

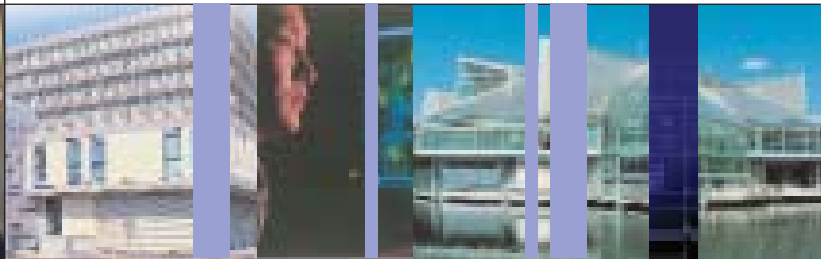
The substantial increase in the number of packaged substations being incorporated in modern commercial premises and throughout industry can be attributed to the advances made in cast resin transformer design and construction and the many benefits resulting from the close coupling of MV switchgear, cast resin transformers and the low voltage distribution switchboard.

ABB has been at the forefront of this technology from the outset and are able to offer the complete packaged substation solution from its extensive range of MV devices, cast resin transformers and LV switchgear all of which is assembled and tested as an operational unit prior to despatch and final installation.

By incorporating the MV and LV elements and the cast resin transformer into a close coupled homogenous unit installation costs are reduced dramatically. Savings in the cost of large low voltage cables are eliminated due to the fact that energy is delivered to the packaged substation at medium voltage and then reduced by the transformer for transmission at low voltage.

Significant savings also result from the the reduction in building works which are associated with convential liquid filled transformers. No longer is there a requirement for fire walls, sprinkler systems and drainage pits and bunds for the containment of spillages which are essential when installing conventional transformers.

The manufacture of an assembly combining both high and low voltage equipment requires careful attention to be exercised at the design and application stages to ensure that safety is not compromised.



The ABB package substation does not compromise on safety and exhaustive testing at all stages of the development process were carried out to ensure the ABB range of packaged substations can be relied upon to provide optimum performance in a working environment providing unparalleled levels of safety.

Savings on installation costs, reduced operational costs and safety and reliability are just some of the advantages offered by the decision to invest in an ABB packaged substation.

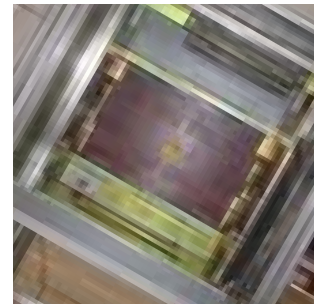
By incorporating 11kV Switchgear, Cast Resin Transformers, Low Voltage Switchgear and Automatic Power Factor Correction Equipment into a compact unit, installation costs are dramatically reduced. Delivering power at high voltage to the Packaged substation before stepping it down eliminates the substantial costs of installing low voltage, high current cable runs in conventional group mounted transformers.

Significant savings are achieved in building works. Cast Resin Transformers do not require fire resistant walls, sprinkler systems and drainage pits for the containment of the spillages associated with liquid filled transformers.

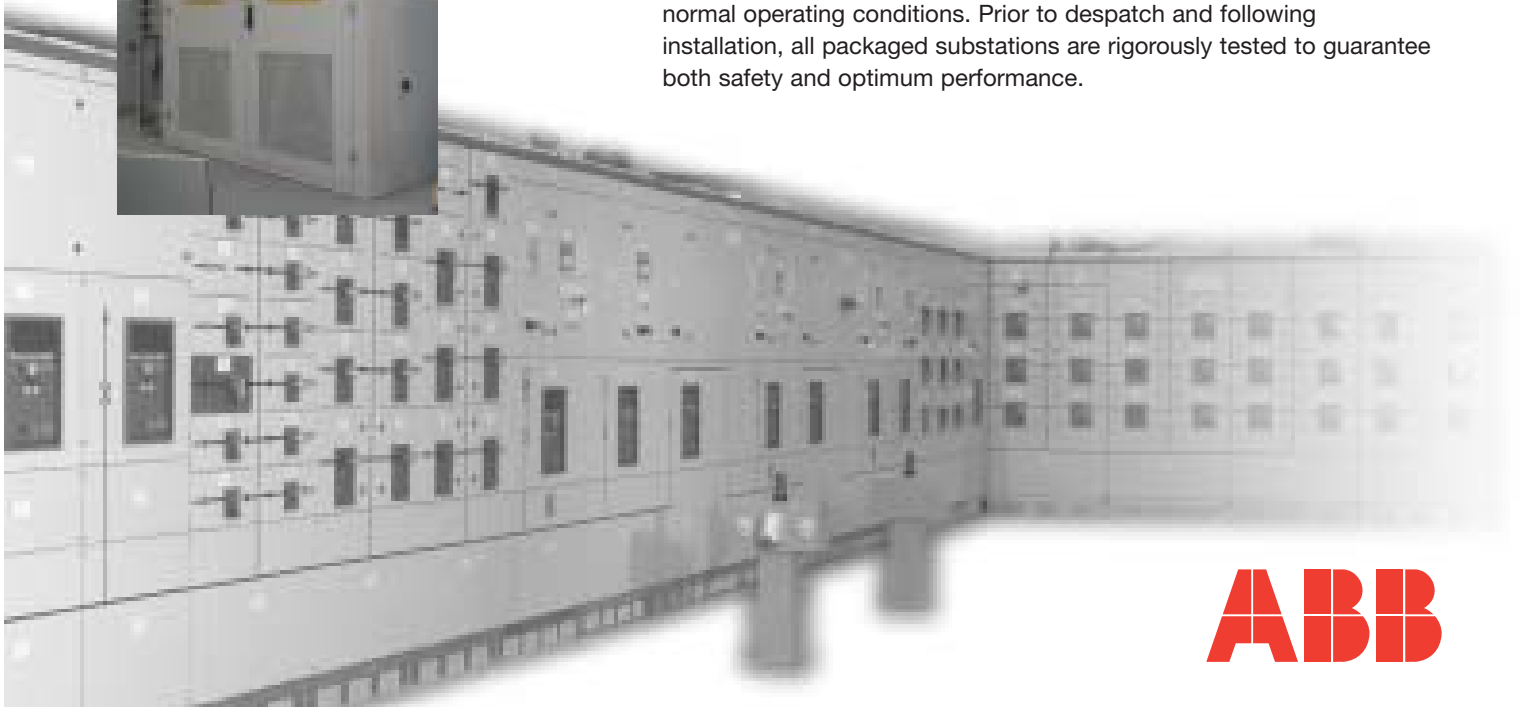
Cost Effective Installations

With space at a premium in modern day buildings the compact dimensions of ABB Packaged Substations is hugely beneficial, releasing valuable floor space. Furthermore, if the compact dimensions of the unit can't be accommodated within the buildings then purpose built outdoor weatherproof GRP enclosures mounted on skids can be supplied. The Packaged Substation is equipped for positioning on a roof, in a car park or anywhere a suitable space can be found. Where operating conditions demand high peak loads for a short period, forced cooling of the cast resin transformer can boost short term capacity by up to 50%, allowing considerable savings to be achieved. The use of smaller transformers with forced draught ventilation can also result in considerable savings at the installation stage and indeed by reduced on-going operational costs.

Providing the ultimate in safety and reliability was a vital consideration to ABB designers in the development stages of the package substation project. In a situation combining High Voltage, Low Voltage and Transformers there can be no margin for error. No compromise was made on safety in the ABB Package Substation, while exhaustive testing of both individual elements and the combined unit ensure that the end product fulfils all expectations.



Package Substations are systematically type-tested by ASTA in accordance with BSEN 60439-1:1999 for temperature rise and short circuit withstand. Successful testing of ABB's package substation provides confirmation that the composite assembly will perform under normal operating conditions. Prior to despatch and following installation, all packaged substations are rigorously tested to guarantee both safety and optimum performance.



GENERAL

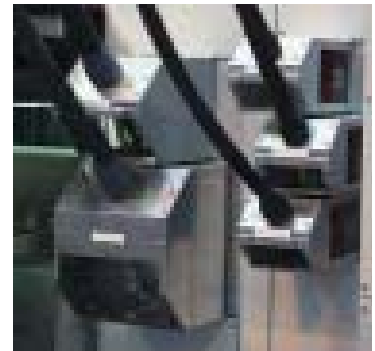
Segregation within the modern switchboard is of paramount importance. With demand for operator safety increasing and device performance levels continually improving, the structure which converts these devices into a working system needs to combine optimum performance with uncompromised levels of safety.

Primary segregation within MNS is achieved through the division of the switchboard section into the three distinct zones of busbar, functional and cabling. In simple terms the busbar zones contain the main and distribution busbars; the functional zone houses the operational, incoming and outgoing devices; the cable zone segregates the cables and wiring into an area which prevents the inevitable debris associated with these tasks coming into contact with the busbar and functional areas during installation and maintenance.

Internal division is in the form of ventilated, galvanised sheet steel barriers providing a degree of protection conforming to IP 2X. Where cables pass 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.

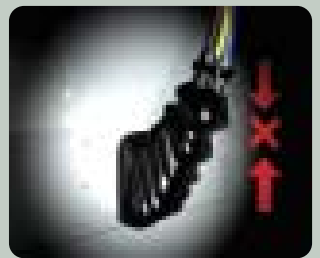


Outgoing cable connections



External Cableboxes to Form 4b Type 7

All internal control wiring is carried out in multi strand annealed copper conductors which is 600/1000volt grade PVC insulated with a minimum cross section of 1.0mm. Tri-rated cable complying with BS6231 is used throughout having a temperature rating of 105C. Wire ends are terminated with crimped connectors of the spade, ring or pin type, appropriate to the termination to which they are connected.



Click for
animation

GO

Irrespective of the trip setting or fuse rating all power wiring is sized to the maximum current or frame size of the appropriate device to ensure minimum disturbance should the circuit be upgraded at a later date.

Internal power wiring is carried out in tri-rated multi strand annealed copper conductors in accordance with BS6231. Insulation colour is black throughout with each cable end being clearly identified with phase coloured tape or strapping. Cables are rated in accordance with the latest edition of the IEE wiring regulations and are provided with crimped cable plugs of the appropriate size and type.

All cables are clearly identified using indelibly machine printed cable markers located at both ends of the cable.

Connection of functional units to outgoing cables is carried out in the cable zone in accordance with BS EN 60439-1:1999 Form 4B. Dependent 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 7).

Cable boxes are sized to comply with the cable termination and spreading requirements contained in BS5398:1999. Terminations are once again, irrespective of the trip setting or fuse rating sized to the maximum current or frame size of the device enabling circuits to be upgraded at a later date with minimum disruption. Should oversize or parallel conductors be specified provision will be made to accommodate these.

As a consequence however the level of segregation achievable may be compromised.



Outgoing terminals with
boot retainer



Flexible boots fitted to
retainer Form 4b Type 5

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

The flexible and modular design allows countless outgoing circuit device options to meet the demands of wide ranging applications in diverse markets.

ABB is one of the world's largest manufacturers of low voltage electrical components. Its comprehensive MNS-BS range includes air and moulded case circuit breakers, isolators and combination switches, motor starters, contactors and control devices and power factor correction equipment.



OUTGOING

Air Circuit Breakers installed in MNS for outgoing circuits are selected from the ABB Emax range of technically advanced high performance Air Circuit Breakers complying fully with the requirements of BS EN 60947-2:1999 and IEC 60947-2:1999.

The constant increase in the technological and functional complexity of electrical installations makes it essential for every component particularly those such as protection circuit breakers which are crucial to safety to offer the highest levels of continuity of service and reliability combined with minimal maintenance requirements.

ABB has designed the new generation of Emax low voltage air circuit breakers in line with these advanced installation requirements featuring high resistance to mechanical, electrical and thermal stresses.

Emax Air Circuit Breakers are designed to operate in conjunction with ABB Isomax moulded case circuit breakers and have like them been designed for integration and accurate co-ordination with the many different low voltage products available from ABB.

Emax air circuit breakers are available in five different frame sizes E1, E2, E3, E4 and E6 all with the exception of E1 are available for incorporation in MNS. The current ratings and rated ultimate-short circuit breaking capacity of each frame size at 415volts are as follows:

- E2 up to 2000Amps 130kA
- E3 up to 3200Amps 130kA
- E4 up to 4000Amps 100kA
- E6 up to 6300Amps 150kA



Emax - E2



Emax - E3



Emax Air Circuit Breaker - E4



Emax Air Circuit Breaker - E6

OUTGOING

A feature of the range is the modularity and the fact that all breakers irrespective of rating have identical height and depth dimensions. Breakers are available in both triple and four pole configurations and for TPN applications a fixed neutral with detachable link, removable from the front of the switchboard is mounted alongside the breaker.



Air Circuit Breaker Emax - E3

Within MNS switchboards Emax air circuit breakers are mounted in individual cassettes fabricated from galvanised sheet steel with the front cover being painted to match the exterior finish. Connections between the ACB and the main or distribution busbars are carried out in single or multi laminations of HDHC copper bar using purpose manufactured connector blocks at the termination points.

Outgoing cable access is provided at the rear of the ACB cassette and entry into the switchboard can be from above or below or a combination of both. Where a multi ACB installation is anticipated positioning the main horizontal busbars at the centre of the switchboard frequently results in a cost effective solution and simplifies the cable installation.

In the majority of installations ACBs are mounted in individual cubicles to allow ample room for cabling and trunking.

Both dual and triple stacked ACB arrangements are available combining E2 and E3 frame Air Circuit Breakers. In such installations however care must be exercised to ensure that adequate cabling capacity is available however and that the movement of cooling air through the structure is not compromised.

Barriers are provided between the busbar and outgoing side of the ACB connections ensuring full compliance with the segregation requirements of BSEN 60439-1:1999 Form 4.

- E2 up to 2000Amps 130kA
- E3 up to 3200Amps 130kA
- E4 up to 4000Amps 100kA
- E6 up to 6300Amps 150kA



Dual stacked ACBs

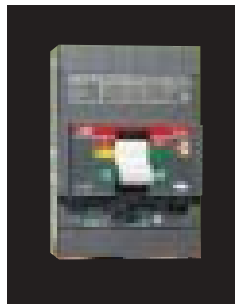
Rear view of 6300A ACB connections to main Busbars

OUTGOING

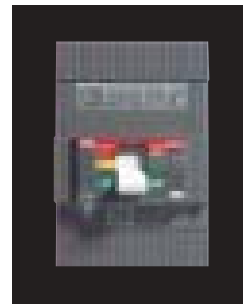
Moulded Case Circuit Breakers employed in MNS are selected from the technically advanced high performance Isomax S range and fully comply with International Standards BS EN.60947-2:1999 and IEC 60947-2:1999. For outgoing circuits, however, options are increased with the addition of ABB's revolutionary Tmax breaker with ratings from 1 to 250Amps with both fixed and withdrawable options. Tmax comes in three frame sizes T1, T2 and T3 all of which are designed to operate and coordinate with each other. Selections of function and performance previously unavailable in a breaker of this size are readily available and practically any application up to 250Amps can be catered for within the three frame sizes.

The same criteria for the selection of air circuit breakers applies to moulded case circuit breakers. It is again essential for every component particularly those crucial to safety to provide exceptional levels of reliability and minimal maintenance requirements.

These criteria were a vital aspect of the development of the Isomax S range of MCCBs and resulted in a range of MCCBs of outstanding technical performance. Equipped with advanced state of the art electronic protection units, all are housed in enclosures with uniquely compact dimensions.



Tmax - T2



Tmax - T3



Isomax - S4

Isomax - S5

Isomax - S6

Isomax - S7

OUTGOING

Dependent on frame size, breakers are available in MNS switchboards as fixed or withdrawable units and can be supplied fully protected or as isolators. Both three and four pole units are available in all frame sizes. For TPN applications a fixed neutral with detachable link, removable from the front of the switchboard, is mounted alongside the breaker.

Breakers are mounted in individual, ventilated cassettes fabricated from smooth, galvanised sheet steel. Each cassette is fitted with a bolted cover or hinged door again depending on frame size through which the operating handle protrudes. Both doors and covers are painted to match the switchboard's exterior finish. Connections between moulded case circuit breakers and the main or distribution busbars are produced in single or multi laminations of electro-tinned HDHC copper bar. Purpose made connector blocks are used at the busbar juncture. Outgoing cable access is provided at the rear of the MCCB, with entry from above or below or a combination of both.

4 Pole Tmax MCCB connected to distribution bars with fully insulated terminals



Outgoing rear connections from MCCB with insulated Busbar plate removed



Rotary handle MCCBs

- Tmax - T1 160A Thermal/Magnetic
- Tmax - T2 160A Electronic
- Tmax - T3 250A Thermal/Magnetic
- Isomax - S4 250A Electronic
- Isomax - S5 400A Electronic
- Isomax - S6 800A Electronic
- Isomax - S7 1250A Electronic

Customised
MNS Energy
Range

Rear Access
11kV/400v
Packaged
Sub-stations

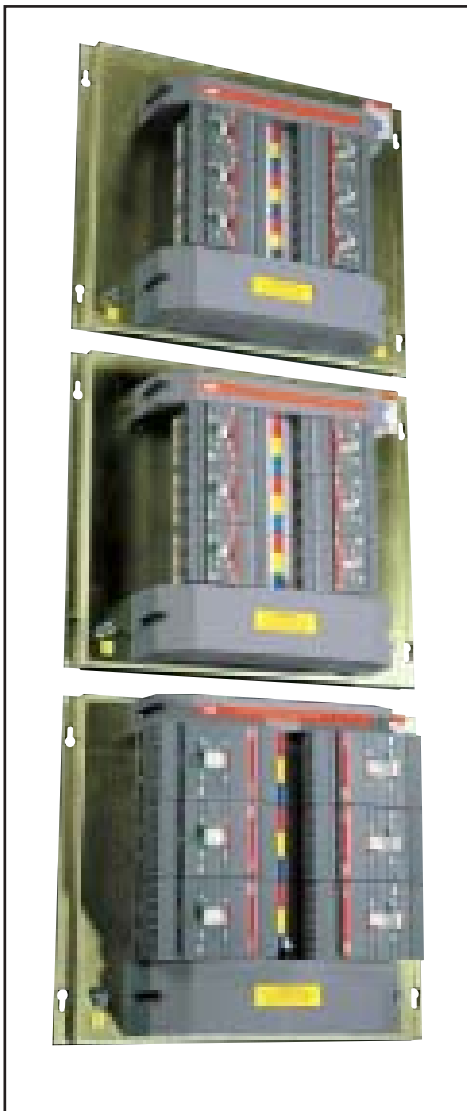
MCCB Backpan Assemblies

3.5.6e

OUTGOING

The installation of Moulded Case Circuit Breakers for outgoing circuits within MNS is further enhanced by the range of Backpan Assemblies available for group mounting of MCCBs. Identical in all respects to the backpan so successful in the MNS range of MCCB Panelboards this product allows for the mounting of both single pole and multipole devices in an extremely compact and cost effective manner.

Of particular interest to the Building Services and Retail market sectors where inclusion of single pole devices is frequently required, backpans are available in six, twelve or eighteen way triple pole units and can be provided with a range of incoming protective devices or for direct connection. Segregation is achieved between devices by the use of rigid mouldings and compliance up to BS EN 60439-1:1999 Form 4a. Type 5 is also available. The fully shrouded busbar system within the backpan utilises an innovative patented design feature that encapsulates the busbars within insulated housings supported by extruded aluminium sections. These sections, designed to provide maximum strength and support, enable both conductors and devices to be mounted in close proximity.



OUTGOING

ASTA certified in accordance with BS EN 60439-1:1999 to withstand a through fault of 50kA for 1 second the one piece 800Amp busbar system has no joints and is specifically designed to prevent the occurrence of hot spots. The aluminium busbar support provides an effective medium for the dissipation of heat in high ambient temperatures.



- Tmax - T1 1P 160A Thermal/Magnetic
- Tmax - T1 160A Thermal/Magnetic
- Tmax - T2 160A Electronic
- Tmax - T3 250A Thermal/Magnetic

Incoming and outgoing devices are selected from the ABB range of high performance Isomax S and Tmax moulded case circuit breakers.

Within MNS MCCB backpans are mounted in individual, ventilated galvanised sheet steel compartments supplied complete with a lockable hinged door which is finished in electrostatic powder coated durable stove enamel Light Grey to RAL7035 Texture.

Inside the compartment there are no exposed parts and the complete backpan is fully shrouded to prevent accidental contact.

Connection between the main or distribution busbar and the backpan are carried out in single or multi laminations of electro-tinned HDHC copper bar using purpose manufactured connector blocks at the busbar juncture.

Outgoing cable access is provided at the rear of the backpan and entry into the switchboard can be from above or below or a combination of both.



Customised
MNS Energy
Range

Rear Access
11kV/400v
Packaged
Sub-stations

Combination Switchfuses and Isolators

3.5.6g

OUTGOING

Switchfuses incorporated in MNS are selected from the ABB Powerline range of combination switches with ratings ranging from 125Amps to 800Amps. The Powerline switchfuse combines a fused short circuit protection device with load break switching on both sides of the fusible element.



Slimline Switchfuse with outgoing cables

The fuse links are mechanically stationary elements, ensuring a long electrical and mechanical life for both AC and DC network applications. The units are of extremely compact dimensions allowing the construction of cost effective compact switchboards.

Powerline switchfuses are available in single to four pole configurations and can be specified with either switched or bolted neutrals with detachable neutral links.

In the case of switched neutral versions the contacts can be arranged for either simultaneous or early make/late break switching.

The design and manufacture of fuse technology employ the latest technology in the design and manufacture of fuse technology and have been fully tested in accordance with IEC947-3. Among the many advanced operational and safety features. The following are included:

- Fuse carriers fully IP20 protected
- Fully protected fuse housings
- Patented operator independent quick make/quick break contacts which are self cleaning
- Wide selection of auxiliary contacts
- Flexible mounting
- Choice of operators



Within MNS switchfuses are located in individual, ventilated, galvanised sheet steel compartments complete with hinged door which is painted Light grey RAL7035 Texture to match the exterior finish of the switchboard. A rotary door interlocked operating handle is provided which can be locked in the OFF position.

Connections between switchfuses and the main or distribution busbars are carried out in single or multi laminations of electro-tinned HDHC copper bar using purpose manufactured connector blocks at the busbar juncture.

Incoming cable access is provided at the rear of the switchfuse compartment and entry into the switchboard can be from above or below or a combination of both.

- Powerline OS Switchfuses 125A - 200A
- Powerline OESA Switchfuses 400A - 800A
- Slimline SRM Plug-in Switchfuses 63A - 630A

OUTGOING

The incorporation of motor control facilities in low voltage distribution switchboards is an infrequent occurrence and for most installations the requirement for motor control is performed by a dedicated Motor Control Centre such as the MNS fully withdrawable system described under section 3.1.0 of this programme.

The provision for the incorporation of a variety of motor control arrangements is however available in the MNS Low Voltage Switchboard in both fixed and withdrawable chassis arrangements.

Withdrawable starters are in all respects identical to those employed in the MNS Motor Control Centre and are interchangeable thus eliminating the necessity for parallel holdings of spare or replacement units.

In situations where the available space provided by the Multi-functional wall (described under 3.3.4c) is not fully utilised substantial savings in cost can be achieved by combining along with the motor starter chassis plug in SRM switchfuse units and reactive power factor correction modules.

Notwithstanding the community benefits of the aforementioned should the requirement for motor control be for a single or low number of units, then employment of the functional wall and plug in chassis may be considered uneconomic. In such circumstances motor starters and associated controls can be mounted in Universal Box Assemblies and connected direct to the Distribution Busbar using HDHC electro-tinned copper bar.

Withdrawable units are designed with plug-in connections for the supply from the vertical busbar system and for the outgoing power and control cables. This allows changing, adding and testing the withdrawable units while the switchgear is live. Connections of all cables can therefore be carried out safely in the separate cable compartment.

By using withdrawable units the maximum possible use of space is achieved. For example up to 36 starters can be accommodated in one vertical column with a width of 600mm. Fused and MCCB starters available with type 2 coordination up to 690V.

Typical Motor Control Centre with motor starters and slimline SRM Switchfuses



OUTGOING

Withdrawable modules size 8E/4 and 8E/2.

These modules consist of the instrument panel and side panels made of insulating material, the rear wall with integrated cable connections, and a 20-pole control connector as well as one or two profile sections for mounting snap-mounted components. If required the withdrawable module size 8E/2 can be equipped with 2 x 20 pole control connectors.

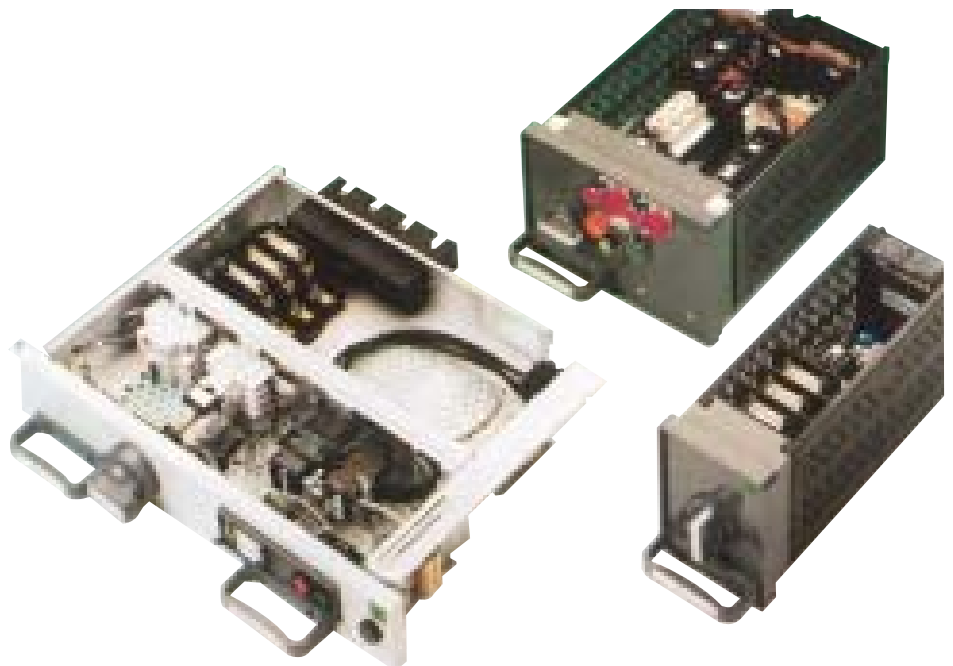
The instrument panel has preformed knockouts for mounting, measuring, operating and indicating instruments.

The main switchgear (normally a fused motor switch or circuit-breaker) is operated by means of the operating handle located at the instrument panel, which is also used for the electrical as well as the mechanical interlocking function. A micro-switch with 1 make and 1 break contact is provided for electrical interlocking.

The withdrawable module condaptor is designed for a current up to 125A and can hold 2 modules size 8E/2 up to 63A or 4 modules size 8E/4 up to 45A.

It comprises a 20-pole control connector for each module size 8E/4 and one or two 20-pole control connectors for each module size 8E/2.

The connections between the incoming and outgoing side are arranged inside the withdrawable module condaptor and are protected against accidental arcs.



Motor Starters upto 315kW - Feeders up to 800A. Withdrawable modules size 4E, 8E, 12E, 16E, 20E, 24E, 36E and 40E

The withdrawable modules consist of an instrument panel and a rear wall made of insulating material, and a front cover and side panels made of sheet steel, as well as mounting channels. The hinged front cover offers the advantage of easy accessibility of the built-in components (eg. for replacing fuses) from the front without withdrawing the module.

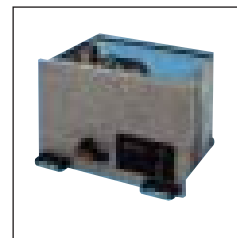
Withdrawable module condapter for fast expansion and modification of an energised switchgear cubicle with small withdrawable modules size 8E/4 and 8E/2.



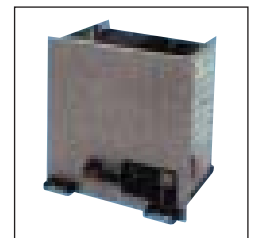
The front cover incorporates a cut out section for an instrument panel which remains in position when the cover is opened. It also is designed with preformed knockouts for mounting instruments.



MNS - Main PowerContact



Module size 16E
(with compartment door) up to 132kW.
Maximum 4in cubicle.



Module size 24E
(with compartment door) up to 250kW.
Maximum 3in cubicle.

● Drop down menu. Content to be added

GENERAL



ABB has for many years been the market leader in dry type power factor correction capacitor technology. In that time the company's reputation has grown worldwide for producing capacitors offering:

- Long life even under electrical stress
- Peak current handling capacity
- Minimum dielectric losses
- An integrated approach to facility and personnel safety consisting of self healing capacitor elements contained in a vermiculite filled container complete with internal protection for the elements

The practise of incorporating Power Factor Correction equipment into distribution switchboards has become commonplace in the last decade and the solution provided within MNS offers levels of flexibility and compactness hitherto unachievable. Among these benefits are the following:

- Cost savings by integration of the compensation modules into the switchgear system
- Compact size by combining the compensation modules with withdrawable distribution feeders and motor starters on a common functional wall riser
- Protection against accidental contact with the live distribution busbars provided by fully shrouded plug and socket shrouds
- High operational reliability and personal safety through internal arc partitioning between equipment compartment and busbar compartment

On installations where harmonics are present caused by non-linear electrical loads such as variable speed drives, rectifiers, UPS systems and computer reactors can be provided. These are mounted alongside the capacitors and form part of the withdrawable PFC chassis.

Control and switching of the PFC stages is performed by an ABB Type RVC or RVK relays selection of which is dependent on the application. In addition to the controlling function relays are provided with monitoring and measurement functions and communication facilities.

GENERAL

In addition to the comprehensive range of modules which house devices such as moulded case circuit breakers and switchfuses, a comprehensive range of universal box assemblies complete the MNS system and is available for the mounting of:

- MCB distribution boards
- instrumentation and meters
- contactors and relays
- fixed pattern motor starters
- control equipment



Each Universal Box assembly includes a hinged door and internal mounting plate, the position of which is adjustable at 50mm intervals to a maximum depth of 310mm. All internal box components are manufactured from smooth galvanised sheet steel. Doors are equipped with concealed lift off hinges and can be supplied, drilled or punched to accommodate door mounted equipment such as meters and relays. Exterior finish is durable electro statically applied powder coated paint Light Grey RAL7035 texture. Alternative finishes are available to order at additional cost.

On Universal Boxes up to 600mm wide by 1000mm high (40E) a single door is provided which can be hinged on either side. Above this size Universal Boxes are provided with double doors.



While accepting the importance of the structure and functions carried out by the incoming and outgoing devices, the busbar system could justifiably be considered the most important element of the modern day switchboard. Both the incoming power delivering devices and the outgoing devices which control and distribute the energy are connected to it.

In developing the MNS range ABB designers were aware that an innovative busbar design was necessary to account for the stresses imposed by ever increasing energy levels being distributed at low voltage while simultaneously providing the flexibility to allow devices to be easily added or removed. A compact solution enabling the maximum number of circuits to be incorporated was also vital in view of the restrictions imposed by architects and specifiers. In the new MNS range the busbar system meets all the above criteria. Independent tests by ASTA in accordance with BSEN 60439-1: 1999 achieved up to 100kA for 1 second on main busbars and up to 80kA for 1 second on distribution busbars and risers.



Cast copper connection on main Busbars
to distribution bars

The main busbar support structure comprises high density, modular glass reinforced polyester mouldings surrounded by a rigid stainless steel frame.

The whole busbar assembly can be located at the top, centre or bottom of the switchboard to provide flexibility in the mounting of incoming and outgoing devices and to aid the entry of incoming and outgoing cables. Irrespective of location the busbar system is extendible at either end of the switchboard.

Main busbars are manufactured from electro tinned, rectangular section, hard drawn, high conductivity copper bar. For current ratings up to and including 4000Amps, two laminations of copper bar are used for both phase and neutral conductors. For 5000 and 6300 Amp assemblies, four laminations arranged in a packetised formation for maximum current carrying efficiency are used for both phase and neutral. Ratings up to 10000Amps are available to order. For systems with high harmonic content the neutral conductor can be supplied at twice the rating of the phase conductors.



4000A main Busbars

At no point in the busbar system is the cross sectional area of a main busbar conductor reduced by the insertion of connection holes. All fasteners used with the clamping blocks are manufactured from zinc-plated, high tensile steel. Pressure disc washers are used throughout, ensuring that the integrity of joints is maintained and future maintenance of the busbar system is minimal. Busbars are supplied air insulated as standard. Fully insulated systems are available as an option and employ rigid barriers designed to slot into the busbar support mouldings. Due to the risk of damage should a busbar fault develop, flexible sleeving is never incorporated.

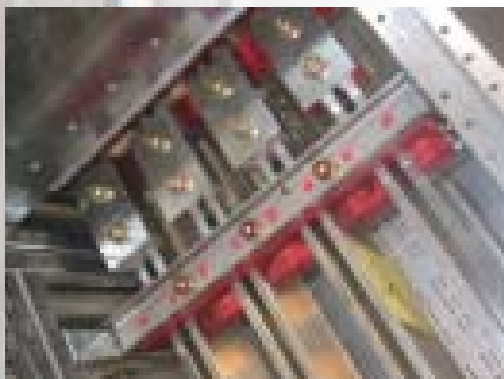
All connections between shipping sections and busbar connected devices are achieved by the use of specially designed extruded copper clamping blocks.



2 Tier main Busbars
6300A



Assembled
clamping
blocks



Customised
MNS Energy
Range

Rear Access
11kV/400v
Packaged
Sub-stations

Distribution Busbars and Risers

3.5.5c

Available in 2000Amp and 4000Amp ratings, distribution busbars and risers are manufactured from specially developed extruded sections of hard drawn, high conductivity copper or aluminium. The copper extrusion is electro-tinned and the aluminium anodized to eliminate the possibility of any chemical interaction when connecting with dissimilar metals.

Distribution busbars and risers are located in a ventilated sheet steel chamber and are held in place by high density glass reinforced mouldings with securing bolts locking the mountings together. Connection between the main busbar system and the distribution busbar riser is achieved by the use of a purpose designed copper casting of immense strength profiled to lock onto the main busbar providing a highly secure connection. The profile allows the connection of devices to each side of the riser enabling a high number of devices to be installed in a relatively small space. Connections between the distribution busbar and devices is by electro-tinned, hard drawn, high conductivity copper bar. Attachment of the device connections to the distribution busbar uses specially designed non-rotating cast bolts fitted with pressure disc washers.



Distribution bars



TP&N MCCB connected to
distribution bars



Providing a safe working environment is a vital aspect of the design and construction of MNS-BS. The likelihood of internal arcing faults has been minimised by careful design, but in areas considered to present any kind of risk insulated coatings are applied to the conductors. In all other areas, clearances phase/phase, phase/neutral, phase/earth are maintained at levels equal to or greater than that specified in BSEN 60439-1:1999

The risk of internal arcing faults is further reduced by enclosing both main and distribution busbars and risers in segregated sheet steel chambers, thus preventing intrusion by foreign bodies. In addition, where conductors from devices are attached to busbars, moulded bushing plates are provided to rigidly support the conductors, thus preventing any likelihood of movement. A further option to satisfy the requirements of IEC 1641 are fully encapsulated vertical distribution risers.

A further option available within MNS and satisfying the requirements of IEC 1641:1996-01 protection against Internal arcing faults are fully encapsulated vertical distribution risers (functional wall).

Within the functional wall, each vertical busbar is completely encased in a specially insulated, multi-functional separation wall designed to prevent accidental arcing by eliminating phase/phase and phase/earth faults. Access for the attachment of outgoing devices is achieved by the inclusion of fully shrouded apertures at 25mm intervals allowing entry of the special plug assemblies attached to the device modules.

Because of the flexibility of the functional wall and the simplicity by which devices can be removed, routine maintenance items such as power factor correction modules, motor starters and control devices are installed using the functional wall. Furthermore, where a compact installation is required and the segregation level does not exceed Form 4b using protective gaiters and bushes for outgoing cables, the incorporation of ABB SRM 'plug in' fuse switches provides an extremely cost-effective solution.



Powerconnectors
to plug into
multi-functional
wall

Multi-functional wall
connected to main
Busbars

The flexibility of MNS permits the accommodation of a comprehensive range of incoming options, all designed to maximise performance, provide ample space for incoming cables and where applicable bus trunking and to ensure many years of trouble free service with the minimum of maintenance.

Incoming devices are selected from the comprehensive range of low voltage devices manufactured by ABB all of which can be guaranteed to provide high levels of performance with long lasting capability. Tested independently in accordance with international specifications the full range of devices can be relied upon to provide superior performance and unprecedented levels of operator and system safety.

Available in the list of incoming options are the following:

- ACBs up to 6300Amps
- MCCBs up to 2000Amps
- Fuse Switches up to 800Amps
- Isolators up to 3150Amps
- Direct Cable
- Bus Trunking



Emax Air Circuit Breaker



Fuseswitch



Tmax MCCB



Air Circuit Breakers installed in MNS-BS are selected from the ABB Emax range of technically advanced high performance Air Circuit Breakers complying fully with the requirements of BS EN 60947-2:1999 and IEC 60947-2:1999

The constant increase in the technological and functional complexity of electrical installations makes it essential for every component particularly those such as protection circuit breakers which are crucial to safety to offer the highest levels of continuity of service and reliability combined with minimal maintenance requirements.

ABB has designed the new generation of Emax low voltage air circuit breakers in line with these advanced installation requirements featuring high resistance to mechanical, electrical and thermal stresses.

Emax Air Circuit Breakers are designed to operate in conjunction with ABB Isomax moulded case circuit breakers and have like them been designed for integration and coordination with the many different low voltage products available from ABB.

Emax air circuit breakers are available in five different frame sizes E1, E2, E3, E4 and E6. All with the exception of E1 are available for incorporation in MNS. The current ratings and rated ultimate short circuit breaking capacity of each frame size at 415 volts are as follows:

- E2 up to 2000Amps 130kA
- E3 up to 3200Amps 130kA
- E4 up to 4000Amps 100kA
- E6 up to 6300Amps 150kA



Emax - E2



Emax - E3



Emax Air Circuit Breaker - E4



Emax Air Circuit Breaker - E6

A feature of the range is the modularity and the fact that all breakers irrespective of rating have identical height and depth dimensions. Breakers are available in both triple and four pole configurations and for TPN applications a fixed neutral with detachable link, removable from the front of the switchboard is mounted alongside the breaker.



Cable connections to incoming or outgoing ACB Copperwork



ACB housed in a 'Cassette' showing removable neutral link

Within MNS-BS switchboards Emax air circuit breakers are mounted in individual cassettes fabricated from galvanised sheet steel with the front cover being painted to match the exterior finish. Connections between the ACB and the main or distribution busbars are carried out in single or multi laminations of hard drawn high conductivity copper bar using purpose manufactured connector blocks at the termination points.

Incoming cable access is provided at the rear of the ACB cassette and entry into the switchboard can be from above or below or a combination of both. Where a multi ACB installation is anticipated positioning the main horizontal busbars at the centre of the switchboard frequently results in a cost effective solution and simplifies the cable installation.

In the majority of installations ACBs are mounted in separate cubicles to allow ample room for cabling and trunking and for compartments to house the metering and protection devices frequently required. Current Transformers are provided on incoming busbars for both protection and metering purposes.

Barriers are provided between the incoming and busbar side of the ACB connections ensuring full compliance with the segregation requirements of BSEN 60439-1:1999 Form 4. When used as bus couplers both sides of the ACB are totally segregated. Using barriers as previously described and by utilising bus transition sections, segregation between each busbar is achieved.

Both dual and triple stacked ACB arrangements are available combining E2 and E3 frame breakers. In such installations however care must be exercised to ensure that adequate cabling capacity is available and that the movement of cooling air through the structure is not compromised.

- E2 up to 2000Amps 130kA
- E3 up to 3200Amps 130kA
- E4 up to 4000Amps 100kA
- E6 up to 6300Amps 150kA

2 Tier main Busbars showing copperwork connections to ACB

Moulded Case Circuit Breakers employed as incomers in MNS-BS are selected from the technically advanced high performance Isomax S range and fully comply with International Standards BS EN.60947-2:1999 and IEC 60947-2:1999.



The same criteria for the selection of air circuit breakers applies to moulded case circuit breakers. It is again essential for every component particularly those crucial to safety to provide exceptional levels of reliability and minimal maintenance requirements.

These criteria were a vital aspect of the development of the Isomax S range of MCCBs and resulted in a range of MCCBs of outstanding technical performance. Equipped with advanced state of the art electronic protection units, all are housed in enclosures with uniquely compact dimensions.

Although the Isomax S range comprises eight different frame sizes only the S5 to S8 are used as incoming units in MNS-BS. The current ratings and rated ultimate short circuit breaking capacity of each frame size at 415volts are as follows:

- S5 up to 630Amps 65kA.
- S6 up to 800Amps 65kA.
- S7 up to 1600Amps 65kA.



Isomax - S5

Isomax - S6

Isomax - S7



Dependent on frame size, breakers are available in MNS switchboards as fixed or withdrawable units and can be supplied fully protected or as isolators. Both three and four pole units are available in all frame sizes. For TPN applications a fixed neutral with detachable link, removable from the front of the switchboard is mounted alongside the breaker. Breakers are mounted in individual, ventilated cassettes fabricated from smooth, galvanised sheet steel. Each cassette is fitted with a bolted cover or hinged door again depending on frame size through which the operator protrudes. Both doors and covers are painted to match the switchboard's exterior finish. Connections between moulded case circuit breakers and the main or distribution busbars are produced in single or multi laminations of electro-tinned HDHC copper bar. Purpose made connector blocks are used at the busbar juncture. Outgoing cable access is provided at the rear of the MCCB, with entry from above or below or a combination of both.

Incoming cable access is provided at the rear of the MCCB compartment and entry into the switchboard can be from above or below or a combination of both.



MCCB in cassette mounted in switchboard

- S5 up to 630Amps 65kA
- S6 up to 800Amps 65kA
- S7 up to 1600Amps 65kA



4 Pole Tmax MCCB connected to distribution bars with fully insulated terminals

Switchfuses used in MNS-BS are selected from the ABB Powerline range of combination switches. Ratings range from 20Amps to 800Amps. The Powerline switchfuse combines a fused short circuit protection device with load break switching on both sides of the fusible element. The fuse links are mechanically stationary elements, ensuring a long electrical and mechanical life for both AC and DC network applications. Extremely compact unit dimensions allow the construction of cost effective compact switchboards.



Powerline switchfuses are available in one to four pole configurations and can be specified with either switched or bolted neutrals with detachable neutral links. In the case of switched neutral versions, the contacts can be arranged either simultaneously or early make/late break switching. The design of Powerline switchfuses incorporates the latest techniques in the design and manufacture of fuse technology and have been fully tested in accordance with IEC947-3. Included among the many advanced operational and safety features are the following:



- Current Ratings 400 to 800Amps, 3 and 4 Pole
- Fully IP20 protected fuse carriers
- Fully protected fuse housings
- Patented operator independent quick make/quick break self cleaning contacts
- Wide choice of auxiliary contacts
- Flexible mounting
- Choice of operators

Within MNS-BS, switchfuses are located in individual, ventilated, galvanised sheet steel compartments complete with a hinged door painted to match the exterior finish of the switchboard. (light grey RAL7035 Texture)

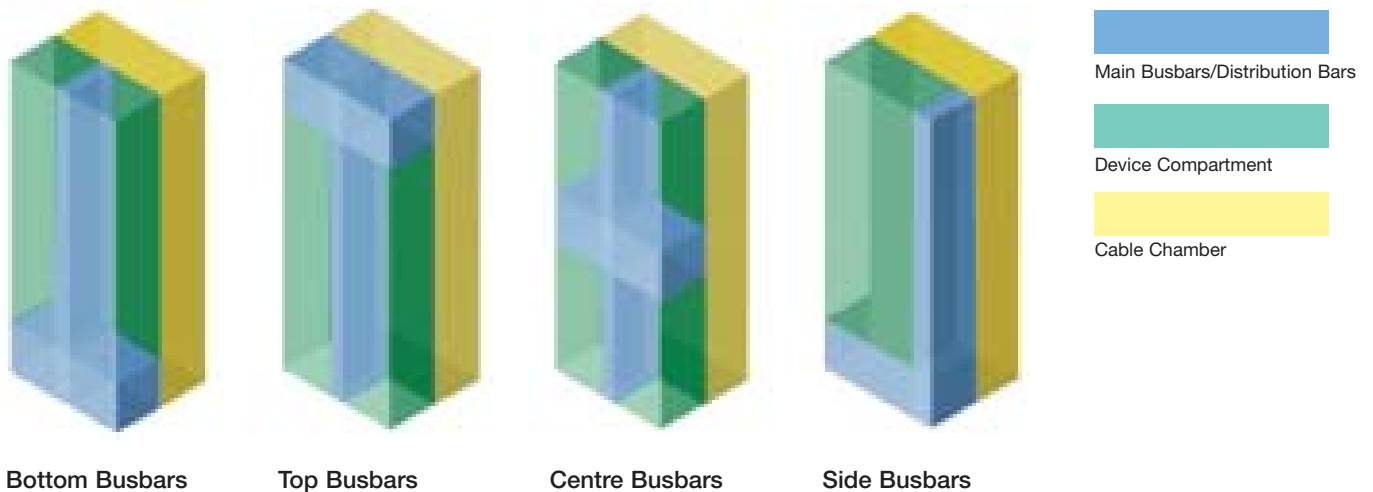
A lockable rotary door operating handle is provided which can be locked in the OFF position. Connections between switchfuses and the main or distribution busbars are produced in single or multi laminations of electro-tinned HDHC copper bar. Purpose manufactured connector blocks are used at the busbar juncture. Incoming cable access is provided at the rear of the switchfuse compartment and entry into the switchboard can be from above, below or a combination of both.

OESA Combination Switchfuses

40A Fuseswitch connected to distribution bars with fully insulated terminals

Segregation in the modern day switchboard is of paramount importance. Sophisticated electronic devices should not be exposed to the mechanical functions of installing heavy cables and main and distribution busbar systems should be segregated to prevent the ingress of foreign materials ever present during the installation process.

BS EN 60439-1:1999 and IEC 60439-1:1999 provide clear guidelines on effective segregation and four headline categories of construction are listed in the main body of the standard. Further sub-divisions are contained under annexes to the standard to meet the specific requirements of the UK market.



Frequently interpreted as cabling options the recommendations contained in the standard are for the safety of the operator and to ensure that switchboards are constructed in a manner which provides a safe and reliable working environment. MNS fulfills without exception the most onerous requirements of the standard. As part of the standard MNS design, all cubicles are divided into three prime functional areas as shown in the diagrams above.

Each zone is segregated from the other by galvanised steel barriers and where solid conductors or cables pass between zones insulated bushing plates are inserted. Terminations for outgoing devices are positioned in the cabling area. Dependent on the form of segregation specified terminations will either be protected from accidental contact by insulated gaiters or in the higher forms of construction individual galvanised steel cable boxes.

A detailed description of cabling options is contained under 3.3.6.

Reliable electrical power is at the heart of our industries, our institutions and our communities. In applications as varied as power generation plants, manufacturing operations, heavy process industries and the utility distribution infrastructure, ABB SafeRing and SafePlus products enable the reliable and safe distribution of electrical energy.



SafeRing is an SF6 insulated ring main unit for the secondary distribution network. SafeRing can be supplied in a number of different configurations suitable for most switching applications in 12/24kV distribution networks. It is extendible and combined with the SafePlus concept, which is ABB's flexible, modular compact switchgear, represent's a complete solution for 12/254kV secondary distribution networks. SafeRing and SafePlus are equipped with identical user interfaces.

SafeRing is a completely sealed system with a stainless steel tank containing all live parts and switching functions. A sealed tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety and a virtually maintenance free system.

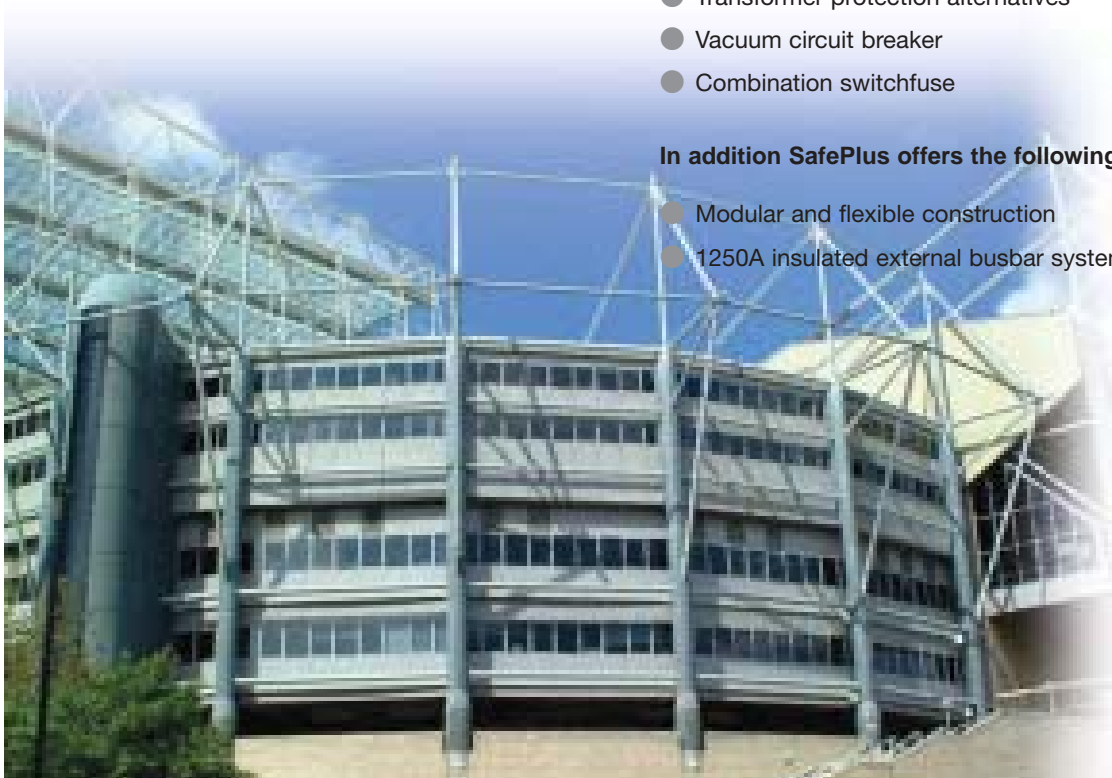
The SafeRing concept offers a choice of either a switchfuse combination unit or circuit breaker with relay for protection of the transformer. As the first ring main unit, SafeRing can be supplied complete with an integral remote control and monitoring unit.

Listed among the features of the range are the following:

- Continuously rated at 630Amps at 12/24kV
- Integrated control and monitoring unit
- SF6 insulation media
- Compact dimensions
- High degree of personnel safety
- Impervious to climate changes
- Requires minimum maintenance in operation
- Transformer protection alternatives
- Vacuum circuit breaker
- Combination switchfuse

In addition SafePlus offers the following additional benefits:

- Modular and flexible construction
- 1250A insulated external busbar system



Cast resin transformers supplied in MNS-BS packaged substations are manufactured at the Zaragosa plant of ABB Diestre on the Spanish Mainland.

The first encapsulated transformer was produced by ABB Diestri in 1981 since which time ABB cast resin transformers have been successfully supplied worldwide to a diverse range of customers. Applications range from off-shore and on-shore petrochemical installations, motor manufacturers, public utilities and commercial office re-developments. Such is the versatility of the cast resin transformer.

The growth of Cast Resin Transformers in all areas has been remarkable and it may be worth considering what advantages the fully encapsulated transformer offers:

- Available as standard up to 2500kVA. Larger sizes available to order
- They do not propagate fire and are self extinguishing
- No risk of leakages of inflammable or contaminating substances such as oil or silicon
- They are maintenance free
- They have a long working life
- Installation costs are substantially reduced
- Compact dimensions are much reduced compared with liquid filled equivalents
- High specification and superior performance characteristics
- Ability to boost output by up to 40% for short periods by the addition of forced draught fan cooling

All these factors only serve to enhance the already substantial benefits of the close coupled Packaged Substation.

Within the Packaged Substation the low voltage interconnections between the transformer and the LV Busbar system are carried out in electro-tinned HDHC copper bar. The busbar system within the transformer house is an extension of the system installed within the switchboard and is ASTA certified to the appropriate short circuit level.

The transformer house itself is constructed from electro-galvanised press formed sheet steel panels interlocked to prevent unauthorised access. Access to the transformer is by double hinged doors positioned on the front or end of the housing. Roller guides are provided at the base of the cubicle to allow easy insertion and removal of the transformer.

Ventilation for the transformer is effected by the positioning of grilles at the bottom and top of the housing and when required additional grilles are placed on the roof. Protection against the ingress of dust and water is provided by the positioning of suitably constructed roof cowls.

Air baffles are positioned in the lower part of the transformer enclosure directing cool air into the centre of the transformer and upwards past the core creating an effective chimney maximising cooling efficiency.



