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Rear Access Switchgear
Front Access Switchgear
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Magnum DS Switchgear—Overview

Eaton’s Magnum DS® power circuit breaker switchgear is backed by 40 years of power circuit breaker and switchgear development that have set the industry standards for quality, reliability, maintainability and extended operating life, when it comes to protecting and monitoring low-voltage electrical distribution systems. Magnum DS switchgear is designed to meet the changing needs of our customers by providing:

- Lower installation and maintenance costs
- Higher interrupting ratings and withstand ratings
- Better coordination capability
- Increased tripping sensitivity
- Enhanced safety measures
- Higher quality, reliability and maintainability
- Communications and power quality monitoring and measuring capabilities
- Flexible layouts that maximize use of capital by minimizing equipment footprint

Magnum DS switchgear can meet the needs of general applications, service entrances, harsh environments, multiple source transfers, special grounding systems and many others.

With a modern design, Magnum DS metal-enclosed low-voltage switchgear and power circuit breakers provide:

- 100% rated, fully selective protection
- Integral microprocessor-based breaker tripping systems
- Two-step stored-energy breaker closing
- Standard 100 kA short-circuit bus bracing
- Optional 150 and 200 kA short-circuit bus bracing
- Optional metal barriers to isolate the cable compartment from the bus compartment
- Both indoor and outdoor aisle and aisleless enclosures
- Full range of safety solutions dealing with arc flash hazard and operator error

Many other features for coordinated, safe, convenient, trouble-free, and economical control and protection of low-voltage distribution systems are also provided.

Magnum DS breakers are designed to:

- ANSI Standards C37.13, C37.16, C37.17, C37.50
- UL 1066

Magnum DS switchgear conforms to the following standards:

- CSA® C22.2, No. 31-10
- ANSI C37.20.1
- ANSI C37.51
- UL® Standard 1558 and UL Standard 891
- American Bureau of Shipping (ABS)
- Built in an ISO® certified facility

Maximum ratings for Magnum DS switchgear are 600 Vac, 10,000 A continuous cross bus and 200,000 A short-circuit capacity.

Seismic Qualification

Refer to www.eaton.com/seismic or see Tab 1 at www.eaton.com/CAG for information on seismic qualification for this and other Eaton products.

Structure Features

Standard finish: Gray paint finish (ANSI 61) using a modern, completely automated and continuously monitored electrostatic powder coating. This continually monitored system includes spray de-grease and clean, spray rinse, iron phosphate spray coating spray rinse, non-chemical seal, oven drying, electrostatic powder spray coating and oven curing.

Integral base: The ruggedly formed base greatly increases the rigidity of the structure, reduces the possibility of damage during the installation of the equipment, and is suitable for rolling, jacking and handling. A lifting angle is permanently welded into the bus compartment structure for increased strength. The bottom frame structure members are indented to allow the insertion of a pry bar.

Heavy-duty door hinges: Each breaker door is mounted with hinge pins. Removal of the door is easily accomplished by just lifting the hinge pin. This allows easy access to the breaker internal compartment for inspection and maintenance.

Rear cover/doors: In Magnum DS switchgear, standard rear bolted covers are provided. They are split into two sections to facilitate handling during removal and installation. Optional rear doors are also available.
Through-the-door design: The following functions may be performed without the need to open the circuit breaker door—lever the breaker between positions, operate manual charging system and view the spring charge status flag, close and open breaker, view and adjust trip unit and read the breaker rating nameplate.

Cassette design: The breaker cassette supports the breaker in the cell, as well as on the movable extension rails when the breaker is placed into or removed from the cell. The extension rails allow the breaker to be drawn out without having to de-energize the entire switchgear lineup.

Accessibility: When the door is open or removed, each breaker compartment provides front access to isolated, vertical wireways, primary disconnects, cell current transformers and other breaker compartment accessories for ease of field wiring and troubleshooting field connections.

Four-position drawout: Breakers can be in connected, test, disconnected or removed position. The breaker can be moved between the connected, test and disconnected positions while the compartment door is closed.

Closing spring automatic discharge: Mechanical interlocking automatically discharges the closing springs when the breaker is removed from its compartment.

Optional safety shutters: Positive acting safety shutters that isolate the breaker connections to the main bus when the breaker is withdrawn from the cell is an option offered for additional safety beyond our standard design. They reduce the potential of accidental contact with live bus. Insulating covers (“boots”) are furnished on live main stationary disconnecting contacts in compartments equipped for future breakers.

Breaker inspection: When withdrawn on the rails, breaker is completely accessible for visual inspection; tilting is not necessary. The rails are permanent parts of every breaker compartment.

Interference interlocks: Supplied on breakers and in compartments where the compartments are of the same physical size. Interference interlocks ensure an incorrect breaker cannot be inserted.

Optional key interlock (switchgear mounted): This mechanism holds the breaker cell mechanically trip-free to prevent electrical or manual closing. Breaker can be stored in compartment, and completely removed for maintenance or for use as a spare without disturbing the interlock. Modification of the breaker is not required.

Optional mechanical interlock: Available between adjacent breakers to ensure the proper sequence of operation between two circuit breakers.

Bus ampacities: Vertical and main bus ratings in Magnum DS are 2000, 3200, 4000 and 5000 A. In addition, a 6000, 8000 and 10,000 A main bus rating is available. Vertical section bus is sized per main cross bus maximum rating or by ANSI C37.20.1 to a maximum of 5000 A.

Bus bracing: Standard bracing is 100,000 A. Unique vertical bus configuration provides an optional industry-leading short-circuit withstand rating of 200,000 A. The “U” shaped bar is the heart of the Magnum DS vertical bus. This configuration provides a much higher mechanical strength. To further demonstrate the strength and rigidity of this bus system, it has been verified through testing to withstand 85,000 A short-circuit for a full 60 cycles.

Silver and tin plating: Bolted, silver-plated copper bus is standard. The plating is over the entire length of the bar, not just at the joints. Optional tin-plated copper bus is available.

Bus joints: All joints are bolted and secured with Belleville-type spring washers for maximum joint integrity. These washers reduce the potential of joint hardware loosening during the change of joint temperature associated with variations of the loads. Optional maintenance-free hardware is also available.

Full neutral: For four-wire applications, the neutral bus is rated 100% of main bus rating as standard. Neutral ratings up to a maximum of 10,000 A are available as an option. Additionally, four-pole breakers can be used in conjunction with four-wire systems.

Ground: A ground bus is furnished the full length of the switchgear assembly and is fitted with terminals for purchaser’s connections.

Glass reinforced polyester and Ultramid® standoff insulation system: Glass reinforced polyester has been used on both low and medium voltage switchgear for decades. By combining this industry proven material with Ultramid insulation, a total system providing exceptional mechanical and dielectric withstand strength, as well as high resistance to heat, flame and moisture, is produced. Substantial testing to demonstrate accelerated effects of heating and cooling on the mechanical and dielectric properties of this system prove it to provide superior performance for decades of trouble-free operation.

For more information, visit: www.eaton.com/consultants
Optional epoxy bus coating: For applications requiring additional bus protection in harsh environments, Magnum DS switchgear is designed for the addition of optional conductor insulation covering, in addition to providing full UL air clearance without insulation. This material is applied during the assembly of the bus, and covers all vertical and horizontal phase bus bars. Removable boots provide access to section-to-section bus joints for inspection and maintenance purposes.

Barriers: Optional grounded metal barriers isolate the main bus and connections from the cable compartment providing added safety to the workers while reducing the potential of objects falling into the bus compartment. In addition, vertical barriers between cable sections can be added to reduce potential hazards. Barriers are removable to give access to the bus compartment for inspection and maintenance. Barriers can be either solid metal or vented for ease of infrared scanning.

Wiring Features

Cable compartment: The cable compartment gives ample room for terminating the power cables. Removable top roof sheets allow for easy conduit hub installation. The floor of the cable compartment is open to allow cable entry from underground duct banks. Optional floor plates are available.

In addition to cable, Pow-R-Way® busway and nonsegregated bus duct can be terminated in the compartment.

Lug pad: The lugs are located on the breaker run-backs to accommodate lug orientations at a 45° angle to reduce the bending radius of the cable needed for making the connections, thus reducing installation and maintenance time. Mechanical setscrew type lugs are standard. Optional NEMA two-hole compression lugs are available as an option.

Control wireway: An isolated vertical wireway is provided for routing of factory and field wiring in each switchgear section. Breaker secondary terminal blocks are mounted as standard above each circuit breaker. The terminal blocks are rated 30 A, and will accept bare wire, ring or spade terminals for wire size ranges of #22–#10. Extruded loops are punched in side sheets of the vertical wireway to allow securing of customer control wiring without the use of adhesive wire anchors.

Control circuits may be wired in all cells without removing the circuit breaker. In addition, power circuits may be connected in the rear of the switchgear at the same time control circuits are being wired in the front of the switchgear.

Control wire: Standard wire is Type SIS insulated stranded copper, extra flexible No. 14 AWG minimum. Type VW-1 wire is available.

Control wire marking: Each wire is imprinted with ink cured under ultraviolet light for durability and for easy identification by the user. The enhanced solvent resistance and durability of the aerospace grade UV cure ink has been tested for severe environments. The imprinting is made every 3.00 inches (76.2 mm) along the length of the wire to make field troubleshooting easier. The point of origin, wire designation and point of destination are imprinted in the following format: <origin zone/ wire name/destination zone>. Each device has a uniquely designated zone. “<” indicates the direction of the wire origination and “>” indicates the direction of the wire destination. As an option, wire name marking can be made using sleeve type or heat shrink sleeve type.

Control Wire Marking

Secondary terminal compartment: There are 72 finger-safe secondary connections for a standard frame Magnum breaker, 60 for a narrow frame Magnum breaker and 54 for a Series NRX breaker. The customer’s secondary terminal connections are located at the front of the structure behind a separate door providing access to these connections without the need to open the breaker compartment door.

Short-circuiting terminal blocks: One provided for each set of instrumentation or relaying application current transformers.

Shipping split connection: At each shipping split, the control connections are made with plug-in terminal blocks rated 800 V, 40 A. The terminal blocks mechanically interlock without removing the line or load connections. This method of making the shipping split control connections increases the speed of installation and reduces the potential of incorrect connections.
Instrumentation/Metering Features

Flexibility: Magnum DS switchgear allows for a variety of metering options. See CAG Tabs 2, 3 and 4 for Metering and Power Management products.

- Analog switchboard type meters such as ammeters and voltmeters
- Electronic power metering such as the Power Xpert Meter 4000/6000/8000 series, Power Xpert Meter 2000 series and IQ 250/260 series
- Instrument compartments—white interior panels for ease of visibility

Voltage transformers: Voltage transformers are rated 10 kV BIL, and are protected by both primary and secondary fuses. The primary fuses are of the current limiting type.

Current transformers: Current transformers for metering and instrumentation are mounted in the breaker compartments and are front accessible. Secondary wiring between the current transformer and the standard shorting terminal block is color-coded for ease of identification. Bus mounted CTs are available for metering and relaying.

Control power transformers: Control transformers are provided when required for AC control of circuit breakers, space heaters and/or transformer fans. Like voltage transformers, they are protected by current limiting primary fuses. Non-current limiting fuses are used on the secondary side to protect branch circuits.

Instrumentation—secondary terminal compartment door: Devices, such as electronic power metering and analog switchboard type meters that do not fit on the secondary terminal compartment door, are mounted on the instrument compartment door or on a panel of a blank cell.

Instrument compartment door: Devices, such as electronic power metering and analog switchboard type meters that do not fit on the secondary terminal compartment door, are mounted on the instrument compartment door or on a panel of a blank cell.

Accessories and Options

Switchgear accessories: Standard accessories furnished with each Magnum DS switchgear assembly include:

- One breaker racking tool
- Insulating covers or “boots” furnished on live main stationary disconnecting contacts in compartments equipped for future breakers
- Removable cover to block opening in the door when the breaker is temporarily removed from its compartment

Optional Accessories

- Traveling type circuit breaker lifter, rail-mounted on top of switchgear
- Floor-running portable circuit breaker lifter and transfer truck with manual lifting mechanism. This requires approximately 84.00 inches (2133.6 mm) deep front aisle space
- Test cabinet for electrically operated breakers, with pushbuttons, control cable and receptacle, for separate mounting
- Optional space heaters to be placed in the bottom of the breaker, cable and bus compartments. Space heaters are provided as standard in outdoor gear to reduce condensation
- Portable test kit (MTK2000) for secondary injection testing and verification of trip units. Uses standard 120 V, 15 A, single-phase, 60 Hz supply, available from any outlet. Allows for testing of Magnum breakers
- Remote racking device (MRR1000) for both breaker racking and operation (open/close) from a safe distance. Mounts to any existing Magnum DS breaker. Uses standard 120 V, 15 A, single-phase, 60 Hz supply, available from any outlet
Enhanced Switchgear Options

- Infrared scanning windows for bus thermal scans
- Maintenance-free (Torque-&-Forget) bus hardware
- Lug booting that provides additional protection against accidental contact to live parts in the cable compartment
- Grounding balls and covers for protecting maintenance personnel downstream of switchgear feeder breakers
- Pendant for remote open and close of electrically operated breakers

![Grounding Balls and Covers](image1)

![Remote Control Pendant](image2)

![MTK2000 Trip Unit Test Kit](image3)
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Rear Access Switchgear

Application Description

- Healthcare
- Commercial construction
- Machine building
- Infrastructure
- Data centers
- Mining, minerals and metals
- Education
- Oil and gas
- Electric utilities
- Pulp and paper
- Industrial and manufacturing
- Food and beverage
- Transportation
- Government
- Water/wastewater

Features and Benefits

- Improved uptime
  Higher interrupting ratings and withstand ratings, better coordination capability
- Improved maintainability
  Dedicated secondary terminals with separate access door and front-accessible control wireway
- Increased reliability
  Modular design allows for reduced parts for both structures and breakers
- Increased safety
  Complete enhanced performance suite of options
- Reduced installation cost
  Front-accessible controls and wiring enables rapid installation and commissioning

Optional features

Automatic Transfer and Intelligent Control
Increase uptime and simplify switchgear design by specifying one of Eaton's pre-engineered automatic transfer and intelligent control packages for Magnum DS low-voltage switchgear. The packages are designed with features to meet typical customer applications while still maintaining the flexibility to meet specific requirements. The packages are available on front and rear access in standard and arc-resistant designs.

Enhanced Safety

Zone Selective Interlocking
The Digitrip RMS zone selective interlocking (ZSI) capability provides positive system coordination without time delays. ZSI allows the breaker closest to the fault to trip without any preset time delay.

Arcflash Reduction Maintenance System™
Eaton's Arcflash Reduction Maintenance System employs a separate, dedicated analog trip circuit that eliminates microprocessor latencies, resulting in clearing times that are faster than standard instantaneous tripping.

Integrated High Resistance Grounding
High resistance grounding can add the safety of a grounded system while minimizing the risk of service interruptions due to grounds.

Aftermarket Solutions
Eaton has an extensive low-voltage switchgear aftermarket offering of replacement and retrofit parts as well as breakers. This extensive offering allows for life extension of older switchgear that has obsolete breakers yet life available in the assemblies. Please contact your local Eaton sales engineer for details.

Standards and Certifications

- Assembly designed to UL 1558, CSA®, ANSI C37.20.1 and C37.51
- Breaker designed to UL 1066, ANSI C37.13, C37.15 and C37.17
- Seismic Certified to UBC, IBC and California Building Code to exceed Zone 4
- ABS certified
Rear Access Switchgear—
Integrated Unit Substation

The integrated unit substation addresses issues that matter to building owners, electrical contractors and engineers, including:
- Reduction in installation time
- Fewer structures
- Reduction in overall floor space
- Reduction in overall installed costs
- Reduction in material handling and rigging requirements

Product Offering
- Up to 15 kV, 1200 A primary (VCP-T breaker up to 25 kAIC)
- Up to 600 V, 3200 A secondary (Magnum DS breaker up to 100 kAIC)
- Main structure is 24 inches (609.6 mm) wide x 91 inches (2311.4 mm) deep
- Standard coordination available to Eaton dry-type substation transformers
- Top entry MV cables only

Features
- Fewer control wiring interconnections
- Improved transformer access—transformer is not sandwiched between primary and secondary equipment
- Reduction of arc-flash hazard by incorporating VCP-T primary breaker with Arcflash Reduction Maintenance System trip unit

IUS Standards
The integrated unit substation primary/secondary breaker section is UL listed. The IUS complies with ANSI C37.20.1 and ANSI C37.51 for the low-voltage compartment, and ANSI C37.20.3 for the medium voltage compartment.

Low-voltage power switchgear distribution sections are UL 1558 listed and comply with ANSI C37.20.1.

Transformer sections are UL 1562 listed and comply with ANSI C37.30.

Application Description
When electrical room space is limited or when additional electrical system capacity is required for renovation of an existing building, unit substation dimensions can create layout challenges for electrical designers and engineers. The solution to these problems is Eaton’s integrated unit substation.

By combining transformer primary and secondary protective devices in a single section, Eaton’s IUS offers a significant floorspace reduction compared to other substation designs.

The IUS uses a 5 or 15 kV class VCP-T drawout vacuum breaker for transformer primary protection, integrated with a 600 V Magnum DS drawout air circuit breaker for transformer secondary protection. Both breakers are in a single UL listed structure.

Figure 20.2-1. Dry-Type Transformer

<table>
<thead>
<tr>
<th></th>
<th>Eaton Dry-Type Transformer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 3200 A Secondary</td>
<td></td>
</tr>
<tr>
<td>5 or 15 kV VCP-T Primary</td>
<td></td>
</tr>
<tr>
<td>Eaton Dry-Type Transformer</td>
<td>24 inches UL 1562</td>
</tr>
<tr>
<td>UL 1558</td>
<td>18–60 inches Distribution Structures UL 1558</td>
</tr>
</tbody>
</table>

Primary Voltages—5 kV or 15 kV
Secondary Voltages—480 V or 208 V
Front Access Switchgear

The front-accessible switchgear offering allows mounting against a wall, or in other tight locations, where a standard rear-accessible switchgear lineup would not normally fit.

Eaton’s Magnum DS front-accessible switchgear combines the robustness of UL® 1558 low-voltage switchgear with the flexibility of UL 891 switchboard design. The three divisions of rear-accessible switchgear are redistributed into two vertical sections, with the breaker and the bus in one half and cable and bus in the other half on the right-hand side. Both sections can be easily accessed by operators and maintenance personnel from the front of the switchgear.

Product Offering

- UL 1558
- UL 891
- 2000–6000 A bus
- 800–6000 A breakers
- 100, 150 and 200 kA bus bracing
- 600 Vac class
- NEMA® 1 indoor (corner section available for layout flexibility)
- NEMA 3R outdoor, both aisle and aisleless enclosures

Application Description

- Commercial—Office buildings, high rise and convention centers
- Industrial—Automotive, petrochemical, pharmaceutical, pulp and paper, utility and data centers
- Institutional—Universities and hospitals
- Government—Water treatment, federal buildings and municipalities
- Critical Power OEMs—Generator and UPS manufacturers

Features

- Standard 40.20-inch (1021.0 mm) switchgear depth
- Up to 4-high Magnum DS breaker arrangement
- Up to 8-high Series NRX breaker arrangement
- Breaker sections are 18, 22, 24 or 44 inches (457.2, 558.8, 609.6 or 1117.6 mm) wide depending on breaker type and frame sizes
- Cable compartments are 18, 22, 24, 30 or 44 inches (457.2, 558.8, 609.6, 762.0 or 1117.6 mm) wide depending on cable or conduit sizes
- Substation arrangement, with close coupling to dry-type or liquid-filled transformers, where required
- Can be close-coupled to traditional rear-access switchgear
Arc Quenching Switchgear

Product Description
When the Arc Quenching Device (AQD) receives a trigger signal from the Eaton Arc Flash Relay, it produces a lower impedance arc in a controlled micro-environment within the arc containment vessels located in the AQD. The lower impedance arc collapses the voltage and immediately extinguishes the unintended arcing fault as the current begins to flow into the AQD. This quenching operation occurs in less than 4 ms. The arcing continues safely contained inside the AQD until the upstream power circuit breaker trips.

Application Description
The Arc Quenching Device (AQD) can be located on the line- or the load-side of the main low-voltage circuit breaker in an Arc Quenching Switchgear (AQS) lineup. With the switchgear energized and the Arc Quenching System active, the entire AQS lineup will be C37.20.7 arc-resistant regardless of the location of the AQD. However, the incident energy of the lineup is affected by the location of the AQD.

Load-side Application
The standard AQS application includes the AQD mounted on the load-side of the low-voltage main circuit breaker. See Figure 20.2-2.

In this application, the lineup will carry two different incident energy levels while the Arc Quenching System is active (indicated by the illumination of the white light above the AQD). The incident energy on the line side of the low-voltage main breaker will be determined by the clearing time of the upstream overcurrent protective device. The incident energy on the load-side of the low-voltage main breaker will be determined by the arc quenching time of the Arc Quenching System. Typically, the load-side incident energy in this application will be less than 1.2 cal/cm². See Figure 20.2-3.

Figure 20.2-2. AOD Load-Side Application

If the Arc Quenching System is inactive (either due to a malfunction, loss of control power, disconnection of the AQD, or if the upstream LV main device is open), the white indicator light above the AQD will cease to be lit. In this case, the incident energy on the line-side of the main low-voltage breaker will remain the same (as determined by the clearing time of the upstream overcurrent protective device). Furthermore, when the main breaker is closed with the AQS inactive, the incident energy on the load-side of the low-voltage breaker will increase, determined by the total clearing time of the Eaton Arc Flash Relay (EAFR) tripping the low-voltage main breaker.

Figure 20.2-3. Standard Application Incident Energy

WARNING
SHOCK & ARC FLASH HAZARD
Look-out: SHOCK & ARC FLASH HAZARD

Arc Flash Boundary

Arc Flash Boundary

0.8 cal/cm² MAXIMUM INCIDENT ENERGY AT 1/8 WORKING DISTANCE

400 V Shock Hazard

Arc Flash Boundary

Loose Cable Class to Restricted Approach Boundary: 5’ – 10’

AOD Load-side Application Example
AOD Line-Side Application

The substation AQS application includes the AOD mounted on the line-side of the low-voltage main circuit breaker, and must include a wired trip signal from the EAFR to the upstream medium-voltage circuit breaker with a verified clearing time of less than 30 cycles. See Figure 20.2-4. It is not possible to shunt-trip an upstream medium-voltage switch unless the switch is rated to interrupt full available fault current within 30 cycles or less.

Figure 20.2-4. AOD Load-Side Application

In this application, the entire low-voltage switchgear lineup will carry a single incident energy level while the Arc Quenching System is active (indicated by the illumination of the white light above the AOD). The incident energy of the entire lineup, including the line-side of the low-voltage main breaker, will be determined by the arc quenching time of the Arc Quenching System. Typically, the incident energy of the entire low-voltage switchgear lineup in this application will be less than 1.2 cal/cm². See Figure 20.2-5.

If the Arc Quenching System is inactive (either due to a malfunction, loss of control power, or disconnection of the AOD), the white indicator light above the AOD will cease to be lit. In this case, the incident energy of the entire low-voltage switchgear lineup (on the line-side and load-side of the low-voltage main breaker) will be determined by the total clearing time of the Eaton EAFR tripping the upstream medium-voltage breaker.

Figure 20.2-5. Substation Application Incident Energy

Notes for Line- and Load-Side Applications

After switchgear installation, it is highly recommended to perform an arc flash study and label the switchgear with the calculated incident energy.

The Arc Quenching System is electrically interlocked with the main breaker to prevent closing the main if the health contact of either the EAFR or AOD is open, either because the device is still powering up or if there is an error.

The Arc Quenching System requires approximately 30 seconds of boot time on power-up. For applications in which the primary bus could become energized with the main breaker of the protected switchgear closed, an external control power source is recommended. Alternatively, a UPS internal to the switchgear can be specified to ensure that the Arc Quenching System is operational prior to energizing the switchgear primary bus. This will provide protection in the unlikely event that an arc occurs in the switchgear while energizing.

Features

- Short-circuit withstand rating up to 85 kA at 635 Vac
- Short-time withstand current rating, 85 kA for 30 cycles
- <4 ms arc quenching time
- >25% reduction in peak fault current
- >44% reduction in peak system stress
- Complete system self-supervision with health status communicated via Modbus and dry contacts
- Available in rear access and front access switchgear configurations
- Anti-nuisance trip technology

Enclosure Configurations

Arc Quenching Switchgear is available in various enclosure constructions to meet specific application requirements:

Traditional Arc-Resistant Construction

- Active arc-resistant protection and incident energy reduction under normal operating conditions
- Traditional passive arc-resistant protection if the AOD is removed and arc-resistant breaker cell provisional cover installed

NEMA 1 Construction

- Active arc-resistant protection and incident energy reduction without the need for ducts, plenums or special enclosure construction
- Reduced installation costs and reduced overhead clearance requirements compared to traditional arc-resistant switchgear

NEMA 3R Construction

- Industry-exclusive NEMA 3R arc-resistant protection
- Arc-resistant protection and incident energy reduction for outdoor switchgear

Standards and Certifications

- Tested to ANSI/IEEE C37.20.7, Type 2B test guide in NEMA 1 construction
- AOD is a UL recognized component per UL 2748
- Arc Quenching Switchgear designed to UL 1558, ANSI C37.20.1, CSA C22.2 No. 31-10, and C37.51
Arc-Resistant Switchgear

Eaton arc-resistant switchgear is Type 2B.

Arc-resistant switchgear performance is defined by its accessibility type in accordance with IEEE test guide C37.20.7 as follows:

**Type 1**: Switchgear with arc-resistant designs or features at the freely accessible front of the equipment only.

**Type 2**: Switchgear with arc-resistant designs or features at the freely accessible exterior (front, back and sides) of the equipment only. (Type 2 incorporates Type 1.)

**Type 2B**: Switchgear with Type 2 accessibility plus arc-resistant in front of the instrument/control compartment with the instrument/control compartment door opened. (Type 2B incorporates Type 2.)

**Normal Operating Conditions**

Eaton arc-resistant switchgear is Type 2B. Instrument/control compartment door and breaker secondary door can be open and maintain Type 2B protection. Arc-resistant features are intended to provide an additional degree of protection to the personnel performing normal operating duties in close proximity to the equipment while the equipment is operating under normal conditions.

The normal operating conditions for proper application of arc-resistant switchgear designs are as follows:

- All breaker doors and rear covers are properly closed and latched
- Pressure relief devices are free to operate
- The fault energy available to the equipment does not exceed the rating of the equipment (short-circuit current and duration)
- There are no obstructions around the equipment that could direct the arc fault products into an area intended to be protected
- The equipment is properly grounded

The user should also refer to documents such as NFPA 70E, for safety training and safe work practices and methods of evaluating safe work distances from energized equipment based on the potential flash hazard, and use proper PPE when working on or near energized equipment with the door/cover opened or not properly secured.

**Product Offering**

Arc-resistant switchgear comes standard with:

- Type 2B construction, including breaker secondary compartment
- Up to 100 kA short circuit at 508 Vac maximum and 85 kA short circuit at 635 Vac maximum
- Up to 10 kA horizontal main bus continuous current
- Up to 5 kA vertical bus continuous current
- Magnum DS power circuit breaker frame ratings between 800 A and 6000 A
- Up to four high breaker configuration
- Requires 10-foot equipment base to ceiling clearance
- Additional safety without increasing the footprint of regular Magnum DS switchgear
- Indoor rear access construction available
- Indoor front access construction available
Standard Features

- **ANSI Type 2B arc-resistance:** Type 2B arc-resistant switchgear regardless of whether the arc originates in the breaker, bus or cable compartment
- **Stronger door and latch:** The robust doors are made of heavy 12 gauge metal and secured with two-point latches
- **Breaker bellows:** Bellows surround the breaker door, preventing arc gasses from escaping around the nose of the breaker while ensuring easy racking of the breaker into the disconnected position
- **Rear dynamic flap system:** The ventilation openings in the breaker are open during operation to allow proper equipment ventilation, and then sealed off during an arc event. The rear dynamic flap system uses gravity to keep the flaps open during normal operating conditions and the arc pressure wave to close the flaps during an arcing event. The design is such that there are no electrical parts that could break or fail
- **Ventilation system:** Each breaker compartment is vented to allow ionized gas to flow into the bus compartment from any location in the switchgear and then exit the switchgear through the hinged flaps
- **Bottom or top cable or bus duct entry**
- **Cable compartment floor plates**

Optional Features

- **Plenum:** The plenum is mounted on top of arc-resistant gear to direct dangerous arc gasses as they leave the switchgear. The exit path can either be a side or rear exit, with a 4-foot blast zone around the exit
- **Zone selective interlocking protection:** Zone selective interlocking capability is also available in arc-resistant gear, allowing the breaker closest to the fault to trip without any preset time delay while the remainder of the distribution system remains online
- **Arcflash Reduction Maintenance System™**
- **Safety shutters**
- **One piece hinged and bolted rear panel**
- **Insulated bus**
- **Vented bus/cable compartment barriers:** Bus/cable compartment barriers are only available vented to allow flow of arc gasses in the case of an arc event
- **Cable compartment segregation barrier**

Standards and Certifications

- UL 1558/UL 1066
- ANSI C37.20.1, C37.13, C37.51
- ANSI C37.20.7
- CSA C22.2 No 31-04
- Third-party UL witnessed and certified
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Magnum DS Power Circuit Breakers

Eaton’s Type MDS power circuit breakers constitute a complete, modern and rugged line of low-voltage power circuit breakers using Eaton’s DE-ION® principle of arc extinction. The breaker family is distinguished by its similarity of appearance and operation frame to frame. All frame sizes are either manually or electrically operated. Refer to Tab 26 for detailed information on Magnum DS low-voltage power circuit breakers.

Breaker Features

Four Physical Frame Sizes
Narrow, standard, double narrow and double to promote breaker application in compact modular enclosures and to improve enclosure density.

Contacts
Magnum DS has silver tungsten moving contacts and silver graphite stationary contacts. The contacts provide a long-wearing, low-resistance joint. The contacts are protected from arcing damage even after repeated interruptions by the “heel-toe” action, which causes the integral arcing contacts to mate before the main contacts part. The arcing contacts then part last, striking the arc away from the main contacts.

The main contacts are of the butt type and are composed of multiple fingers to give many points of contact without alignment being critical.

Stored-Energy Mechanism
A cam-type closing mechanism closes the breaker. It receives its energy from a spring that can be charged by a manual handle on the front of the breaker or by a universal electric motor.

Release of the stored energy is accomplished by manually depressing a button on the front of the breaker or electrically energizing a releasing solenoid.

Magnum DS Breaker Contacts
(Arc Chutes Removed)

Magnum MDSL Current Limiting Power Circuit Breakers have integral current limiters to provide interrupting ratings of 200 kA at 600 Vac.

Magnum MDSX Current Limiting Power Circuit Breakers have fast opening contacts to provide interrupting ratings up to 200 kA at 480 Vac without current limiters.

Arc Chute
There are three basic means of extinguishing an arc: lengthening the arc path; cooling by gas blast or contraction; deionizing or physically removing the conduction particles from the arc path.

The DE-ION principle is incorporated in all Magnum DS circuit breakers. This makes possible faster arc extinction for a given contact travel, ensures positive interruption and minimum contact burning.

Levering Mechanism
The worm gear levering mechanism is self-contained on the breaker drawout element and engages slots in the breaker compartment. A standard 3/8-inch (10 mm) drive set is used to lever the breaker between the connected, test and disconnected positions.

Mechanical interlocking is arranged so that levering cannot be accomplished unless the breaker is in the opened position.
Protection During Levering Operation
When levering the breaker between the connected, test and disconnected positions, the operator is protected from contact with live parts by the breaker door.

True two-step stored energy closing: Refers to the sequence required to charge and close the breaker.

1. The breaker closing springs are charged either through the manual-charging handle or by the optional charging motor. The breaker is mechanically interlocked to prevent closing of the breaker until the closing springs are fully charged.

2. With the closing springs fully charged, the breaker can then be closed by pressing the manual close pushbutton on the breaker, or by the optional spring release device for fast transfer when the breaker is ready to close. Can be wired to the spring release device for external indication or wired out for external indication.

This means that the energy required to open the breaker is always restored following a closing operation.

“Stored energy” is energy held in waiting, ready to open or close the breaker within five cycles or less. The unique cam and spring design provides necessary energy for a single close-open sequence as well as the energy for multiple charge-close operations such as this possible sequence: charge-close-recharge-open-close-open.

The closing springs are interlocked with the breaker racking mechanism to ensure the closing springs are discharged before the breaker can be removed from the compartment.

Optional Breaker Accessories
- Shunt trip device (ST): Provides for remote electrically controlled breaker opening when energized by a rated voltage input
- Spring charge motor (MOT): Charges the breaker closing springs automatically, facilitating remote or local closing. The motor assembly includes its own cut-off switch that changes state at the end of the charging cycle. This contact can be wired out for external indication.
- Spring release device (SR): Provides for remote electrically controlled breaker closing when its coils are energized by a rated voltage input
- Undervoltage release (UVR): Traps the breaker when an existing voltage signal is lost or falls below an established threshold
- Auxiliary switch: Up to 6a/6b auxiliary individual dedicated contacts are available for customer use to indicate if the breaker is in the OPEN or CLOSE position
- Mechanical trip indicator flag: The red trip indicator flag pops out when the Digitrip RMS trip unit acts to trip the breaker on an overcurrent condition. Available in two options: an interlocked version that mechanically locks out the breaker until the indicator is manually reset and a non-interlocked version for indication only
- Bell alarm/overcurrent trip switch (OTS): Provides two Form C contacts that change state when the Digitrip RMS trip unit acts to trip the breaker. The contacts are available for external indication or customer use and are manually reset by the mechanical trip indicator
- Padlockable pushbutton cover: Permits padlocking hinged cover plates to block access to the PUSH ON and PUSH OFF buttons on the breaker faceplate
- Mechanical operations counter: Records mechanical operations of the breaker over its installed life
- Latch check switch: Provides one Form C contact that changes state when the breaker is ready to close. Can be wired to the spring release device for fast transfer applications or wired for external ready-to-close indication

Provisions for padlocking: All breakers include provision for padlocking open to prevent electrical or manual closing. This padlocking can secure the breaker in the connected, test or disconnected position by preventing levering of the breaker.

Ease of inspection and maintenance: Magnum DS breakers are designed for maximum accessibility and the utmost ease of inspection and maintenance.

Manually operated breakers: Manually operated breakers are equipped with a manual charging handle to charge the closing springs. Manual closing and tripping pushbuttons are used to operate the breaker. Remote closing and tripping signals can be accomplished by installing optional electric spring release and shunt trip coils. The breaker closing springs must be charged manually, then remote closing and tripping signals can be sent to the breaker.

Electrically operated breakers: Electrically operated breakers are equipped with a spring charging motor and electrically operated spring release and shunt trip coils. The breaker manual charging handle can be used to charge the closing springs when power is not available to the charging motor.

Optional Breaker Accessories
- Shunt trip device (ST): Provides for remote electrically controlled breaker opening when energized by a rated voltage input
- Spring charge motor (MOT): Charges the breaker closing springs automatically, facilitating remote or local closing. The motor assembly includes its own cut-off switch that changes state at the end of the charging cycle. This contact can be wired out for external indication.
- Spring release device (SR): Provides for remote electrically controlled breaker closing when its coils are energized by a rated voltage input
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**Magnum DS Switchgear—Trip Units**

**Digitrip™ RMS trip unit.** Eaton’s Digitrip RMS trip units feature a dependent curve that is depicted in the nameplate by a blue shaded area of the trip curve. The dependent curve affords better protection flexibility. Additionally, all of the trip units have, as standard, thermal memory, 50/60 Hz operation and thermal self-protection at 90 °C.

**Digitrip RMS integral microprocessor-based breaker overcurrent trip systems:** Provide maximum reliability with true rms sensing as standard, gives excellent repeatability and requires minimum maintenance. No external control source is required for its protective functions.

**Trip functions:** Magnum DS trip units provide the maximum in flexibility and are available in the following configurations: LSI, LSIG, LSIA (ground fault alarm only). In each case, either the short delay or instantaneous (not both) functions may be defeated. This reduces the need for spare breaker inventories and provides maximum usage of interchangeable breakers.

**Digitrip RMS 520:** Enables the user as many as nine phase and ground current protection settings for maximum flexibility in trip-curve shaping and multi-unit coordination, and adds zone selective interlocking.

**Digitrip RMS 520M:** Adds phase, neutral and ground current metering with a four-character LCD display window with 2% current metering accuracy and type LSIA alarm when ground fault settings are exceeded.

**Digitrip RMS 520MC:** Adds INCOM communication of trip values and breaker status (open, close and tripped). Adds Arcflash Reduction Maintenance System (ARMS).

**Digitrip RMS 1150+:** Provides programmability for more sophisticated distribution systems. Adds Arcflash Reduction Maintenance System (ARMS).

- Increased protection and coordination capabilities
- Systems monitoring information including power factor, voltage current, harmonic distortion values, and waveform capture with a three-line, (eight characters per line) LED display
- Two programmable contacts for customer use
- Time stamping of trip events for improved troubleshooting and diagnostics
- Accuracy of 1% on metered values and 2% on energy and power
- Systems diagnostic information
- INCOM communications
- Breaker health menu
- Additional protection functions:
  - Undervoltage/overvoltage
  - Underfrequency/overfrequency
  - Voltage unbalance
  - Reverse power

**Zone selective interlocking:** The Digitrip RMS zone selective interlocking (ZSI) capability provides positive system coordination without time delays. ZSI allows the breaker closest to the fault to trip without any preset time delay. The breaker closest to the fault trips first, while the remainder of the distribution system remains online, thus avoiding unnecessary and costly downtime.

The use of ZSI in Spot Network Systems is not recommended by Eaton. See the discussion in section 18 for the technical reasons why Eaton does not recommend ZSI in Spot Network Systems.
Arcflash Reduction Maintenance System

The Arcflash Reduction Maintenance System Maintenance Mode function of the Digitrip 520MC and 1150+ can reduce arc flash incident energy that is generated on a fault condition. Eaton’s Arcflash Reduction Maintenance System employs a separate, dedicated analog trip circuit that eliminates microprocessor latencies, resulting in clearing times that are faster than standard instantaneous tripping. This provides superior arc flash reduction to competing systems that simply lower the standard instantaneous pickup set point.

There are three ways to arm the Maintenance Mode Arc Flash Reduction setting. One method is locally at the trip unit front panel. For the 520MC, the 2-position switch in the Maintenance Mode section of the trip unit is used. Turning the switch to the ON position will arm the setting. For the 1150+, the local front keypad is used to enable the Maintenance Mode setting. The setting is located in the SYSTEM submenu of programmable settings (PGM SET).

For the second method of arming the Maintenance Mode function, a remote switch wired through the breaker secondary contacts can remotely arm the Maintenance Mode setting. A high-quality gold-plated or palladium contact is required in this application.

A third method to arm the maintenance setting is via a communication device. This can be accomplished through a Power Xpert® Gateway.

For Magnum DS breakers, the Arcflash Reduction Maintenance System setting has five unique settings (2.5, 4.0, 6.0, 8.0, 10.0 x In}. To adjust this setting, a rotary switch on the trip unit face is provided for the 520MC while the 1150+ trip unit uses its local keypad. For the Series NRX breakers, the Arcflash Reduction Maintenance System setting has a constant setting of 5000 A.

For all three arming methods, the 520MC provides a blue LED to confirm the Maintenance Mode function is on. In addition, there is also a normally open breaker contact that allows the user to wire in an external stacklight or annunciator for remote indication. For the 1150+, the message “Maintenance Mode Enabled” will be shown on its LED display. The 1150+ also has an alarm relay that can be programmed to track the Maintenance Mode state.

The Maintenance Mode function will provide fast tripping even when the regular Instantaneous is set to OFF. The Instantaneous LED position is also used to indicate a trip initiated by the Maintenance Mode setting. The 520MC LCD display, if powered, will indicate with four dashes while the 1150+ will display the message “Maintenance Mode Trip.”

Arcflash Reduction Maintenance System

The Arcflash Reduction Maintenance System can be wired out to a separate lockable switch/light combination mounted on the switchgear for ease of operation. Additionally, the switch can be wired out to a remote station for operation outside the arc flash boundary of the switchgear, and the alarm can be wired to an optional beacon or audible device.
### Table 20.3-1. Digitrip Trip Units for Magnum DS and SB ANSI/UL Rated Power Circuit Breakers

<table>
<thead>
<tr>
<th>Trip Unit Type</th>
<th>Digitrip 520</th>
<th>Digitrip 520M</th>
<th>Digitrip 520MC</th>
<th>Digitrip 1150+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampere Range</td>
<td>200–600 A</td>
<td>200–600 A</td>
<td>200–600 A</td>
<td>200–600 A</td>
</tr>
<tr>
<td>Interrupting rating at 480 V rms sensing</td>
<td>42–200 kA</td>
<td>42–200 kA</td>
<td>42–200 kA</td>
<td>42–200 kA</td>
</tr>
</tbody>
</table>

#### Protection and Coordination

- **Protection Ordering options**
  - Fixed rating plug (Iₚ)
  - Overcurrent trip
- **Long delay protection (L)**
  - Long delay pickup
  - Long delay time Iₚ at 6 x Iₑ
  - Long delay time IEEE curves
  - Long Delay Thermal Memory
- **Short delay protection (S)**
  - Short delay pickup
  - Short delay time Iₚ at 8 x Iₑ
- **Instantaneous protection (I)**
  - Instantaneous pickup making current release off position
- **Ground fault protection (G)**
  - Ground fault alarm
  - Ground fault pickup
  - Ground fault delay Iₚ at 0.625 x Iₑ
- **Disable ground fault protection**
- **Neutral protection (N)**

#### System Diagnostics

- **Cause of trip LEDs**
- **Magnitude of trip information**
- **Remote signal contacts**
- **Programmable contacts**

#### System Monitoring

- **Digital display**
  - Current (% ) full scale sensor
- **Voltage (%) L to L**
- **Power and energy (%)**
- **Apparent power kVA and demand**
- **Reactive power kvar**
- **Power factor**
- **Crest factor**
- **Power quality—harmonics**
- **THD, waveform capture**

#### System Communications

- **Type**
  - Power supply in breaker
- **Additional Features**
  - Trip log (three events)
  - Electronic operations counter
- **Arcflash Reduction Maintenance System**
  - Breaker health monitor
  - Programmable relay functions

#### Legend:
- Iₑ = Rating Plug and Sensor Rating.
- Iₚ = Long Delay Pickup setting.
- Over and undervoltage alarm or trip, over and underfrequency alarm or trip, voltage unbalance alarm or trip, reverse power trip and phase rotation alarm are included.
Table 20.3-2. Magnum DS Breakers Digitrip Adjustable Trip Settings

<table>
<thead>
<tr>
<th>Time/Current Characteristic</th>
<th>Pickup Setting</th>
<th>Pickup Point ¹</th>
<th>Time Bands, Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long delay</td>
<td>0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95, 1.0</td>
<td>( I_n ) times long delay setting</td>
<td>2, 4, 7, 10, 12, 15, 20, 24</td>
</tr>
<tr>
<td>Instantaneous</td>
<td>Off, 2, 3, 4, 6, 8, 10, M1</td>
<td>( I_n ) times instantaneous setting</td>
<td>—</td>
</tr>
<tr>
<td>Short delay</td>
<td>2, 2.5, 3, 4, 6, 8, 10, M1</td>
<td>( I_n ) times short delay setting</td>
<td>0.1, 0.2, 0.3, 0.4, 0.5 (flat response) 0.1, 0.03, 0.05 ³</td>
</tr>
<tr>
<td>Ground fault</td>
<td>0.25, 0.3, 0.35, 0.4, 0.5, 0.6, 0.75, 1.0</td>
<td>( I_n ) times ground fault setting</td>
<td>0.1, 0.2, 0.3, 0.4, 0.5 (flat response) 0.1, 0.3, 0.5 ³</td>
</tr>
</tbody>
</table>

¹ \( I_n \) = Rating plug value  
² \( I_n \) = Long delay pickup setting x \( I_n \)  
³ \( I_n \) = Long delay pickup setting x \( I_n \) with flat response
Series NRX-NF

In switchgear, it’s important that the breaker be easily accessible during scheduled equipment maintenance. The design of the breaker and cassette enables full use of the breaker handle and cassette rails with a gloved hand, allowing electricians to remain in the appropriate PPE protective gear.

The breaker’s ergonomic design also maximizes functionality. Individual Series NRX-NF breaker door will open in a “saloon” or “barn” type of arrangement so that personnel can access one of the side-by-side breakers without having to interact with the other. The breaker’s handle allows the operator to easily apply leverage across seven complete strokes (with an average of only 21 lb of force) charging the breaker quickly and easily, and making it easier to cycle when needed during commissioning or scheduled maintenance. Series NRX-NF breakers use a true two-step stored energy mechanism similar to Magnum DS breakers.

The reduced weight of the Series NRX-NF makes it easier to handle during start-up and scheduled inspection. A three-pole, fully populated drawout breaker weighs only 54 lb/24 kg.

The Series NRX-NF enables twice as many feeder breakers in a standard structure for a reduction in overall assembly size of up to 50%.

The small size, 10.00 inches (254.0 mm) wide by 10.70 inches (271.8 mm) deep by 14.20 inches (360.7 mm) high, of the Series NRX-NF allows for much higher densities of power circuit breakers in a structure—up to eight breakers in a 24.00-inch (609.6 mm) wide structure—2.50-inch (63.5 mm) customer wireway. This means that two Series NRX-NF breakers can be mounted side-by-side in the same space typically used for one Magnum DS breaker.

The Series NRX-NF breakers can also be mixed and matched with Magnum DS breakers, increasing layout flexibility and providing the ability to stack feeder breakers around larger main and tie breakers. See layout guide for more details.

All optional Magnum DS breaker attachments and accessories are also available for the Series NRX-NF breakers. Series NRX-NF accessories can be quickly installed at the job site, without any special tools. Each breaker comes standard with an accessory tray; the needed accessories simply plug and lock into the tray.

The Series NRX-NF uses one CT for the breaker frame. This eliminates the need to match CTs and rating plugs to change the continuous current rating of the breaker. For example, changing from 1200 to 800 A on previous breaker designs required changing CT from 1200 to 800 A and changing the rating plug from 1200 to 800 A. This is accomplished through the Series NRX-NF’s Rogowski air core CT. The Rogowski coil does not saturate like a traditional ferrous core CT, allowing the CT to be used across a broad current range with greater accuracy. One sensor accommodates 200–1200 A range.

A full range of trip units, ranging from basic protection (LSI or LSIG) to metering, system diagnostics, protective relay functions and communications, complement the breaker offering. Two of the trip unit models, the Digitrip 520M and 1150, include (optional) Eaton’s Arcflash Reduction Maintenance System, built to reduce arc flash energy on a downstream unit during system maintenance. Zone selective interlocking is also available.

When communication capability is required, the Series NRX-NF breaker has cassette-mounted modules, eliminating the need for readressing replacement breakers. These DIN rail mounted modules save space and time during installation and are available for field mounting capability. Modules for Modus and Eaton’s INCOM system are available with future releases for PROFIBUS and Ethernet compatible with Eaton’s Power Xpert Architecture protocols. Refer to Tab 26 for more detailed information on Series NRX-NF breakers.
### Table 20.3-3. Digitrip Trip Units for Series NRX ANSI/UL Rated Circuit Breakers

<table>
<thead>
<tr>
<th>Trip Unit Type</th>
<th>Digitrip 520</th>
<th>Digitrip 520M</th>
<th>Digitrip 1150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampere range</td>
<td>200–1600 A</td>
<td>200–1600 A</td>
<td>200–1600 A</td>
</tr>
<tr>
<td>Interrupting rating at 480 V</td>
<td>42 kA</td>
<td>42 kA</td>
<td>42 kA</td>
</tr>
<tr>
<td>rms sensing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

#### Protection and Coordination

- **Protection Styles**
  - LI, LSI, LSI, LSI
  - LSI, LSI, LSI, LSI, RLSI, RLSI
  - LSI, LSI, LSI, RLSI, RLSI, RLSI

- **Long delay protection (L)**
  - Long delay pickup: 0.5–1.0 x \( I_{lp} \), 2–24 seconds
  - Long delay time \( I_{4t} \): 2–24 seconds
  - Long delay thermal memory: Yes

- **Short delay protection (S)**
  - Short delay pickup: 200–1000% x \( I_{sp} \), 100–500 ms
  - Short delay time \( I_{4t} \): No

- **Instantaneous protection (I)**
  - Instantaneous pickup: 200–1200% x \( I_{ip} \), Yes

- **Ground fault protection (G)**
  - Ground fault alarm: No
  - Ground fault pickup: 25–100% x \( I_{gp} \), Yes

- **Neutral protection (N)**
  - Yes

#### System Diagnostics

- **Cause-of-trip LEDs**
  - Yes

- **Magnitude of trip information**
  - Yes

- **Remote signal contacts**
  - No

- **Programmable contacts**
  - Yes

#### System Monitoring

- **Digital display**
  - 4-character LCD

- **Power supply**
  - N/A

- **Voltage (%) L to L**
  - No

- **Power and energy (%)**
  - No

- **Apparent power kVA and demand**
  - No

- **Reactive power kVAR**
  - No

- **Power factor**
  - No

- **Crest factor**
  - No

- **Power quality—harmonics**
  - No

- **% THD, waveform capture**
  - No

#### System Communications

- **Type**
  - N/A

- **Power supply**
  - Yes (\( +24 \) Vdc)

#### Additional Features

- **Trip log**
  - No

- **Electronic operations counter**
  - No

- **Testing method**
  - Test set

- **Waveform capture**
  - No

- **Arcflash Reduction Maintenance System**
  - No

- **Breaker health monitor**
  - Yes

- **Programmable relay functions**
  - No

#### Notes:

1. 1200 A maximum ground fault setting per UL/NEC.
2. Optional communications modules available: Ethernet (Web-browsing, Modbus TCP/IP and SNMP), Modbus RTU, INCOM, PROFINET, PROFIBUS DP.

**Legend:** \( I_{lp} \) = Rating Plug and Sensor Rating. \( I_{ip} \) = Long Delay Pickup setting.
Table 20.3-4. Digitrip Adjustable Trip Settings for Series NRX Breakers

<table>
<thead>
<tr>
<th>Time/Current Characteristic</th>
<th>Pickup Setting</th>
<th>Pickup Point ¹</th>
<th>Time Band, Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long delay</td>
<td>0.5, 0.6, 0.7, 0.75, 0.8, 0.9, 0.95, 1.0</td>
<td>Iₚ times long delay setting</td>
<td>2, 4, 7, 10, 12, 15, 20, 24 (at 6 times pickup value)</td>
</tr>
<tr>
<td>Instantaneous</td>
<td>2, 3, 4, 5, 6, 8, 10, 12</td>
<td>Iₚ times instantaneous setting</td>
<td>—</td>
</tr>
<tr>
<td>Short delay</td>
<td>2, 2.5, 3, 4, 5, 6, 8, 10</td>
<td>Iᵣ times short delay setting</td>
<td>0.1, 0.2, 0.3, 0.4, 0.05 (flat response)</td>
</tr>
<tr>
<td>Ground fault</td>
<td>0.25, 0.3, 0.35, 0.4, 0.5, 0.6, 0.75, 1.0 (1200 A maximum)</td>
<td>Iᵣ times ground fault setting</td>
<td>0.1, 0.2, 0.3, 0.4, 0.05 (flat response)</td>
</tr>
</tbody>
</table>

¹ Iₚ = Rating plug value
² Iᵣ = Long delay pickup setting x Iₚ
³ I₂t response.

For more information, visit: [www.eaton.com/consultants](http://www.eaton.com/consultants)
### Table 20.3-5. Magnum DS Switchgear Class UL 1066 Low-Voltage Power Circuit Breakers

<table>
<thead>
<tr>
<th>Frame Amperes</th>
<th>Breaker Type</th>
<th>Frame Type</th>
<th>m/s Symmetrical Current Ratings kA</th>
<th>Short-Time Withstand Rating</th>
<th>Fixed Internal Instantaneous Trip</th>
<th>Available Current Sensor and Rating Plugs for Digitrip RMS Trip Unit (Establishes Breaker Iₜ Rating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>MDN-408 Narrow</td>
<td>Narrow</td>
<td>42 65 100 20 42 65 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>MDN-408 Standard</td>
<td>Standard</td>
<td>42 65 100 20 42 65 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td>MDN-616 Narrow</td>
<td>Narrow</td>
<td>42 65 100 20 42 65 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td>MDN-616 Standard</td>
<td>Standard</td>
<td>42 65 100 20 42 65 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>MDN-620 Narrow</td>
<td>Narrow</td>
<td>42 65 100 20 42 65 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>MDN-620 Standard</td>
<td>Standard</td>
<td>42 65 100 20 42 65 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3200</td>
<td>MDN-640 Double Narrow</td>
<td>Double Narrow</td>
<td>200 100 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>MDN-640 Double Narrow</td>
<td>Double Narrow</td>
<td>200 100 100 20</td>
<td>200, 200, 300, 400, 600, 800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Interrupting ratings shown based on breaker equipped with integral Digitrip RMS trip unit. Interrupting ratings for non-automatic breakers are equal to the published short-time withstand rating. These interrupting ratings are based on the standard duty cycle consisting of an open operation, a 15-second interval and a close-open operation, in succession, with delayed tripping in case of short-delay devices. The standard duty cycle for short-time ratings consists of maintaining the rated current for two periods of 1/2 second each, with a 15-second interval of zero current between the two periods.


4. Series NRX uses the same sensors for all trip settings. No changes to sensors required.

5. Breaker applied in a tested fan cooled enclosure.
Power Xpert Meter 4000/6000/8000 Series

For detailed information, refer to Tab 3.

Power Xpert Meter Display

General Description

The Power Xpert Meter 4000/6000/8000 Series monitors the critical aspects of an electrical distribution system. This premier power quality metering instrument is simple to use, and is powerful, scalable and highly flexible. The Power Xpert Meter 4000/6000/8000 offers a new level of intuitive user interface design, presenting critical electrical distribution system information in simple-to-navigate and easy-to-understand information architecture.

The Power Xpert Meter 4000/6000/8000 graphic display visualizes the information from up to 16 meter modules. The embedded Web server displays comprehensive power quality data using standard Internet browsers and allows for device configuration from the browser.

Both the local graphic display and the embedded Web server present real-time, historical and event information in a browser-style graphical format to help the user interpret key circuit information, such as:

- Current loading
- Voltage and power levels
- Power factor
- Energy usage
- I/O status
- Power quality measurements
- Harmonic plots
- Disturbance and transient waveforms
- ITIC disturbance summary screen

The Web server presents real-time, historical and event information in a browser-style graphical format to help the user interpret information such as current loading, voltage and power levels, power factor, energy usage, I/O status and power quality measurements, as well as harmonic plots. The embedded Web server also offers a waveform view to visualize steady-state harmonic content, which is critical for power quality analysis.

The Web server provides the energy and demand readings required to help manage the cost of energy.

Application Description

Identify Power Quality Problems to Help:

- Protect motors from damage
- Preserve the integrity of processes and batches
- Prevent blown capacitor bank fuses
- Protect transformers and conductors from overheating

Monitor Circuit Loading to Help:

- Avoid overloads and nuisance overload trips
- Maximize equipment use
- Manage emergency overloads

Manage Energy Use to Help:

- Reduce peak demand charges and power factor penalties
- Identify excessive energy consumption

For more details, see Tab 3.
IQ 250/260

For detailed information, refer to Table 3.

IQ 250/260

General Description
This microprocessor device provides metering that meets ANSI C12.20 revenue metering accuracy, and has capabilities such as fast sampling rate and accurate metering for a full range of power attributes. In addition, the IQ 250 and IQ 260 Meters are “prepared for the future.” Built-in slots allow for upgrades to capabilities yet to be developed.

- Comprehensive metering
- High-end accuracy
- Self-test capability to validate accuracy
- Large, easy-to-read display
- Local or remote configuration
- Industry-standard communication protocols
- Mix-and-match input/output options
- Integration with Eaton’s Power Xpert Architecture
- Field-upgradeable

IQ 130/140/150

General Description
The IQ 100 meter family provides metering that meets ANSI C12.20 revenue metering accuracy, and has capabilities such as fast sampling rate and accurate metering for a full range of power attributes. Providing the first line of defense against costly power problems, Eaton’s IQ 100 series electronic power meters can perform the work of an entire wall of legacy metering equipment using today’s technology.

When space is at a premium, yet you need ANSI C12.20 accuracy, the IQ 100 series fits the bill. These meters are ideal for electrical equipment assemblies, machine control panels, such as panelboard and switchboard mains and feeders, low-voltage metal-enclosed switchgear feeders and motor control centers. Requiring far less space than other meters with similar functionality, IQ 100 series meters fit into a standard ANSI or IEC cutout on a panelboard or other electrical equipment, and therefore fit easily into retrofit applications.

Application Description
- Utility and commercial metering
- Substations, industrial facilities, power generation sites and campuses
- Submetering
- Load studies and voltage recording
- Analog meter replacement

Features and Benefits
- Measure and display real-time information about critical power parameters with a sampling rate of 400 samples per cycle
- Monitor power use and quality with ANSI C12.20 accuracy (0.5%)
- Verify meter accuracy with KYZ test pulse self-certification capabilities
- Optional Modbus RTU communications
- Available as transducer only or with display
- Designed to accommodate upgrades
- Integrate into Eaton’s Power Xpert Architecture for a holistic system level view

For more information, refer to Table 3.

Communications
Ethernet communications available via Power Xpert Gateway PXG900. See Table 2 for power management connectivity and monitoring.
Automatic Transfer and Intelligent Control

Automatic transfer and intelligent control packages are as follows:

- Eaton ATC-900 controller
  - Automatic transfer for a two source lineup with no tie breaker
  - Additional option for a 7-inch screen available

- Eaton programmable logic controller (PLC) with Eaton touch screen
  - Automatic transfer for main-tie-main arrangement
  - Standard sequence provided with configurable options
  - Custom sequence of operations available

- Power Xpert Dashboard
  - The Power Xpert Dashboard is an intelligent collection of views displayed on a single touchscreen from switchgear-mounted devices including meters, relays, trip units and transfer controls
  - The Dashboard can be integral to the switchgear assembly or remotely mounted
  - Detail information about each breaker is displayed
  - Remote enabling of the Arcflash Reduction Maintenance System via communication as a standard
  - Ability to configure/monitor alarms for various devices
  - Remotely open/close circuit breakers through control mode
  - Initiate a transfer scheme in a main-tie-main switchgear for uninterrupted power supply
Low-Voltage High Resistance Grounding

General Description
Where continuity of service is a high priority, high-resistance grounding can add the safety of a grounded system while minimizing the risk of service interruptions due to grounds. The concept is a simple one: provide a path for ground current via a resistance that limits the current magnitude, and monitor to determine when an abnormal condition exists. This provides for maximum continuity of service, because no tripping occurs for the resistance limited ground fault.

The ground current path is provided at the point where the service begins, by placing resistance in the connection from system neutral to ground. Control equipment continuously measures ground current; a relay detects when the current exceeds a predetermined level. An alarm alerts building personnel that a ground exists. The system has built-in fault tracing means to assist in finding the source of the ground. An integral transformer provides control power from the primary source.

Standard Features
- Current sensing ground fault detection (1–5 A pickup/0.5–20 second delay)
- Ground current transformer (10/10 ratio)
- Control circuit disconnect switch (fused)
- Lockable door handle
- Ground current ammeter (0–10 A, 1% accuracy)
- Indicating lights:
  - Red (ground fault)
  - Green (normal)
  - White (pulse)
- Adjustable pulsing timer (0–10 seconds)
- Tapped resistors (1–5 A)
- Three-position selector switch (normal, pulse, test)
- Control switch for manual or automatic reset
- Ground fault contacts (1NO/1NC)
- Shorting terminal block for ground current transformer
- UL label
- Rated for use up to 200 kA fault current system
- Front accessible
- Nylon flag type wiremarkers
- Three “zig-zag” or “wye-broken delta” grounding transformers for systems without a neutral point

Figure 20.4-1. Typical Distribution System

1. Phase-to-neutral loads require a delta-wye distribution transformer. The neutral on the secondary side of this transformer must be solidly grounded.
Table 20.5-1. Voltage Ratings (AC)

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Maximum Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>208/240</td>
<td>254</td>
</tr>
<tr>
<td>480</td>
<td>508</td>
</tr>
<tr>
<td>600</td>
<td>635</td>
</tr>
</tbody>
</table>

Table 20.5-2. Available Bus Ratings

<table>
<thead>
<tr>
<th>Cross Bus Ampacity</th>
<th>Bus Bracing kA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>100, 150, 200</td>
</tr>
<tr>
<td>3200</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>5000</td>
<td>100, 150, 200</td>
</tr>
<tr>
<td>6000</td>
<td></td>
</tr>
<tr>
<td>8000</td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td></td>
</tr>
</tbody>
</table>

Table 20.5-3. Heat Loss Data (1)

Estimated Heat Loss Per Breaker (Watts)

<table>
<thead>
<tr>
<th>Breaker Frame</th>
<th>Drawout Mounting Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>150</td>
</tr>
<tr>
<td>1600</td>
<td>329</td>
</tr>
<tr>
<td>2000</td>
<td>374</td>
</tr>
<tr>
<td>3200</td>
<td>719</td>
</tr>
<tr>
<td>4000</td>
<td>749</td>
</tr>
<tr>
<td>5000</td>
<td>1000</td>
</tr>
<tr>
<td>6000</td>
<td>1440</td>
</tr>
</tbody>
</table>

Vertical section bus is sized per main cross bus maximum rating or by ANSI C37.20.1 to a maximum of 5000 A (4000 A in 18.00-inch [457.2 mm] structure.)

Note: In addition to the available bus bracings shown in Table 20.5-2, the bus has been tested for short-circuit values of 85,000 A for a full 60 cycles.

Closing Times of Magnum DS and Series NRX Breakers

- 5 cycles or less

For lower than maximum load currents, watt loss may be estimated by reducing the full load loss by the following:

\[ W_L = \left(\frac{I_L}{I_{FL}}\right)^2 W_{FL} \]

Where:

- \( W_L \) = Load Watts
- \( W_{FL} \) = Full Load Watts
- \( I_L \) = Actual Load Current
- \( I_{FL} \) = Full Load Current
### Table 20.5-4. Indoor 2000 A LVA Loss Analysis R2

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Double-Ended Losses</th>
<th>Case 2</th>
<th>Single Ended Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item No.</td>
<td>Quantity</td>
<td>Description</td>
<td>IFL Full Load Rating</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2000 A 480 Main Bus</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2000 A Main M1 Breaker</td>
<td>2000</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2000 A Distribution Section</td>
<td>2000</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>800AF/500AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>800AF/400AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>800AF/300AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>800AF/200AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>2000 A Tie and Section Bus</td>
<td>2000</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>2000 A 480 Volt Distribution Bus</td>
<td>2000</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>800AF/600AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>800AF/300AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>800AF/250AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>800AF/150AT MDS Feeder CB</td>
<td>800</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>2000 A Main M2 Breaker</td>
<td>2000</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>2000 A 480 Bus Main Bus</td>
<td>2000</td>
</tr>
</tbody>
</table>

Total with Each Main at 50% Load 985.52

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Quantity</th>
<th>Description</th>
<th>IFL Full Load Rating</th>
<th>WFL Watts Full Load Loss</th>
<th>IL Actual Loading Amperes</th>
<th>Rating Factor</th>
<th>WL Watts Net Item Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2000 A 480 Main Bus</td>
<td>2000</td>
<td>700</td>
<td>1806</td>
<td>0.815</td>
<td>570.79</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2000 A Main M1 Breaker</td>
<td>2000</td>
<td>775</td>
<td>1801</td>
<td>0.811</td>
<td>628.45</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2000 A Distribution Section</td>
<td>2000</td>
<td>700</td>
<td>903</td>
<td>0.204</td>
<td>142.70</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>800AF/500AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>350</td>
<td>0.191</td>
<td>28.71</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>800AF/400AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>180</td>
<td>0.051</td>
<td>7.59</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>800AF/300AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>200</td>
<td>0.063</td>
<td>9.38</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>800AF/200AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>73</td>
<td>0.008</td>
<td>1.25</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>2000 A Tie and Section Bus</td>
<td>2000</td>
<td>675</td>
<td>903</td>
<td>0.204</td>
<td>137.60</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>2000 A 480 Volt Distribution Bus</td>
<td>2000</td>
<td>700</td>
<td>903</td>
<td>0.204</td>
<td>142.70</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>800AF/600AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>403</td>
<td>0.254</td>
<td>38.06</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>800AF/300AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>403</td>
<td>0.254</td>
<td>38.06</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>800AF/250AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>403</td>
<td>0.254</td>
<td>38.06</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>800AF/150AT MDS Feeder CB</td>
<td>800</td>
<td>150</td>
<td>403</td>
<td>0.254</td>
<td>38.06</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>2000 A Main M2 Breaker</td>
<td>2000</td>
<td>775</td>
<td>903</td>
<td>0.204</td>
<td>157.99</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>2000 A 480 Bus Main Bus</td>
<td>2000</td>
<td>700</td>
<td>903</td>
<td>0.204</td>
<td>142.70</td>
</tr>
</tbody>
</table>

Total with One Main at 100% Load 1720.99

Notes: Full Load of Section or Breaker comes from the frame or bus ratings of the product. Actual Amperes is a loading profile over all the devices for the operating scenario of interest. Rating Factor is a value that appropriately “weights” the nominal losses at full load to the actual losses for the actual loading value. The formula is Rating Factor = (Actual Loading/Full Load Rating) x (Actual Loading/Full Load Rating). The Rating Factor is applied (multiplied) by the Full Load Loss Watts to get Net Watts for each item. See Table 20.5-3 for Nominal heat loss data for devices and sections.

Please see Section 26—Power Circuit Breakers & Insulated Case Circuit Breakers for additional information.
### Application

**Center of Gravity**
For seismic calculations, the following dimensions should be used to locate the center of gravity for Indoor Magnum DS switchgear.

**Table 20.5-5. Center of Gravity Location**

<table>
<thead>
<tr>
<th>Dimensions in Inches (mm)</th>
<th>Vertical</th>
<th>Left-to-Right</th>
<th>From the Front</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.00 (1524.0)</td>
<td>Center of lineup</td>
<td>26.00 (660.4)</td>
<td></td>
</tr>
</tbody>
</table>

### Technical Data/Dimensions/Weights

#### Table 20.5-6. Magnum DS Indoor Rear Switchgear Structure Approximate Weights (Standard Construction Less Breakers) ①

<table>
<thead>
<tr>
<th>Width in Inches (mm)</th>
<th>Depth in Inches (mm)</th>
<th>Approximate Weight in Lb (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breaker Structure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.00, 22.00 and 24.00 (4572, 558.8 and 609.6)</td>
<td>60.00 (1542.0)</td>
<td>1250 (568)</td>
</tr>
<tr>
<td></td>
<td>60.00 (1542.0)</td>
<td>1300 (591)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
<td>1350 (614)</td>
</tr>
<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>1400 (639)</td>
</tr>
<tr>
<td></td>
<td>84.00 (2133.6)</td>
<td>1450 (659)</td>
</tr>
<tr>
<td></td>
<td>90.00 (2286.0)</td>
<td>1500 (682)</td>
</tr>
<tr>
<td>30.00 (762.0)</td>
<td>60.00 (1542.0)</td>
<td>1900 (864)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>2000 (909)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
<td>2100 (955)</td>
</tr>
<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>2200 (1000)</td>
</tr>
<tr>
<td></td>
<td>84.00 (2133.6)</td>
<td>2300 (1045)</td>
</tr>
<tr>
<td></td>
<td>90.00 (2286.0)</td>
<td>2400 (1091)</td>
</tr>
<tr>
<td>44.00 (1176)</td>
<td>60.00 (1542.0)</td>
<td>2500 (1136)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>2600 (1182)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
<td>2700 (1227)</td>
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<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>2800 (1273)</td>
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<td></td>
<td>84.00 (2133.6)</td>
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<td></td>
<td>90.00 (2286.0)</td>
<td>3000 (1364)</td>
</tr>
<tr>
<td>60.00 (1524.0)</td>
<td>60.00 (1542.0)</td>
<td>3800 (1727)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>4000 (1818)</td>
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<td></td>
<td>72.00 (1828.8)</td>
<td>4200 (1909)</td>
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<td></td>
<td>78.00 (1981.2)</td>
<td>4400 (2000)</td>
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<td></td>
<td>84.00 (2133.6)</td>
<td>4600 (2091)</td>
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<td></td>
<td>90.00 (2286.0)</td>
<td>4800 (2182)</td>
</tr>
<tr>
<td><strong>Auxiliary/Transition Structures</strong></td>
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</tr>
<tr>
<td>12.00 (304.8)</td>
<td>60.00 (1542.0)</td>
<td>475 (216)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>500 (227)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
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<td>78.00 (1981.2)</td>
<td>550 (250)</td>
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<td>84.00 (2133.6)</td>
<td>576 (261)</td>
</tr>
<tr>
<td></td>
<td>90.00 (2286.0)</td>
<td>600 (273)</td>
</tr>
<tr>
<td>18.00, 22.00 and 24.00 (4572, 558.8 and 609.6)</td>
<td>60.00 (1542.0)</td>
<td>950 (432)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>1000 (455)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
<td>1050 (477)</td>
</tr>
<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>1100 (500)</td>
</tr>
<tr>
<td></td>
<td>84.00 (2133.6)</td>
<td>1150 (523)</td>
</tr>
<tr>
<td></td>
<td>90.00 (2286.0)</td>
<td>1200 (545)</td>
</tr>
<tr>
<td>30.00 (762.0)</td>
<td>60.00 (1542.0)</td>
<td>1700 (773)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>1750 (795)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
<td>1800 (818)</td>
</tr>
<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>1850 (840)</td>
</tr>
<tr>
<td></td>
<td>84.00 (2133.6)</td>
<td>1900 (864)</td>
</tr>
<tr>
<td></td>
<td>90.00 (2286.0)</td>
<td>1950 (888)</td>
</tr>
<tr>
<td><strong>Utility Structures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38.00 (965.2)</td>
<td>60.00 (1542.0)</td>
<td>1600 (726)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>1625 (738)</td>
</tr>
<tr>
<td></td>
<td>72.00 (1828.8)</td>
<td>1650 (749)</td>
</tr>
<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>1675 (760)</td>
</tr>
<tr>
<td></td>
<td>84.00 (2133.6)</td>
<td>1700 (772)</td>
</tr>
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<td></td>
<td>90.00 (2286.0)</td>
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</tr>
<tr>
<td>50.00 (1270.0)</td>
<td>60.00 (1542.0)</td>
<td>1650 (749)</td>
</tr>
<tr>
<td></td>
<td>66.00 (1676.4)</td>
<td>1675 (760)</td>
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<td></td>
<td>72.00 (1828.8)</td>
<td>1700 (772)</td>
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<tr>
<td></td>
<td>78.00 (1981.2)</td>
<td>1725 (783)</td>
</tr>
<tr>
<td></td>
<td>84.00 (2133.6)</td>
<td>1750 (795)</td>
</tr>
<tr>
<td></td>
<td>90.00 (2286.0)</td>
<td>1775 (806)</td>
</tr>
</tbody>
</table>

① See Table 20.5-8 on the following page for breaker weights.
### Table 20.5-7. Magnum DS Front Access Construction Switchgear Structure Approximate Weights (Less Breakers)

<table>
<thead>
<tr>
<th>Breaker Structure</th>
<th>Width in Inches (mm)</th>
<th>Depth in Inches (mm)</th>
<th>Approximate Weight in Lb (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.00, 22.00 and 24.00 (457.2, 558.8 and 609.6)</td>
<td>40.00 (1016.0)</td>
<td>1100 (500)</td>
<td></td>
</tr>
<tr>
<td>30.00 (762.0)</td>
<td>40.00 (1016.0)</td>
<td>1750 (795)</td>
<td></td>
</tr>
<tr>
<td>44.00 (1117.6)</td>
<td>40.00 (1016.0)</td>
<td>2200 (1000)</td>
<td></td>
</tr>
<tr>
<td>Cable Compartment</td>
<td>Width in Inches (mm)</td>
<td>Depth in Inches (mm)</td>
<td>Approximate Weight in Lb (kg)</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>18.00, 22.00 and 24.00 (457.2, 558.8 and 609.6)</td>
<td>40.00 (1016.0)</td>
<td>800 (363)</td>
<td></td>
</tr>
<tr>
<td>30.00 (762.0)</td>
<td>40.00 (1016.0)</td>
<td>1550 (705)</td>
<td></td>
</tr>
<tr>
<td>44.00 (1117.6)</td>
<td>40.00 (1016.0)</td>
<td>1600 (727)</td>
<td></td>
</tr>
</tbody>
</table>

Note: See Table 20.5-8 for breaker weights.

### Table 20.5-8. Magnum DS and Series NRX Breaker Weights

<table>
<thead>
<tr>
<th>Breaker</th>
<th>Drawout in Lb (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact</td>
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<tr>
<td>MDN-408</td>
<td>130 (59)</td>
</tr>
<tr>
<td>MDN-508</td>
<td>130 (59)</td>
</tr>
<tr>
<td>MDN-608</td>
<td>130 (59)</td>
</tr>
<tr>
<td>MDN-C08</td>
<td>130 (59)</td>
</tr>
<tr>
<td>MDN-416</td>
<td>130 (59)</td>
</tr>
<tr>
<td>MDN-516</td>
<td>130 (59)</td>
</tr>
<tr>
<td>MDN-616</td>
<td>145 (66)</td>
</tr>
<tr>
<td>MDN-C16</td>
<td>145 (66)</td>
</tr>
<tr>
<td>MDN-620</td>
<td>145 (66)</td>
</tr>
<tr>
<td>MDN-C20</td>
<td>145 (66)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Narrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDN-408</td>
</tr>
<tr>
<td>MDN-508</td>
</tr>
<tr>
<td>MDN-608</td>
</tr>
<tr>
<td>MDN-C08</td>
</tr>
<tr>
<td>MDN-416</td>
</tr>
<tr>
<td>MDN-516</td>
</tr>
<tr>
<td>MDN-616</td>
</tr>
<tr>
<td>MDN-C16</td>
</tr>
<tr>
<td>MDN-620</td>
</tr>
<tr>
<td>MDN-C20</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-408</td>
</tr>
<tr>
<td>MDS-508</td>
</tr>
<tr>
<td>MDS-608</td>
</tr>
<tr>
<td>MDS-C08</td>
</tr>
<tr>
<td>MDS-416</td>
</tr>
<tr>
<td>MDS-516</td>
</tr>
<tr>
<td>MDS-616</td>
</tr>
<tr>
<td>MDS-820</td>
</tr>
<tr>
<td>MDS-820</td>
</tr>
<tr>
<td>MDS-C20</td>
</tr>
<tr>
<td>MDS-X20</td>
</tr>
<tr>
<td>MDS-632</td>
</tr>
<tr>
<td>MDS-832</td>
</tr>
<tr>
<td>MDS-C32</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Double Wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-X32</td>
</tr>
<tr>
<td>MDS-640</td>
</tr>
<tr>
<td>MDS-840</td>
</tr>
<tr>
<td>MDS-C40</td>
</tr>
<tr>
<td>MDS-640</td>
</tr>
<tr>
<td>MDS-C40</td>
</tr>
<tr>
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<td>MDD-X40</td>
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<td>MDS-850</td>
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<td>MDS-X50</td>
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<tr>
<td>MDS-C60</td>
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<tr>
<td>MDD-X60</td>
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<table>
<thead>
<tr>
<th>Fused</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-L08</td>
</tr>
<tr>
<td>MDS-L16</td>
</tr>
<tr>
<td>MDS-L20</td>
</tr>
</tbody>
</table>

Note: Impact weight equals 1.5 times breaker static weight. Three-pole frame weight given; four-pole frame weight equals 1.33 times more.

### Table 20.5-9. Magnum DS Arc-Resistant Switchgear Additional Approximate Weights

<table>
<thead>
<tr>
<th>Arc-Resistant Component</th>
<th>Approximate Weight (kg/Foot (m))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plenum</td>
<td>34 (50.60)</td>
</tr>
<tr>
<td>Exhaust duct</td>
<td>38 (56.55)</td>
</tr>
</tbody>
</table>
### Application

#### Standards
Magnum DS circuit breakers meet or exceed all applicable requirements of ANSI Standards C37.13, C37.17, C37.50 and CSA.

#### System Voltage and Frequency
Magnum DS breakers are designed for operation on AC systems only, 60 Hz or 50 Hz, 635 V maximum.

#### Continuous Current Ratings
Unlike transformers, generators and motors, circuit breakers are maximum-rated devices and have no built-in temporary overload current ratings. Consequently, it is vital that each application take into consideration the maximum anticipated current demand, initial and future, including temporary overloads.

The continuous rating of any Magnum DS breaker is limited to the sensor rating, or the frame size current rating, whichever is the lesser. For instance, an MDS-616 1600 A frame breaker with 800 A sensors has a maximum continuous rating of 800 A, but the same breaker with 1600 A sensors is limited to 1600 A maximum.

All current ratings are based on a maximum ambient air temperature of 40 °C (104 °F).

#### Ambient Temperature
The temperature of the air surrounding the enclosure should be within the limits of: –30 °C (–22 °F) to +40 °C (+104 °F).

#### Altitude
The breakers are applicable at their full voltage and current ratings up to a maximum altitude of 6600 ft (2012 m) above sea level. When installed at higher altitudes, the ratings are subject to the following correction factors in accordance with ANSI C37.20.1.

### Technical Data/Dimensions/Weights

#### Table 20.5-10. Altitude Derating Factors

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Voltage Correction</th>
<th>Current Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet</td>
<td>Meters</td>
<td></td>
</tr>
<tr>
<td>6600</td>
<td>2012</td>
<td>1.000</td>
</tr>
<tr>
<td>7000</td>
<td>2134</td>
<td>0.989</td>
</tr>
<tr>
<td>7500</td>
<td>2286</td>
<td>0.976</td>
</tr>
<tr>
<td>8000</td>
<td>2438</td>
<td>0.963</td>
</tr>
<tr>
<td>8500</td>
<td>2591</td>
<td>0.950</td>
</tr>
<tr>
<td>9000</td>
<td>2743</td>
<td>0.933</td>
</tr>
<tr>
<td>9500</td>
<td>2896</td>
<td>0.917</td>
</tr>
<tr>
<td>10,000</td>
<td>3048</td>
<td>0.900</td>
</tr>
<tr>
<td>10,500</td>
<td>3200</td>
<td>0.883</td>
</tr>
<tr>
<td>11,000</td>
<td>3353</td>
<td>0.867</td>
</tr>
<tr>
<td>11,500</td>
<td>3505</td>
<td>0.850</td>
</tr>
<tr>
<td>12,000</td>
<td>3658</td>
<td>0.833</td>
</tr>
<tr>
<td>12,500</td>
<td>3810</td>
<td>0.817</td>
</tr>
<tr>
<td>13,000</td>
<td>3962</td>
<td>0.800</td>
</tr>
</tbody>
</table>

All low-voltage air power circuit breakers are tested per the ANSI Standard C37.1 for a system X/R ratio of 6.6 maximum. It is common within low-voltage systems to experience power factor and X/R values outside the range of the standard values, and thus a means to evaluate published product ratings is necessary.

For applications of power breakers within distribution systems having calculated X/R ratios higher than 6.6, the derating of the air power breakers kAIC rating is required. Per IEEE sanctioned methodology, the calculated short circuit current at the point of interest is increased by the Table 20.5-10 multiplying factors (MF) to yield an “apparent value of short circuit current,” which is then compared to the published breaker ratings. Only breakers having published ratings higher than the “apparent fault current” can be safely applied.

For example, if unfused air power breakers rated 65 kAIC were being considered within a 480/277 Vac distribution system where the X/R at the point of breaker application is 14.25 and the calculated fault current was determined to be 60 kA, the determination of the suitability of these breakers yields:

Apparent Fault Current = 60 kA x MF

Table 20.5-10

Table 20.5-11. Air Power Breaker Derating

<table>
<thead>
<tr>
<th>System X/R Ratio</th>
<th>System % PF</th>
<th>Fused Derating</th>
<th>MF</th>
<th>Unfused Derating</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.73</td>
<td>50.0</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>3.18</td>
<td>30.0</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>3.87</td>
<td>25.0</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>4.90</td>
<td>20.0</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
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<td>6.59</td>
<td>15.0</td>
<td>0.939</td>
<td>1.065</td>
<td>1.000</td>
<td>1.000</td>
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<tr>
<td>8.27</td>
<td>12.0</td>
<td>0.898</td>
<td>1.114</td>
<td>0.962</td>
<td>1.000</td>
</tr>
<tr>
<td>9.95</td>
<td>10.0</td>
<td>0.870</td>
<td>1.149</td>
<td>0.937</td>
<td>1.067</td>
</tr>
<tr>
<td>11.72</td>
<td>8.5</td>
<td>0.849</td>
<td>1.178</td>
<td>0.918</td>
<td>1.089</td>
</tr>
<tr>
<td>14.25</td>
<td>7.0</td>
<td>0.827</td>
<td>1.209</td>
<td>0.899</td>
<td>1.112</td>
</tr>
<tr>
<td>19.97</td>
<td>5.0</td>
<td>0.797</td>
<td>1.255</td>
<td>0.874</td>
<td>1.144</td>
</tr>
</tbody>
</table>
Unusual Environmental and Operating Conditions

Special attention should be given to applications subject to the following conditions:

1. Damaging or hazardous fumes, vapors, etc.
2. Excessive or abrasive dust.
   
   For such conditions, it is generally recommended that the switchgear be installed in a clean, dry room, with filtered and/or pressurized clean air. This method permits the use of standard indoor switchgear and avoids the derating effect of non-ventilated enclosures.

3. Salt spray, excessive moisture, dripping, etc.
   
   Drip shields in equipment rooms and space heaters in indoor weatherproof enclosures, may be indicated, depending upon the severity of the conditions.

4. Excessively high or low ambient temperatures.
   
   For ambient temperatures exceeding 40 °C, and based on a standard temperature rise of 65 °C, the continuous current ratings of breaker frame sizes, and also buses, current transformers, etc., will be subject to a derating factor calculated from the following formula:

   \[
   \frac{105^\circ \text{ Total—Special Ambient, } °\text{C}}{105^\circ \text{ Total—} 40^\circ \text{C Standard Ambient}}
   \]

   Circuit breakers are not adversely affected by very low outdoor ambient temperatures, particularly when energized and carrying load currents. The standard space heaters in weatherproof switchgear will raise the temperature slightly and prevent condensation.

   Electrical components such as relays and instruments, however, must be applied within the manufacturer’s specified limits.

5. Exposure to seismic shock.
   
   Magnum DS assemblies and breakers have been certified for applications through International Building Code 2009 (IBC) and California Building Code 2010 (CBC). Assembly modifications may be required, so such conditions must be specified.

6. Abnormally high frequency of operation.
   
   In line with above, a lesser number of operations between servicing, and more frequent replacement of parts, may be indicated.
## Magnum DS Rear-Accessible Switchgear—Dimensions in Inches (mm)

![Diagram of Breaker Structures]

### Table 20.6-1. Layout Guide

<table>
<thead>
<tr>
<th>Rear-Accessible Switchgear</th>
<th>Ampacity Available</th>
<th>Structure Widths—Allowable Breaker Placements—Inches (mm)</th>
<th>100 kAIC ≤</th>
<th>200 kAIC</th>
<th>220.00 (558.8)</th>
<th>240.00 (609.6)</th>
<th>300.00 (762.0)</th>
<th>440.00 (1117.6)</th>
</tr>
</thead>
</table>
| Narrow (MDN)              | 800–2000 MDN4-
SDN6- | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Double (MDN)              | 4000 MDN4-600 MDN-
C40 | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Standard (MDS)            | 800–2000 MDS4-
MDS6-
MDS8-
MDSX-
MDSX- | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Standard (MDS)            | 3200 MDS6-
MDS8-
MDSX-
MDSX- | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Standard (NRX-NF)         | 800–1200 NRS5-
NRS6- | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Double (MDS)              | 4000–5000 MDS8-
MDS8-
MDSX-
MDSX- | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Double w/fans (MDS)       | 4000 MDS8-
MDSX-
MDSX- | Feeder—A, B, C, D Tie—B Main—B, C, D | 18.00 (457.2) | 22.00 (558.8) | 24.00 (609.6) | 30.00 (762.0) | 44.00 (1117.6) |
| Instrument compartment     | All positions | All positions | All positions | All positions | All positions | All positions | All positions |

For more information, visit [www.eaton.com/consultants](http://www.eaton.com/consultants)
Magnum DS Rear-Accessible Switchgear—Dimensions in Inches (mm)

<table>
<thead>
<tr>
<th></th>
<th>Metering</th>
<th>Feeder MDN-608 800 A</th>
<th>Feeder MDN-608 800 A</th>
<th>Metering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>Main MDS-632 3200 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Metering</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Main MDS-632 3200 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Metering</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Metering</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Metering</td>
</tr>
</tbody>
</table>

Using Narrow and Standard Breakers

<table>
<thead>
<tr>
<th></th>
<th>Metering</th>
<th>Feeder MDN-608 800 A</th>
<th>Feeder MDN-608 800 A</th>
<th>Metering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A/E</strong></td>
<td>Metering</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>Metering</td>
</tr>
<tr>
<td><strong>B/F</strong></td>
<td>Main MDS-840 4000 A</td>
<td>SPD Tie MDS-630 3200 A</td>
<td>SPD Tie MDS-630 3200 A</td>
<td>SPD Metering</td>
</tr>
<tr>
<td><strong>C/G</strong></td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Feeder MDN-608 800 A</td>
<td>SPD Metering</td>
</tr>
<tr>
<td><strong>D/H</strong></td>
<td>SPD Feeder MDN-616 1600 A</td>
<td>SPD Feeder MDN-616 1600 A</td>
<td>SPD Feeder MDN-616 1600 A</td>
<td>SPD Metering</td>
</tr>
</tbody>
</table>

Using Standard and Double Breakers

**Figure 20.6-2. Main-Tie-Main Typical Layouts**

*Note:* Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.

**Figure 20.6-3. Typical Structure and Breaker Arrangements—4000 A, MDN Mains, Ties, Feeders and Miscellaneous**

*Note:* Minimum structure depth is 72 inches.
Figure 20.6-4. Typical Structure and Breaker Arrangements—Magnum DS Mains, Ties, Feeders and Miscellaneous, 3200 A and Below

1. A transition section is required when close-coupling to an Eaton sourced liquid filled transformer. A transition section is required when close coupling to non-Eaton sourced transformers. A transition section is required when close coupling to other distribution equipment.
2. A maximum of two 3200 A breakers are permitted per 22.00-inch (558.8 mm) width of switchgear, one of which must be a main or tie. For a 3200 A frame breaker mounted in the same enclosure with a 4000 A or 5000 A main or tie, contact Eaton.
3. Contact Eaton for placement of 2000 A frame breaker in this compartment.
4. A maximum of three 2000 A breakers are permitted per 22.00-inch (558.8 mm) width of switchgear. If three are required, positions B, C and D must be used.
5. Any 22.00-inch (558.8 mm) wide compartment can be a blank or instrument compartment.

Notes: Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
## Magnum DS Rear-Accessible Switchgear—Dimensions in Inches (mm)

<table>
<thead>
<tr>
<th>Arrangement 12</th>
<th>Arrangement 13</th>
<th>Arrangement 14</th>
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</thead>
<tbody>
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<td><strong>Blank or Instrument</strong></td>
<td><strong>Blank or Instrument</strong></td>
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<td><strong>Main</strong></td>
<td><strong>Main</strong></td>
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<td><strong>Feeder</strong></td>
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<td><strong>Feeder</strong></td>
<td><strong>Feeder</strong></td>
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</table>

**Notes:**
- Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
- If you have four-wire service and service entrance requirement, busway connection or cable connection, the bus or cables must enter from the top.
- A maximum of two 3200 A breakers are permitted per 22.00-inch (558.8 mm) width of switchgear, one of which must be a main or tie. For a 3200 A frame breaker mounted in the same enclosure with a 4000 A or 5000 A main or tie, contact Eaton.
- Service entrance option is not available with feeder breakers mounted in this structure.
- Any 22.00-inch (558.8 mm) wide compartment can be a blank or instrument compartment with the following exception: A 44.00-inch (1117.6 mm) wide instrument compartment must be adjacent to another 44.00-inch (1117.6 mm) wide compartment in the structure.
Layout Guide

Magnum DS Rear-Accessible Switchgear—Dimensions in Inches (mm)

Figure 20.6-4. Typical Structure and Breaker Arrangements (Continued)—Magnum DS Mains and Ties, 4000 A and 5000 A

1. Fixed-mounted main breakers are not permitted in the “D” position.
2. If you have four-wire service and service entrance requirement, busway connection or cable connection, the bus or cables must enter from the bottom.
3. If you have four-wire service and service entrance requirement, busway connection or cable connection, the bus or cables must enter from the top.
4. A maximum of two 3200 A breakers are permitted per 22.00-inch (558.8 mm) width of switchgear, one of which must be a main or tie. For a 3200 A frame breaker mounted in the same enclosure with a 4000 A or 5000 A main or tie, contact Eaton.
5. Any 22.00-inch (558.8 mm) wide compartment can be a blank or instrument compartment with the following exception: A 44.00-inch (1117.6 mm) wide compartment must be adjacent to another 44.00-inch (1117.6 mm) wide compartment in the structure.

Notes: Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
## Magnum DS Rear-Accessible Switchgear—Dimensions in Inches (mm)

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<thead>
<tr>
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<th>Feeder</th>
<th>Feeder</th>
<th>Feeder</th>
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<table>
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<tbody>
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<td>2000</td>
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</table>

### Notes:
- Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
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**Figure 20.6-4. Typical Structure and Breaker Arrangements (Continued)—Magnum DS Ties and Feeders, 4000 A and 5000 A**

1. “B” and “D” position feeders must be reverse fed.
2. Any 22.00-inch (558.8 mm) wide compartment can be a blank or instrument compartment with the following exception: A 44.00-inch (1117.6) wide instrument compartment must be adjacent to another 44.00-inch (1117.6) wide compartment in the structure.
<table>
<thead>
<tr>
<th>Feeder</th>
<th>Feeder</th>
<th>Blank or Instrument</th>
<th>Feeder</th>
<th>Feeder</th>
<th>Blank or Instrument</th>
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<tr>
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<td>800 NRX</td>
<td>A</td>
<td>800 NRX</td>
<td>800 NRX</td>
<td>A</td>
<td>800 NRX</td>
<td>800 NRX</td>
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<tr>
<td>800 NRX</td>
<td>800 NRX</td>
<td>E</td>
<td>800 NRX</td>
<td>800 NRX</td>
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<td>800 NRX</td>
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24.00 (609.6) Arrangement 28
24.00 (609.6) Arrangement 29
24.00 (609.6) Arrangement 30
24.00 (609.6) Arrangement 31

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<tr>
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<th>Blank or Instrument or SPD</th>
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<td>C</td>
</tr>
<tr>
<td>800 NRX</td>
<td>800 NRX</td>
<td>D</td>
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24.00 (609.6) Arrangement 32
24.00 (609.6) Arrangement 33

---

**Figure 20.6-4. Typical Structure and Breaker Arrangements (Continued)—Magnum DS Mains and Ties, and Series NRX Feeder Breakers**

1. Feeder and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
Figure 20.6-4. Typical Structure and Breaker Arrangements (Continued)—Magnum DS Mains and Ties, 6000 A

1. A maximum of two 3200 A breakers are permitted per 22.00-inch (559 mm) width of switchgear, one of which must be a main or tie. For a 3200 A frame breaker mounted in the same enclosure with a 4000 A, 5000 A or 6000 A main or tie, contact Eaton.

2. When a top-of-gear breaker lifter is used, height is 99.00 inches (2514.6 mm) total.

3. Any 22.00-inch (558.8 mm) wide compartment can be a blank or instrument compartment with the following exception: 44.00-inch (1117.6) wide instrument compartment must be adjacent to another 44.00-inch (1117.6) wide compartment in the structure.

4. May need a 44.00-inch wide section on both sides of the tie for layout to be correct.

Notes:

Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.

Figure 20.6-5. Integrated Group-Mounted Molded-Case Circuit Breaker Switchboard

Note: Structures using molded-case breakers for distribution will be UL 891 rated with 30-cycle bus bracing.
Magnum DS Front-Accessible Switchgear—Dimensions in Inches (mm)

Figure 20.6-6. Front-Accessible Breaker Structures

1. 18.00 (457.2), 22.00 (558.8), 24.00 (609.6), 30.00 (762.2), 44.00 (1117.6)

2. 22.00 (558.8), 24.00 (609.6), 30.00 (762.2), 44.00 (1117.6)

3. 24.00 (609.6), 30.00 (762.2), 44.00 (1117.6)

4. See Table 20.6-4 for information on cables and conduits.

Notes:
- Cable section can ONLY be on the right. Shipping splits are not allowed between breaker section and its cable section.
- Shipping splits must be adjacent to a cable section.

Table 20.6-2. Layout Guide

<table>
<thead>
<tr>
<th>Breaker Type</th>
<th>Frame Ampacity Available ≤100 kAIC</th>
<th>Breaker Section Widths—Dimensions in Inches (mm)</th>
</tr>
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<tbody>
<tr>
<td>Narrow Magnum DS Frames (MDN)</td>
<td>800–2000  MDN4- MDN6-</td>
<td>Feeder—A, B, C, D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tie—B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main—B, C, D</td>
</tr>
<tr>
<td>Standard Magnum DS Frame (MDS)</td>
<td>800–3200  MDS4- MDS6- MDS8- MDS8C-</td>
<td>Feeder—A, B, C, D</td>
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<td></td>
<td>Tie—B</td>
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<tr>
<td></td>
<td></td>
<td>Main—B, C, D</td>
</tr>
<tr>
<td>Standard Series NRX Frames (NRX)</td>
<td>800–1200  NSS5- NSS6-</td>
<td>Feeder—A, B, C, D</td>
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<tr>
<td>Instrument compartment (SPD, HRG, metering, controls, panelboard, etc.)</td>
<td>All positions</td>
<td>All positions</td>
</tr>
</tbody>
</table>

Note 1: 18.00 (457.2), 22.00 (558.8), 24.00 (609.6), 30.00 (762.2), 44.00 (1117.6)

Note 2: 22.00 (558.8), 24.00 (609.6), 30.00 (762.2), 44.00 (1117.6)

Series NRX 65 kAIC maximum.
### Magnum DS Front-Accessible Switchgear—Dimensions in Inches (mm)

<table>
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<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>Main, Tie, Feeder 4000</td>
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<td>Main, Tie, Feeder 4000</td>
<td>Blank or Instrument</td>
</tr>
<tr>
<td>Cable Pull Section</td>
<td>Main, Tie, Feeder 4000</td>
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<td>Blank or Instrument or SPD</td>
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<td>30.00 (762.0)</td>
<td>30.00 (762.0)</td>
<td>30.00 (762.0)</td>
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</table>

**Arrangement 23A**

**Arrangement 23B**

**Arrangement 24A**

**Arrangement 24B**

---

**Figure 20.6-7. Typical Structure and Breaker Arrangements—4000 A, MDN Front Access Mains, Ties, Feeders and Miscellaneous**

**Note:** Front access depth is 40 inches.
### Magnum DS Front-Accessible Switchgear—Dimensions in Inches (mm)

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<tr>
<th>Cable Compartment — Top Entry</th>
<th>Cable Compartment — Top Entry</th>
<th>Cable Compartment — Top Entry</th>
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<th>Instrument or SPD</th>
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**Figure 20.6-8. Combination Breaker/Cable Sections**

**Figure 20.6-9. Front-Accessible Standard and Narrow Breakers Main-Tie-Main Typical Layout**

**Figure 20.6-10. Main-Tie-Main Typical Layout—MDS Mains and Tie, Series NRX/MDS Feeders**

**Notes:** Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Cable compartment must be at least as wide as the breaker compartment. Cable sections must be on the right-hand side of the breaker sections when facing the front. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
Magnum DS Front-Accessible Switchgear—Dimensions in Inches (mm)

<table>
<thead>
<tr>
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<th>Arrangement 4</th>
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<td>Main 800</td>
<td>24.00 (609.6)</td>
<td>Feeder 800 F</td>
<td>30.00 (762.0)</td>
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<tr>
<td>Feeder 800 C</td>
<td>1600 2000 3200</td>
<td>24.00 (609.6)</td>
<td>Feeder 800 G</td>
<td>44.00 (1117.6)</td>
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<td>Feeder 800 A</td>
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<td>Feeder 800 H</td>
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Figure 20.6-11. Typical Structure and Breaker Arrangements—Series NRX and Magnum DS Breakers

1. 24 structure feeders are limited to Series NRX frame, 800 A maximum.
2. Main and Tie are Magnum DS frames, limited to frame ampacities shown.
3. Feeder breaker may be Magnum DS type, limited to the ampacities shown.

Notes: Breaker and cell utilization should keep load amperes below rating of MAIN due to vertical bus limitations. Cable used in the conduit areas are limited to 75 °C ampacity values per the NEC for ampacity calculations. Any cell not used as a feeder breaker may be a blank, or a feeder breaker provision for future breakers, or SPD surge. Cable compartment must be at least as wide as the breaker compartment. Cable sections must be on the right-hand side of the breaker sections when facing the front. Section bus sized per main bus rating (maximum) or by ANSI C37.20.1.
Conduit Area Location—Dimensions in Inches (mm)

Figure 20.6-12. Floor Plans and Available Conduit Space—18.00, 22.00, 30.00, 44.00-Inch (457.2, 558.8, 762.0, 1117.6 mm) Wide Rear-Access Structures

@ This dimension is reduced by 12.00 inches (304.8 mm) when vertical section is close coupled to a dry-type transformer due to secondary bus connections.

Note: See Table 20.6-3 for further information on cable and conduit recommendations.

Figure 20.6-13. Floor Plans and Available Conduit Space—Front-Access Structures

Note: See Table 20.6-4 for further information on cable and conduit recommendations.
### Table 20.6-3. Rear-Access Structure Dimensions in Inches (mm)

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<th>A</th>
<th>CC</th>
<th>Recommended Number of Conduits</th>
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</thead>
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<td>18.00 (457.2)</td>
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<td>18.00 (457.2)</td>
<td>7.30 (185.4)</td>
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<td>22.00 (558.8)</td>
<td>54.00 (1371.6)</td>
<td>18.00 (457.2)</td>
<td>7.30 (185.4)</td>
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<tr>
<td>24.00 (609.6)</td>
<td>60.00 (1524.0)</td>
<td>24.00 (609.6)</td>
<td>9.00 (229.0)</td>
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<tr>
<td>30.00 (762.0)</td>
<td>54.00 (1371.6)</td>
<td>18.00 (457.2)</td>
<td>7.30 (185.4)</td>
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<tr>
<td>44.00 (1117.6)</td>
<td>54.00 (1371.6)</td>
<td>18.00 (457.2)</td>
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<tr>
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</table>

**Conduits for Top Entry**

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<tr>
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<tr>
<td>17.89 (454.4)</td>
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### Table 20.6-4. Front-Access Structure Dimensions in Inches (mm)

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<tr>
<td>30.00 (762.0)</td>
<td>25.89 (657.6)</td>
<td>11</td>
</tr>
<tr>
<td>44.00 (1117.6)</td>
<td>39.89 (1013.2)</td>
<td>17</td>
</tr>
</tbody>
</table>

### Table 20.6-5. Arc-Resistant Structure Dimensions in Inches (mm)

<table>
<thead>
<tr>
<th>W</th>
<th>D</th>
<th>A</th>
<th>CC</th>
<th>Recommended Number of Conduits</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.00 (558.8)</td>
<td>72.00 (1828.8)</td>
<td>36.00 (914.4)</td>
<td>14.80 (375.9)</td>
<td>6</td>
</tr>
<tr>
<td>30.00 (762.0)</td>
<td>72.00 (1828.8)</td>
<td>36.00 (914.4)</td>
<td>14.80 (375.9)</td>
<td>8</td>
</tr>
<tr>
<td>44.00 (1117.6)</td>
<td>72.00 (1828.8)</td>
<td>36.00 (914.4)</td>
<td>14.80 (375.9)</td>
<td>12</td>
</tr>
</tbody>
</table>

**Note**: Arc-resistant switchgear's conduit space for bottom entry is the same as regular rear-accessible gear.

For more information, visit: [www.eaton.com/consultants](http://www.eaton.com/consultants)
Figure 20.6-14. Section View of a Typical Structure with Magnum DS Breakers

See Table 20.6-3, Page 20.6-14 for depth information and recommended number of cables.
Figure 20.6-15. Section View of a Typical Structure with Series NRX Breakers

See Table 20.6-3, Page 20.6-14 for depth information and recommended number of cables.
Section View—Dimensions in Inches (mm)

Figure 20.6-16. Front-Access Section View

Note: Top-mounted breaker lifting device available for bottom cable entry/exit only. For cables exiting the top of the switchgear, a floor-mounted lifter must be used.

Table A. Bus Cross-Sections

<table>
<thead>
<tr>
<th>Ampere Rating</th>
<th>800 A</th>
<th>1200/1600 A</th>
<th>2000 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runback Cross-Section</td>
<td>3.50 x 0.25</td>
<td>2.50 x 0.38</td>
<td>4.50 x 0.50</td>
</tr>
</tbody>
</table>
Outdoor Walk-in Switchgear—Dimensions in Inches (mm)

Floor Plan

See Figure 1 Above for Bus Duct Orientation Info.

Side View

Available Rear Access Structure Widths

<table>
<thead>
<tr>
<th>Structure</th>
<th>Weight-Lb (kg) (not including breakers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>End Trims One set per lineup</td>
<td>1500 (681)</td>
</tr>
<tr>
<td>18-inch (4572) wide breaker structure</td>
<td>2500 (1135)</td>
</tr>
<tr>
<td>22-inch (558.8 mm) wide breaker structure</td>
<td>2600 (1180)</td>
</tr>
<tr>
<td>30-inch (762.0 mm) wide breaker structure</td>
<td>2700 (1226)</td>
</tr>
<tr>
<td>44-inch (1117.6 mm) wide breaker structure</td>
<td>5200 (2361)</td>
</tr>
<tr>
<td>22-inch (558.8 mm) wide auxiliary breaker structure</td>
<td>2300 (1044)</td>
</tr>
<tr>
<td>22-inch (558.8 mm) wide transition structure</td>
<td>2300 (1044)</td>
</tr>
<tr>
<td>38-inch (965.2 mm) wide utility structure</td>
<td>2700 (1226)</td>
</tr>
<tr>
<td>50-inch (1270.0 mm) wide utility structure</td>
<td>3200 (1453)</td>
</tr>
<tr>
<td>Transformer throat</td>
<td>150 (68)</td>
</tr>
</tbody>
</table>

For more information, visit: www.eaton.com/consultants

Reference Drawing: 9255C35
Outdoor Non-Walk-in Switchgear—Dimensions in Inches (mm)

See Figure 1 Above for Bus Duct Orientation Info.

Floor Plan

Side View

Top View

Available Rear Access Structure Widths

Structure Weight-Lb (kg)

End Trims One set per lineup
18-inch (4522) wide breaker structure 1500 (681)
22-inch (558.8 mm) wide breaker structure 2500 (1136)
30-inch (762.0 mm) wide breaker structure 2600 (1180)
44-inch (1117.6 mm) wide breaker structure 2700 (1226)
22-inch (558.8 mm) wide auxiliary structure 2300 (1044)
22-inch (558.8 mm) wide transition structure 2300 (1044)
38-inch (965.2 mm) wide utility structure 2700 (1226)
50-inch (1270.0 mm) wide utility structure 3200 (1453)
Transformer throat 150 (68)

Reference Drawing: 9255C06

Figure 20.6-18. Outdoor Non-Walk-in Enclosure

0.75-inch (19.1 mm) hardware recommended in all tie down locations.

Table: Centerline of copper connection from bottom of structure

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.38</td>
<td>51.23</td>
<td>10.70</td>
</tr>
<tr>
<td>46.63</td>
<td>57.00</td>
<td>18.70</td>
</tr>
<tr>
<td>52.63</td>
<td>63.00</td>
<td>18.70</td>
</tr>
</tbody>
</table>
Arc-Resistant Switchgear

All Magnum rear-accessible layouts (see Table 20.6-1) are available with the following considerations:

1. Utility compartments are not arc resistant.
2. Only allowed structure widths are 22.00-inch (558.8 mm), 30.00-inch (762.0) and 44.00-inch (1117.6).
3. Group-mounted molded-case circuit breaker switchboard sections are not arc resistant.
4. Only MDS and MDN breakers are allowed.

The following minimum dimensional requirements also apply:

Table 20.6-6. Minimum Dimensional Requirements

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Minimum in Inches (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall width required</td>
<td></td>
</tr>
<tr>
<td>85 kAIC and 100 kAIC</td>
<td>60.00 (1524.0)</td>
</tr>
<tr>
<td>65 kAIC</td>
<td>44.00 (1117.6)</td>
</tr>
<tr>
<td>65 and 85 kAIC front access</td>
<td>66.00 (1676.4)</td>
</tr>
<tr>
<td>Depth (rear access)</td>
<td>72.00 (1828.8)</td>
</tr>
<tr>
<td>Depth (front access)</td>
<td>54.00 (1371.6)</td>
</tr>
<tr>
<td>Height (without plenum)</td>
<td>96.10 (2440.9)</td>
</tr>
<tr>
<td>Height (with plenum)</td>
<td>117.00 (2971.8)</td>
</tr>
</tbody>
</table>

1. Overhead clearance required with no overhead horizontal obstructions, i.e., lights, conduits, smoke detectors, etc. See Figure 20.6-21. Arc-Resistant Switchgear Side View Showing the Arc Plenum and Figure 20.6-22. Arc-Resistant Switchgear Side Elevation (Front-Access) with Plenum.

Outdoor/sprinkler proof enclosures are not currently available in arc-resistant gear.

Dimensions in Inches (mm)

![Diagram showing dimensions](image)

Figure 20.6-19. Arc-Resistant Structure Floor Plans and Available Conduit Space

1. 36.00 inches (914.4 mm) is the recommended front clearance for breaker removal with top-of-switchgear-mounted breaker lifter. If a portable breaker lifter is to be used, allow at least 84.00 inches (2133.6 mm) of aisle space.

Note: See Table 20.6-5 for further information on assembly depth and recommendations for cables and conduits.
Non-Plenum—Dimensions in Inches (mm)

Figure 20.6-20. Non-Plenum Top Exit Configuration

Note: Contact Eaton for authorization of obstructions in this area.
### Layout Dimensions

#### Plenum—Dimensions in Inches (mm)

![Diagram of Arc-Resistant Switchgear Side View Showing the Arc Plenum](image)

<table>
<thead>
<tr>
<th>D (inches)</th>
<th>A (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72.00</td>
<td>21.70</td>
</tr>
<tr>
<td>78.00</td>
<td>27.70</td>
</tr>
<tr>
<td>84.00</td>
<td>33.70</td>
</tr>
<tr>
<td>90.00</td>
<td>39.70</td>
</tr>
</tbody>
</table>

**Figure 20.6-21. Arc-Resistant Switchgear Side View Showing the Arc Plenum**

Note: Refer to Table 20.6-5, Page 20.6-14 for complete dimensions.
Plenum—Dimensions in Inches (mm)

Figure 20.6-22. Arc-Resistant Switchgear Side Elevation (Front-Access) with Plenum
### Figure 20.6-23. Arc-Resistant Switchgear Exhaust Configurations

**Notes:** Gear shown with rear covers.

Eaton arc resistant rating with or without plenum and arc duct are up to 85 kA at 635 Vac maximum and 100 kA at 508 Vac maximum.
Figure 20.6-23. Arc-Resistant Switchgear Exhaust Configurations (Continued)

Notes: Gear shown with rear covers.
Eaton arc resistant rating with or without plenum and arc duct are up to 85 kA at 635 Vac maximum and 100 kA at 508 Vac maximum.
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