

Low Voltage Systems

MNS MCC rear access

Tested, tried & trusted solutions

Power and productivity
for a better world™





MNS MCC rear access

Overview



Switchgear Evolution

ABB is the global leader for low voltage switchgear with over 2 million MNS cubicles delivered worldwide since the inception of this system in 1973. ABB's history in switchgear can be traced back even further, to the 1890's when we first manufactured switchgear systems in Sweden.

With these credentials it is no surprise that the MNS system is the benchmark for operational safety, reliability and quality.

ABB draws on this wealth of background knowledge in designing and manufacturing low voltage solutions for its global and local customers. This together with the global service and support network established in over 30 manufacturing locations world wide ensures that the choice of MNS will be the right decision.

MNS MCC rear access

Overview

The ABB MNS system is a low voltage switchgear assembly. It's design is verified in accordance with IEC 61439-1/-2. The consistent application of the modular principle both in electrical and mechanical design as well as the use of standardised components allows its flexible and compact design. Depending on operating and environmental conditions different design levels are available.



Notable system advantages with regard to design aspects:

- Optimum protection for personnel and plant
- Design verified by type testing including arc fault containment
- High operational reliability and availability
- Earthquake, vibration and shock-proof designs are available
- Maintenance accessible busbar
- Rigid frame construction
- Simple retrofitting procedures
- Compact, space saving design
- Simplified project implementation utilising ABB's dedicated engineering tool
- Rigid frame construction

The MNS design proves to have the approved solution for the following industries:

- Oil & Gas, on and offshore
- Chemical/Petrochemical
- Pharmaceutical
- Power Stations, conventional, biomass, energy from waste
- Paper
- Water treatment
- Mining
- Steel
- Food
- Marine

MNS MCC rear access

Technical data

Standards		Low Voltage Switchgear and Controlgear Assemblies – Verification by testing*	IEC 61439-1/-2
Test certificates	ASTA, Great-Britain (resist. 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 ABG Industrieanlagen Betriebsgesellschaft, Vibration and shock tests Complying with Germanischer Lloyd, Hamburg		
Electrical data	Rated Voltages	Rated insulation voltage Ui	1000 V 3~, 1500 V- **
		Rated operating voltage Ue	690 V 3~, 750 V- **
		Rated impulse withstand voltage Uimp	6 / 8 / 12 kV **
		Overvoltage category	I / III / IV **
		Degree of pollution	3
		Rated frequency	up to 60 Hz
	Rated current	Copper Busbars:	
		Rated current Ie	up to 6300 A
		Rated peak withstand current Ipk	up to 250 kA
		Rated short-time withstand current Icw	up to 100 kA
		Copper Distribution bars:	
		Rated current Ie	up to 2000 A
		Rated peak withstand current Ipk	up to 176 kA
		Rated short-time withstand current Icw	up to 100 kA
	Arc Fault Containment	Rated operational voltage	up to 690 V
		Prospective short-circuit current	up to 100 kA
		Duration	300 ms
		Criteria (IEC 61641)	1 to 7
	Forms of Segregation		up to Form 4b
Mechanical characteristics		Cubicles and frame	DIN 41488
		Recommended height	2200 mm
		Recommended width	400, 600, 800, 1000, 1200 mm
		Recommended depth	400, 600, 800, 1000, 1200 mm
		Basic grid size	E = 25 mm acc. to DIN 43660
	Degrees of Protection	According to IEC 60529	External from IP 30 to IP 54 Internal from IP 2X
	Surface protection/Paint	Frame, incl. internal subdivisions	2.0 / 2.5 mm
		Cladding, internal	1.5 / 2.0 mm
		Cladding, external	1.5 mm
		Frame, incl. internal subdivisions	Zinc or Alu-zinc coated
		Cladding, internal	Zinc or Alu-zinc coated
		Cladding, external	Zinc or Alu-zinc coated and Powder coated RAL 7035 (light grey)
	Plastic components	Halogen-free, self-extinguishing, flame retardant	IEC 60707, DIN VDE 0304 part 3
Optional Extras, available on request	Busbar system	Busbars	Bare, tinned or silver plated bars. Fully insulated with heat shrinkable sleeving and removeable rubber boots.
	Special qualification	Test certificates	See test certificates listed above
	Paint	Enclosure	Special colours on request

* Design verification by testing: Where an Assembly has previously been tested in accordance with IEC 60439-1, and the results fulfil the requirements of IEC 61439-1/-2, the verification of these tests need not be repeated.

** Depending on the electrical equipment

MNS MCC rear access

Operational safety & availability

The fulfillment of all instructions of the relevant standard for Low Voltage switchgear and controlgear assemblies assures a basic level for personal and system protection. MNS exceeds these levels as a standard. This has been proven by type tests in accordance with IEC 60439-1 and by design verification by test in accordance with IEC 61439-1 and -2. ABB goes beyond these standards with the proven “Safety Plus” for Operators and Plants and additionally in cases where a high degree of exposure is anticipated, or specific risks e.g. earthquake risk have to be observed.

The MNS low voltage switchgear system has been subjected to verification by testing in compliance with the standards. In order to ensure the highest possible degree of safety, ABB continues to conduct tests as per a continuous development program. These tests are based on the most critical representative applications of the entire product or performance range of the switchgear with respect to the test standard.

In addition to the specifications ABB adopted as a standard IEC/TR 61641:2008-01 for testing under conditions of arcing due to an internal fault. To meet the requirements of IEC/TR 61641:2008-01, the switchgear is connected and supplied corresponding to the normal service arrangement. An arc is then initiated within the switchgear, the point of ignition is chosen to produce the most stress on the assembly. There are five criteria observed for the test of personal protection. In line with its “Safety Plus” statement ABB ensures that all five are met. In addition to these five criteria ABB also meets the additional plant protection criteria as detailed in IEC 61641 (criteria 6 and 7). For more information on arc fault containment the “MNS Safety Aspects” brochure delivers essential considerations concerning plant and personal safety assured by MNS, such as:

- Basic safety philosophy
- Switchgear assembly verified by testing
- Arc fault protection
- Degrees of protection (IP codes)
- Internal separation
- Earthquake, vibration and shock
- Neutral conductor dimensioning



MNS MCC rear access Switchgear design

Frame construction

The basic elements of the MNS 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.

Enclosure

MNS 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, each compartment and sub-compartment which requires access for commissioning, operation or maintenance, has its own door.

Busbar System

The MNS main busbar system is arranged for top or bottom of the switchgear. The main busbar system is fully separated from the equipment compartment as well as from the cable compartment.

The busbar system options are available for Thermographic Windows or Thermal Sensors. The busbar system and all associated parts are manufactured from copper in accordance with DIN 40500. Options are available for bare, tinned or silver plated busbars and fully insulated with heat shrinkable sleeving and removable rubber boots.

Protective Earth and Neutral Bars

The neutral bar as standard forms part of the main busbar system and can be rated from 50% to 100%. The Earth bar can be mounted internally or externally and fastened to the frame to assure electrical continuity.

Distribution Bars

A fully phase segregated and encapsulated 3 or 4 pole distribution bar system runs the full height of the cubicle. The distribution bars are silver plated as standard



MNS MCC rear access Switchgear design

Multifunction Wall

The multifunction wall (MFW) with the embedded distribution bars is a unique MNS 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 single phase segregation is assured prior to the connection of the power contacts to the distribution bars.

Power Contact

Connection to the distribution bar is realised using the precision engineered MNS power contacts. The power contact is characterised by a turnable 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 achieved by the supporting plate and the contact spring where the contact fingers ensure positive electrical contact. Contact fingers are silver plated as standard.

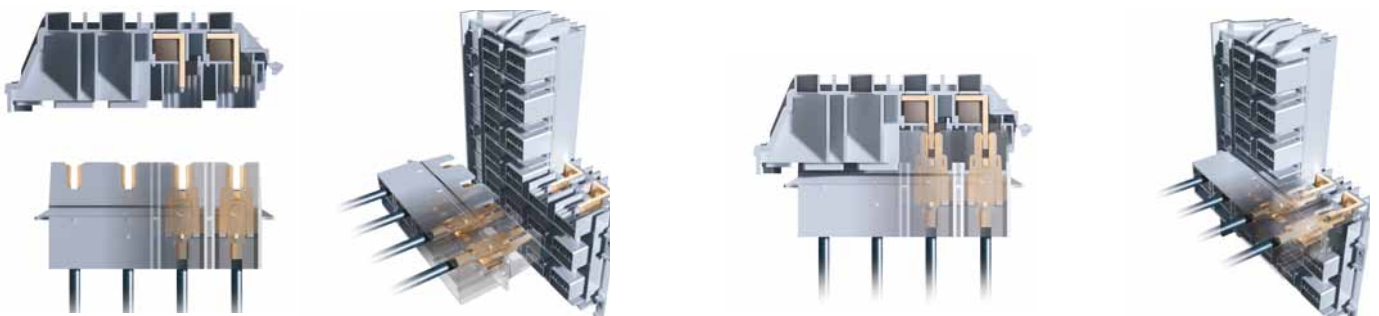
The contact has been subjected to several tests in order to prove the sophisticated design and the high quality, which provides a life cycle up to 1000 insertions.

System Highlights

- Maintenance accessible busbar construction
- Easy switchgear extension
- Main busbar arrangement at the top and bottom 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 4b Types 1-7 separation for both incoming and outgoing assemblies
- Active and passive arc fault prevention tested according to IEC 61641 – Isolating materials are free of CF gases
 - Operational life cycle up to 1000 insertions (independently certified)
 - Bearing construction eliminating cable stress
 - Full single phase segregation assured prior to the connection of the power contacts to the distribution bars

Tests:

- Design verification acc. IEC 61439-1/-2
- 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



MNS MCC rear access

Incoming solutions

All of the MNS incoming solutions are verified in accordance with IEC 61439-1/-2, 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.

In order to satisfy all requirements there are three main switch incoming options:

- Load break switches
- Moulded case circuit breakers (MCCBs)
- Air circuit breakers (ACBs)

Please refer to the technical reference section of this document for a list of related documentation.

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

Incoming options cont.

- 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 disconnecter option
- ACB handling truck
- Configuration and test unit

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



MNS MCC rear access

Incoming solutions

In addition to the above ABB circuit breakers offer a series of integrated programmable releases (PRs), where combinations of protection functions maybe selected with:

- Overload protection - L
- Selective short circuit protection - S
- Instantaneous short circuit protection - I
- Earthfault protection - G

ACB withdrawable operation

In a withdrawable solution the ACB assembly consists of two components, the fixed part (cassette) and the moving part (ACB). This enables the ACB to be located in 3 positions:

CONNECTED: The moving part is fully inserted into the fixed part with the connection of both the power terminals and the auxiliary contacts. The circuit breaker is operational and the mechanical indicator shows 'CONNECTED'.

TEST/ISOLATED: The moving part is inserted into the fixed part without the connection of the power terminals, but with connection of the auxiliary terminals. The circuit breaker may be operated for offline tests. The mechanical indicator shows 'TEST ISOLATED'.

DISCONNECTED: The moving part is inserted into the fixed part without any connection of the power and auxiliary terminals. In this position all electrical operation of the ACB is prevented. The mechanical indicator shows 'DISCONNECTED'. The switchgear compartment door can remain closed, therefore not compromising the IP rating of the switchgear.

The ACB cassette (fixed part) has shutters which are positively driven closed during the racking out process to prevent the possibility of contact with live parts.



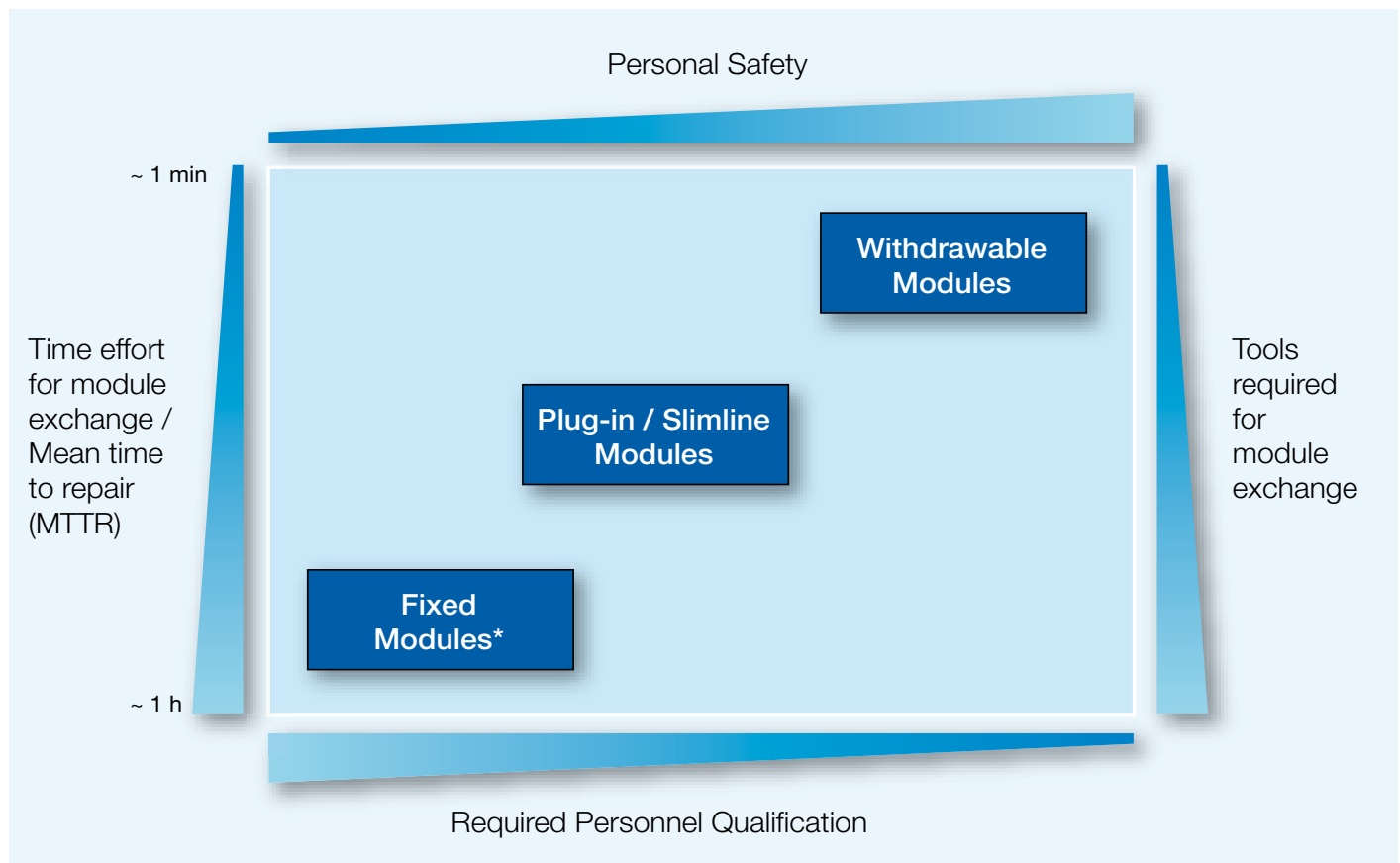
MNS MCC rear access

Outgoing modules

The available module types have typical characteristics as shown in the graphic below. Where high process availability is essential and minimal time is required for module exchange the withdrawable solution has proved to be the definitive choice. In installations where internal access to the switchgear does not present an obstacle the plug-in option may be the practical solution.

Depending upon the choice of outgoing modules selected, the skill set of the personnel required to operate and maintain the switchgear may also differ.

Switchgear requirements differ from project to project. MNS easily allows the assembly to be configured to suit all plant operational procedures.



MNS MCC rear access Outgoing modules

Plug-in Modules

AC Industrial Drive

Due to its inherent modular design MNS can easily be adapted to house the ABB range of AC Industrial Drives. The switchgear can accommodate multiple drives in a single section. Each drive compartment has an individual isolator, options are available for filters to be installed and for the drive control panel to be door mounted to enable interrogation and para-meterization without the need to open the door.

Full size cubicles are also available for the AC Industrial Drives solution. These are, however, of a fixed technique, enabling MNS to offer a complete range of drives all supplied from a common AC bus.



Reactive Power Compensation

MNS also offers the possibility of integrating reactive power compensation modules into its standard design thus reducing the requirements for additional external cubicles. The modular design offers highest flexibility to adjust the compensation power to changes of the load connected to the network.

The standard range covers:

- Network voltages up to 690 V –50 or 60 Hz
- All common reactor rates
- Modules up to 50 kVar
- Controllers available for 6 or 12 step



Withdrawable Modules

Full width modules. These modules are available ranging from 4E to 48E in physical sizes. The construction of the full modules differs slightly from that of the small modules in utilising a full width hinged door which is mechanically interlocked to the isolator.

All operational procedures for the modules are possible without the need to open the door of the module.

Full width modules connect directly to the distribution bars through the multifunction wall. The design of the module enables auxiliary components to be located on both the vertical and horizontal mounting plates within the module, thus optimizing the available space usage within the module. Cable connections for main and auxiliary circuits are accessible from the cable compartment.

System Highlights

- High stacking density, resulting in a reduced footprint
- Complete phase isolation of main power contact prior to connection to the distribution bars
- Full module functionality with external operation
- Module replacement possible in less than 1 minute, no tools required

MNS MCC rear access

Outgoing modules

Withdrawable Modules

Withdrawable module positions

All main and auxiliary connections are self locating, without the need of additional tools.

ON: Module is inserted, main switch closed, main and control circuit connected

OFF: Module is inserted, main switch open, main and control circuit disconnected, padlocking possible.

TEST: Module is inserted, main switch open, main circuit disconnected, control circuit connected, padlocking possible.

ISOLATED: Module is withdrawn 30 mm from the inserted position, main switch open, main and control circuit disconnected, padlocking possible.

MOVE: Module may be completely withdrawn from the switchgear.

All positions/situations are clearly marked on the fixed section of the operation handle in accordance with IEC 61439-1/-2.



MNS MCC rear access Segregation

Segregation within the modern switchboard is of paramount importance. With demand for operator safety increasing and device performance levels continually improving, the structure which converts these devices into a working system needs to combine optimum performance with uncompromised levels of safety.

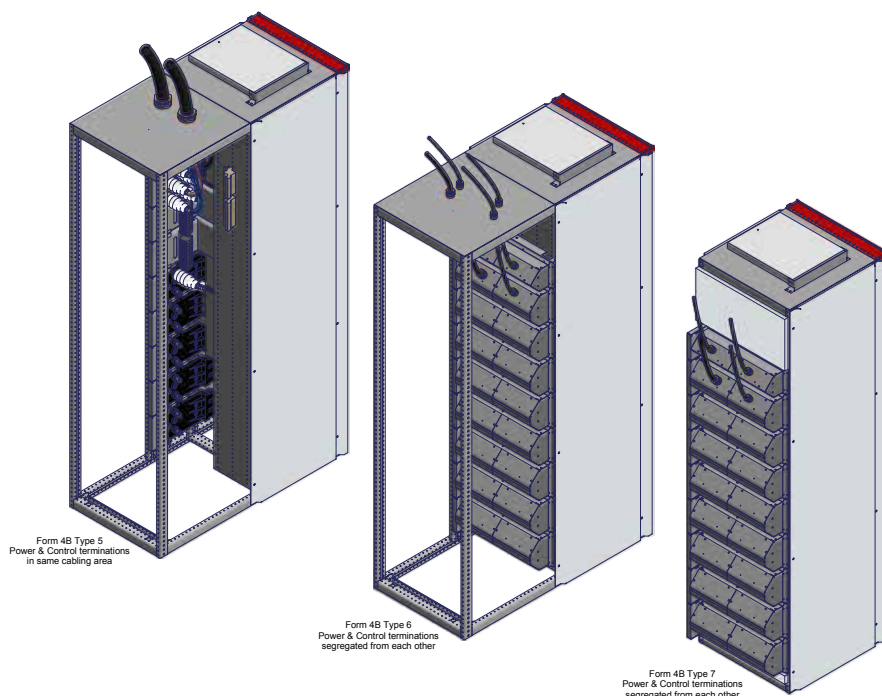
Internal division is in the form of ventilated, galvanised sheet steel barriers providing a degree of protection conforming to IP 2X/3X. Where cables are passing through plates then these are suitably harnessed and protected using grommets or insulated bushes. Cables between doors and the fixed chassis are fully protected using flexible conduit or sleeving.

Dependant on the application and project specification, additional levels of segregation can be provided ranging from insulated bushes equipped with protective shrouds (Form 4b Type 5) up to individual fabricated steel cable boxes equipped with removable gland plates (Form 4b Type 6/7).

Cable boxes are sized to comply with the cable termination and spreading requirements contained in BS5398. Terminations are rated for the maximum current of the device.

Entry of incoming and outgoing cables can be done from above or below or a combination of both. The space available for the termination of the cables is extremely generous and allows ample room for the cable installation contractor to work unimpeded.

Form 4b



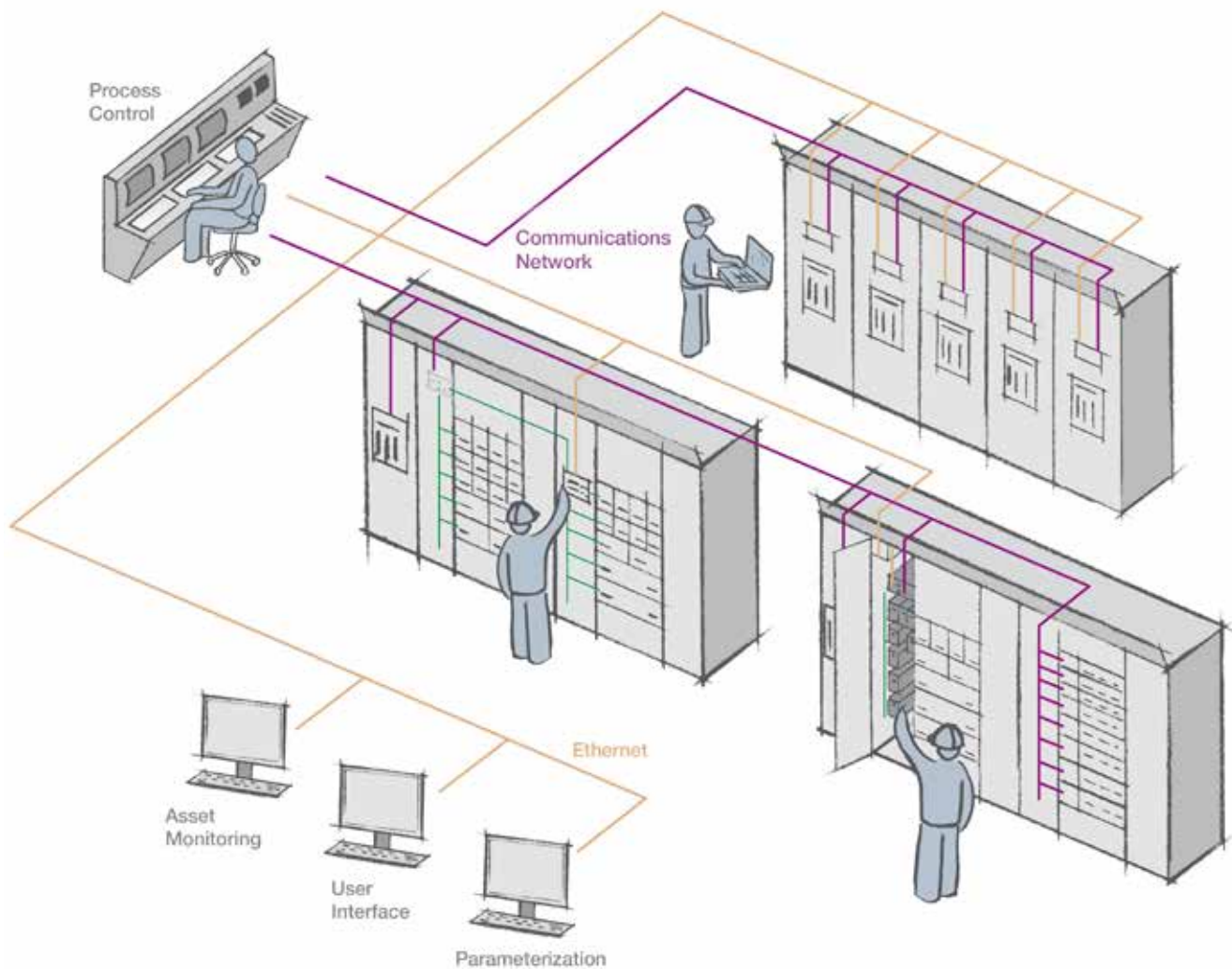
MNS MCC rear access

Integration into plant-wide Control Systems

ABB's structure with respect to offering site wide information is that a communications network connection for process control information and switching commands is utilised. An additional interface, which is typically Ethernet is used to support functions such as parameterization, data distribution to electrical SCADA and/or asset optimisation systems. This configuration is also continued through the ABB medium voltage product portfolio.

With the introduction of MNS ABB has been providing market leading low voltage switchgear systems technology. In 1987 ABB installed the world's first intelligent low voltage motor control center, since then ABB has delivered over 100,000 intelligent motor controllers.

Configuring the structure as detailed above ensures that the critical process data path is not compromised by also being utilised for parameterization and additional data required for engineering and maintenance.



MNS MCC rear access

Annex

Items subject to agreement between manufacturer and user

The following details are intended as a checklist for the specification of low voltage switchgear.

Extract from IEC 61439-1/-2

User defined functions and characteristics	Reference clause (for Parts 1 and 2)
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 fn (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,

MNS MCC rear access

Annex - continued

User defined functions and characteristics	Reference clause (for Parts 1 and 2)
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 conductors8.8External 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 arrangementsAccess 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 authorised 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
Current carrying capability	
Rated current of the ASSEMBLY I_n (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 I_{nc} (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 mm ² 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 mm ² 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

Contact us

ABB Ltd

Hanover Place
Sunderland
Tyne & Wear
SR4 6BY

Tel: +44 (0) 191 514 4555

Fax: +44 (0) 191 514 5505

www.abb.co.uk/lowvoltage