the neutral conductor can be arranged within the busbar compartment running in parallel with the main busbars.

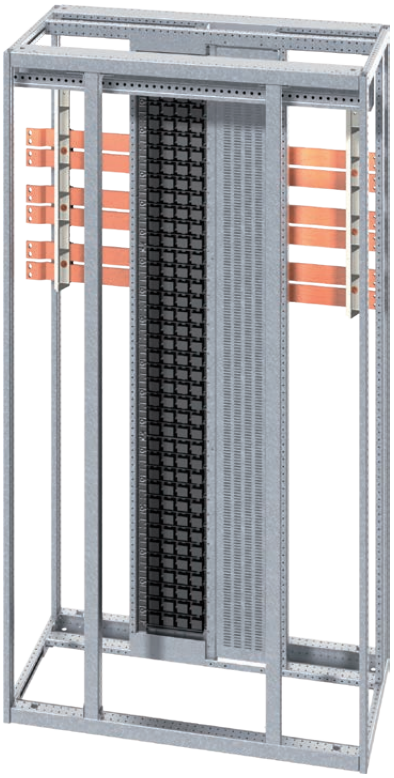
Multifunction wall
The multifunction separation wall (MFW) with the embedded distribution bars is a unique ABB design. It constitutes a complete barrier between the main busbars and the equipment compartment.

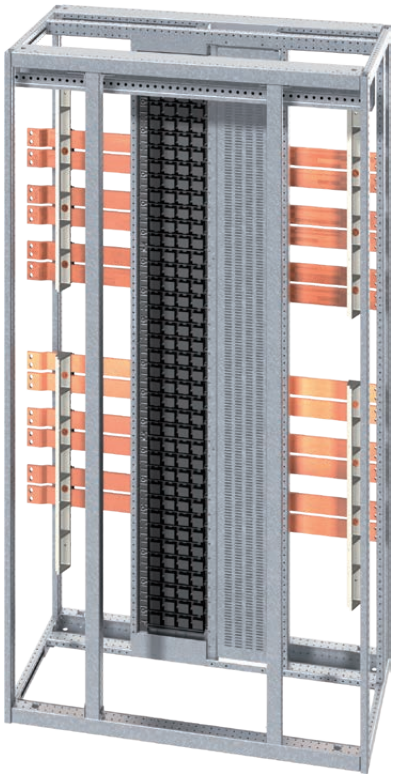
The distribution bars are fully phase segregated and insulated. This design makes it virtually impossible for an arc to pass between distribution bar phases or between main busbars and equipment compartment. The insulation material is CFC and halogen free, it is also flame-retardant and self-extinguishing.

Contact openings are finger proof (IP 2X) so that personal safety is guaranteed even when modules are removed.

With the use of MNS specific power contact housings full individual phase segregation is assured prior to the connection of the power contacts to the distribution bars (see page 23 for details).

System highlights
- Maintenance free busbar construction
- Easy switchgear extension
- Main busbar arrangement at the rear thus assuring
  - maximum safety to personnel
  - effective withstand against highest stresses in case of short circuit
  - optimum heat dissipation
- Gas tight seals for connection from the equipment compartment to the main busbar system
- Option for Form 4 separation for both incoming and outgoing assemblies
- Active and passive arc fault prevention tested according to IEC 61641
- Isolating materials are free of CFC and halogens





MNS iS design aspects
MNS iS power modules MStart

Module options
Available options for the selection of MStart modules are:
- Starter types:
  - Non-reversing Direct Online (NR-DOL)
  - Reversing Direct Online (REV-DOL)
  - Heavy Duty (HD)
  - Star-Delta (NR-S/D)
  - Contactor Feeder (CF)
  - Feeder (Energy distribution module)
- Rated voltages: 400V, 500V, 690V
- Short circuit protection device (SCPD): fused, fuseless

For more information on the available module types, please refer to the module selection tables in the Technical Data section.

Withdrawable modules MStart
The withdrawable design of MStart provides a maximum of plant and operator safety.

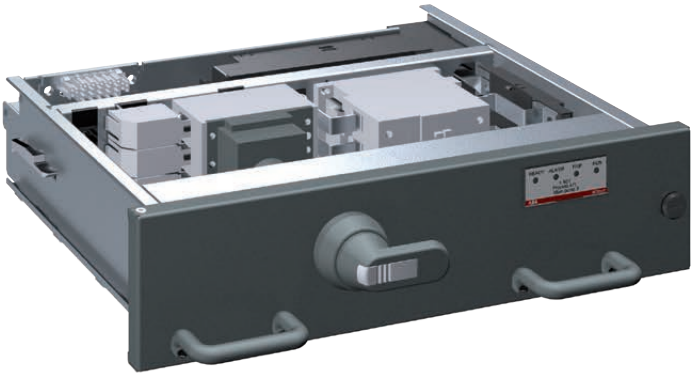
As per definition in IEC 61439 series, withdrawable modules can be electrically connected and disconnected (“withdrawn”). This is applicable to the main incoming circuit, the main outgoing circuit as well as the auxiliary circuits. MStart modules can be withdrawn without the help of a specific tool. MStart are standardized components, ready-to-use and offered for a wide range of motor starter ranges and applications leading to maximum flexibility.

The high device packing density allows a comparatively low footprint of the MCC.

Main characteristics
- Multi-functional operating handle connecting to module interlocking mechanism
- Ergonomic module handle to withdraw the module
- Motor status display (4 LED) integrated in module front
- Module rear wall with integrated contact system and sensors
- Control terminal block

MStart comprises the power and control circuit together with the measurement functionality. Scalable control, protection and monitoring functionality is taken over by the allocated MControl located in the control cable compartment.

System highlights
- Standardized motor starter and feeder modules
- MStart can be replaced while switchboard is energized
- Patented shunt sensor technology
- Power loss reduction due to separation of control components permits high-density module arrangement in the switchboard
- Halogen free cabling



Fixed Modules MStart
Fixed modules are utilized for motor starting solutions where a rating is in excess of 250 kW.

The motor starter components such as the switching device, contactor and shunt modules are mounted in the main compartment.

The MControl and field I/O connections are located either in the upper compartment or lower compartment, dependant upon the cable entry requirements. For example, when cable entry is from below the MControl is located in the upper compartment and vice versa.

MNS iS design aspects
Module connection to distribution bars

Power contact
Connection to the distribution bars is realized using the precision-engineered MNS power contacts. The power contact is characterized by a turn-able bearing, thus decoupling cable stress and electrical contact. Consequently any cable bending forces cannot affect the stability of the power contact.

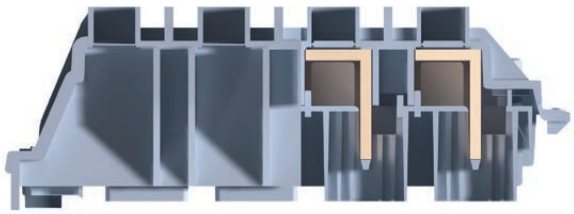
The mechanical stabilisation is taken over by the supporting plate and the contact spring where the contact fingers ensure positive electrical contact. Contact fingers are silver plated as standard.

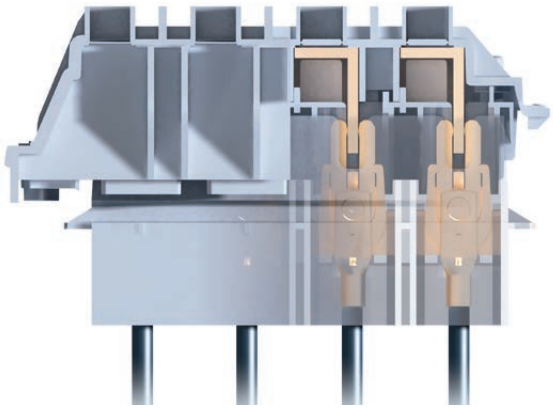
The contact has been subjected to several tests in order to prove the sophisticated design and the high quality:
- Verification by testing acc. IEC 61439 series
- Corrosion test acc. DIN 50017 and IEC 60068-2-60
- Crimping quality check acc. IEC 61238-1
- Vibration and shock test acc. IEC 60068-2-6 and IEC 60068-2-27

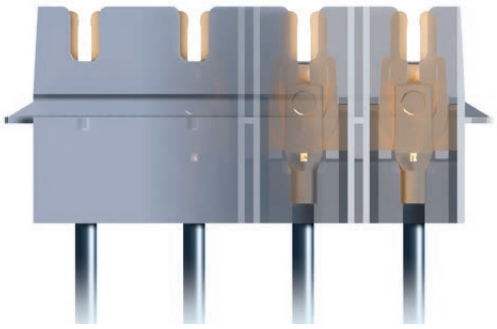
A condaptor unit facilitates the horizontal distribution of power from the vertical distribution bars for 6E/4 and 6E/2 modules, see illustration on page 35. The condaptor enables the modules to be located adjacently within the same horizontal position of the cubicle.

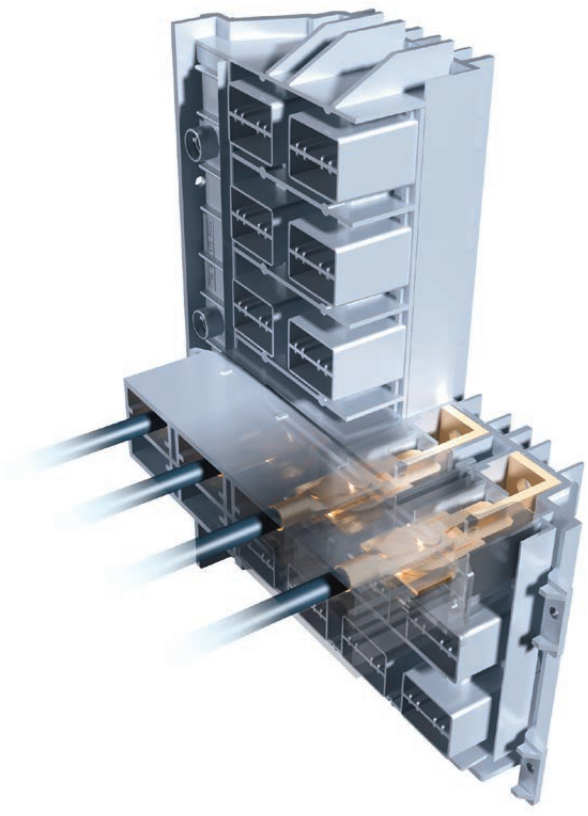
Modules of size 6E and above are connected directly to the vertical distribution bars.

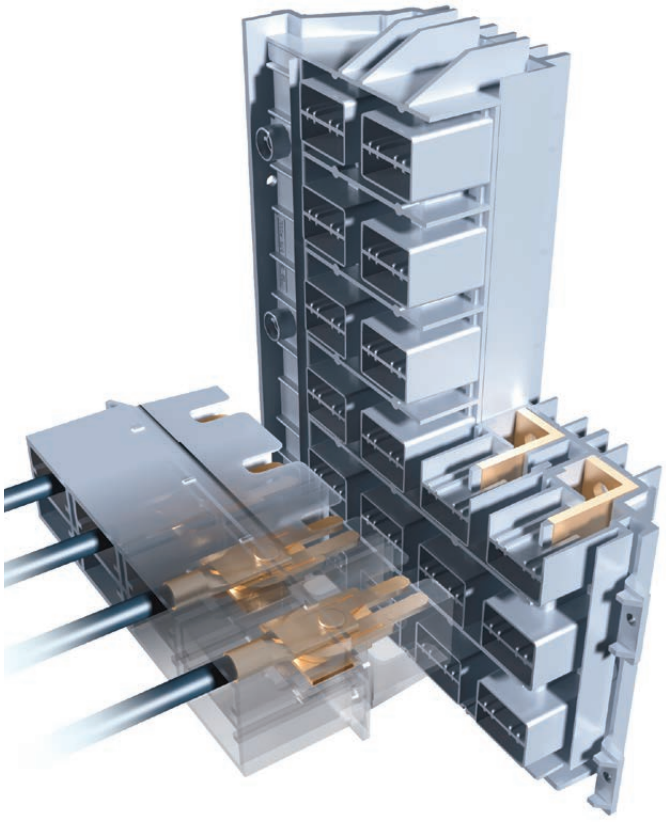
System highlights
- Although IEC 61439 series requires 200 connection cycles only, the MNS contact system is tested, certified and proven for contact cycles (plug in/unplug) up to 1,000
- The contacts are silver coated as standard
- Full individual phase segregation assured prior to the connection of the power contact. See illustrations on the following page











MNS iS design aspects
Incoming feeders and bus couplers

MNS incoming solutions are verified by testing in accordance with IEC 61439 series, in addition to IEC 60947-1 required for the individual apparatus, and engineered to meet the requirements of IEC 61641. This ensures ABB's offering of 'Proven Safety Plus' for operators and plant.

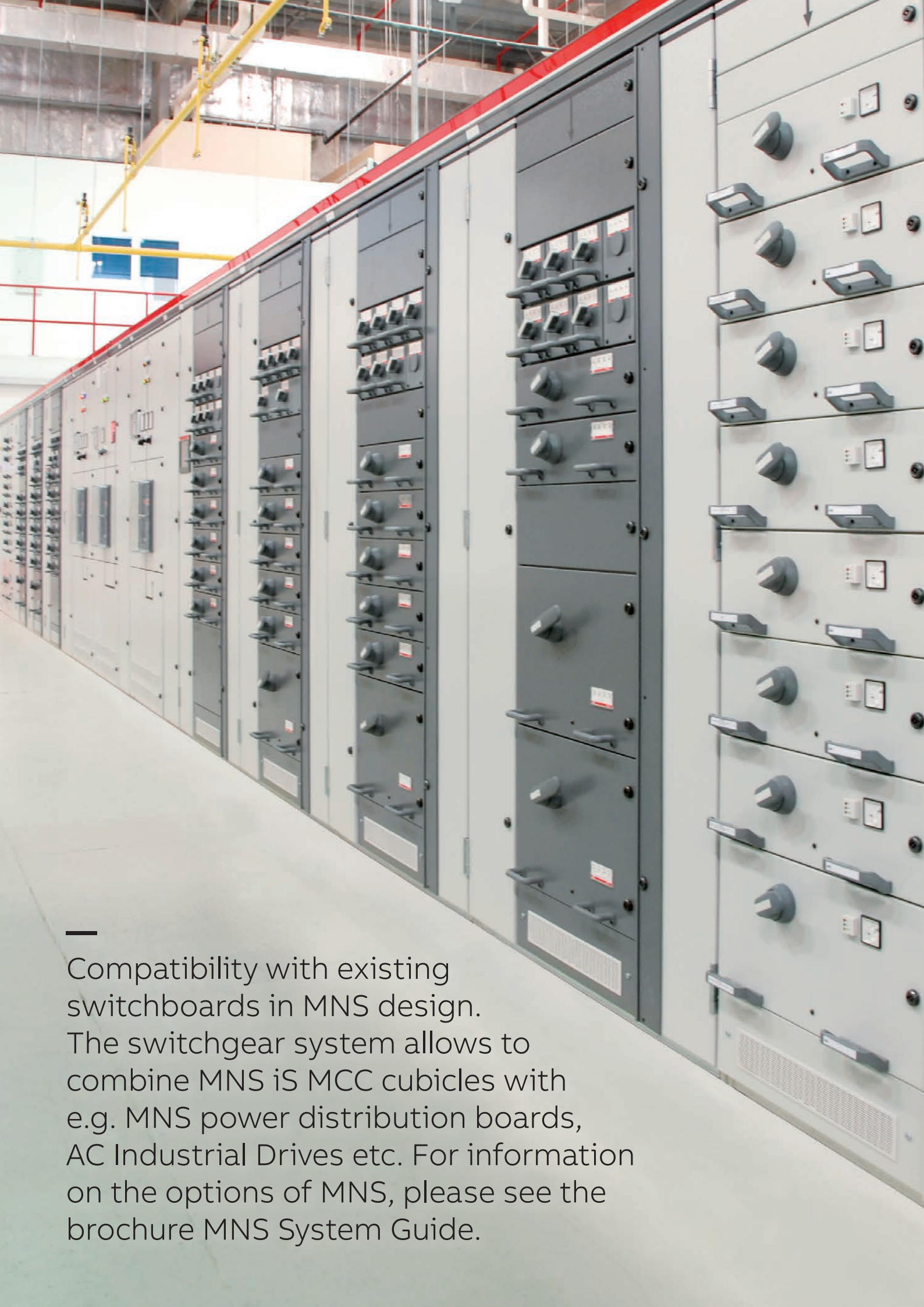
Incoming options
All ACBs have as a minimum the following features:
- Manual charging lever and 'charged' indication
- Manual open/close push buttons
- Mechanical 'open'/'closed' indication
- Mechanical signalling of 'overcurrent' release
- 4 auxiliary contacts

Project specific options
- Gas sealed connections to the main busbars (separation wall)
- 3 or 4 pole solutions
- Withdrawable/fixed configuration
- Top or bottom cable entry/bus duct
- 50% or 100% neutral
- Shunt opening/closing release
- Undervoltage release
- Electrical signalisation of ACB status
- Key locking facilities
- Shutter locking facilities
- Mechanical indication 'racked in'/'racked out'/'test isolated' position
- Locking in racked in/racked out/test isolated position
- Switch disconnector option
- ACB handling truck
- Configuration and test unit

ABB's electronic releases of PR series offer a variety of programmable protection functions for all mentioned circuit breaker types:
- Overload protection L
- Selective short circuit protection S
- Instantaneous short circuit protection I
- Earthfault protection G

Further options available (but not limited to):
- Zone selectivity
- Dual protection settings
- Directional short circuit protection
- Reverse power
- Under-/overvoltage protection
- Annunciation of measured values, alarms
- Maintenance data
- Integration into a plant wide process control system

In order to satisfy other incomer requirements there are further options:
- Load break switches
- Moulded case circuit breakers (MCCBs)



Compatibility with existing switchboards in MNS design. The switchgear system allows to combine MNS iS MCC cubicles with e.g. MNS power distribution boards, AC Industrial Drives etc. For information on the options of MNS, please see the brochure MNS System Guide.

MNS iS user interface
Integration into plant wide monitoring and control systems

MNS iS leads the way with the first truly integrated switchgear system, not only from the electrical and safety point of view but with the high capability for easy and reliable information distribution.

MNS iS offers multiple possibilities for process operators, electrical and maintenance teams as well as plant managers to access the desired information.

Plant control system
Process industry control applications require support of varied combinations of systems interfacing to switchgear and motor control centres. This is either due to specific customer philosophy for control operation or need of information at different operator locations.

MNS iS caters to customers' requirements effectively by supporting various combinations of industry standard communication interfaces and applications.

Electrical network monitoring /SCADA
With plant availability demands increasing, the demand for electrical statistics and conditions also increases. The ability to provide the right information at the right time is critical for profitable plant operation. This functionality is an integral component of MNS iS.

For access to electrical data an industry standard Ethernet interface is available. This interface supports OPC functionality, an open interface standard, enabling easy access to all of the following data;
- Measurement values, device status and diagnostics
- Time stamped alarm and events

Engineering and maintenance
The Ethernet interface enables full access to all system parameters and settings should the relevant user rights be granted. A Windows based engineering tool provides a user optimized possibility to engineer all system parameters over a network connection.

MNS iS Condition Monitoring
Maintenance expenditure is one of the largest forms of expenditure in a process plant of today. MNS iS facilitates a structured approach to maintenance and with this enables cost reduction in conjunction with a predictive maintenance procedure.

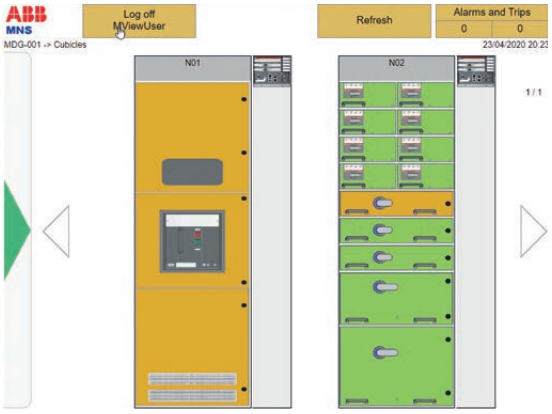
The MNS iS Condition Monitoring is based on ABB Ability™ CMES and continuously monitors the switchgear utilizing real time information.

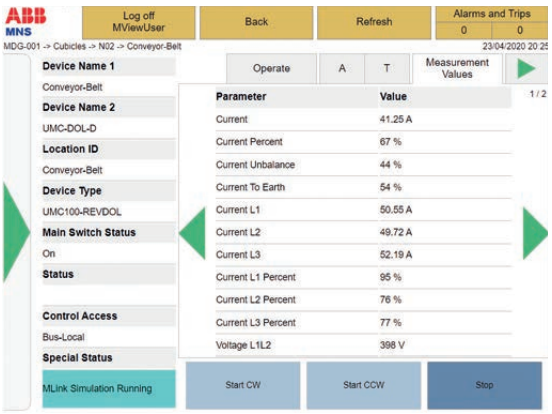
Any status change in the switchgear is monitored and analysed converting data received into valuable system information. This information is then provided in the following format:
- What is the problem?
- Where is the problem?
- What is the severity?
- What has caused the problem?
- Who should initiate the rectification?
- What actions are required to solve the problem?

MNS iS user interface
Interrogation and operation

MView
The functionality of the MView is that of a web interface. The web server runs as an application on the MLink, and can be accessed by any standard PC running web browser software.

As a standard solution the MView is available as an industry standard touch panel PC mounted directly on the switchgear. ABB's plant wide information philosophy is fully applicable here, as a further possibility exists. The MView web interface can be accessed by any Windows standard PC within the switchgear control network.





The MView function provides the user with the following options, based upon sufficient access rights:

Control:
- Stop/Start/Reset.

Engineering:
- Interrogation of control and protection parameters
- Download of configuration and protection parameters

Process information:
- Current in Amps
- Current in %
- Thermal image
- Time to trip
- Time to reset
- Active, reactive and apparent power

Status and diagnostics:
- Available/Stopped
- Running
- Tripped
- Alarms and events

Maintenance:
- Module insertion cycles
- Contactor switching cycles
- Main contact temperature
- Hours run
- Module serial number

MNS iS user interface
Parameterization and engineering

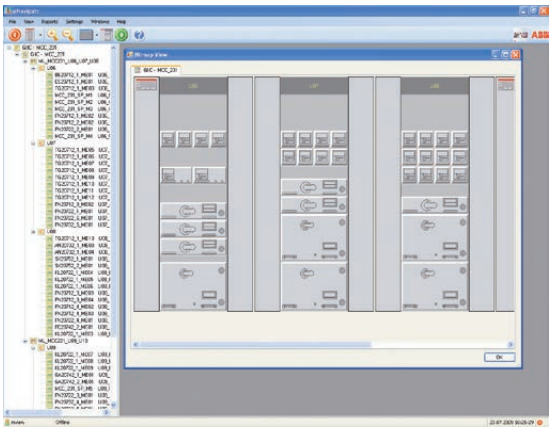
MNavigate
MNavigate is a multifunctional engineering tool utilized both by ABB and end customers. The tool is utilized over the complete lifecycle of the switchgear, from the engineering and project department through factory acceptance tests, to commissioning assistance and start up. Following on from this it then becomes the tool used by the operations and maintenance departments for any tuning of the system during the life cycle including any service and maintenance schedules.

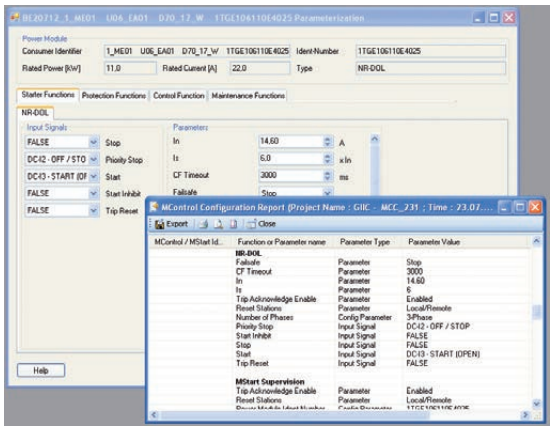
MNavigate is based upon Microsoft Windows. Utilizing the familiar Windows environment it enables engineers to configure, parameterize, and maintain the system from anywhere in the switchgear control network, providing user access rights are granted. MNavigate enables the user to parameterize and configure the MNS iS system:

Control and power module setup:
- Online help file
- Motor protection parameters
- Configuration of the connected plant I/O (auxiliary circuits)
- Configuration of logic blocks for e.g. field interlocking
- Configuration of the power module indication

Communications setup:
- Fieldbus configuration
- Failsafe configuration
- Switchgear network configuration
- Time synchronisation setting
- Download and configuration of fieldbus data mapping

Administrative functions:
- User access rights
- Activity reports
- Parameterization reports
- Archive/restore of the projects
- Generation of the following reports to .csv format:
  - MLink configuration
  - MControl configuration
  - Switchgear configuration
  - Switchgear network configuration





MNS iS communication
Communication interface

The MLink is the scalable platform for the interface between the process control system and the MControl modules. The connection to the PCS is possible with the MLink functioning as a standard fieldbus slave device, supporting the following protocols:

- Profibus DP and DP V1
- Profinet I/O (to ABB systems)
- Modbus RTU
- Modbus TCP

In addition to the fieldbus interface the MLink also provides a separate Ethernet port. This interface is available as standard and easily enables the following applications to be simultaneously available over a standard Ethernet network (see illustration below):

- Parameterization/configuration
- Web interface

To offer the maximum flexibility for fieldbus control structure the option exists to directly connect to the MControl with Profibus DP. Please refer to page 36 for more details.

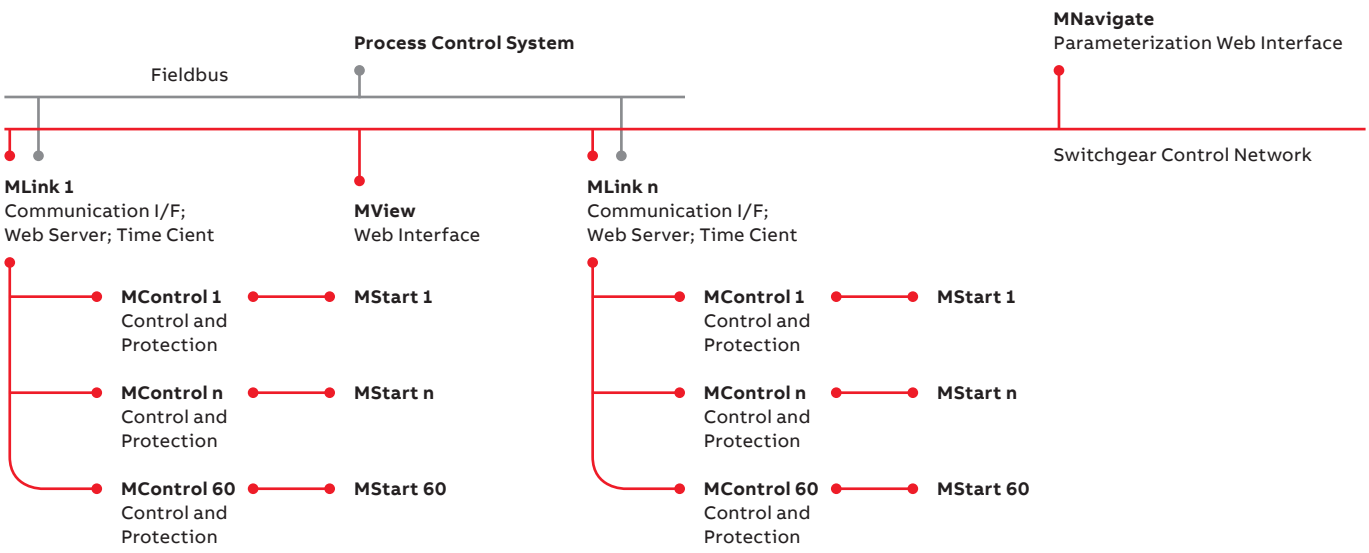
The communication between the MLink and MControl utilizes a real time, master-slave protocol running at 10 Mbps, which continuously polls all the MControls. Each MControl requires 2 ms to receive a command and 2 ms to set the relevant status information. A maximum of 60 MControls may be connected to a single MLink.

The figures shown here are based upon an Ethernet connection to the PCS.

Examples:
For the given number of MControls connected, the following system internal response time figures are applicable.

For 60 MControls	
Communications overhead	18 ms
1st Poll (command received)	60×2 ms=120 ms
2nd Poll (set status)	60×2 ms=120 ms
MNS iS response time	258 ms

For 60 MControls	
Communications overhead	18 ms
1st Poll (command received)	30×2 ms = 60 ms
2nd Poll (set status)	30×2 ms = 60 ms
MNS iS response time	138 ms



MNS iS communication
Time synchronization

MNS iS has the capability to be easily enabled for time synchronization. Typically one time server provides the time synchronization signal for the entire installation, this signal is then distributed through the entire network. This means that all connected assets such as the MControls are synchronized to the same time. When an alarm or event occurs within the system this information is then available via the OPC Server together with time stamp.

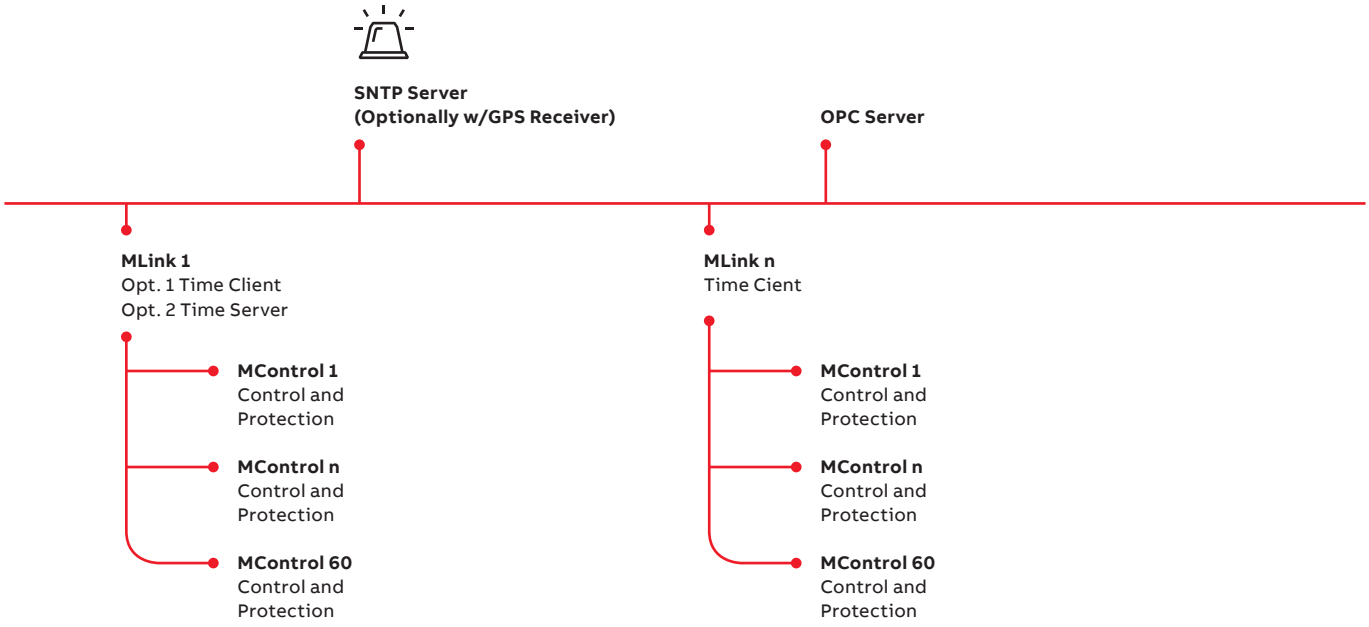
The MLink receives the accurate time via standard Ethernet protocol NTP (network time protocol) from a time server residing in the switchgear control network. Alternatively one MLink can be configured to act as a time server.

Time stamped messages are not sent through fieldbus interfaces in MNS iS.

Option 1
A time server exists in the switchgear network. Its time signal is received by all MLinks and distributed internally. 3rd party products allow the connectivity to a GPS receiver for highly accurate time synchronization plant wide.

Option 2
If no time server is available, one MLink is configured as time server. The time signal is sent to all other MLinks on the switchgear network and processed accordingly.

GPS – Global positioning system
The satellite global positioning system (GPS) distributes precise time, frequency and position worldwide. An atomic clock runs in every satellite whose time is constantly transmitted together with the orbital data. The GPS receiver records the data of up to 6 satellites and uses this information to calculate its position and time. This information is then used by a time server and the signal is distributed as described above.

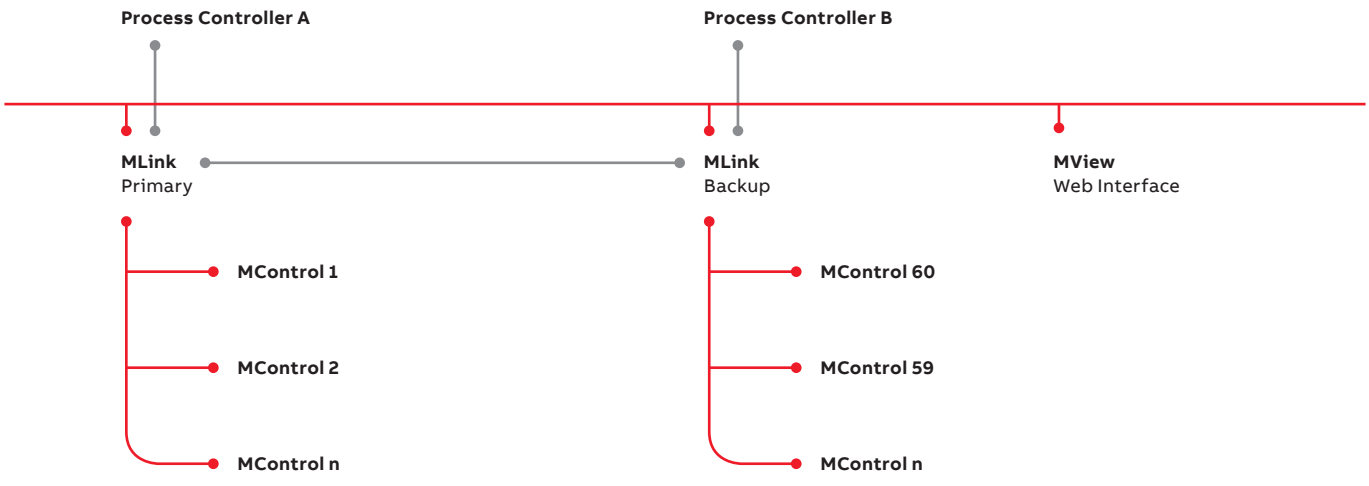


MNS iS communication
Dual redundancy

Process operations today demand a high level of availability. MNS iS may be configured for dual redundant communication. This allows for communication via two independent data paths from the switchgear to controller A and controller B.

In normal operation both PCS controllers can read all data available from both the primary and backup MLinks, however, only the primary MLink is enabled to process the switching commands from the PCS. In the event that a changeover is initiated the primary MLink passes switching command permission to the backup MLink, via the 'redundant link'. This link ensures no communication is lost and full status information is available for the PCS, i.e. a 'bumpless' changeover is performed.

System highlights
- Redundant fieldbus communication increases process vailability
- Inbuilt functionality controlling switching command permissions
- Ability to read information from the system simultaneously by both controller A and controller B
- Web interfaces are automatically directed to the primary MLink



MNS iS control and protection
MStart – motor starter power module

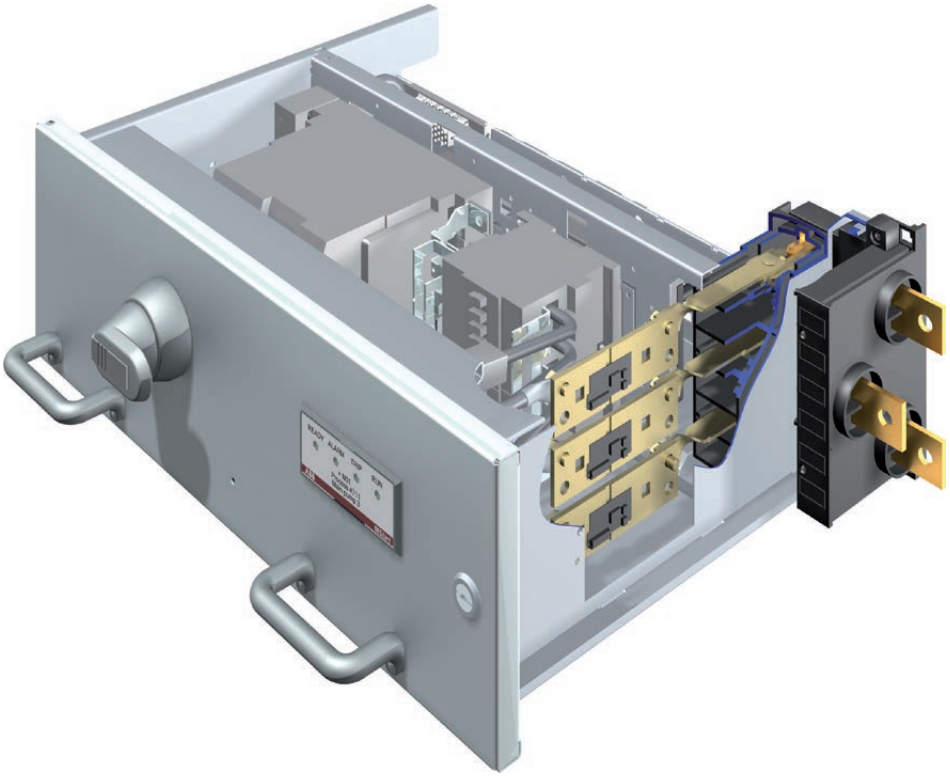
The withdrawable MStart modules are available in the size from 6E/4 to 24E depending on the kW rating of the connected motor/load. Each MStart has a motor isolator, short circuit protection, contactor, control circuit and sensor modules.

Sensor technology
In conventional technologies, measuring is performed with current and voltage transformers whereas in MNS iS, measurement is based on sensor technology especially developed for data logging in electric and electronic systems.

Three sensor modules are located directly in the outgoing line of the MStart modules. A combination of high precision shunt and microprocessor forms a complete measuring system, which not only measures current very precisely, but at the same time measures the voltage and temperature. From these values, it is then possible to provide detailed information and status of the connected load application in a plant environment.

System highlights
- Simultaneous high accuracy measurement of phase current and voltage for AC
- Temperature measurement
- Industrial standard proven sensor product

—
Sensors located in the outgoing line of the MStart module



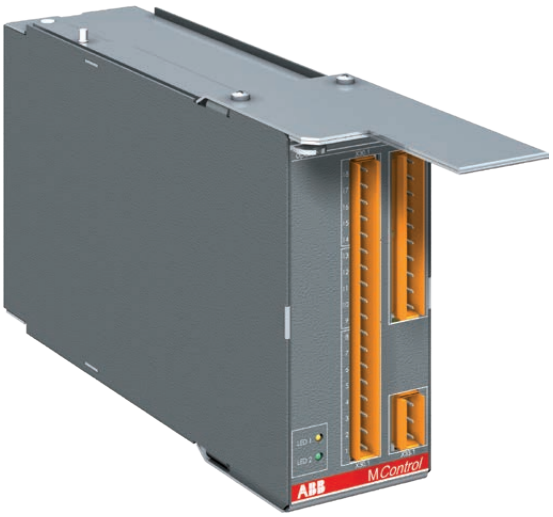
MNS iS control and protection
MControl – motor starter control unit

The MControl is a scalable controller for motor protection and energy distribution. It performs all tasks required to offer advantages in:

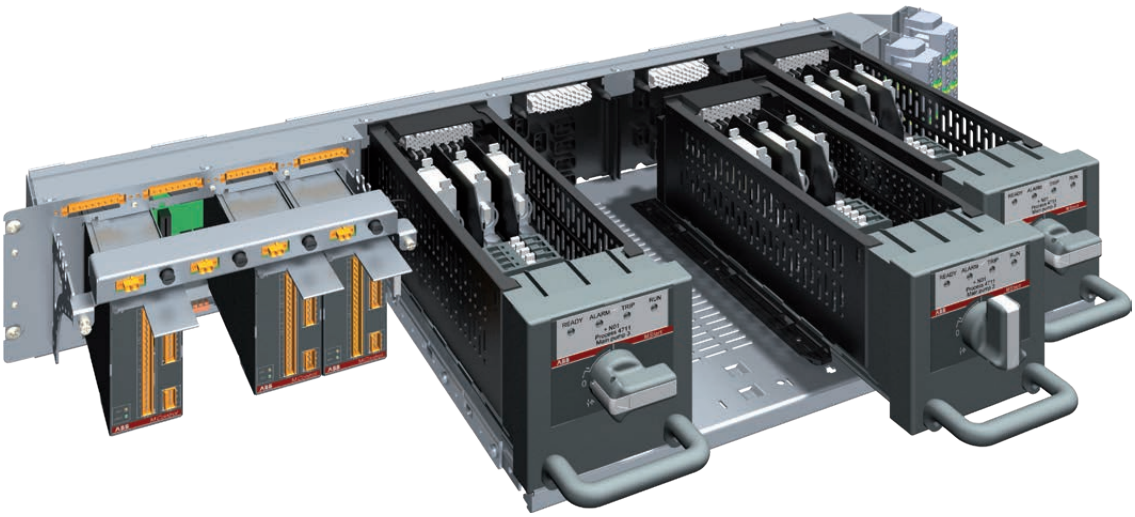
- Operational performance and safety
- Protection and control
- Proactive maintenance possibilities

Scalability is achieved by selecting software modules to perform protection, control or maintenance functions required by the user (see details on page 37). Hardware functionality may also be expanded with a wide range of additional I/O interfaces to meet user demands (see page 36).

To expand the functionality of the MControl, no additional space is required within the switchgear, the MControl remains the same physical size.



— MControl Motor starter control unit



— Control and power condapter with MControl and 6E/4 MStart configuration

MNS iS control and protection
I/O interfaces

MNS iS provides the scalability to fulfill the different requirements for plant operation and control resulting from the wide variation of plant operational procedures across both industries and specific customers' philosophies.

Digital signals
Digital signals such as pushbuttons, limit switches etc. are directly connected to the MControl main board.

The following I/Os are provided as standard:
- 7 binary inputs (24 V DC)
- 4 relay outputs (up to 230 V AC)

Optionally more digital signals can be connected to additional I/O cards:
- 7 DI (110 V AC or 230 V AC)
- 4 DI /2 DO (230 V AC or 24 V DC)

Analog signals
Analog input and output signals e.g. position measuring or current indication can be connected using the analog I/O card:
- 1 analog input and 1 analog output
- 2 analog inputs

The signal level is 0-20 mA, 4-20 mA or 0-10 V DC (selectable).

—
MControl Main board with add-on cards and Profibus interface

Relay card
Two options exist for relay cards to be added to the MControl:
- Relay card with 1 NO + 1 NC contacts
- Relay card with 2 NO + 1 NC contacts

The operation of these relays is independent from the MControl itself. Switching of the contacts requires a 24 V DC signal to be applied to the relay coil. For further technical information, please refer to page 52.

Motor temperature PTC
Motor winding temperature supervision is provided by using the PTC input card type. The board contains 1 measurement input for PTCs according DIN 44081 and 44082.

Short circuit situations or open connections at the PTC connection are monitored by the circuit supervision.

Motor temperature PT100
Two options exist for the PT100 function:
- PT100 single channel input
- PT100 triple channel input

Both of the options have a 4 wire configuration for measuring PT100 in accordance with IEC 60751.

Profibus direct/Profinet direct
MNS iS offers the possibility to connect directly to the MControl with Profibus DP V0 and DP V1 or Profinet, where the MControl then acts as a standard slave device.

The MControl is PNO certified for both V0 and V1 conforming to the 'profiles for low voltage switchgear'. The process control system can send 8 bytes of control data and receive up to 244 data bytes from each MControl.

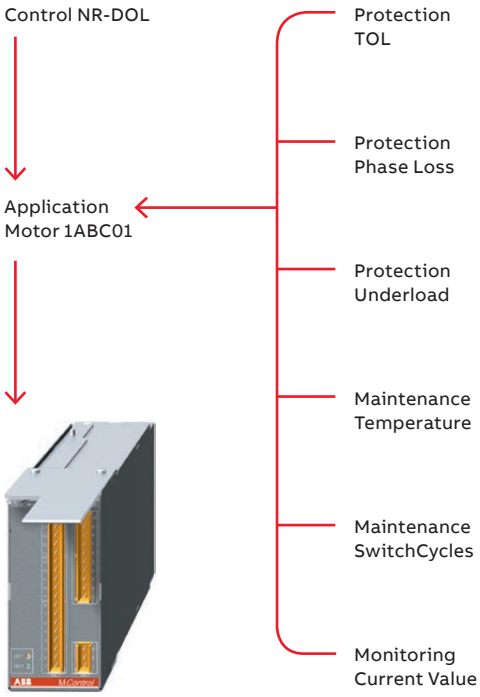
MNS iS control and protection
Modular software application

In MNS iS the control and protection device MControl contains an application program with selected software modules from the following categories (details on the following pages):

- Starter type
- Protection functions
- Control functions
- Maintenance functions

The functional software modules required for the motor/load application are selected during engineering phase and downloaded as an application to the MControl prior to switchgear routine verification. Further functional modules may be added at any stage of the project.

Logic block functionality
Within the control functions category, it is possible to select multiple logic blocks. This provides an easy and flexible way to combine internal and external signals with logical operations such as AND, OR, EXOR, TIMER etc.



MNS iS control and protection
Protection function modules

The motor protection functions safeguard the motor against unwanted influences, either mechanical or electrical.

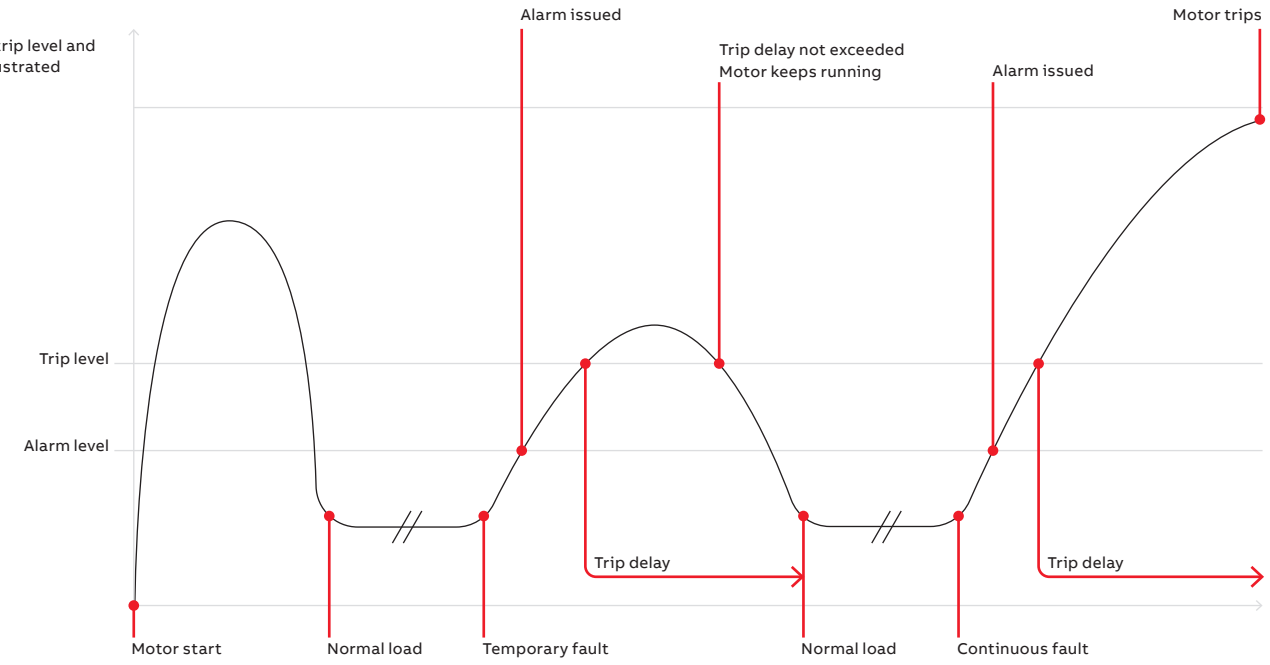
The protection functions are configurable and can be enabled or disabled depending on the requirement.

The philosophy is simple: Alarms are generated when the pre-set alarm level is reached and the adjustable “alarm delay” time is expired. If the “trip level” is crossed and the “trip delay” expires the motor will trip. In each event specific messages are generated.

Additionally, a variety of protection functions can be set to trip only or alarm only.

The trip-reset modes can be configured for auto/remote/local/remote and local trip reset.

Alarm level, trip level and trip delay illustrated



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

Thermal overload protection

Thermal overload protection (TOL) protects the motor against overheating. The motor thermal condition is calculated both when running and when stopped, resulting in the value “thermal capacity”. Utilizing this value enables operations and maintenance to maximize productivity.

- Functionality of the thermal model according to IEC 60947-4-1 (class 5-40)
- MControl calculates “time to trip” and “time to reset”. Additionally a message “TOL reset level reached” is generated to inform the user of a possibility to reset the trip.

—
Thermal overload protection models

Thermal motor protection (IEEE no.)*	Alarm level	Alarm delay	Trip Level	Trip delay	Description
TOL Standard (49)	•		•		Uses the highest measured phase current for the calculation. The thermal capacity calculation considers actual load, phase unbalance and motor rated load in ambient temperature.
TOL EEx-e	•		•		TOL for EEx-e application. Takes into consideration stall/ nominal current ratio and the maximum temperature allowed by the environment class definition. Functionality certified acc. to ATEX Directive 94/9/EC. Approval number PTB 07 ATEX 3128.

*IEEE Standard C377.2-2008 Electrical power system device function number

Unique Proof-test function and test report in MNavigate tool addresses requirements from ATEX installations for regular inspection acc. IEC60097-17 clause 4.2.2 without additional specific tools.

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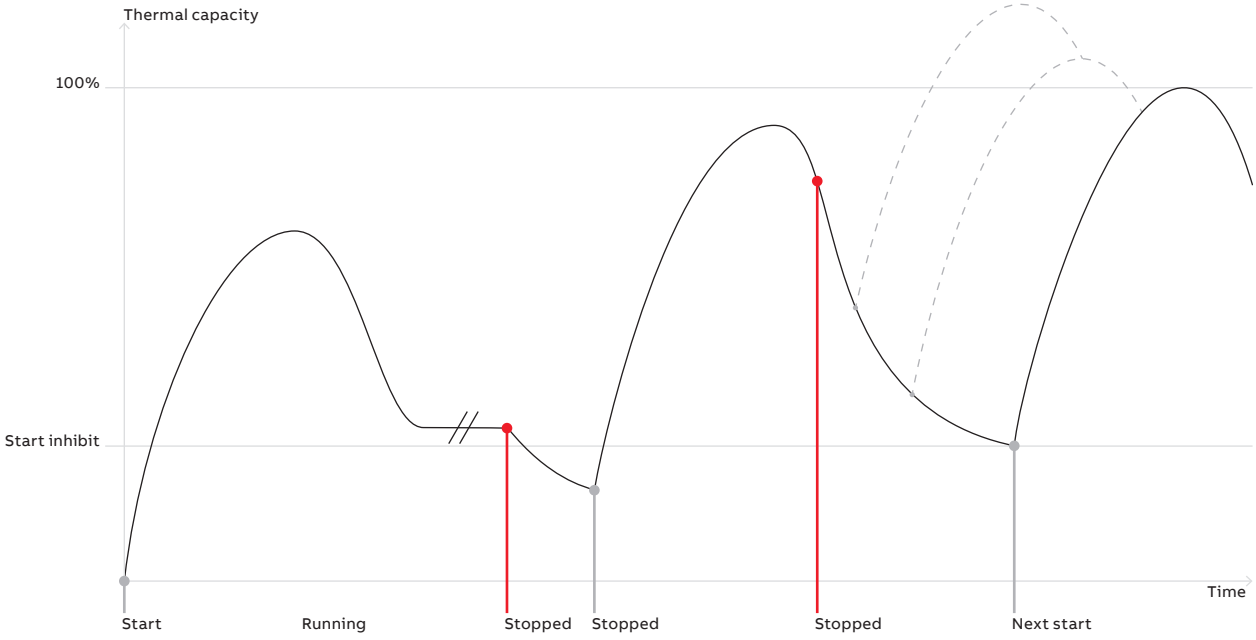
Thermal overload protection illustrated



● start command
● stop command

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

Motor protection module
Any deviation from normal condition of motor operation is monitored and alarmed.

Based on measurement of current, voltage and motor temperature an alarm is issued and after exceeding trip limits, the motor is stopped immediately.

Motor protection function (IEEE no.)*	Alarm level	Alarm delay	Trip Level	Trip delay	Description
Phase loss (46)	•	•	•	•	Phase loss can be caused by blown fuse etc. The protection function uses the highest and lowest measured phase currents to compare against set levels.
Phase current unbalance (46)	•	•	•	•	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.
Undervoltage (27)	•	•	•	•	Protects the motor against undervoltage condition (voltage drop or loss).
Motor temperature PTC (49)	•		•		Protects against too high temperature by using PTC sensors. The resistance values are compared against the set levels. Supervises for open circuit and short circuit conditions.
Motor temperature PT100 (49)	•		•		Monitors motor winding temperatures from PT 100 sensors against preset values, options are available for single or triple channel monitoring.
Earth leakage (50G/51G)	•	•	•	•	MControl uses the measured phase current to calculate the earth fault current level. The value is compared against set level.

*IEEE Standard C377.2-2008 Electrical power system device function number

Process monitoring module
Plants are running continuously for a long time. Mechanical stress can cause problems in mechanical connection of motor to machines and pumps. With MNS iS mechanical motor connection and machines are supervised by monitoring the motor current.

Other problems may be caused by process related starts/stops of the motor. Too many starts or an increased load may cause interruption.

Any deviation can be informed to the automation and maintenance system.

Motor protection function (IEEE no.)*	Alarm level	Alarm delay	Trip Level	Trip delay	Description
Stall (51R)	•	•	•	•	Protects against stall, the highest measured phase current to compare against the set parameters, activates only after motor start-up time is complete.
Underload (37)	•	•	•	•	Uses the highest measured phase current, to compare against set parameters. Trip level can be disabled; therefore MControl can be set to alarm only.
No load (37)	•	•	•	•	Similar to Underload but with different set levels and messages. No load uses the highestmeasured phase current to compare against the set parameters.
Underload cos phi (37)	•	•	•	•	Protects the motor against underload condition based on cos phi detection. The cos phi value is compared against the set levels. This function offers the most accurate method of protecting against cavitation.
Emergency Stop	•		**trip**		When the emergency stop is operated the MControl executes a contactor trip. The release of the emergency stop button will not start the motor.
Start Limitation (66)	•		•		Limits the number of starts during a time interval. Number of starts and time interval are parameter settings.

*IEEE Standard C377.2-2008 Electrical power system device function number

MNS iS control and protection
Maintenance function module

In addition to the protection functions MNS iS has the possibility to monitor maintenance data. The information below is available to the user via communication links or at the MView display.

MNS iS provides predictive maintenance functions, which is one of the key factors in operations and maintenance in today's process plants. The Condition Monitoring function provides the possibility of proactive maintenance. For details, see page 27.

Maintenance function module	Alarm level	Alarm delay	Trip Level	Trip delay	Description
Contact temperature supervision	•	•	•	•	Contact temperature is measured in the outgoing phases of the motor starter and compared against the pre-set level.
Contact temperature unbalance	•	•	•	•	The difference in contact temperatures of all 3 phases is compared against a pre-set level.
Contactor switching cycles	•				Each complete close-open cycle of every single contactor is counted and updated. When the contactor switch cycle limit is exceeded MControl initiates an alarm.
Operating hours	•				The MControl counts the motor running hours. An alarm is initiated when the predefined operating hours limit is exceeded.
MStart insertion cycles	•				Counting insertion cycle of MStart module, an alarm is initiated if alarm level is reached.
MStart supervision	**fixed**				This function supervises the communication status between the MControl and the connected MStart. In addition, the MStart type (ident number) connected to the MControl is verified to ensure the correct MStart is inserted. An alarm is issued if a communication error or an incompatibility is detected.
MControl location supervision			**fixed**		Location recognition and supervision detects MControl module hardware and the loaded application are in the correct location within the switchboard. If the wrong location is detected, a trip is issued.

MNS iS control and protection
System status

MNS iS provides detailed system status information with respect to communication, hard-/software interlocking and asset availability.

System status	Description
System integrity	
Failsafe	Supervises the network communication. If a loss of communications is detected the failsafe activates with either one of the following pre-parameterized functions: no operation, start motor or stop motor.
Control access	Control access provides the facility to define the access control rights for a specific location (such as MView or the process control system or locally via pushbutton etc.)
Starter monitoring	
Main switch supervision	MControl monitors the main switch position of the MStart: on, off and test position.
Contactor feedback supervision	Following receipt of a command signal, the MControl monitors the status of motor and contactor to ensure correct execution. Status is checked by using feedback signals and by current measurement.
Ready indication	Ready indication is provided when no alarms, trips and interlocks are present.
Control voltage supervision	Contactor control voltage level is monitored, any deviation from the set value leads to a trip of motor.
Auto-Restart	After main voltage loss the restart of the motor can be initiated automatically. Restart times can be parameterized in order to allow staggered start of motor in the plant.

MNS iS control and protection
Measurements and monitoring

Status information and measured values from MNS iS are available system wide. Depending on the application, the values are used for process control or maintenance tasks. Process and maintenance related values are freely selectable. Table below is a guideline only.

Measuring and monitoring module	Process related value	Maintenance related value	Description
Motor status	●	●	Motor status such as on/off; open/closed; tripped etc.
Phase currents	●		Three motor phase currents. Absolute and relative values.
Outgoing line temperature		●	Temperature measurement in the outgoing line of all three phases of MStart/MFeed
Calculated thermal capacity	●	●	Thermal capacity calculated from motor and environmental parameters.
Time to trip	●		Estimated time to reach 100% thermal capacity.
Time to reset	●		Estimated cool-down time at which the thermal capacity of the motor allows a restart.
Phase voltages	●		Three phase voltages. Absolute measured values.
Power factor		●	Calculated value.
Active power	●		Active power as absolute value.
Reactive power		●	Reactive power as absolute value.
Apparent power		●	Apparent power as absolute value.
Active energy counter	●		kWh as an absolute value.
Earth fault current	●		Earth fault current calculated as absolute value.
Frequency	●		Frequency of the electrical power system, absolute value.
Digital in-/output	●		Monitoring of binary in-/outputs of MControl to connect external devices (i.e. remote I/O).
Analog in-/output	●		Analog in-/outputs are available for external indication and control.

MNS iS control and protection
Additional function modules

Additional functions like remote control unit (RCU) and emergency stop (Em-Stop) are provided with terminal connections to the MStart power module.

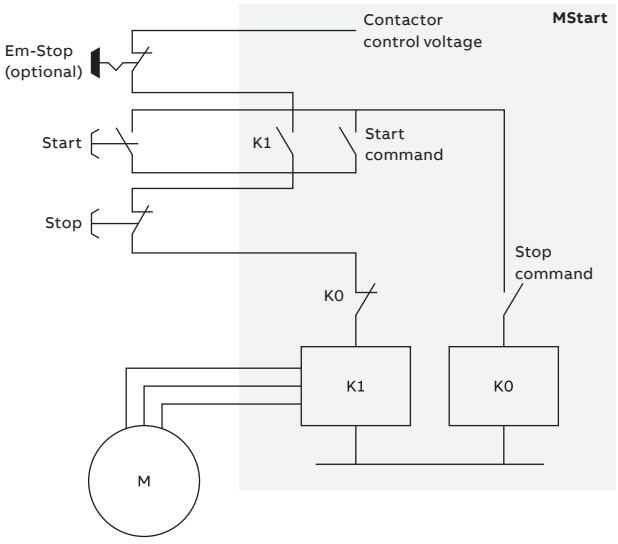
RCU/Em-Stop connection terminals are located on the control condapter of the associated MControl.

RCU
RCU* is a control function that allows the operator to bypass MControl control function by using a local switching panel.

*MControl device must be present to enable RCU control work.

Emergency stop
The Em-Stop connection fulfills the standard requirement to de-energize the main contactor immediately without additional devices.

Hardwired control
MNS iS also provides the possibility to be operated by conventional hardwired control directly to the digital inputs on the MControl. This configuration may be used when no process control system is available.



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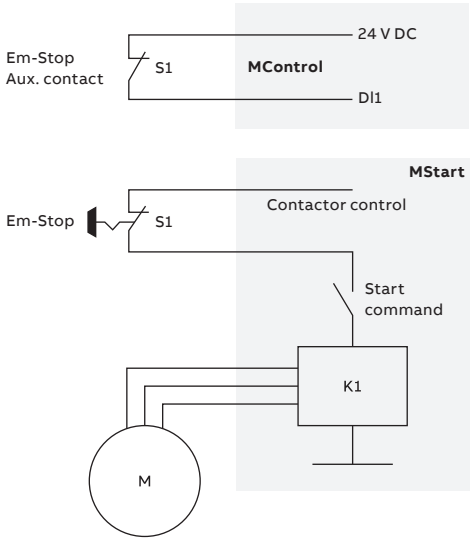
RCU control function



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Emergency stop connection

After sales and service

ABB's goal is to ensure the assets' maximum performance and availability. ABB has supplied over 1.5 million low voltage switchgear cubicles from its worldwide manufacturing locations. Each of these locations operates with an after sales and service department, offering unparalleled global support.

ABB Service technician's start offering their support from Installation and Commissioning by ensuring the equipment installed as per the guidelines. On completion of commissioning, the switchgear is at the peak of its performance. To maintain this condition, it is essential to adopt a service and maintenance plan for the MNS iS.

By establishing an effective maintenance plan, the risk of unwanted shutdowns are dramatically reduced. In production the availability of the switchgear ensures productivity, and any downtime is a lost opportunity for profit.

This is where ABB can offer its services. Building a Service Agreement customized to your operating conditions, incorporating services that range from Emergency Call-Out to Predictive Maintenance, we have all the necessary options that will ensure your MNS iS and related production is at optimum condition.

Downtime can be attributed to the following maintenance practices:

- Reactive maintenance is costly for both production and unplanned downtime;
- Preventive or continuous maintenance is usually performed on an annual basis, during a scheduled shutdown;
- By evaluating information from the intelligent switchgear, it is possible to adopt a Condition based or Predictive maintenance schedule.

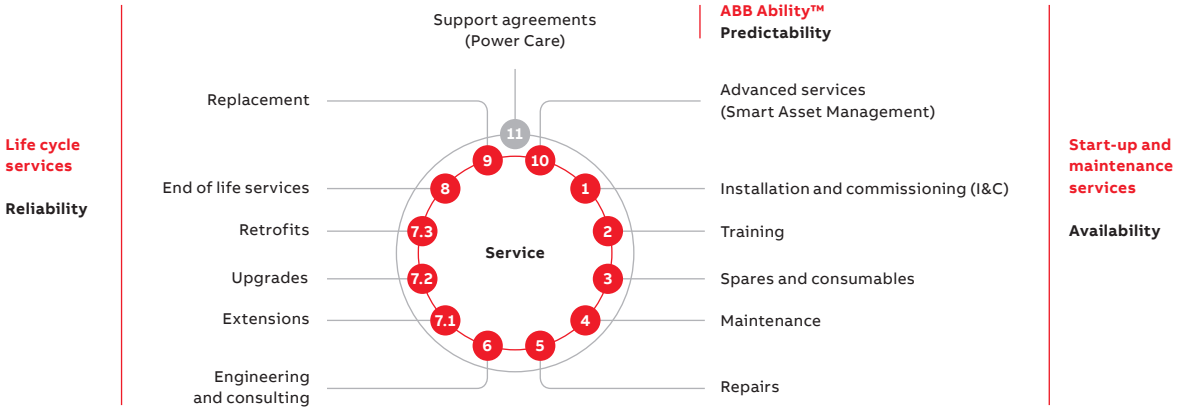


ABB Ability™ Condition Monitoring for electrical systems (CMES) enables maintenance to be taken into an even predictive maintenance practice, where the information available from the switchgear can further assist with maintenance workflow. Running on an Edge device, no Cloud connection is necessary for the system to operate.

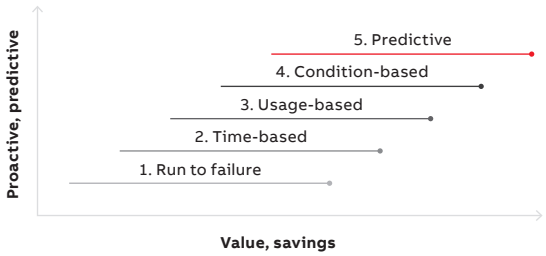
Routine Maintenance regimes can prevent and allow the operator to understand the condition of the equipment.

In practical terms

- Overheating equipment within a switchgear or field can be identified and the condition of the equipment is reported by the tool.
- Trends of equipment performance can be analyzed, any anomalies detected are reported with Asset Condition Monitoring.
- Reports are provided as configured by the user that shows the faults and the energy usage in a specified period.
- Reduced exposure of personnel to operating equipment is made possible with remote monitoring.
- Support from ABB service experts from all over the world can be benefitted. Important for sites in remote locations.
- Avoidance of cost by early identification of possible failures

The operator should consider the costs associated with inspection of the equipment and the loss of production due to an unexpected failure.

Utilizing the latest sensor technology, the Digital platform allows increased visibility on the switchgear. Incorporating this information with advanced algorithms that have been developed specifically by ABB as the OEM of switchgear.



If the system has been utilized from the commissioning phase, the complete performance history is available for analysis. With ABB Ability Market Place™, the users can benefit the future developments and add it to their system.

Developments such as Intelligent Trend Analysis, Diagnostic Flows and Artificial Intelligence are expected in near future. Real OPEX savings are made by utilizing Digital switchgear, which we estimate up to 30 percent.

Utilizing ABB expertise can help to increase the operational lifetime of the switchgear.

MNS iS technical data
MNS iS mechanical and electrical characteristics

MNS iS Standards and approvals

Standards	
Design verification by testing* according to:	
IEC/EN 61439-1	Low voltage switchgear and controlgear assemblies – General rules
IEC/EN 61439-2	Low voltage switchgear and controlgear assemblies – Power switchgear and controlgear assemblies
CEI 60439-1	
DIN EN 60439-1	
VDE 0660 part 500	
BS EN 60439-1	
UTE 63-412	
IEC/EN 60947-1	Low voltage switchgear and controlgear – General rules
IEC/EN 60947-4-1	Low voltage switchgear and controlgear – Contactors and motor-starters – Electromechanical contactors and motorstarters
Test certificates	
ASTA, Great-Britain (resistance to accidental arcs acc. to IEC 61641 and IEC 60298, Appendix AA)	
DLR German Research Institute for Aerospace e. V. Jülich, Earthquake Test for Security Areas in Nuclear Power Stations**	
IABG Industrieanlagen Betriebsgesellschaft, Vibration and shock tests	

MNS iS Mechanical characteristics

Dimensions	
Cubicles and supporting structures	DIN 41488
Basic grid size	E=25 mm acc. to DIN 43660
Further details see page 46	
Degrees of protection	
According to IEC 60529 or DIN 40050	IP 30 up to IP 54
Plastic components	
Halogen-free, self-extinguishing, flame retardant, CFC-free	IEC 60695-11-20 DIN VDE 0304 part 3
Steel components	
Frame (C shape profiles)	2.0 mm
Frame (Transverse sections)	2.5 mm
Cladding, external	1.5 mm
Cladding, internal	1.5/2.0 mm
Compartment bottom plates	2.0 mm
Surface protection	
Frame, incl. internal subdivisions	Zinc or Alu-zinc coated
Transverse sections	Zinc or Alu-zinc coated
Enclosure	Zinc or Alu-zinc coated and Powder coated (RAL 7035, module doors RAL 7012)
Options (on request)	
Busbars	Insulated with heat shrinkable sleeving, Silver plated

MNS iS technical data
MNS iS standards and approvals

MNS iS Electrical characteristics

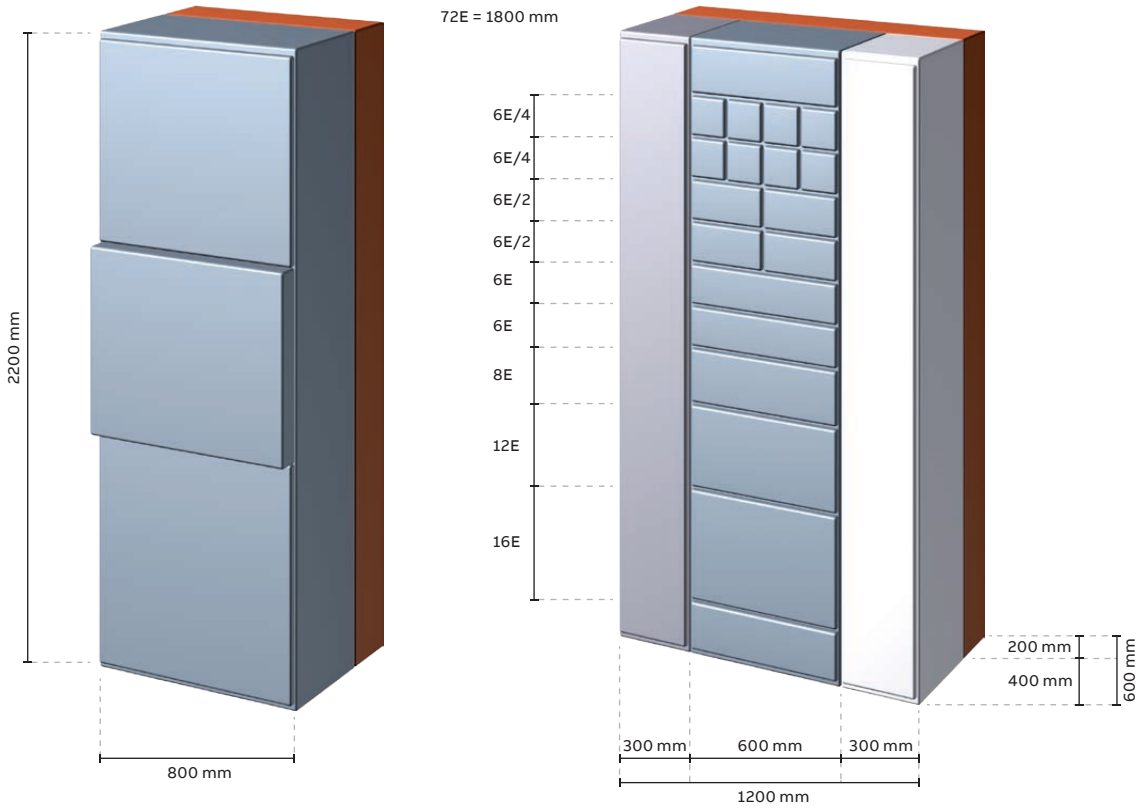
Rated voltages	
Rated insulation voltage U_i	up to 1000 V 3~***
Rated operating voltage U_e	690 V 3~
Rated impulse withstand voltage U_{imp}	6 /8 /12 kV***
Overvoltage category	II/III/IV***
Degree of pollution	3
Rated frequency	up to 60 Hz
Rated current	
Copper busbars:	
Rated current I_e	up to 6300 A
Rated peak withstand current I_{pk}	up to 250 kA
Rated short-time withstand current I_{cw}	up to 100 kA
Copper distribution bars:	
Rated current I_e	up to 2000 A
Rated peak withstand current I_{pk}	up to 176 kA
Rated short-time withstand current I_{cw}	up to 100 kA
Arc fault containment	
Rated operational voltage/ Prospective short-circuit current	400 V/100 kA 690 V/65 kA
Duration	300 ms
Criteria 690 V	1 to 5
Criteria 400 V	1 to 7
Forms of separation	

MNS iS technical data
MNS iS switchboard dimensions

MNS iS switchboard dimensions

MCC				
	Control cable compartment	Equipment compartment	Power cable compartment	Busbar compartment
Width	300 mm	600 mm	300 mm	1200 mm=overall width
	400 mm	600 mm	400 mm	1400 mm=overall width
Depth	400 mm			200/400 mm
Height	2200 mm			

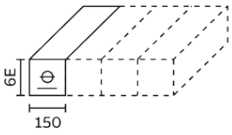
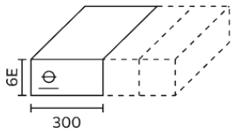
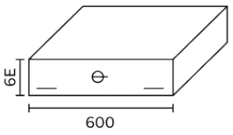
Incomer			
		Equipment compartment	Busbar compartment
Width		400/600/800/1000/1200 mm	
Depth + Options		400 mm (+80mm pagoda for withdrawable devices)	200/400 mm
		600 mm (+80mm pagoda for withdrawable devices)	200/400 mm
		800 mm (for ≥4000 Amp)	200/400 mm
Height		2200 mm	

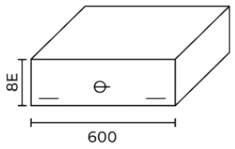
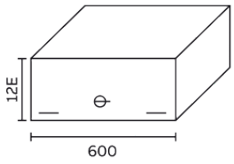
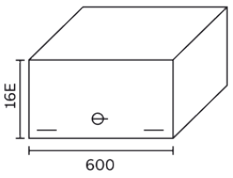
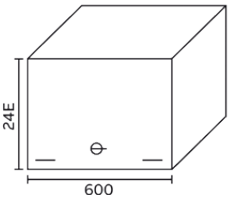


MNS iS technical data
Module types and dimensions

For maximum output per module size and starter type, see detailed module selection tables.

Withdrawable modules

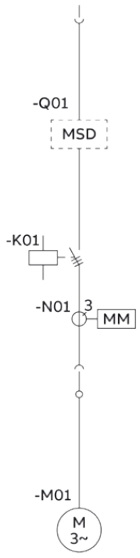
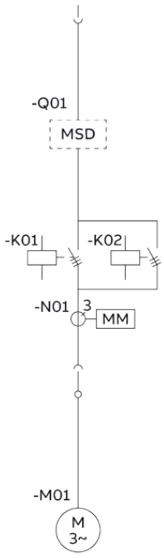
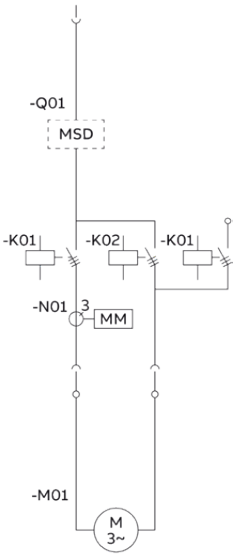
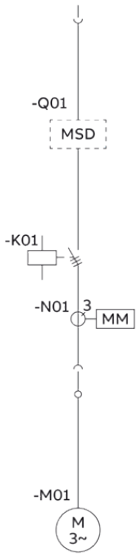
6E/4	6E/2	6E
height 150mm; width 150mm	height 150mm; width 300mm	height 150mm; width 600mm
		

8E	12E	16E	24E
height 200mm; width 600mm	height 300mm; width 600mm	height 400mm; width 600mm	height 600mm; width 600mm
			

Fixed modules

Height 2200 mm (full cubicle height), width 400 or 600 mm

MNS iS starter types **MNS iS feeder**

NR-DOL, HD Direct online starters, Heavy duty starters	REV-DOL Reversing starters	NR-SD Star/Delta starters	CF Contactor feeder
			

Abbreviations:
MM = Measuring module
MSD = Main switching device (fused or fuseless)

MNS iS technical data
Module selection tables

The module selection tables detail the available range at the time of publication of this brochure. For more information on the full range please contact your local ABB representative.

MStart selection
Rated voltage = 400 V

—
Fused motor starters 50/65 kA, type 2 coordination

									MStart module size
						Withdrawable Type			**Fixed Type**
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤15 kW	≤22 kW	≤37 kW		≤55 kW	≤132 kW	≤250 kW	≤315 kW	
REV-DOL	≤5.5 kW	≤22 kW	≤15 kW	≤37 kW		≤90 kW	≤132 kW		
HD	≤15 kW	≤22 kW	≤22 kW		≤45 kW	≤90 kW	≤200 kW	≤250 kW	
SD				≤55 kW		≤132 kW	≤160 kW		≤295 kW

—
Fused motor starters 80 kA, type 2 coordination

									MStart module size
						Withdrawable Type			**Fixed Type**
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤15 kW	≤22 kW	≤37 kW		≤55 kW	≤132 kW	≤250 kW		
REV-DOL	≤5.5 kW	≤22 kW	≤15 kW	≤37 kW		≤90 kW	≤132 kW		
HD	≤15 kW	≤22 kW	≤22 kW		≤45 kW	≤90 kW	≤200 kW		
SD				≤55 kW		≤132 kW	≤160 kW		

—
Fused motor starters 50 kA, type 2 coordination

									MStart module size
						Withdrawable Type			**Fixed Type**
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤11 kW	≤30 kW	≤75 kW			≤200 kW	≤250 kW	≤315 kW	
REV-DOL	≤11 kW	≤30 kW		≤37 kW	≤75 kW		≤160 kW		
HD		≤22 kW	≤75 kW			≤132 kW	≤200 kW		
SD				≤55 kW	≤110 kW	≤132 kW	≤160 kW		

—
Fused motor starters 65 kA, type 2 coordination

									MStart module size
						Withdrawable Type			**Fixed Type**
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤4 kW	≤30 kW	≤55 kW	≤75 kW		≤200 kW	≤250 kW		
REV-DOL	≤4 kW	≤30 kW		≤37 kW	≤75 kW		≤160 kW		
HD		≤22 kW	≤45 kW	≤75 kW		≤132 kW	≤200 kW		
SD				≤55 kW	≤75 kW	≤132 kW	≤160 kW		

Contactor feeder selection
Rated voltage = 400 V

—
Contactor feeders - Fused 50/65/80 kA, type 2 coordination

								Module size	
						Withdrawable Type			Fixed Type
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole	25 A	40 A	63 A		100 A	250 A	400 A		
4 pole		25 A		63 A		100 A	160 A		

—
Contactor feeders - Fuseless 50 kA, type 2 coordination

								Module size	
						Withdrawable Type			Fixed Type
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole	28 A	56 A	125 A			320 A	400 A		
4 pole		56 A		125 A		200 A	400 A		

—
Contactor feeders - Fuseless 65/85 kA, type 2 coordination

								Module size	
						Withdrawable Type			Fixed Type
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole		50 A	100 A	125 A		320 A	400 A		
4 pole				80 A		200 A	400 A		

Energy distribution module selection
Rated voltage = 400 V

—
ED modules – Fused 50/65/80 kA, type 2 coordination

								Module size	
						Withdrawable Type			Fixed Type
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole	25 A	63 A	125 A	250 A		400 A	600 A		
4 pole		63 A		125 A		250 A	600 A		

—
ED modules - Fuseless 50/65 kA, type 2 coordination

								Module size	
						Withdrawable Type			Fixed Type
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole	25 A	63 A	160 A	250 A		400 A	630 A		
4 pole		63 A (50 kA only)		160 A		400 A	630 A		

MStart selection
Rated voltage = 500 V

—
Fused motor starters 50/65 kA, type 2 coordination

									MStart module size
						Withdrawable Type		**Fixed Type (also 65 kA)**	
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤18.5 kW	≤30 kW	≤37 kW		≤75 kW	≤160 kW	≤250 kW	≤400 kW	
REV-DOL	≤7.5 kW	≤30 kW		≤37 kW		≤110 kW	≤132 kW		
HD	≤18.5 kW	≤30 kW			≤55 kW	≤110 kW	≤200 kW	≤355 kW	
SD				≤55 kW		≤160 kW			≤400 kW

—
Fuseless motor starters 50 kA, type 2 coordination

									MStart module size
						Withdrawable Type			**Fixed Type**
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤2.2 kW	≤37 kW	≤55 kW	≤110 kW		≤250 kW			
REV-DOL	≤2.2 kW	≤37 kW			≤110 kW		≤160 kW		
HD		≤30 kW	≤55 kW	≤90 kW		≤160 kW	≤200 kW		
SD				≤55 kW	≤90 kW	≤160 kW			

Energy distribution module selection
Rated voltage = 500 V

—
ED modules – Fused 50 kA, type 2 coordination

									Module size
						Withdrawable Type			**Fixed Type**
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole	25 A	63 A	125 A	250 A		400 A	600 A		
4 pole		63 A		125 A		250 A	600 A		

—
ED modules - Fuseless 50 kA, type 2 coordination

									Module size
						Withdrawable Type			**Fixed Type**
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole		63 A	160 A	250 A		400 A	630 A		
4 pole				160 A		400 A	630 A		

MStart selection
Rated voltage = 690 V

—
Fused motor starters 50/65 kA, type 2 coordination

									MStart module size
						Withdrawable Type		**Fixed Type (50 kA only)**	
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤22 kW		≤37 kW		≤75 kW	≤160 kW	≤250 kW	≤500 kW	≤800 kW
REV-DOL	≤5.5 kW	≤22 kW		≤37 kW		≤132 kW	≤160 kW		
HD	≤18.5 kW		≤30 kW		≤55 kW	≤110 kW	≤200 kW	≤355 kW	
SD				≤55 kW		≤160 kW			≤560 kW

—
Fuseless motor starters 50/65 kA, type 2 coordination

									MStart module size
						Withdrawable Type			**Fixed Type**
Starter type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
NR-DOL	≤4 kW		≤15 kW	≤90 kW		≤250 kW		≤400 kW	≤800 kW
REV-DOL	≤4 kW				≤90 kW		≤160 kW		
HD			≤15 kW	≤90 kW		≤200 kW			
SD						≤160 kW			

Energy distribution module selection
Rated voltage = 690 V

—
ED modules – Fused 50/65 kA, type 2 coordination

									Module size
						Withdrawable Type			**Fixed Type**
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole	25 A	63 A		200 A		315 A	500 A		
4 pole		63 A				200 A	500 A		

—
ED modules - Fuseless 50/65 kA, type 2 coordination

									Module size
						Withdrawable Type			**Fixed Type**
Type	6E/4	6E/2	6E	8E	12E	16E	24E	400 mm	600 mm
3 pole				250 A		400 A	630 A		
4 pole				160 A		400 A	630 A		

MNS iS technical data
Control and communication components

	MStart	MControl	MLink	MView
Electrical data				
Auxiliary supply voltage(s)				
Supply voltage	24 V DC	24 V DC	24 V DC	24 V DC
Voltage range	19 – 31 V DC	19 – 31 V DC	19 – 31 V DC	19 – 28 V DC
Power consumption				
Typical	200 mA	150 mA	1000 mA	1200 mA
Maximum	240 mA	270 mA	1700 mA	1500 mA
Mechanical data				
Dimensions (HxWxD) mm	Depending on starter type	125 x 53 x 260	110 x 265 x 230	247 x 185 x 82
Weight	Depending on starter type	0.7 kg	2.0 kg	5.0 kg
Environmental conditions				
Storage temperature	- 20 … + 70 °C	- 20 … + 70 °C	- 20 … + 70 °C	- 20 … + 60 °C
Operation temperature	- 5 … + 55 °C	- 5 … + 55 °C	0 … + 55 °C	0 … + 40 °C
Degree of protection	up to IP54 **	IP20	IP20	up to IP54 **
Reliability				
MTBF (meantime between failures) at 40 °C	48 years	19 years In combination: 13 years	15 years	8 years
MTTR (meantime to repair)***	1 min	15 min	15 min	15 min

*Max. operation temperature for MView display, refers to switchgear room
**When installed in MCC/switchgear
***Provided spare component is available

In-/output connections on MControl front *						
			Input			
			(optical isolated, one common)			(two outputs share one common)
Overvoltage class			II			II
Pollution severity			3			3
Impulse withstand level			0.33 kV			2.5 kV
Nominal cross section of connector			1.5 mm² solid cable 2.5 mm² flexible stranded cable			1.5 mm² solid cable 2.5 mm² flexible stranded cable
Nominal voltage	24 V DC	110 V AC	230 V AC			250 V AC 50/60 Hz
Voltage level 1 **	≥ 18 V DC	≥ 74 V AC	≥ 159 V AC			
Voltage level 0 **	≤5 V DC	≤20 V AC	≤40 V AC			
Nominal current	8 mA	1.5 mA	3 mA			1 A
Minimum operations						5 * 106 mechanical 3 * 104 electrical
Max. switching voltage				230 V AC	230 V AC	24 V AC
Max. switching current				1 A	150 mA	6 A
Max. switching capacity						500 VA

*All values for AC to be considered as r.m.s.
**Values in accordance with IEC 61947-1

Relay card specfications	**Nominal switching capacity**	**Max switching voltage**	**Coil nominal operating power**	**Coil nominal voltage**	**Coil pick-up**	**Coil drop-off**
1 NO 1 NC	8 A 250 V AC	380 V AC	200 mW	24 V DC	18 V DC	2.4 V DC
	8 A 30 V AC	125 V AC				
2 NO 2 NC	6 A 250 V AC	440 V AC	500 mW	24 V DC	18 V DC	2.4 V DC
	6 A 30 V AC	30 V AC				

MNS iS technical data
Certificates

Electromagnetic compatibility		
Standard	**Subject**	**Performance criterion**
EN 55011	Radio interference voltage	Level A
EN 55011	Radio interference field strength	Level A
IEC 61000-6-2	Electromagnetic compatibility (EMC) – Generic standard – Immunity for industrial environments	Criteria for applications in industrial environment are met or even exceeded, see following results of IEC 61000-4-x
IEC 61000-4-2	Electrostatic discharge	
	Contact discharge	Level A
	Air discharge	Level A
IEC 61000-4-3	Radiation	Level A
IEC 61000-4-4	Burst	Level A
IEC 61000-4-5	Surge	Level A
IEC 61000-4-6	Inlet	Level A
IEC 61000-4-8	Power frequency magnetic field	Level A
IEC 61000-4-11	Voltage dips 230 V	Not applicable, for power supply only

Annex

Items subject to agreement between manufacturer and user

Extract from IEC 61439 series
The following details are intended as a checklist for the specification of low voltage switchgear.

User defined functions and characteristics	Reference clause (IEC 61439 series)
Electrical system	
Earthing system	5.5, 8.4.3.2.3, 8.6.2, 10.5, 11.4
Rated voltage Un (Volts)	3.8.8.1, 5.2.1, 8.5.3
Overvoltage category	5.2.4, 8.5.3, 9.1, Annex G
Unusual voltage transients, voltage stresses, temporary overvoltages	9.1
Rated frequency f_n (Hz)	3.8.11, 5.4, 8.5.3, 10.10.2.3, 10.11.5.4
Additional on site testing requirements: wiring, operational performance and function	11.10
Short circuit withstand capability	
Prospective short circuit current at supply terminals Icp (kA)	3.8.6
Prospective short circuit current in the neutral	10.11.5.3.5
Prospective short circuit current in the protective circuit	10.11.5.6
SCPD in the incoming functional unit	9.3.2
Co-ordination of short-circuit protective devices including external short-circuit protective device details	9.3.4
Data associated with loads likely to contribute to the shortcircuit current	9.3.2
Protection of persons against electric shock in accordance with IEC 60364-4-41	
Type of protection against electric shock - Basic protection (protection against direct contact) NOTE This type of protection is intended to protect against electric shock due to direct contact within the ASSEMBLY during normal service conditions.	8.4.2
Type of protection against electric shock - Fault protection (protection against indirect contact) NOTE These types of protection are intended to protect against the consequences of a fault within the ASSEMBLY.	8.4.3
Installation environment	
Location type	3.5, 8.1.4, 8.2
Protection against ingress of solid foreign bodies and ingress of liquid	8.2.2, 8.2.3
External mechanical impact (IK) NOTE IEC 61439-1 does not nominate specific IK codes.	8.2.1, 10.2.6
Resistance to UV radiation (applies for outdoor assemblies only unless specified otherwise)	10.2.4
Resistance to corrosion	10.2.2
Ambient air temperature – lower limit	7.1.1
Ambient air temperature – upper limit	7.1.1
Ambient air temperature – daily average maximum	7.1.1
Maximum relative humidity	7.1.2
Pollution degree	7.1.3
Altitude	7.1.4
EMC environment	9.4, 10.12, Annex J
Special service conditions (e.g. vibration, exceptional condensation, heavy pollution, corrosive, environment, strong electric or magnetic fields, fungus, small creatures, explosion hazards, heavy vibration and shocks, earthquakes)	7.2, 8.5.4, 9.3.3, Table 7

User defined functions and characteristics	Reference clause (IEC 61439 series)
Installation method	
Type	3.3, 5.5
Portability	3.5
Maximum overall dimensions and weight	6.2.1
External conductor type(s)	8.8
Direction(s) of external conductors	8.8
External conductor material	8.8
External phase conductor, cross sections, and terminations	8.8
External PE, N, PEN conductors cross sections, and terminations	8.8
Special terminal identification requirements	8.8
Storage and handling	
Maximum dimensions and weight of transport units	6.2.2, 10.2.5
Methods of transport (e.g. forklift, crane)	6.2.2, 8.1.7
Environmental conditions different from the service conditions	7.3
Packing details	6.2.2
Operating arrangements	
Access to manually operated devices	8.4, 8.5.5
Isolation of load installation equipment items	8.4.2, 8.4.3.3, 8.4.5.2
Maintenance and upgrade capabilities	
Requirements related to accessibility in service by ordinary persons; requirement to operate devices or change components while the ASSEMBLY is energised	8.4.5.1
Requirements related to accessibility for inspection and similar operations	8.4.5.2.2
Requirements related to accessibility for maintenance in service by authorized persons	8.4.5.2.3
Requirements related to accessibility for extension in service by authorized persons	8.4.5.2.4
Method of functional units connection NOTE This refers to the capability of removal and reinsertion of functional units.	8.5.1, 8.5.2
Protection against direct contact with hazardous live internal parts during maintenance or upgrade (e.g. functional units, main busbars, distribution busbars)	8.4
Method of functional units connection NOTE This refers to the capability of removal and reinsertion of functional units.	8.5.101
Form of separation	8.101
Capability to test individual operation of the auxiliary circuits relating to specified circuits while the functional unit is isolated	3.1.102, 3.2.102, 3.2.103, 8.5.101, Table 103
Maintenance and upgrade capabilities	
Rated current of the ASSEMBLY InA (Amps)	3.8.9.1, 5.3, 8.4.3.2.3, 8.5.3, 8.8, 10.10.2, 10.10.3, 10.11.5, Annex E
Rated current of circuits Inc (Amps)	5.3.2
Rated diversity factor	5.3.3, 10.10.2.3, Annex E
Ratio of cross section of the neutral conductor to phase conductors: phase conductors up to and including 16 mm² NOTE Current in the neutral may be influenced where there are significant harmonics, unbalanced phase currents, or other conditions in the load that will necessitate a larger conductor.	8.6.1
Ratio of cross section of the neutral conductor to phase conductors: phase conductors above 16 mm² NOTE For the standard value, the neutral current is assumed not to exceed 50% of the phase currents. Current in the neutral may be influenced where there are significant harmonics, unbalanced phase currents, or other conditions in the load that will necessitate a larger conductor.	8.6.1

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