

# Motor Control Centers —Low Voltage

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### Specifications

See Eaton's *Product Specification Guide*, available on CD or on the Web.

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FlashGard .....	<b>Section 16482D</b>	<b>Section 26 24 19.13</b>



**Freedom 2100 Motor  
Control Center**



**Freedom FlashGard  
Motor Control Center**

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## General Description

Freedom 2100 and  
Freedom FlashGard®  
Motor Control Center

Freedom 2100 Motor Control Center



Freedom FlashGard Motor Control Center

## General Description

## Freedom 2100

## Introduction

Eaton's Freedom 2100 motor control centers (MCCs) provide a convenient method for grouping motor control, as well as associated distribution equipment. Freedom 2100 Series MCCs may be applied on electrical systems up to 600V, 50 or 60 Hz, having available fault currents of up to 100,000A rms. Enclosure designs include NEMA® 1 Gasketed, NEMA 2, 12 and 3R. All controllers are assembled with Eaton components of proven safety, quality and reliability. All components are wired in accordance with NEC® and UL® standards. A comprehensive range of communications options are available, including DeviceNet™, Modbus®, PROFIBUS®, Modbus TCP and EtherNet/IP.

## Freedom 2100 Features

- UL 845 label
- 42, 65 and 100 kAIC ratings
- Molded-case and air power circuit breakers
- Across-the-line, reduced voltage and solid-state starters
- Variable frequency drives and VFD options
- Unit latch
- Spring-loaded door latches
- All standard industrial communication options
- Automatic transfer switches
- Panelboards and transformers

## Freedom FlashGard

## Introduction

Eaton's Freedom FlashGard MCCs are an industry first in addressing the dangers associated with an arc flash event by minimizing the risk of arc flash exposure, and lowering the PPE requirements as defined by the NFPA® 70E.2004, for low voltage applications. Freedom FlashGard offers features to help prevent injury from electric shock, arc-flash burn and arc-blast impacts. A retractable stab mechanism, 120V based electromechanical and solid-state motor control with communications capability enables these MCCs to provide the highest level of safety, quality and innovation for group motor control. A comprehensive range of communications options are available, including DeviceNet, Modbus, PROFIBUS and EtherNet/IP.

The new Freedom FlashGard MCC uses a "retractable stab" mechanism, called RotoTract™, which allows the electrical worker to connect and disconnect power to the bucket with the unit door closed. A visual indication is provided on the unit door on the "Connected" and "Disconnected" positions of RotoTract. A visual indication on the position of the shutters that enclose the stabs is also provided (open shutters indicates that stabs are extended and closed shutters indicate that the stabs are withdrawn). In addition, a number of safety interlocks prevents scenarios where removal or insertion of FlashGard bucket could compromise arc flash safety. A motorized tool, such as an electric screwdriver with a 3/8-inch (9.5 mm) square bit or standard 3/8-inch (9.5 mm) drive ratchet is required to operate RotoTract's "retractable stab" mechanism. An optional remote racking accessory with a pendant station is available

as to enable the operator to connect and disconnect starters safely behind the arc flash boundaries prescribed by National Fire Protection Agency (NFPA).

## Freedom FlashGard Features

- UL 845 label
- 42, 65 and 100 kAIC ratings
- Retractable stab mechanism with "connected" and "disconnected" positions
- Molded-case and air power circuit breakers
- Unit latch
- Spring-loaded door latches
- Remote racking
- Across-the-line, reduced voltage and solid-state starters
- Variable frequency and solid-state reduced voltage starter options
- All standard industrial communication options
- Automatic transfer switches
- Panelboards and transformers

## Product Description

MCCs provide the best method for grouping motor control as well as associated distribution equipment. Eaton's Freedom 2100 and Freedom FlashGard Series control centers are specially designed to operate machinery, industrial processes and commercial building systems.

The MCC enclosure consists of a strong and rigid steel channel framework assembled into standardized vertical sections and bolted together to form a complete shipping section of up to 80.00-inch (2032.0 mm) maximum, four structures each. Structures include horizontal and vertical bus, insulation and isolation barriers, horizontal and vertical isolated wiring troughs, cable entrance areas, and space for inserting starter and control equipment.

All control units, removable or fixed mounted, are assembled with Eaton components of proven safety, quality and reliability. All components are wired in accordance with NEC and UL standards. Specifically designed bus stabs, insertion guides, handle mechanisms and safety interlocks are added to form a standardized plug-in unit, which meets the highest safety standards.

## General Description

Freedom 2100 and Freedom FlashGard Series MCCs may be applied on electrical systems up to 600V, 50 or 60 Hz having available fault currents of up to 100,000A rms. Enclosure designs include NEMA 1 Gasketed, 2, 12, 3R, 3R Walk-in and 3R Walk-in Tunnel. An ongoing temperature and short-circuit design test program, as required by UL 845, ensures a quality product that meets the latest safety codes.

Freedom DC motor control centers are available up to 250 Vdc, having available fault currents up to 22,000A rms.

## NEMA Classifications (ICS 3, Part 1)

### Class I Control Centers

A mechanical grouping of combination motor control, feeder tap and/or other units arranged in a convenient assembly. Connections from the common horizontal power bus to the units are included. Interwiring or interlocking between units or to remotely mounted devices is not included. Only diagrams of the individual units are supplied.

When master terminal blocks are specified, a sketch showing general location of terminals is provided.

### Class II Control Centers

The same as Class I, but designed to form a complete control system. They include the necessary electrical interlocking and interwiring between units and interlocking provisions to remotely mounted devices. A suitable diagram illustrating operation of the control associated with the motor control center will be provided.

When master terminal blocks are specified, the terminal arrangement and required wiring connections are shown on the diagram.

## NEMA Types of Wiring

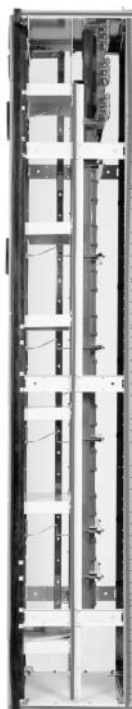
**Type A** includes no terminal blocks. Combination line starters power wiring are factory wired and assembled in the structure in the most efficient arrangement. Auxiliary devices can be supplied, wired or unwired as specified. All feeder circuit breaker or fusible disconnect units are in this classification.

**Type B** duplicates Type A except that all control wires terminate at blocks on the side or near the bottom of each unit. Plug-in type terminal blocks are standard for all control wiring.

**Type C-S** all factory-supplied control terminals are brought to a master terminal block located in the structure.

**Type C-M** all factory-supplied control terminals are brought to a master terminal block located in a separate marshaling structure.

## Structures



Standard Structure—Side View

## Construction

The standard vertical structure is 90.00 inches (2286.0 mm) high and 20.00 inches (508.0 mm) wide. Front-mounted-only structures can be either 16.00 inches (406.4 mm) or 21.00 inches (533.4 mm) deep. Back-to-back unit mounting is 21.00 inches (533.4 mm) deep.

The structure framework is made of 12-gauge formed steel channels. The subframes for the front and rear of each structure are welded. These subframes are then bolted to longitudinal members to form the complete frame, which is rigid and self-supporting. Side, back and roof covers of 14-gauge steel are mounted with screw fasteners for quick and easy removal. All doors are 14-gauge steel with a 0.50-inch (12.7 mm) flange to provide a rigid,

secure closure for all openings. Doors mounted on removable pin hinges are provided on all unit compartments. Vertical wireways, top horizontal wireways and bottom horizontal wireways are standard.

The unit pan forms the top barrier of each unit space. In conjunction with the unit wrapper, this provides isolation between adjacent units and wireways. The guide rails are an integral part of this pan and provide precise alignment of the unit stabs on the vertical bus.

## Standard Structure Arrangements

Standard structural height is 90.00 inches (2286.0 mm) with 9.00-inch (228.6 mm) horizontal wireways available at top and bottom for wiring. The balance of vertical compartments, 72.00 inches (1828.8 mm), is available for mounting of control units. This space can provide up to 12 6.00-inch (152.4 mm) high (X spaces) or any combination thereof.

**Note:** In the rear of common vertical bus back-to-back structures, the top horizontal wireway is 15.00 inches (381.0 mm) high and the bottom wireway is 9.00 inches (228.6 mm). This means that back-to-back structures have only 66.00 inches (1676.4 mm) 11X of usable space in the rear. 72.00-inch (1828.8 mm) 12X of mounting space is available with a 3.00-inch (76.2 mm) bottom wireway. Two front-mounted only structures can be supplied in a back-to-back configuration, allowing 12X rear usable space (depth dimension will increase).

## Special Structures

In addition to the standard 20.00-inch (508.0 mm) wide structure, extra wide structures are available in 4.00-inch (101.6 mm) increments up to 40.00 inches (1016.0 mm) wide.

Reduced height structures, in increments of 6.00 inches (152.4 mm) 1X from 90.00 to 54.00 inches (2286.0 to 1371.6 mm), are available for applications with limited access.

Another special structure is a transition section between Type W and the Freedom 2100 Series. This structure is 10.00 inches (254.0 mm) wide to provide for horizontal bus splicing.

## General Description

**Paint**

All enclosure parts are thoroughly cleaned and given a phosphatizing treatment to inhibit rust and to prime the metal for the finish coating. A 2 mil thick electrostatic powder paint coat is applied to all surfaces. The paint type and process meets UL 1332 for electrical equipment steel enclosures. All exterior enclosure covers and doors are painted ANSI 61 gray (Munsell No. 8.3G/6.10/0.54). For improved interior visibility, the interior of the enclosure and plug-in units are painted white (Munsell No. N9.43/0.21B, 0.23).

**Enclosures**

The standard enclosure type is NEMA Type 1 Gasketed General Purpose—Indoor. This enclosure is appropriate for installations with normal atmospheric conditions.

The NEMA Type 2 Dripproof—Indoor employs a special roof panel with a drip shield and water channels. This prevents liquid from dripping onto the front of the control center.

The NEMA Type 3R Rainproof and Sleet Resistant—Outdoor consists of a NEMA 1 gasketed enclosure mounted on a special base with an outdoor house erected around and over it. Non-walk-in, walk-in aisle and tunnel types are available.

The NEMA Type 12 Dust-tight and Driptight—Indoor has gasketed material around all doors, door cutouts, cover plates, side, top and back sheets. A gasketed bottom plate is provided with this enclosure. This construction provides maximum protection against airborne matter and dripping liquids.

Indoor enclosures comply with NEC UL 845's "Two Meter Rule" when the bottom of the MCC is at the same level as the operator's platform. MCCs elevated on a raised pad or installed on unembedded channel sills may require operator handle extensions for the uppermost operators. Handle extensions are optionally available and may be installed on-site.

**Seismic Qualification**

Refer to **Tab 1** for information on seismic qualification for this and other Eaton products.

**Vertical Wireway**

A vertical wireway is provided in each structure. Located on the right side, it extends the full 90.00-inch (2286.0 mm) height of the structure. The width of the wireway is 4-5/8 inches (117.5 mm) at the rear of the vertical frame members. Overall depth of the wireway is 8.00 inches (203.2 mm) providing a cross-sectional area of nearly 35 square inches (889 square mm) to easily accommodate control and load wiring. Supports are provided at suitable intervals to secure all wiring and cables.

The doors swing open 115° and opposite to the unit doors for maximum accessibility. The doors are mounted on concealed removable pin hinges for quick detachment and are secured in the closed position by spring-loaded quarter-turn indicating type fastener.

**Horizontal Wireways****Top Horizontal Wireway****Bottom Horizontal Wireway**

The top front horizontal wireway is 9.00 inches (228.6 mm) high and 8.00 inches (203.2 mm) deep in front-mounted only structures and in the front of back-to-back mounted structures. It extends the full width of each structure and is totally isolated from the main horizontal bus. The bottom horizontal wireway is 9.00 inches (228.6 mm) high and extends the full depth of the structure. The entire floor area under the control center is open for unrestricted conduit entry. For top entry, the top wireway can be increased to 15.00 inches (381.0 mm) high, reducing the bottom wireway height to 3.00 inches (76.2 mm).

For back-to-back unit mounted, the rear top horizontal wireway is 15.00 inches (381.0 mm) high and 5.00 inches (127.0 mm) deep.

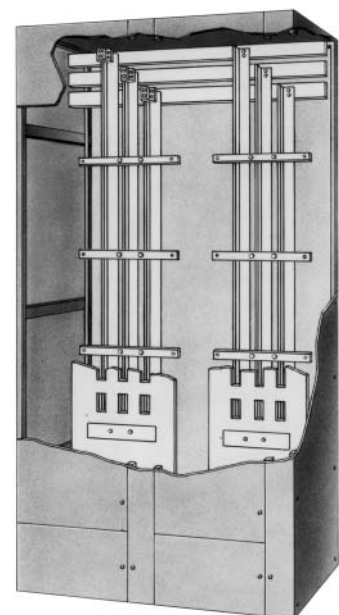
All horizontal wireway openings are covered by doors for increased accessibility. Each door is mounted with removable pin hinges to allow quick detachment.

**Bus System**

The bus system is designed to efficiently distribute power throughout the MCC and provides inherent mechanical strength in the event of faults.

**Vertical Bus****Vertical Bus Configuration**

The vertical bus provides three-phase power distribution from the main horizontal bus into the vertical compartments. The bus is a unique angular configuration with a "Z" shape for front-mounted structures and for back-to-back. These shapes have the inherent mechanical strength to withstand fault stresses. They also provide a smooth stabbing surface for unit connection.

**MCC Bus Layout**



## General Description

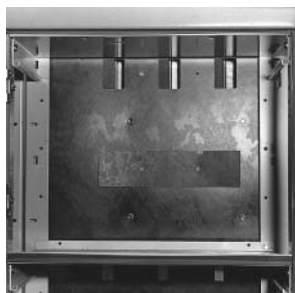
Due to the high-strength capability of the bus bars, bus bracing at 65,000 rms symmetrical amperes is standard. Optional bracing is available at 42,000 and 100,000A rms. Bus braces are molded from a glass-reinforced polyester material, which is non-tracking and impervious to moisture and other adverse atmospheric operating conditions.

The vertical bus is available in ratings of 600, 800 and 1200A for front-mounted only, and 600, 800 and 1200A for back-to-back mounted.

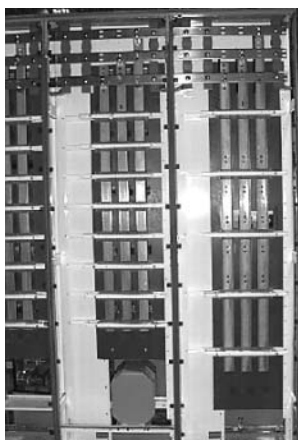
**Vertical bus bars are tin-plated copper only.** In addition to tin plating having environmental superiority over silver, its mechanical strength is better able to withstand the stresses of unit insertion and removal on and off the bus. Vertical bus of the incoming section will match the horizontal bus when applicable.

Isolation of the Freedom 2100 vertical bus compartment from the unit compartment is accomplished by a full height barrier.

This is a single sheet of glass-reinforced polyester with cutouts to allow the unit stabs to engage the vertical bus. Snap-in covers are available for the cutout openings to provide total isolation during maintenance procedures.



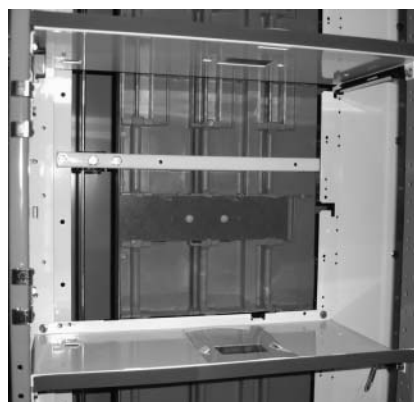
*Standard Isolation Barrier*



*Standard Isolation Barrier Rear View*

When insulation and isolation of the vertical bus is required, a **labyrinth design barrier**, as shown below, as an option for Freedom 2100 and as a standard for Freedom FlashGard. This barrier is molded glass-reinforced polyester and forms a labyrinth around the bus bars to prevent fault propagation. This design provides maximum protection against phase-to-phase insulation breakdown. Thermal efficiency is maintained by a close tolerance fit between the bus bars and the barrier, which minimizes air pockets.

An automatic shutter mechanism is standard with the labyrinth barrier to provide complete isolation of the vertical bus. The shutter moves automatically to cover the stab openings when a unit is removed. This provides maintenance personnel with maximum protection because the vertical bus is never exposed. As the unit is reinserted in the compartment, the shutter moves sideways to uncover the stab openings in the barrier.



*Labyrinth Barrier with Automatic Shutter Mechanism*

## Horizontal Bus



*Horizontal Bus*

The main horizontal bus provides three-phase power distribution from the incoming line or primary disconnect device to each vertical structure in the motor control center. The bus bars are mounted in a vertical plane, edge to edge. This mounting produces an exceptionally strong assembly, able to withstand high fault current stresses.

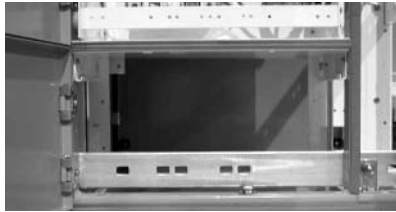
The main horizontal bus is rated at 600A as standard with ratings of 800, 1200, 1600, 2000, 2500 and 3200A optionally available. Tin-plated copper horizontal bus bars are supplied as standard. Silver-plated copper horizontal bus bars are also available.

**Note:** 3200A horizontal bus available in NEMA 1A enclosure only and 65°C rise above 40°C ambient only.

The horizontal main bus is isolated from the top horizontal wireway compartment by a metal isolation barrier. This two-piece steel barrier extends to the full width of each vertical structure. The two-piece design allows access to bus connections without the removal of the entire barrier, for added maintenance convenience. The bus bar layout permits front access to all bus connections. This allows maintenance personnel to make splices and check splice bolt torques from the front of the structure.

## General Description

## Neutral Assemblies

*Neutral Bus (Bottom)*

For three-phase, four-wire applications, a neutral landing pad is provided as standard. This is a 100% rated neutral. As an option, half or fully rated neutral bus can be supplied in the bottom of the entire MCC.

## Ground Bus

*Ground Bus (Top)*

Copper ground bus, rated 300A 0.25-inch by 1.00-inch (6.4 mm by 25.4 mm) is supplied as standard. Mounting is across the top of each vertical structure in the horizontal wireway. The bus can also be mounted across the bottom when the bottom 9.00 inches (228.6 mm) are not occupied by units or master terminal blocks. A 0.25-inch by 2.00-inch (6.4 mm by 50.8 mm) optional copper ground bus rated 600 or 800A is also available.

An optional 300A vertical tin-plated only copper ground bus is available. Located in the vertical wireway, it provides direct starter unit grounding.

## Units

## General

Motor starter units are combination type employing a linestarter and a disconnect device of proven capability. The disconnect device can be a motor circuit protector, circuit breaker or fusible switch. Eaton's Type HMCP and HMCPE motor circuit protectors are furnished as standard.

All starters and soft starters through NEMA Size 5 are a drawout design except Size 5 electromechanical reduced voltage.

All feeder breakers through 400A are a drawout design.

All dimensions and ratings in the following tables are based on NEMA Design B, 1800 RPM motors.

**The HMCP/HMCPE and starter combination has a 65,000 rms symmetrical ampere short-circuit current rating as standard at 480V.**

Starter units are available with optional 100,000A short-circuit current rating. Series C thermal-magnetic circuit breakers (65 kAIC, or optional 100 kAIC) for starter units are also available.

Freedom 2100 and Freedom FlashGard starters meet or exceed IEC 947-4 Type II testing with HMCP, or R and J fuses.

The fusible switch disconnect device is the Type K. It is a quick-make, quick-break, visible blade switch with fuse clips for use with current-limiting or dual element, rejection type, NEMA Class J or R fuses. Rejection fuse clips for Class RK-5 fuses are standard. Fuses are not included as standard.

Both breaker and fuse selection must take into consideration the total short-circuit capacity of the system to which the control center is connected.

Typical starter units available include the following:

- Full voltage, non-reversing
- Full voltage, reversing
- Two-speed, single winding and two winding

- Reduced voltage, autotransformer, closed transition
- Reduced voltage, wye delta
- Reduced voltage, part winding
- Reduced voltage, solid-state
- Adjustable frequency drives

Each starter includes a stainless steel corrosion-resistant safety ground clip that makes connection before the power stabs engage the vertical bus.

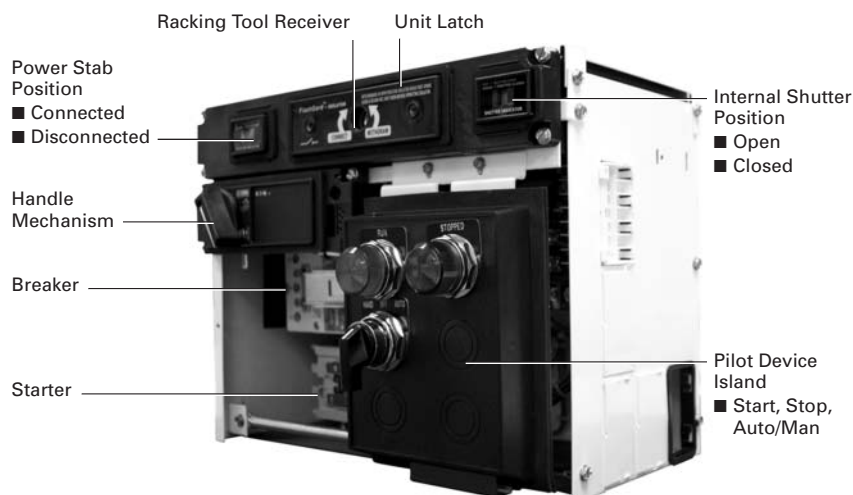
## Units—Freedom 2100 Starter

*Freedom 2100 FVNR Starter*

Freedom Series 2100 starter units are equipped with Eaton's Freedom starters and contactors NEMA Sizes 1 through 5. Size 6 and 7 starters are A200 type. These contactors have been successfully applied in thousands of the most demanding industrial applications. Overload protection is provided by a three-pole adjustable ambient compensated, bi-metallic thermal overload relay. The overload relay also provides single-phase sensitivity and isolated alarm contact. As an option, the overload relay can be upgraded to a standard solid-state overload or an advanced solid-state overload as described on **Page 29.1-20**. An insulated hand reset button extends through the compartment door. Additionally, motor running data and starter status/control are available through one of the many industrial communication protocols.

## General Description

### Units—Freedom FlashGard Starter



*Freedom FlashGard FVNR Starter*

The Freedom FlashGard units are equipped with a “retractable stab” mechanism called RotoTract, that allows the electrical worker to connect and disconnect power to the bucket with the **unit door closed**, thereby minimizing exposure to arc flash. A visual indication is provided on the unit door on the “Connected” and “Disconnected” positions of RotoTract. A visual indication on the position of the shutters that enclose the stabs is also provided (open shutters indicate that stabs are extended and closed shutters indicate that the stabs are withdrawn). A motorized tool such as an electric screwdriver, drill with a 3/8-inch square drill bit or standard 3/8-inch drive ratchet is used to operate RotoTract through its racking tool receiver.

Additional safety features of a FlashGard unit include:

- **Unit Latch**—When the RotoTract is in “Connected” or “Test” position, this latch is mechanically interlocked to hook the bucket to the divider pan that separates the bucket from the unit above, thereby preventing physical removal of the bucket when it is connected to 480V and/or control power. The unit latch also prevents insertion of a bucket with the stabs extended
- **RotoTract racking tool receiver shutter**—When the breaker is in the “On” position, the shutter for the access hole in the RotoTract (access hole is needed for the motorized tool to retract the stabs) is closed, thereby not allowing the stabs to be retracted when the breaker is energized

Freedom FlashGard starters are equipped with electromechanical starters and contactors NEMA size 1–5.

### Units—AC Drives



*Adjustable Frequency Drive*

**Adjustable Frequency Drives** are available from 0.5–1100 hp for control of standard AC motors in processes that benefit from the ability to change motor speed. Use of Inverter Duty motors is recommended. Controllers are available to handle constant torque applications, such as conveyors and crushers, and variable

torque applications, such as fans and pumps. Control schemes are available for volts/Hz, open loop vector and closed loop vector models. SVX9000 drive units include as standard: line reactors and a door-mounted keypad. Units up to 150 hp VT have a standard output reactor for dV/dT filtering. MVX drive units include as standard: a line reactor, viewing window for drive display and an output filter. All drive structures are bus connected, which allows for expansion of the MCC on both sides of the structure. A wide range of AFD features and options are available to meet the requirements of most applications. AFDs are available in NEMA 1A gasketed enclosures. AFDs are available in NEMA 3R MCC enclosures from 1–200 hp, constant torque.

### Units—Solid-State Reduced Voltage Starters



*S801 SSRV Starter 135A*

S801/S811 Solid-State Reduced Voltage (SSRV) starters are designed to reduce the inrush current to a motor during starting and to limit the amount of available starting torque, thus reducing mechanical wear and utility demand requirements. The amount of starting current is field adjustable to match the specific requirements of all applications.

Eaton’s S801/S811 SSRV controllers are available with a wide variety of standard features: kick start, soft stop, phase loss and stall protection. S801/S811 SSRV starters are 30–70% smaller than competitive designs.

Typical applications include conveyors, compressors, machine tools, pumps and fans.



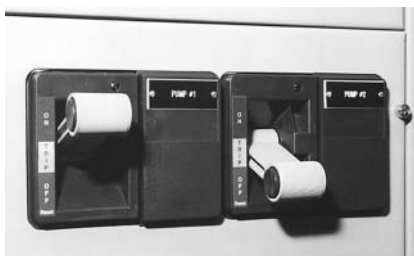
## General Description

## Units—DC Starters

**DC Starter Unit**

UL listed DC MCCs use combination circuit breaker DC starters suitable for motor starting duty only. Using Eaton's Type ME DC definite purpose contactors, all DC starters are suitable for up to 250 Vdc and have a 22 kA withstand rating. Class 135 starting resistors for reduced voltage starters are sized for 200% starting current. Typical applications include emergency lube oil pumps, emergency seal oil pumps and emergency turning gear motors.

## Freedom 2100 Feeder Tap Units

**Freedom 2100 Dual Feeder Tap Unit**

Feeder tap units may contain either circuit breakers or fusible switches. Freedom 2100 drawout breaker units include the fixed trip Type HFD, single- or dual-mounted in ratings through 150A and the interchangeable trip Types HJD and HKD single-mounted through 250A and 400A respectively. Larger Series C® circuit breakers with ratings to 2500A are fixed-mounted.

Fusible feeder tap units use Eaton's Type K visible blade disconnect switch. Fused switches are mounted in drawout units through 400A with 30A and 60A ratings available in dual mountings. Fixed-mounted switch ratings of 600A and 800A are also available.

All switches are supplied with fuse clips for use with current-limiting or dual-element rejection type. Types of fuses include Class J, R or L, which are supplied by "others."

## Freedom FlashGard Feeder Tap Units

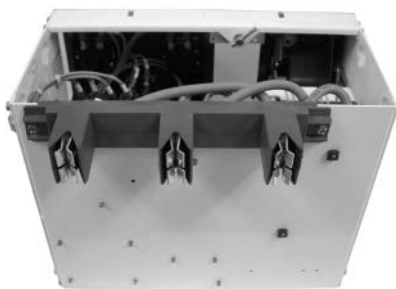
**Circuit Breaker Handle Mechanism**

Feeder tap units may contain either circuit breakers or fusible switches. Drawout breaker units include the fixed trip Type HFD, single-mounted in ratings through 150A and the interchangeable trip Type HJD single-mounted through 250A and Type HKD single-mounted through 400A. Larger Series C circuit breakers with ratings to 2500A are fixed-mounted.

Fusible feeder tap units use Eaton's Type K visible blade disconnect switch. Fused switches are mounted in drawout units through 400A with 30A and 60A ratings available in dual mountings. Fixed-mounted switch ratings of 600A and 800A are also available.

All switches are supplied with fuse clips for use with current-limiting or dual-element rejection type. Types of fuses include Class J, R or L supplied by "others."

## Freedom 2100 Stab Assembly

**Freedom 2100 Plug-in Unit Bus Stabs**

A tin-plated copper alloy stab incorporates the ultimate in mechanical simplicity to provide precise control of contact pressure on the bus.

This ensures a positive connection yet permits easy unit insertion and withdrawal. Self-aligning stabs are mounted in a glass-reinforced plastic insulation block that totally shrouds each stab and absolutely ensures positive alignment of the stabs with the vertical bus. The insulation block is also an integral part of the phase-to-phase isolation system. Power wiring is welded to the stabs and is totally contained within the unit enclosure. This means the vertical bus compartment is completely free of wiring for maximum safety and reliability.

Stab assemblies are accurately matched to the electrical requirements of each individual unit and are provided in 60, 150, 300 or 400A ratings (plug-in through Size 5).

## Freedom FlashGard Stab Assembly

**Stabs Extended****Stabs Withdrawn****Freedom FlashGard Plug-in Unit Bus Stabs**

The Freedom FlashGard MCC uses a "retractable stab" mechanism, called RotoTract, that allows the electrician to connect and disconnect power to the bucket with the unit door closed. A visual indication is provided on the unit door on the "Connected" and "Disconnected" positions of RotoTract. A visual indication on the position of the shutters that enclose the stabs is also provided (open shutters indicate that stabs are extended and closed shutters indicate that the stabs are withdrawn). A motorized tool or standard 3/8-inch (9.5 mm) drive ratchet is used to operate RotoTract's "retractable stab" mechanism. A wired remote racking accessory is also available for operating RotoTract with a pendant station safely beyond the NFPA-prescribed flash protection boundaries.

## General Description

The stabs are constructed from a tin-plated copper alloy, incorporating the ultimate in mechanical simplicity to provide precise control of contact pressure on the bus. This ensures a positive connection, yet permits easy unit insertion and withdrawal. The stabs are self-aligning and are mounted in a glass-reinforced plastic insulation block, which totally shrouds each stab and ensures positive alignment of the stabs with the vertical bus. The insulation block is also an integral part of the phase-phase isolation system. Power wiring is welded to the stabs and is totally contained within the unit enclosure. The wire is designed for a high level of flexibility to be suitable for RotoTract's retractable stab mechanism.

Stab assemblies are accurately matched to the electrical requirements of each individual unit and are provided in 60A, 150A, 300A or 400A ratings (plug-in through Size 5).

## Freedom 2100 Handle Mechanism



*Circuit Breaker Handle Mechanism*

The handle mechanism is designed to provide a high mechanical leverage so that little effort is required to operate any device.

The standard handle mechanism is a vertical motion type device with four positions: ON, OFF, TRIPPED and RESET. Only circuit breaker types have tripped and reset positions. It is securely mounted to the front of the unit and mechanically connected to the breaker or fusible switch, eliminating alignment problems. It provides a positive indication of the breaker or switch position, even with the door open.



*Unit Insertion Interlock*

The handle and exterior front panel are molded from the same plastic material as the device panel. A textured surface preserves the appearance. The ON position indicator is at the top and is a bright red. The OFF/RESET position is at the bottom and is bright green. The TRIP position, a bright yellow, is in the middle, between the ON and OFF position. All position indicator colors contrast with the black background and are highly visible even at considerable distances. The operating handle is designed for rugged duty and solid operator feel.



*Padlocking Bar*

The handle mechanism provides several safety features:

- In the ON position, an interlock prevents the unit door from being opened. A door interlock defeater screw located above the handle is provided to enable authorized maintenance personnel access to the units when required
- With the unit door open and the operating handle in the ON position, an interlock slides into a slot in the divider pan above and prevents removal of the unit. This same interlock prevents insertion of the unit unless the handle mechanism is in the OFF position. The interlock also prevents the operating handle from being turned on with the unit door open

- To ensure that units are not energized accidentally or by unauthorized personnel, the handle mechanism can be padlocked in the OFF position. Sufficient space is available for a maximum of three padlocks. Where critical processes are involved and to prevent unauthorized shutdown, the handle mechanism can be modified to enable padlocking in the ON position

## Freedom FlashGard Handle Mechanism



*Circuit Breaker Handle Mechanism*

The handle mechanism is designed to provide a high mechanical leverage, so that little effort is required to operate any device.

The standard handle mechanism is a vertical motion type device with four positions: ON, OFF, TRIPPED and RESET. Only circuit breaker types have tripped and reset positions. It is securely mounted to the front of the unit and mechanically connected to the breaker or fusible switch, eliminating alignment problems. It provides a positive indication of the breaker or switch position, even with the door open.



*Unit Insertion Interlock*

The handle and exterior front panel are molded from the same plastic material as the device panel. A textured surface preserves the appearance. The ON position indicator is at the top and is a bright red. The OFF/RESET position is at the bottom and is bright green.

## General Description

The TRIP position, a bright yellow, is in the middle, between the ON and OFF position. All position indicator colors contrast with the black background and are highly visible even at considerable distances. The operating handle is designed for rugged duty and solid operator feel.

**Padlocking Bar**

The handle mechanism for Freedom FlashGard provides several safety features:

- In the ON position, an interlock prevents the unit door from being opened. A door interlock defeater screw located to the right of the handle is provided to enable authorized maintenance personnel access to the units when required
- The unit insertion interlock is located to the left of the operating handle. The interlock must be in the locked position in order to turn the disconnect on. When the interlock is in the locked position, the unit cannot be withdrawn or inserted
- To ensure that units are not energized accidentally or by unauthorized personnel, the handle mechanism can be padlocked in the OFF position. Sufficient space is available for a maximum of three padlocks. Where critical processes are involved and to prevent unauthorized shutdown, the handle mechanism can be modified to enable padlocking in the ON position

Each unit has a safe lock position. This interlock will lock the unit in a position off the 480V bus and ensure the unit cannot be inserted or withdrawn.

**Freedom FlashGard Unit Wrapper Side Latch****Device Panel****Standard Device Panel**

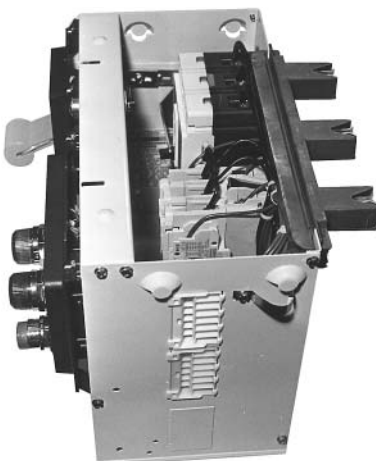
The device panel can accommodate up to six 1-3/16-inch (30.2 mm) Eaton's 10250T type pilot devices such as oiltight pushbuttons, indicating lights, selector switches and miniature meters.

Molded into the panel is a knockout for each device location. This facilitates the future addition of devices to the panel.

The device panel is hinged on a horizontal pivot tube extending across the front of the unit. With the unit door open, loosening two captive retaining screws at the top of the panel and sliding it 0.50-inch (12.7 mm) left, permits it to swing down. This provides ready access to the rear of the panel and increased accessibility to the unit interior.

**Nameplates**

Unit nameplates are engraved with 3/16-inch (4.8 mm) high white lettering on a black background (black lettering on a white background optional). They are heat- and crack-resistant to eliminate the need for replacement. Nameplates are mounted with stainless steel self-tapping screws.

**Freedom 2100 Unit Wrapper****Freedom 2100 Plug-in Unit Wrapper****Freedom FlashGard Unit Wrapper****Freedom FlashGard Plug-in Unit Wrapper**

The unit wrapper is fabricated of 14-gauge steel. After fabrication, it is cleaned and given a rust inhibiting phosphatizing treatment. The finish on a unit wrapper is a baked Munsell No. N9.43/0.21B, 0.23 white. This is highly durable finish, gloss-white in color to increase visibility within the unit and to facilitate wiring and maintenance procedures.

The unit wrapper consists of a three-sided rugged steel shell including the mounting base for the unit components. The smallest unit measures 13-3/4 inches (349.3 mm) wide, 8.00 inches (203.2 mm) deep and 6.00 inches (152.4 mm) high. Units increase in 6.00-inch (152.4 mm) increments to a maximum height of 72.00 inches (1828.8 mm).

The unit wrapper is designed to provide ample space for cable entry from the wireway to the unit.

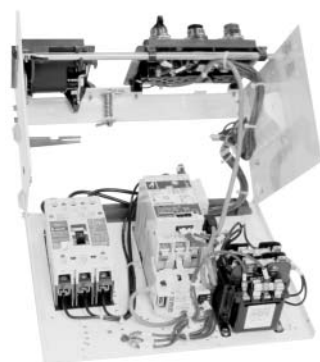
The unit wrapper has four mounting points, two on each side, which support the unit in the structure. They engage guide rails located near the top of each unit space. This mounting point guide rail system produces minimum friction and allows units to be inserted and withdrawn easily. The guide rails also give precise alignment to the unit for accurate stabbing on the vertical bus.



## General Description

The FlashGard unit wrapper is equipped with a quarter-turn side wrapper latch that securely holds the unit in the compartment. The latch can only be engaged when the stabs are fully mated with the vertical bus. Upon release of the latch, the unit can be partially withdrawn such that the stabs disengage from the vertical bus. In this position, the latch can be re-engaged to prevent the unit from being returned to the fully stabbed position or from being removed from the structure. The latch can be padlocked in this position to ensure that the stabs remain disengaged during maintenance.

## Unit Maintenance



*Plug-in Unit Maintenance*

The Freedom 2100 three-piece unit wrapper design facilitates easy work bench maintenance. When removed from the MCC, the unit top/side barrier assembly can easily be swiveled up and back for complete access to components and wiring.

## Terminal Blocks

**A side-mounted, seven-circuit, latching pull-apart terminal block is standard on units with NEMA Type B or C wiring.** This industrial-grade Eaton MCC terminal block provides solid electrical connections while conserving space and making installation and maintenance easier.

Terminal blocks are mounted in knock-outs on the vertical wireway side of the unit housing affording greater access to the unit compartment and interior components. The two-piece terminal block snap-locks together to ensure permanent circuit continuity. To aid installation and wiring checks, the terminal marking strips for both sides of the terminal block are fully visible from the front of the starter compartment.



*Side Mounted—Latched  
Pull-Apart Terminal Block*

Heavy-duty saddle wire terminals are of the resilient collar design, which eliminates loose connections caused by expansion and contracting of the conductor as the current is switched on and off. This unique design maintains constant pressure as the wire expands and contracts. This 600V, 30A rated terminal block will accept 12 AWG stripped wires, as well as 14 AWG ring or spade wire lugs. All terminal block conductors are fully shielded for added safety and cleanliness.

A 12.00-inch (304.8 mm) high (2X space) starter unit accommodates up to three side-mounted terminal blocks providing a maximum of 21 points. Larger units accommodate two additional 7-point terminal blocks for every additional 6.00 inches (152.4 mm) 1X space of unit height. The 6.00-inch (152.4 mm) compact starter unit uses a 9-point pull-apart terminal block, which is installed along the top front of the starter unit.

Control wiring within each starter compartment consists of 16 AWG control wire for Freedom FlashGard MCCs and 2100 Series MCCs. Rated 105°C, the flame-retardant, thermoplastic insulated wire is red. Power wiring is black and sized to carry the maximum full load current of the starter unit.

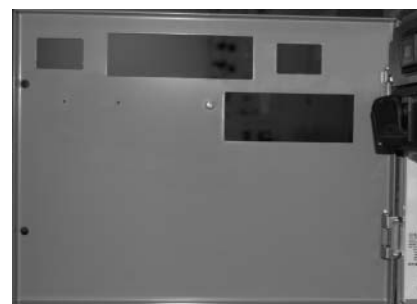
## Front-Rail-Mounted Terminal Blocks

For special applications, other types of rail-mounted terminal blocks are also available. They are installed horizontally at the bottom front of the starter unit. Refer to Eaton for terminal block types available and space restrictions.

## Unit Doors



*Freedom 2100 12.00-Inch (304.8 mm)  
Unit Door*



*Freedom FlashGard 12.00-Inch (304.8 mm)  
Unit Door*

Unit doors are formed of 14-gauge steel with a 0.50-inch (12.7 mm) flange on all four sides. The flange adds rigidity to the door and provides a surface to contain door gasketing. Cut-outs are made in the door as required to accommodate the operating handle and device panel. The doors are cleaned, phosphatized and given a finish of gray, baked-on enamel ANSI 61 (Munsell No. N9.43/0.21B, 0.23).

The doors will open 115° opposite to the wireway doors permitting optimum access to the unit compartment. The doors are mounted on removable concealed pin hinges. This permits quick removal of any door in a vertical structure without disturbing adjacent doors.

Doors 2X and larger are held closed with a minimum of two quarter-turn indicating-type fasteners. They securely hold the door in the closed position, yet allow quick and easy access to the unit when required. The fasteners provide a visual indication of the latched position. The head slot of the fastener is designed to prevent screwdriver slippage.



## General Description

*Spring-Loaded Unit Door Quarter-Turn Latch*

## Options

Eaton's starter and feeder tap units can be modified to meet a variety of specification requirements. Some typical components that can be added include: control power transformers with two primary and one secondary control fuses, control relays, solid-state overload relays, ground fault relays, current transformers, extra electrical interlocks, pushbuttons, selector switches, indicating lights, circuit breaker shunt trip or undervoltage release and auxiliary switches. In most cases, one of these modifications does not increase starter unit size.

## Additional Equipment

In addition to motor starter and feeder units, additional equipment can be supplied including the following:

- Single-phase dry-type distribution transformers in ratings of 0.5, 0.75, 1, 1.5, 2, 3, 5, 7.5, 10, 15, 20, 25, 30 and 45 kVA
- Three-phase dry-type distribution transformers in ratings of 9, 15, 25, 30 and 45 kVA
- Lighting panelboards with up to 42 circuits with either plug-in branch breakers or bolt-on branch breakers, 120/240V, 120/208V or 480V, single- or three-phase
- Metering equipment including the IQ family of solid-state power monitors, voltmeters and ammeters
- PLC and DCS I/O racks
- S801/S811 family of solid-state reduced voltage starters
- SVX9000 and MVX9000 adjustable-frequency controllers

- Active harmonic correction units
- Surge protective device (SPD) units
- Size 4, 5 and 6 vacuum starters and contactors
- Power factor correction capacitors
- Automatic transfer switches
- DeviceNet, Modbus, PROFIBUS, Modbus TCP, EtherNet/IP Communications
- Power Xpert® communications
- Industrial Operator Interface
- Industrial PLCs and PCs

## Control and Load Terminations

*Master Terminal Blocks at Bottom (Class C Wiring)*

For NEMA Type A wiring, each unit is assembled and devices interwired. Terminal blocks are not supplied and control and load wiring is internal to the unit.

For NEMA Type B wiring, control wires are terminated at blocks within the unit. Refer to the discussion of units for types of terminal blocks available.

For NEMA Type C-S wiring, control and load wires are extended from the unit terminal blocks to master terminal blocks located at the top or bottom of each vertical structure.

The mounting location of the master terminal block in front-mounted only structures is in the existing horizontal wireway space at the top or at the bottom as shown above. When mounting is made in an incoming line section, 12.00 inches (304.8 mm) of unit space must be used. When mounting is made in the rear of back-to-back mounted structures, 6.00 inches (152.4 mm) of unit space must be used at the bottom and 12.00 inches (304.8 mm) used at the top.

Master terminal blocks are rack-mounted to permit removal of entire assembly for ease of wiring during installation and maintenance.

For NEMA Type C-M wiring, control and load wires are extended from the unit terminal blocks to master terminal blocks located in a separate marshaling structure.

## Incoming Line

Incoming line cables entering the MCC from either the top or bottom can be easily terminated onto main lugs or connected to a main disconnect. All incoming line sections comply with NEC wiring bending requirements as adopted by UL.

## Main Lugs Only (MLO)

Up to 1200A rated horizontal bus, cables, up to four per phase, are terminated on crimp or screw lugs mounted on adapters solidly bolted to fully rated vertical bus. Top entry cables are terminated at the top of the MCC and bottom entry cables are conveniently terminated near the bottom. **Table 29.1-84** shows spacing requirements for various cable configurations. MLO termination for 1600, 2000, 2500 and 3200A requires a full vertical section.

**Note:** 3200A main lugs only available in NEMA 1A enclosure only and 65°C rise above 40°C ambient only.

## Main Disconnects

Incoming cables may also be easily terminated on a main circuit breaker or fused switch. A variety of main circuit breakers are available. **Tables 29.1-61** through **29.1-67** show spacing requirements for various main devices.

## Metering

*IQ 250/260 Electronic Power Meter*

Eaton's IQ and Power Xpert family of metering and power monitors includes:

**IQ 250** microprocessor-based three-phase power monitor replaces the traditional ammeter, voltmeter and instrument switches. Displays phase currents, voltage, L-L, L-N, power-real and reactive apparent, power factor, frequency, energy (watt-hours, VAR-hours and VA-hours).

## General Description

**IQ 260** includes all of the functions of the IQ 250 plus THD readings for voltage and current. Additionally, the IQ 260 includes contact inputs and outputs. This device is ideal for incoming line monitoring.

**IQ Analyzer** provides extensive metering, power quality analysis, remote input monitoring, control relaying, analog input/outputs, and is communications capable. A display provides the flexibility of exhibiting large characters with high visibility and small characters for detailed descriptions.

These IQ power monitors each contain their own voltage power pack for systems up to 600V. Therefore, separate potential transformers are not required. Either two or three separate current transformers must be used. All IQ power monitors are communications capable. Refer to **Tab 3** for further details.

**Power Xpert 2000/4000/6000/8000** Meters are available with communication features for power management and system software integration in addition to a Web interface. Customers and facility personnel can view the metering data using a standard PC Web browser. The new platform offers advanced functionality like transient capture, high sampling rate, open communications, Web server gateway, field-upgradable firmware, expandable memory and optional I/O.

## Remote Racking Accessory



**Remote Racking Accessory**

- Performs RotoTract racking safely behind NFPA Arc Flash boundaries
- 120 Vac motor driven
- Mounts to RotoTract mechanism
- Wired pendant station for “rack-in”/“rack-out” operation
- Momentary jog
- Mounting offset bracket to clear device panel

## Voltage Presence Indicator (VoltageVision™)



**Voltage Presence Indicator (VoltageVision)**

- Hardwired voltage detector connected to load side of disconnect
- Enables operator to “pre-verify” voltage presence with unit door closed
- Installable in a 30 mm pilot device knockout
- Dual redundant circuitry for reliability
- Phase insensitive

## Automatic Insulation Tester (Motorguard™)



**Automatic Insulation Tester (Motorguard)**

- “Meggers” equipment motor insulation to continuously monitor integrity of insulation for the period that the equipment is de-energized
- Applies 500 Vdc potential at current-limited, operator-safe maximum amperage of 200 microamperes
- Alarms upon detection of a threshold leakage to ground current
- Visual alarm indication and lockout; Form C contact available for remote alarm status

## FlashGard Padlock Accessory



**FlashGard Padlock Accessory**

- Locks out RotoTract operation during maintenance
- Allows operation of FlashGard units by authorized personnel only
- Provided as standard on NEMA 12 FlashGard MCCs (prevents dust entry into RotoTract access port)
- Heavy-gauge steel construction

## Surge Protective Device—SPD



**SPD (Surge Protective Device) with Circuit Breaker Disconnect**

SPD Series units feature advanced thermodynamic fusing technology and are available in 18.00 inch (457.2 mm) space factors. All units (100–400 kA) meet UL 1449, 3rd Edition. Internal fuse protection is up to 200 kAIC.

Standard MCC offering includes Monitoring Display with dual-colored status LEDs. Optional surge counter, Form C alarm contacts and audible alarm enable/disable are also available.

## General Description

## Communications

Eaton's motor control centers offer the industry's most comprehensive communications solutions in motor control providing seamless communicating on all major industry standard field busses. Available with communications to fit new and existing applications, Eaton's motor control centers are custom-made assemblies of conveniently grouped control equipment primarily used for control of motors and power distribution.

Eaton motor control centers not only are capable of communicating to the industry standard protocols, they also have the ability to serve up Web pages, so any Web client can monitor and manage the MCC from any location accessible to the LAN. Ordering the MCC with the Power Xpert® Gateway provides the ability to communicate information to the Web as well as provides a seamless interface between the low voltage, medium voltage and all meters.

## MCC Motor Control Communication Choices

This table is used to determine how each of the communications types are used within the MCC. The Freedom communication solutions provide for a single node per unit configuration where each starter, drive, soft start, breaker, meter or other control device is a single node on the network.

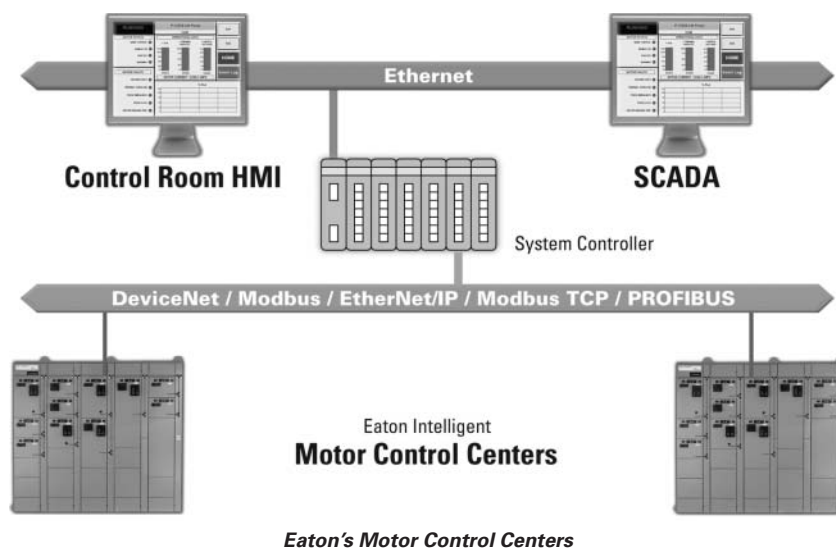


Table 29.1-1. Network Matrix









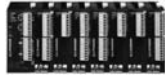
Network Protocol	DeviceNet	EtherNet/IP	Modbus TCP	Modbus Serial	PROFIBUS DP
Topology	Trunk drop	Ethernet	Ethernet	Daisy chain	Daisy chain
Node count	63 devices per network	Devices limited by scanner (~250)	Devices limited by scanner (~250)	32 per segment 254 with repeaters	32 per segment 127 with 3 repeaters
Speed	150–150 Kbaud	10/100 meg	10/100 meg	Usually <115 Kbaud	500K to 12 meg
C306 OL	C441K	C441R	C441R	C441N	C441S
C440 SSOL	C441K	C441R	C441R	C441N	C441S
C441 SSOL	C441K	C441R	C441R	C441N	C441S
SVX9000	OPTC7	OPTCI	OPTCI	OPTC2	OPTC3
Feeders	C441K	C441R	C441R	C441N	C441S
S811 Soft Starts	D77D-DNA	D77D-EIP	D77D-EMA	D77D-EMA	D77D-PNA
MP-3000, MP-4000	DPONI	Gateway	Gateway	MPONI	Gateway
IQ 260	Gateway	Gateway	Gateway	Native	Gateway

**Note:** The Freedom and FlashGard MCCs are Power Xpert capable with the PXG gateway communicating to each bucket.

**General Description**
**Data Parameters**

Each of the MCC types have different ways to get to the target network, and they also use varying types of starters/drives and other types of equipment. Each type of equipment has varying types of data and control associated with it. This table will aid in understanding the type of data available when a style of MCC is selected. Each of the devices has a rich set of data associated with it; consulting the user manual may be needed to determine all available data/parameters.

**Table 29.1-2. Data Parameters**

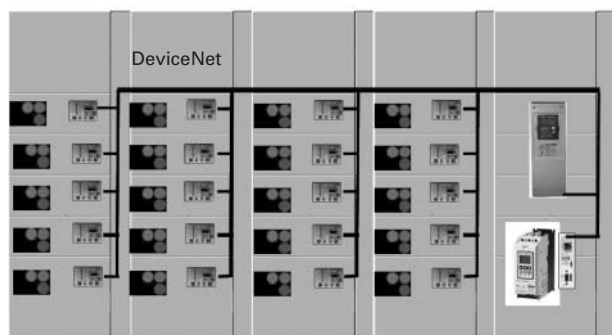
Description	Data	Graphic
<b>S811 Soft Starts</b> DeviceNet Modbus Modbus TCP PROFIBUS EtherNet/IP	Line current (scaled/float) Average current (scaled/float) Power pole temperatures % FLA (Running current/FLA setting) Thermal capacity Fault/warning codes Field wiring status Handle position/breaker status Coil voltage Fault history Status (Run/Fault/Warn/Control/Aux...)	
<b>SVX/M-Max Drives</b> DeviceNet Modbus Modbus TCP PROFIBUS EtherNet/IP	Speed (Hz) Speed (rpm) Torque Current Voltage DC bus voltage temperature Status (Run/Fault/Warn...) Faults More—refer to manual	
<b>C441 IO</b> DeviceNet PROFIBUS Modbus Modbus TCP EtherNet/IP	Four AC inputs (DC is in an option) (Running/Faulted/Breaker status, user denied) Two B300 relay outputs (Run)	
<b>C440 SSOL</b> DeviceNet PROFIBUS Modbus Modbus TCP EtherNet/IP	Line currents % thermal remaining Faults Ground current Status (Run/Fault/input/output...) More—refer to manual	
<b>C441 SSOL</b> DeviceNet PROFIBUS Modbus Modbus TCP EtherNet/IP	Line currents % thermal remaining % current unbalance Line voltages % voltage unbalance Faults kW Status (Run/Fault/input/output...) More—refer to manual	
MP-3000 MP-4000 DeviceNet Modbus RTU	Currents Voltages Power Energy Much more—refer to manual	
<b>Power Xpert Gateway</b> to PowerNet	Data depends on target device Trending Logging Fault indication and more	
<b>Operator Interface</b>	Provides local display of motor parameters and system health. This option is available when using Modbus communication.	
<b>Logic Control</b>	In a single bucket, a PLC is provided for local control of the MCC components.	



## General Description

**DeviceNet**

DeviceNet is an industry standard field bus governed by ODVA and is supported by most major vendors of PLC and DSCs. DeviceNet, like most major field buses, provides simplified control, increased diagnostics, reduced wiring and data richness of the motor control centers. The Eaton DeviceNet MCC solution provides users with significantly reduced installation time and increased uptime through the integration of intelligent devices and advanced software tools. Control products include: ODVA compliant motor starters, variable speed drives, operator interface, line metering and block I/O.

**Freedom 2100 and Freedom FlashGard Styles of MCC***Freedom 2100 and Freedom FlashGard Styles of MCC*

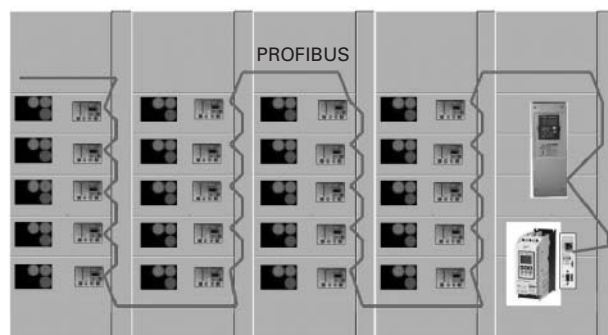
Freedom 2100 and Freedom FlashGard styles of MCC use either a direct connect I/O block or direct connect advanced solid-state overload relay to connect to DeviceNet. The topology is a trunk drop configuration where the trunk runs along the top of the MCC and each device is connected to DeviceNet via a drop cable.

**About DeviceNet**

Learn more about DeviceNet by visiting the Open DeviceNet Vendor Association at [odva.org](http://odva.org).

**PROFIBUS**

PROFIBUS DP is an industry standard field bus governed by the PROFIBUS Trade Organization and is supported by most major vendors of PLC and DSCs. PROFIBUS, like most major field buses, provides simplified control, increased diagnostics, reduced wiring and data richness of the motor control centers. The Eaton PROFIBUS MCC solution provides users with significantly reduced installation time and increased uptime through the integration of intelligent devices and advanced software tools. Control products include: motor starters, variable speed drives, operator interface and block I/O.

**Freedom 2100 and Freedom FlashGard Styles of MCC***Freedom 2100 and Freedom FlashGard Styles of MCC*

The Freedom 2100 and Freedom FlashGard styles of MCC use either a direct connect I/O block or direct connect advanced solid-state overload relay to connect to the PROFIBUS. The topology for PROFIBUS is daisy chain and each device in the MCC will be daisy-chained together to meet the PROFIBUS specification.

**About PROFIBUS**

Learn more about PROFIBUS by visiting the PROFIBUS Trade Organization Association at [profibus.com](http://profibus.com).

## General Description

### Ethernet

There are two supported protocols on Ethernet for the Eaton MCC offering—EtherNet/IP (ODVA) and Modbus TCP (Modbus IDA), which are both industry standard field buses and supported by most major vendors of PLCs and DSCs. Ethernet, like most major field buses, provides simplified control, increased diagnostics, reduced wiring and data richness of the motor control centers. Another added benefit of Ethernet is that a PC can connect directly to the control system and monitor the MCC from any location where remote access is permitted. The Eaton Ethernet MCC solution provides users with significantly reduced installation time and increased uptime through the integration of intelligent devices and advanced software tools. Control products include: motor starters, variable speed drives, operator interface, meters and block I/O.

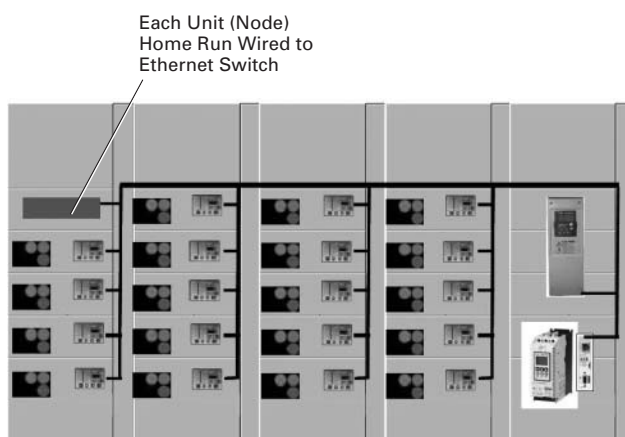
### Understanding Ethernet

Ethernet can be a very misunderstood word and confusing to someone who is trying to build a control or monitoring system and doesn't have much experience specifying this type of communication. To help bring some clarity to how to specify Ethernet, this simple example is going to use an analogy that most of us are very familiar with. When you are at home and pick up the phone to call a friend or neighbor, your conversation is transmitted across a land line (wire) that can be compared to Ethernet. In this example, both the land line and the Ethernet are the physical medias in which the communication is transmitted. When you call your friends to communicate to them, you need to talk in a language that is understood by each other; this language is called the protocol, which is no different than Ethernet, for the devices to communicate to each other they need to support the same language or protocol. Modbus TCP and EtherNet/IP are two widely supported standards for Ethernet industrial protocols. Modbus TCP is a standard founded by Modbus IDA and natively supported by many major PLC and DCS vendors. EtherNet/IP is another standard that is founded by ODVA and supported primarily by AB and other third-party vendors for use in PLC and DCS applications. Now let's add another twist to the example, let's say that you and a friend are talking in one protocol and then you conference in two friends that talk another protocol. Using the same physical media, the four of you can all communicate to each other using multiple protocols. This is no different than Ethernet where the physical media supports both Modbus TCP and EtherNet/IP (and others) on the same physical media at the same time.

In the Eaton MCC when Ethernet is applied, there is a bucket in each lineup that houses an industrial rated Ethernet switch and all the Ethernet devices are then wired back to that switch to the customer to easily connect to the lineup at one convenient location. Over this Ethernet connection, not only can control and monitoring be performed, but also configuration of the end devices allowing for easy access for maintenance personnel to the equipment once they gain access to the Ethernet system.

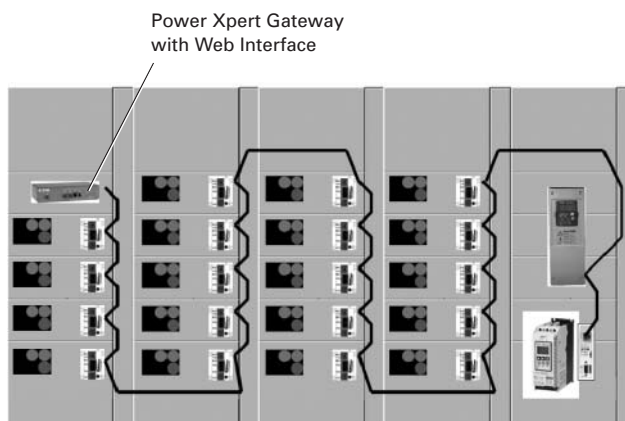
For more information or clarity on the supported Ethernet protocols and the products that support Ethernet, please call 877-ETN-CARE (877-386-2273) Option 2.

### Freedom 2100 and Freedom FlashGard Styles of MCC to EtherNet/IP



*Freedom 2100 and Freedom FlashGard Styles of MCC to EtherNet/IP*

### Freedom 2100 and Freedom FlashGard Styles of MCC to Modbus TCP



*Freedom 2100 and Freedom FlashGard Styles of MCC to Modbus TCP*

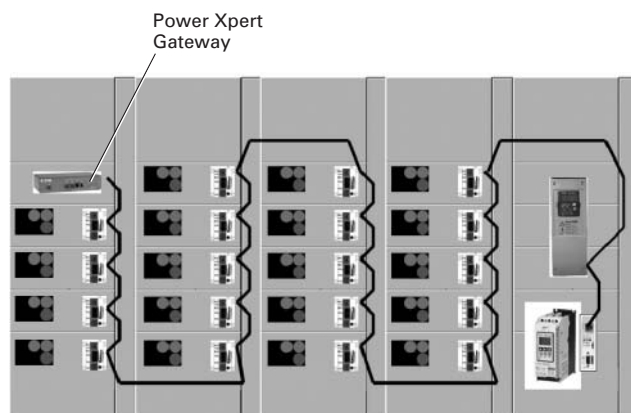
### About Ethernet

Learn more about EtherNet/IP by visiting the ODVA Web site at [odva.org](http://odva.org). Learn more about Modbus TCP by visiting the Modbus IDA Web site at [modbus.org](http://modbus.org).

## General Description

## Web-Enabled MCC

The Power Xpert Gateway provides Web-enabled, real-time monitoring of electrical distribution and control equipment. The Power Xpert Gateway makes integrating power equipment (up to 96 devices) onto an Ethernet network fast and easy. The PXG is installed in a motor control center, low/medium voltage switchgear or switchboard to consolidate data available from components such as breakers, meters, motor controllers and protective relays. Through standard onboard Web pages, Power Xpert Software or third-party software, the PXG allows you to closely monitor the performance of your power infrastructure with easily accessed, real-time, Web-enabled data. In addition to Web-enabling the components in the MCC, the PXG also makes all the data available to upper level PLC, SCADA, and BMS type systems over Modbus TCP, SNMP and BACnet/IP protocols.



Freedom 2100 and Freedom FlashGard Styles of MCC

Figure 29.1-1 through 29.1-6 represent typical Eaton communications equipment found in MCCs. For more available equipment and configurations, please contact your local Eaton representative.

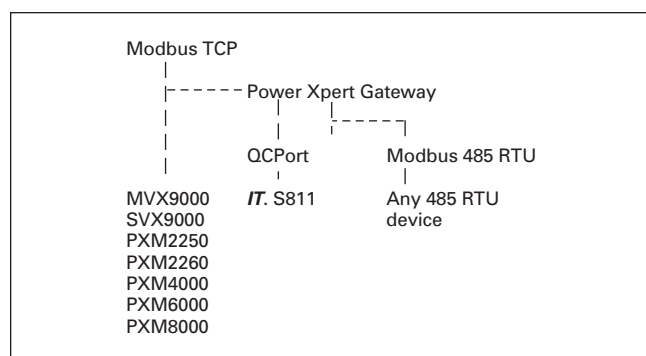


Figure 29.1-1. MCC Configuration—Modbus TCP

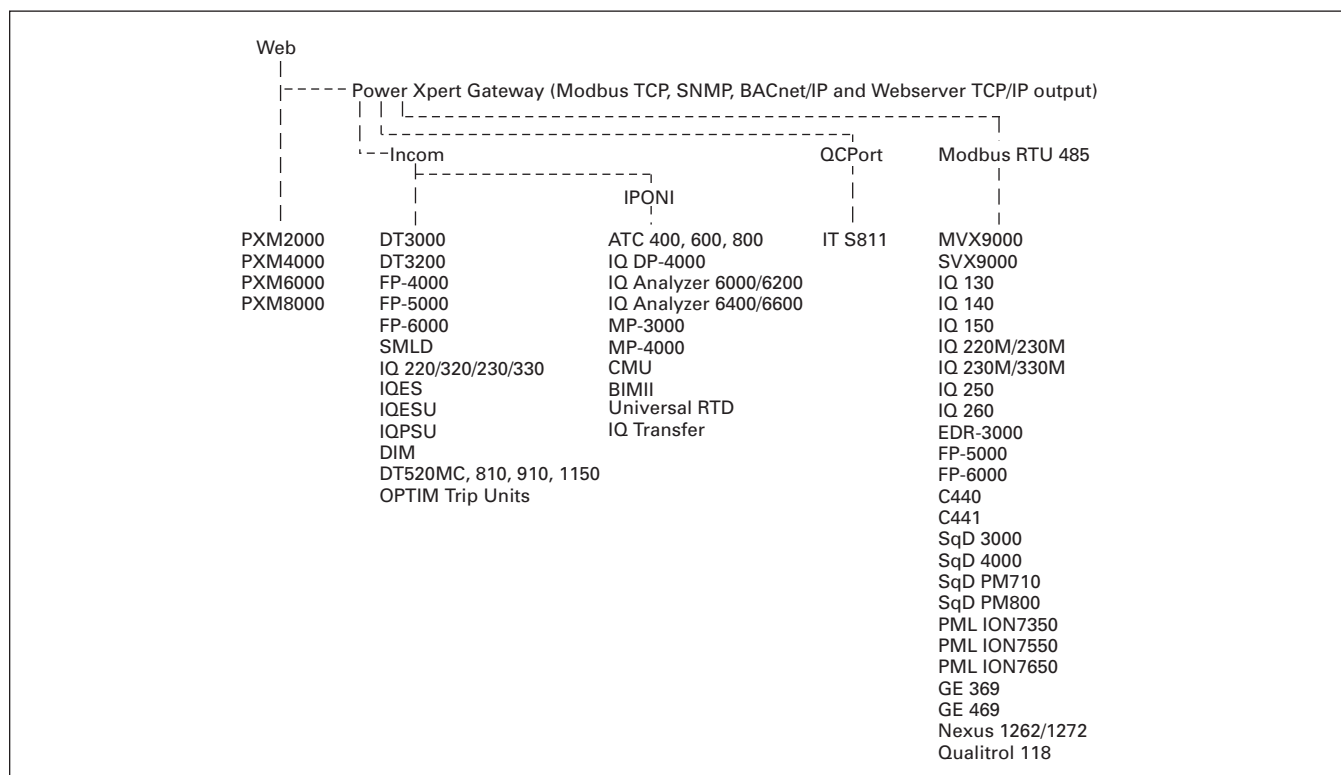


Figure 29.1-2. MCC Configuration—Web-Enabled

General Description

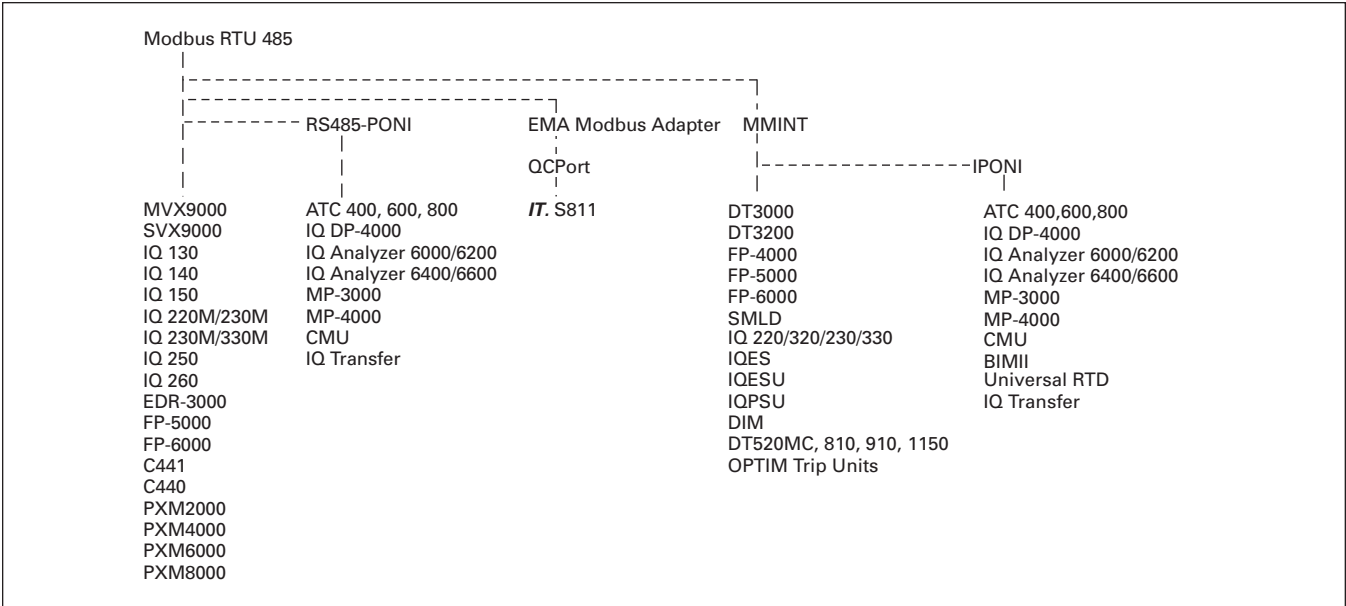


Figure 29.1-3. MCC Configuration—Modbus 485 RTU

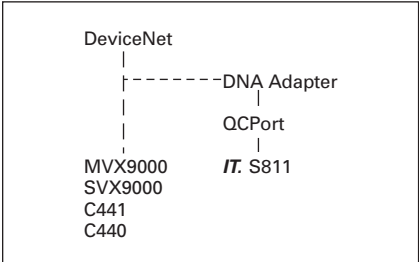


Figure 29.1-4. MCC Configuration—DeviceNet

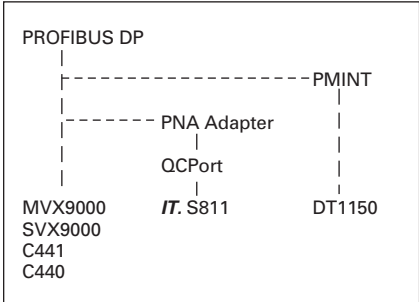


Figure 29.1-5. MCC Configuration—  
PROFIBUS DP

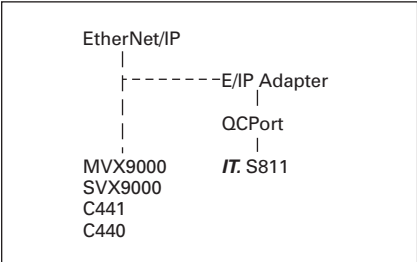


Figure 29.1-6. MCC Configuration—  
EtherNet/IP



## General Description

## PLCs

Programmable controllers can be mounted in all styles of the Eaton MCCs in a wide variety of configurations. Popular mounting configurations include small PLCs (EZ) unit mounted to replace relays and timers, medium-sized PLCs with I/O for control of an MCC lineup and also fieldbus mastering capabilities to control over DeviceNet, Modbus or Modbus TCP. Due to the flexibility of PLCs and the wide variety of applications and configurations, the Eaton MCC is designed to meet the mounting requirements of most applications to control not only the MCC but also auxiliary equipment not in the MCC.

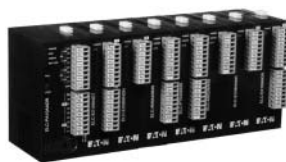
## EZ PLC



EZ PLC

The EZ PLC is a timer and relay replacer capable of being mounted directly inside the MCC bucket and controlling starters or other types of process equipment. This small PLC comes in styles that have AC or DC I/O and analog I/O, and also the ability to expand the I/O for larger I/O counts. From the face of the EZ, a user can change set points and count values or other program values to easily manipulate the process it is controlling.

## ELC PLC



ELC PLC

**Flexibility**—Handle I/O counts from 10 I/O up to 256 I/O using a single controller. ELCs eliminate the process of counting I/O and deciding which controller to use, as modules can easily be added and removed as needed. ELC modules come in many flavors of I/O from modules containing 4 in/4 out to modules containing 8 in/8 out. ELC controllers and modules mount to a DIN rail, and the modules are added by simply snapping them into the mating connectors and closing the attached locks.

**Large PLC Features**—Include the feature set of larger PLCs such as multiple communication ports, remote I/O, data storage, high-speed counters, high-speed pulse outputs, interrupts, timer resolution to 1 ms, PID, plus much more. The ELC also has mastering capabilities to control DeviceNet, Modbus and Modbus TCP slaves over an industrial network.

**Power of One**—Regardless of the level of integration needed, Eaton MCCs provide an easy and comprehensive solution to be part of a larger system or be the entire system all by itself. The Power Xpert gateway allows for seamless integration into the Power Xpert architecture, linking switchgear, meters and medium voltage assemblies. When the MCC is the control, integrating the ELC with one of the Eaton operator interface units and communicating to starters, drives, soft starts, meters and feeder breakers is integrated into a clean, easy-to-use solution.

## Monitoring and Configuration Tools

For all the advanced MCC choices, a tool is available to allow for configuration and monitoring of the MCC and its devices. The complimentary tool located at [www.eaton.com](http://www.eaton.com) is called CH Studio, and is a Windows-based configuration and monitoring package.

CH Studio allows the user to custom configure I/O data for the starters and drives, to verify loads and configuration parameters, and to view the faults and operation status of the end devices. In addition to this, CH Studio is also able to print out a detailed report for the system programmer to use with designing their program. To get an early start on the system design, CH Studio provided the ability to create the system offline and then synchronize the offline settings to the online system once the MCC arrives.

## General Description

## Clean Control Center with Active Harmonic Control—Typical Layout

The layout to the right is a typical arrangement for Eaton's Clean Control Center including harmonic correction units for nonlinear loads such as AC Variable Frequency Drives. The horizontal bus of the Clean Control Center is virtually free of harmonic current content at the point where the harmonic correction unit connects to the bus. From this point to the connection at the utility bus, the Clean Control Center complies with the most stringent requirements of IEEE® 519 and provides a clean waveform to the upstream distribution system. Harmonic correction may be applied to loads fed directly from the MCC (e.g., MCC mounted AC drives) or loads fed indirectly from the MCC (e.g., MCC mounted circuit breakers feeding remote drives). Multiple correction units may be used to achieve the level of harmonic correction as required by the amount of nonlinear loads within the MCC lineup.

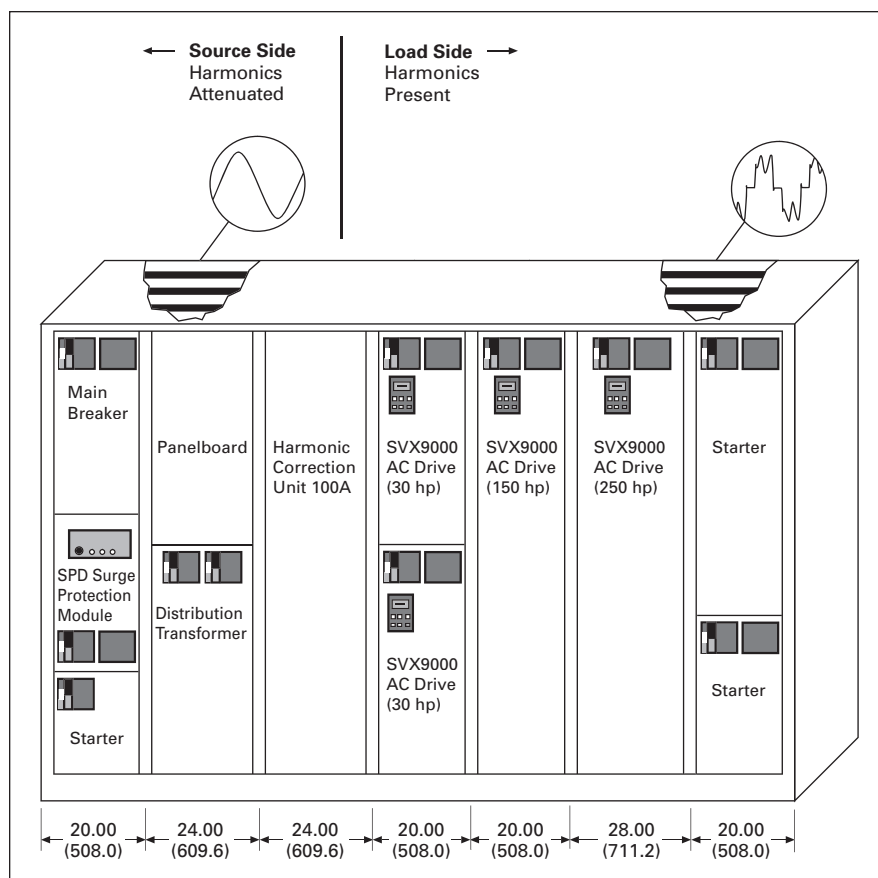


Figure 29.1-7. Clean Control Center with Active Harmonic Control—Dimensions in Inches (mm)

**Note:** As seen by the upstream electrical system—compliance to the most stringent standards of IEEE 519 is ensured.

## Harmonic Correction

The Clean Control Center uses a harmonic correction unit to provide harmonic cancellation directly on the motor control center horizontal bus. The harmonic correction unit senses the load current and injects into the AC lines a synthesized waveform that is inverted compared to the remaining signal. The result is a clean waveform as seen by the upstream electrical system. Single or multiple harmonic correction units may be applied within a Clean Control Center providing an economical solution to excessive harmonics due to AC drives or other nonlinear loads. Use of the Clean Control Center will provide compliance to the most stringent 5% Total Demand Distortion (TDD) requirements of IEEE 519. Clean Control Center assemblies include a 24.00-inch (609.6 mm) wide MCC structure, active harmonic correction unit, current transformers and a door-mounted digital interface panel.

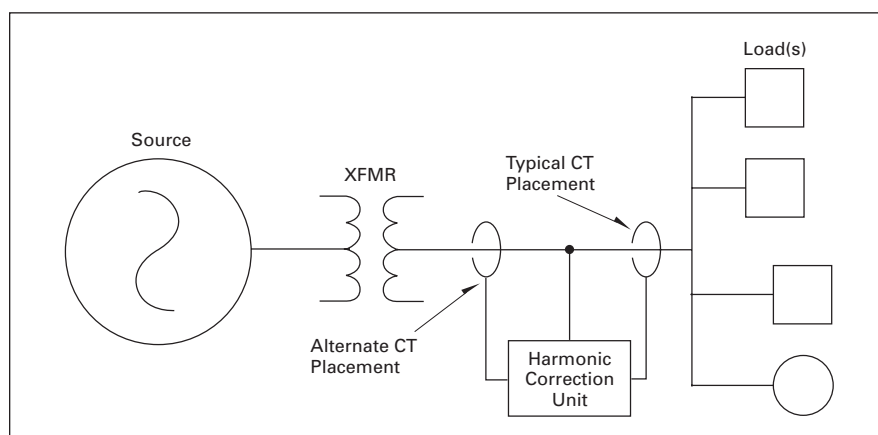


Figure 29.1-8. Clean Control Center Installation Diagram

## General Description

## Motor Protection

**C440/XT Electronic Overload Relay**

Eaton's C440 and C441 solid-state overload relay offers improved motor protection due to high repeat accuracy and fast reaction times to phase failures. The state-of-the-art microelectronics design permits the choice of relays with different trip classes (Class 5, 10, 20, 30) to accommodate motors with a variety of application needs.

The C440 solid-state overloads are available on all Freedom starter sizes. (Size 5 and up use CTs with the overload relay.) Key features include:

- Phase loss
- Phase imbalance
- Wide adjustment range
- Low energy usage
- Reduced heat

With the simple addition of a communication module, the C440 is capable of communicating to one of the following industrial field busses: DeviceNet, Modbus RTU, PROFIBUS, EtherNet/IP or Modbus TCP.

**C441 Overload Relays**

The C441 Motor Insight® is a micro-processor-based solid-state overload relay providing superior motor protection, communications and motor monitoring features. This overload provides the standard set of protections that includes I<sup>2</sup>t, jam, stall and phase protections. The C441 also provides ground fault, phase reversal, voltage unbalance, programmable trip class, trip history, thermal capacity, power factor and voltage, current and power monitoring. With the simple addition of a communication module, the C441 is capable of communicating to one of the following industrial field busses: DeviceNet, Modbus RTU, PROFIBUS, EtherNet/IP or Modbus TCP.

Key features of C441 Motor Insight communicating overloads include:

- DeviceNet, Modbus, PROFIBUS and Ethernet communication options
- Three-phase voltage monitoring
- Three-phase current monitoring
- kWh usage indication
- Motor power factor indication
- Last four faults history
- Optional remote mounted display
- I/O communication adapter with four inputs and two outputs
- Programmable set points, including:
  - Low voltage set point
  - High voltage set point
  - Voltage unbalance set point
  - CT multiplier/ratio settings
  - Overcurrent set point
  - Current unbalance trip point
  - Trip Class (5, 10, 15, 20, 30, and/or Jam)
  - Rapid cycle timer
  - Restart delay timer
  - Underload restart delay timer
  - Number of restarts after faults (Manual/Auto)
  - Undercurrent trip delay
  - Ground fault trip set point

**MP-3000 Overload Relays**

The MP-3000 motor overcurrent relay is a microprocessor-based relay that provides superior motor protection for critical process motors. Standard protective features provided in the MP-3000 include: I<sup>2</sup>t, programmable locked rotor protection, instantaneous overcurrent, ground fault, under load, jam, phase loss/unbalance/reversal, limit starts per hour, alarm and trip modes, and the capability to use motor RTD for motor protection. Functions are user programmable via data entry and display panel mounted in the door of the MCC. The MP-3000 can be monitored via its communications port. For further details, refer to **Tab 4**.

**MP-4000 Overload Relays**

The MP-4000 motor overload relay provides the ultimate in motor protection. In addition to all the protective features included in the MP-3000, the MP-4000 also includes voltage-based protection/metering as well: undervoltage, negative sequence, power factor, overvoltage, over/under frequency and forward/reverse power. For further details, refer to **Tab 4**.

### General Description

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#### Additional Services

##### Startup Assistance

To ensure complete customer satisfaction and to expedite equipment startup for motor control centers, this service provides a factory-trained representative at the job site during equipment energization. This service is provided on a fixed price basis. In addition to factory directed startup, the standard equipment warranty is extended for a period of 24 months. This service is especially beneficial when solid-state equipment is incorporated within the MCC due to the flexibility in adjusting solid-state equipment for each application.

##### Maintenance and Operational Training

A full range of training and operational training programs are available for all types of MCC-mounted equipment. In addition, preventative maintenance programs are available to ensure years of trouble-free operation.

##### Retrofits

Existing installations can many times benefit from some of the “new” technology equipment available in today’s MCCs. Eaton offers a full range of retrofit capabilities to upgrade existing MCC lineups. Examples include: vacuum contactors, reduced voltage solid-state starters, solid-state metering and solid-state overload protection. Starter retrofit kits for selective competitor MCCs are also available. Consult factory for availability.



**2100 Series Motor  
Control Center***Freedom 2100 Motor Control Center***Quick Reference Layout Guide Index**

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## Layout and Technical Data

### Technical Data

**Table 29.1-3. Short-Circuit Ratings for Motor Control (480V)**

Short-Circuit Protective Device	Combination Starter FV and RV (kA)	Solid-State Reduced Voltage (kA)	Adjustable Frequency Drives (kA)
HMCP motor circuit protector (standard rating)	65	65	65
HMCP motor circuit protector (optional rating)	100	100	100
MCCB molded-case circuit breaker (standard rating)	65	65	65
MCCB molded-case circuit breaker (optional rating)	100	—	100
Fusible switch	100	100	100

**Table 29.1-4. Combination Starters with Series C Motor Circuit Protectors or Molded-Case Circuit Breakers**

Motor circuit protector ratings are suitable for both NEMA Design B and NEMA Design E (high efficiency) motors. Per NEC, the motor circuit protectors may be adjusted to 17X motor FLA.

NEMA Size	Maximum Horsepower					HMCP/HMCPE Frame ①②	MCCB Frame ③	Freedom 2100		Freedom FlashGard	
								Unit Size		Unit Size	
	208V	240V	380V	480V	600V			Inches (mm)	X Space	Inches (mm)	X Space
Full Voltage Non-Reversing								Type F206		Type F206	
1	7.5	7.5	10	10	10	125 150	E HFD/FDC	6.00 (152.4) ④ 12.00 (304.8) ⑤ 18.00 (457.2)	1X ④ 2X ⑤ 3X	12.00 (304.8) ⑤ 18.00 (457.2)	2X ⑤ 3X
2	10	15	25	25	25	125 150	E HFD/FDC	6.00 (152.4) ④ 12.00 (304.8) ⑤ 18.00 (457.2)	1X ④ 2X ⑤ 3X	12.00 (304.8) ⑤ 18.00 (457.2)	2X ⑤ 3X
3	25	30	50	50	50	125 150	E HFD/FDC	12.00 (304.8) ④ 18.00 (457.2) ⑥ 24.00 (609.6)	2X ④ 3X ⑥ 4X	18.00 (457.2) ⑥ 24.00 (609.6)	3X ⑥ 4X
4	40	50	75	100	100	150	HFD/FDC HJD/JDC	12.00 (304.8) ⑦ 18.00 (457.2) ⑥⑦ 24.00 (609.6) ⑦	2X 3X ⑥ 4X	24.00 (609.6) ⑦ 30.00 (762.0) ⑧	4X ⑦⑧ 5X ⑧
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	36.00 (914.4)	6X	36.00 (914.4) 42.00 (1066.8)	6X 7X
6 ⑧	25 150	100 200	250 300	300 400	400 —	600 1200	HLD/LDC ⑩ HND	42.00 (1066.8) 60.00 (1524.0)	7X ⑩ 10X	48.00 (1219.2)	8X
7 ⑧	—	300	—	600	600	1200	HND	72.00 (1828.8) ⑪	12X	72.00 (1828.8) ⑪	12X
Full Voltage Reversing								Type F216		Type F216	
1	7.5	7.5	10	10	10	125 150	E HFD/FDC	18.00 (457.2) ⑥ 24.00 (609.6)	3X ⑥ 4X	24.00 (609.6) ⑥ 24.00 (609.6)	4X ⑥ 4X
2	10	15	25	25	25	125 150	E HFD/FDC	18.00 (457.2) ⑥ 24.00 (609.6)	3X ⑥ 4X	24.00 (609.6) ⑥ 24.00 (609.6)	4X ⑥ 4X
3	25	30	50	50	50	125/150	HFD/FDC/E	24.00 (609.6) ⑭	6X	24.00 (609.6) ⑭	4X
4	40	50	75	100	100	150	HJD/JDC	30.00 (762.0) ⑭	5X	36.00 (914.4) ⑭	6X ⑥⑬
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	60.00 (1524.0)	10X	66.00 (1676.4)	11X
6 ⑧	125 150	100 200	250 300	300 400	400 —	600 1200	HLD/LDC HND ⑮	72.00 (1828.8) 72.00 (1828.8) ⑩	12X 12X ⑩	72.00 (1828.8) ⑮ 72.00 (1828.8) ⑮	12X 12X ⑮

① Standard combination starter units with HMCP/HMCPE magnetic only disconnect have short-circuit ratings of 65,000A at 480V. Optional HMCP/HMCPE combination starter units are available with 100,000A at 480V.

② E-Frame motor circuit protection available for size 1–3 starters only.

③ Optional combination starter units with thermal-magnetic breaker disconnects are available with either 65,000 or 100,000A at 480V.

④ Maximum of (three) pilot devices, (two) auxiliary contacts 100 VA CPT maximum. Standard lugs only.

⑤ 12.00-inch (304.8 mm)/2X unit is standard.

⑥ 18.00-inch (457.2 mm)/3X unit is standard.

⑦ Minimum 30.00-inch (762.0 mm) space needed with thermal-magnetic circuit breaker.

⑧ Fixed assemblies, no RotoTract.

⑨ 1X additional space required with solid-state overloads.

⑩ 1X additional space with advanced solid-state overload.

⑪ 1200A HMCP frame available in 11X 66.00-inch (1676.4 mm).

⑫ For top entry, 8X space required.

⑬ Requires 28.00-inch (711.2 mm) wide structure.

⑭ 30.00-inch (762.0 mm) space needed for thermal-magnetic circuit breaker.

⑮ 7X with solid-state overloads.

⑯ Requires 36.00-inch (914.4 mm) wide structure.

## Layout and Technical Data

**Table 29.1-4. Combination Starters with Series C Motor Circuit Protectors or Molded-Case Circuit Breakers (Continued)**

Motor circuit protector ratings are suitable for both NEMA Design B and NEMA Design E (high efficiency) motors.  
Per NEC, the motor circuit protectors may be adjusted to 17X motor FLA.

NEMA Size	Maximum Horsepower					HMCP Frame ①②	MCCB Frame ②③	Freedom 2100		Freedom FlashGard	
	208V	240V	380V	480V	600V			Unit Size		Unit Size	
								Inches (mm)	X Space	Inches (mm)	X Space
<b>Two-Speed One Winding, Constant/Variable Torque</b>								<b>Type F946</b>		<b>Type F946</b>	
1	7.5	7.5	10	10	10	125 150	E HFD/FDC	24.00 (609.6) ④	4X	24 (609.6) ④	4X
2	10	15	25	25	25	125 150	E HFD/FDC	24.00 (609.6) ④	4X	24 (609.6) ④ 30 (762.0)	4X 5X
3	25	30	50	50	50	125 150	E HJD/JDC	36.00 (914.4) ④⑤	6X	36 (914.4) ④⑤	6X
4	40	50	75	100	100	150 250	HFD/FDC HJD/JDC	36.00 (914.4) ④⑤	6X	42 (1066.8) ④⑤	7X
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	72.00 (1828.8) ⑥	12X	72 (1828.8) ⑥	12X
<b>Two-Speed Two Winding, Constant/Variable Torque</b>								<b>Type F956</b>		<b>Type F956</b>	
1	7.5	7.5	10	10	10	125 150	E HFD/FDC	24.00 (609.6) ④	4X	24.00 (609.6)	4X
2	10	15	25	25	25	125 150	E HFD/FDC	24.00 (609.6) ④	4X	24.00 (609.6)	4X
3	25	30	50	50	50	125 150	E HFD/FDC	30.00 (762.0) ④	5X	30.00 (762.0)	5X
4	30 40	40 50	60 75	75 100	100 —	150 250	HFD/FDC HJD/JDC	30.00 (762.0) ④ 30.00 (762.0) ④	5X 5X	42.00 (1066.8) 42.00 (1066.8) ⑦	7X ⑧ 7X ⑧
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	72.00 (1828.8) ⑥	12X	72.00 (1828.8) ⑥	12X
<b>Reduced Voltage Autotransformer ⑨</b>								<b>Type F606</b>		<b>Type F606</b>	
2	10	15	25	25	25	150	HFD/FDC	36.00 (914.4)	6X	36.00 (914.4)	7X
3	25	30	50	50	50	150	HFD/FDC	54.00 (1371.6)	9X	48.00 (1219.2)	9X
4	30	50	75	100	100	150	HJD/JDC	54.00 (1371.6)	9X	54.00 (1371.6)	10X
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	72.00 (1828.8)	12X	72.00 (1828.8)	12X
6	150	200	300	400	400	600	HLD/LDC	72.00 (1828.8) ⑩	12X	72.00 (1828.8) ⑩	12X
7	—	300	—	600	600	1200	HND	72.00 (1828.8) ⑩	12X	72.00 (1828.8) ⑩	12X
<b>Reduced Voltage Part Winding ⑨</b>								<b>Type F706</b>		<b>Type F706</b>	
1PW	10	10	15	15	15	150	HFD/FDC	24.00 (609.6) ⑪	4X	24.00 (609.6)	5X
2PW	20	25	40	40	40	150	HFD/FDC	24.00 (609.6) ⑪	4X	24.00 (609.6)	5X
3PW	40	50	75	75	75	150	HFD/FDC	30.00 (762.0) ⑪	5X	30.00 (762.0)	6X
4PW	— 60 75	— 60 75	— 125 150	100 150 —	125 150 —	150 250 400	HFD/FDC HJD/JDC HKD/KDC	36.00 (914.4) ⑪	6X	36.00 (914.4) ⑪	7X
5PW	100 150	125 150	— 250	250 350	300 350	400 600	HKD/KDC HLD/LDC	72.00 (1828.8) ⑩	12X	72.00 (1828.8) ⑩	12X

① Standard combination starter units with HMCP/HMCPE Magnetic Only disconnect have short-circuit ratings of 65,000A at 480V. Optional HMCP/HMCPE combination starter units are available with 100,000A at 480V.

② E-Frame motor circuit protector available through size 3 starter only.

③ Optional combination starter units with thermal-magnetic breaker disconnects are available with either 65,000 or 100,000A at 480V.

④ Add 6.00-inch (152.4 mm) space for low speed disconnect.

⑤ 42.00-inch (1066.8 mm) space needed with Thermal-magnetic circuit breaker. 48.00-inch (1219.2 mm) space needed with thermal-magnetic circuit breaker.

⑥ Requires 28.00-inch (711.2 mm) wide structure.

⑦ 36.00-inch (914.4 mm) space needed for thermal-magnetic circuit breaker.

⑧ 1X additional space required with standard SSOL and 2X additional space required with advanced SSOL.

⑨ Fixed assemblies not available with RotoTract.

⑩ Requires 21.00-inch (533.4 mm) deep, 28.00-inch (711.2 mm) wide structure.

⑪ For starting speed disconnect, add 6.00-inch (152.4 mm) space.

**Layout and Technical Data**
**Table 29.1-4. Combination Starters with Series C Motor Circuit Protectors or Molded-Case Circuit Breakers (Continued)**

Motor circuit protector ratings are suitable for both NEMA Design B and NEMA Design E (high efficiency) motors.  
Per NEC, the motor circuit protectors may be adjusted to 17X motor FLA.

NEMA Size	Maximum Horsepower					HMCP Frame ①②	MCCB Frame ②③	Freedom 2100		Freedom FlashGard	
								Unit Size		Unit Size	
	208V	240V	380V	480V	600V			Inches (mm)	X Space	Inches (mm)	X Space
Reduced Voltage Wye Delta Open Transition ④								Type F806		Type F806	
2YD	20	25	40	40	40	150	HFD/FDC	30.00 (762.0)	5X	30.00 (762.0)	6X
3YD	30	40	75	75	5	150	HFD/FDC	42.00 (1066.8)	7X	42.00 (1066.8)	8X
	40	50	—	—	—	250	HJD/JDC				
4YD	60	75	125	150	150	250	HJD/JDC	42.00 (1066.8)	7X	48.00 (1219.2)	9X
	—	—	150	—	—	400	HKD/KDC				
5YD	100	125	200	250	300	400	HKD/KDC	72.00 (1828.8) ⑤	12X	72.00 (1828.8) ⑤	12X
	150	150	250	300	—	600	HLD/LDC				
Reduced Voltage Wye Delta Closed Transition ④								Type F896		Type F896	
2YD	20	25	40	40	40	150	HFD/FDC	42.00 (1066.8)	7X	42.00 (1066.8)	8X
3YD	40	50	—	—	—	250	HFD/FDC	54.00 (1371.6)	9X	54.00 (1371.6)	10X
4YD	60	75	125	150	150	250	HJD/JDC	60.00 (1524.0)	10X	60.00 (1524.0)	11X
	—	—	150	—	—	400	HKD/KDC				
5YD	100	125	200	250	300	400	HKD/KDC	72.00 (1828.8) ⑤	12X	72.00 (1828.8) ⑤	12X
	150	150	250	300	—	600	HLD/LDC				

① Standard combination starter units with HMCP/HMCPE magnetic only disconnect have short-circuit ratings of 65,000A at 480V. Optional HMCP/HMCPE combination starter units are available with 100,000A at 480V.

② E-Frame motor circuit protector available through size 3 starter only.

③ Optional combination starter units with thermal-magnetic breaker disconnects are available with either 65,000 or 100,000A at 480V.

④ Fixed assemblies not available with RotoTract.

⑤ Requires 21.00-inch (533.4 mm) deep, 28.00-inch (711.2 mm) wide structure.



## Layout and Technical Data

**Intelligent Technologies /T. S811 Solid-State  
Reduced Voltage Starter—HMCP**

Eaton's /T. S811 solid-state reduced voltage starter uses SCRs when starting and a low impedance run circuit during operation. The /T. solid-state starter has five 24 Vdc inputs and two relay outputs. /T. soft start units include a disconnect, starter, 24 Vdc power supply and 100 VA CPT.

**Motor Service Factor (SF) Effect on /T. Starter Selection**

- A 1.0 service factor motor may draw up to 1.00 x full load amperes
- A 1.15 service factor motor may draw up to 1.15 x full load amperes (15% more current)
- /T. starters are current rated devices. In some cases, a larger /T. SSRV starter must be supplied for 1.15 SF motors. See the maximum horsepower chart below

**Table 29.1-5. Standard-Duty Ratings—Motor Circuit Protector Disconnect** ①

Ampere Rating	/T. Width (mm)	Maximum Horsepower or (kW)										HMCP/MCCB Frame	Freedom 2100 Unit Size		Freedom FlashGard Unit Size	
		208V		240V		380V		480V		600V			Inches (mm)	X Space	Inches (mm)	X Space
		1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF					
HMCP ②																
37 66	65	10 15	10 20	10 20	10 20	15 30	18.5 30	20 40	25 50	30 50	30 60	100 100	12.00 (304.8)	2X	18.00 (457.2)	3X
105 135 135	110	30 40 —	30 40 —	30 40 —	40 50 —	45 55 —	55 75 —	60 75 —	75 100 —	75 100 —	100 125 150	150 250	18.00 (457.2)	3X	24.00 (609.6)	4X
180	200	—	—	60	60	—	—	—	—	150	150	250	36.00 (914.4)	6X	42.00 (1066.8)	7X
180 240 304	200	50 60 75	60 75 100	— 75 100	— 75 100	75 110	90 132	125 150 200	150 200 250	— 200 250	— 200 300	400 400 400	36.00 (914.4)	6X	42.00 (1066.8)	7X
304	200	—	—	—	—	132	160	—	—	—	—	400	36.00 (914.4)	6X	42.00 (1066.8)	7X
360 420 500	290	125 150 —	125 150 —	125 — 150	150 — 200	160 200 250	200 220 250	— 300 350	— 350 400	300 350 450	350 450 500	600 600 600	54.00 (1371.6)	9X	54.00 (1371.6) ③	9X
650 720 850	290	200 200 —	200 250 —	200 250 300	250 300 350	315 — 375	375 — 500	450 500 600	500 600 700	600 600 700	600 700 900	1200 1200 1200	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
1000	290	—	—	350	400	500	560	700	800	900	1000	2000	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X

**Thermal-Magnetic Circuit Breaker Disconnect** ②

37 66	65	10 15	10 20	10 20	10 20	15 30	18.5 30	20 40	25 50	30 60	150 150	12.00 (304.8)	2X	18.00 (457.2)	3X	
105 135	110	30 40	30 40	30 40	40 50	45 55	55 75	60 75	75 100	75 100	100 125	18.00 (457.2)	3X	30.00 (762.0)	5X	
180 180	200	— 50	— 60	— 60	— 60	— 75	— 90	— 125	— 150	— 150	— 250	36.00 (914.4)	6X	42.00 (1066.8)	7X	
240 304	200	60 75	75 100	75 100	75 100	110 132	132 160	150 —	200 —	200 —	200 400	36.00 (914.4)	6X	42.00 (1066.8)	7X	
304	200	—	—	—	—	—	—	200	250	300	600	36.00 (914.4)	6X	54.00 (1371.6) ③	9X ③	
360 420 500	290	125 150 —	125 150 —	125 — 150	150 — 200	160 200 250	200 220 250	— 300 350	— 350 400	300 350 450	350 450 600	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X ③	
650 650 720 850	290	200 — 200 —	200 — 250 —	— 200 250 300	— 250 300 350	— 315 — 375	— 375 — 500	450 — 500 600	500 600 700	600 600 700	600 700 900	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X ③	
1000	290	—	—	350	400	500	560	700	800	900	1000	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X ③	

① Standard-duty ratings reflect the maximum starting duty that these units are designed to supply. If starting duty listed is to be exceeded, reference severe duty Table 29.1-9 on Page 29.1-28.

② Standard-duty ampere rating. See Table 29.1-8 below.

③ Fixed assemblies, no RotoTract.

**Note:** Most motors used in industrial applications are 1.15 Service Factor (SF).

**Table 29.1-6. Option Sizing—Dimensions in Inches (mm)**

/T. Width (mm)	Disconnect Type	Starter Size	Option Unit Size ④	Structure Width
<b>Isolating Contactor</b>				
65	HMCP, MCCB	1, 2, 3	30.00 (762.0)	20.00 (508.0)
110	HMCP, MCCB	3, 4	36.00 (914.4)	20.00 (508.0)
110	HMCP, MCCB	5	54.00 (1371.6)	20.00 (508.0)
200	HMCP, MCCB	5, 6	72.00 (1828.8) ⑤	20.00 (508.0)
290	HMCP, MCCB	6	72.00 (1828.8) ⑤	32.00 (812.8)
290	HMCP, MCCB	7	72.00 (1828.8) ⑤	48.00 (1219.2)
<b>Bypass Starter</b>				
65	HMCP, MCCB	1, 2, 3	30.00 (762.0)	20.00 (508.0)
110	HMCP, MCCB	3, 4	36.00 (914.4)	20.00 (508.0)
110	HMCP, MCCB	5	54.00 (1371.6)	20.00 (508.0)
200	HMCP, MCCB	5, 6	72.00 (1828.8) ⑤	24.00 (609.6)
290	HMCP, MCCB	6	72.00 (1828.8) ⑤	32.00 (812.8)
290	HMCP, MCCB	7	72.00 (1828.8) ⑤	48.00 (1219.2)

④ Option fits in standard unit space.

⑤ Fixed assemblies, no RotoTract.

**Note:** Unit size includes space for /T. starter and option.

**Table 29.1-7. Control Options**

Extra 50 VA Control Power Transformer ⑥⑦
24 Vdc Control ⑥
Line or Load MOV Protection ⑥
Pump Control Option ⑥
DeviceNet Communications Module ⑥⑦

⑥ Option fits in standard unit space.

⑦ Option adds 6.00 inches (152.4 mm) (1X) to 37 and 66A units.

**Table 29.1-8. Standard-Duty Ratings**

Ramp Current % of FLA	Ramp Time	Starts Per Hour	Similar to Starting Method
300%	30 seconds	3	Soft start
500%	10 seconds	3	Full voltage
350%	20 seconds	3	Wye delta
480%	20 seconds	2	80% RVAT
390%	20 seconds	3	65% RVAT
300%	20 seconds	4	50% RVAT

## Layout and Technical Data

**IT06—Intelligent Technologies /T. S811 Solid-State  
Reduced Voltage Starter—HMCP**

Eaton's /T. S811 solid-state reduced voltage starter uses SCRs when starting and a low impedance run circuit during operation. The /T. solid-state starter has five 24 Vdc inputs and two relay outputs. /T. soft start units include a disconnect, a starter, 24 Vdc power supply and 100 VA CPT.

**Motor Service Factor (SF) Effect on /T. Starter Selection**

- A 1.0 service factor motor may draw up to 1.00 x full load amperes
- A 1.15 service factor motor may draw up to 1.15 x full load amperes (15% more current)
- /T. starters are current rated devices. In some cases, a larger /T. SSRV starter must be supplied for 1.15 SF motors. See the maximum horsepower chart below

**Table 29.1-9. Severe-Duty Ratings—Motor Circuit Protector Disconnect ①**

Ampere Rating	/T. Width (mm)	Maximum Horsepower or (kW)										HMCP/ MCCB Frame	Freedom 2100 Unit Size		Freedom FlashGard Unit Size	
		208V		240V		380V		480V		600V			Inches (mm)	X Space	Inches (mm)	X Space
		1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF					
HMCP ②																
22	65	5 10	5 10	5 10	7.5 15	7.5 18.5	11 22	10 25	15 30	15 30	20 40	100 100	12.00 (304.8)	2X	18.00 (457.2)	3X
65 80 80	110	15 — 20	20 — 25	20 — 25	20 — 30	22 37 —	30 37 —	40 — 50	50 — 60	50 — 60	60 — 75	100 100 150	18.00 (457.2)	3X	24.00 (609.6)	4X
115 150 150 192	200	30 — 40 —	40 — 50 —	30 50 —	40 50 —	55 — 55 90	55 — 75 90	75 100 —	75 100 —	100 — 125 —	100 — 150 —	150 150 250 250	36.00 (914.4)	6X	42.00 (1066.8)	7X
192	200	50	60	60	75	—	—	125	125	150	200	400	36.00 (914.4)	6X	42.00 (1066.8)	7X
240 305	290	60 75	75 100	— 100	— 100	110 132	132 160	150 200	200 250	— 250	— 300	400 400	54.00 (1371.6)	9X	54.00 (1371.6)	9X
365 420 480	290	100 125 —	125 150 —	125 — 150	150 — 200	160 200 220	200 220 250	250 300 350	300 350 400	300 350 450	350 450 500	600 600 600	54.00 (1371.6)	9X	54.00 (1371.6) ③	9X
525	290	—	—	—	—	—	—	350	450	—	—	600	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
600	290	—	—	—	—	—	—	450	500	500	600	1200	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X

**Thermal-Magnetic Circuit Breaker Disconnect ②**

22	65	5	5	5	7.5	7.5	11	10	15	15	20	150	12.00 (304.8)	2X	18.00 (457.2)	3X
42		10	10	10	15	18.5	22	25	30	30	40	150				
65	110	15	20	20	20	22	30	40	50	50	60	225	18.00 (457.2)	3X	30.00 (762.0)	5X
80		20	25	25	30	37	37	50	60	60	75	225				
115	200	30	40	30	40	55	55	75	75	100	100	400	36.00 (914.4)	6X	42.00 (1066.8)	7X
150		40	50	50	50	55	75	100	100	125	150	400				
192		50	60	60	75	90	90	125	150	150	200	400				
240	290	60	75	100	100	110	132	150	200	250	300	600	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
305		75	100	—	100	132	160	200	250	300	350	800				
365	290	100	125	125	150	160	200	250	300	350	350	1200	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
420		125	150	—	200	200	220	300	350	400	450	1200				
480		—	—	150	200	220	250	350	400	450	500	1200				
525		—	—	—	—	—	—	350	450	—	—	1200				
600	290	—	—	—	—	—	—	450	500	500	600	1200	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X

① Severe-duty ratings listed reflect the maximum starting duty these units are designed to supply. For higher ratings, please contact factory.

**Note:** Most motors used in industrial applications are 1.15 Service Factor (SF).

② Severe-duty ampere rating. See **Table 29.1-12** below.

③ Fixed assemblies, no RotoTract.

**Table 29.1-10. Option Sizing—Dimensions in Inches (mm)**

/T. Width (mm)	Disconnect Type	Starter Size	Option Unit Size ④	Structure Width
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**Isolating Contactor**

65	HMCP, MCCB	1, 2, 3	30.00 (762.0)	20.00 (508.0)
110	HMCP, MCCB	3, 4	36.00 (914.4)	20.00 (508.0)
110	HMCP, MCCB	5	54.00 (1371.6)	20.00 (508.0)
200	HMCP, MCCB	5, 6	72.00 (1828.8) ⑤	20.00 (508.0)
290	HMCP, MCCB	6	72.00 (1828.8) ⑤	32.00 (812.8)
290	HMCP, MCCB	7	72.00 (1828.8) ⑤	48.00 (1219.2)

**Bypass Starter**

65	HMCP, MCCB	1, 2, 3	30.00 (762.0)	20.00 (508.0)
110	HMCP, MCCB	3, 4	36.00 (914.4)	20.00 (508.0)
110	HMCP, MCCB	5	54.00 (1371.6)	20.00 (508.0)
200	HMCP, MCCB	5, 6	72.00 (1828.8) ⑤	24.00 (609.6)
290	HMCP, MCCB	6	72.00 (1828.8) ⑤	32.00 (812.8)
290	HMCP, MCCB	7	72.00 (1828.8) ⑤	48.00 (1219.2)

④ Option fits in standard unit space.

⑤ Fixed assemblies, no RotoTract.

**Note:** Unit size includes space for /T. starter and option.

**Table 29.1-11. Control Options**

Extra 50 VA Control Power Transformer ⑥⑦
24 Vdc Control ⑥
Line or Load MOV Protection ⑥
Pump Control Option ⑥
DeviceNet Communications Module ⑥⑦

⑥ Option fits in standard unit space.

⑦ Option adds 6.00 inches (152.4 mm) (1X) to 37 and 66 ampere units.

**Table 29.1-12. Severe-Duty Ratings**

Ramp Current % of FLA	Ramp Time	Starts Per Hour	Similar to Starting Method
450%	30 seconds	4	Soft start
500%	10 seconds	10	Full voltage
350%	65 seconds	3	Wye delta
480%	25 seconds	4	80% RVAT
390%	40 seconds	4	65% RVAT
300%	60 seconds	4	50% RVAT

## Layout and Technical Data

Table 29.1-13. Combination Starters with Fusible Switches—Dimensions in Inches (mm)

NEMA Size	Maximum Horsepower					Switch Rating ①	Freedom 2100		Freedom FlashGard	
							Unit Size		Unit Size	
	208V	240V	380V	480V	600V		Inches (mm)	X Space	Inches (mm)	X Space
Full Voltage Non-Reversing—Fusible							Type F204		Type F204	
1	7.5	7.5	10	10	10	30	12.00 (304.8)	2X	18.00 (457.2)	3X
2	10	15	25	25	25	60	12.00 (304.8)	2X	18.00 (457.2)	3X
3	25	30	50	50	50	60/100	24.00 (609.6)	4X	24.00 (609.6)	4X
4	40	50	75	100	100	100/200	36.00 (914.4)	6X	36.00 (914.4)	6X ②
5	75	100	150	200	200	400 ③	54.00 (1371.6)	9X	60.00 (1524.0)	10X
6 ④	150	200	300	400	400	600	66.00 (1676.4) 72.00 (1828.8)	11X 12X	66.00 (1676.4) ⑤ 72.00 (1828.8) ⑥	11X 12X
Full Voltage Reversing—Fusible							Type F214		Type F214	
1	7.5	7.5	10	10	10	30	18.00 (457.2)	3X	24.00 (609.6)	4X
2	10	15	25	25	25	60	18.00 (457.2)	3X	24.00 (609.6)	4X
3	25	30	50	50	50	100/200	30.00 (762.0)	5X	30.00 (762.0)	5X
4	40	50	75	100	100	200	40.00 (1016.0)	8X	54.00 (1371.6)	9X
5	75	100	150	200	200	400	72.00 (1828.8)	12X	72.00 (1828.8) ⑦	12X
6	150	200	300	400	400	600	72.00 (1828.8)	12X	72.00 (1828.8) ⑦	12X
Two-Speed One Winding—Fusible							Type F944		Type F944	
1	7.5	7.5	10	10	10	30	24.00 (609.6)	4X	24.00 (609.6)	4X
2	10	15	25	25	25	60	24.00 (609.6)	4X	30.00 (762.0)	5X
3	25 25	30 30	— 50	30 50	50 50	60 100	36.00 (914.4)	6X	36.00 (914.4)	6X
4	— 40	— 50	— 75	— 100	60 100	100 200	60.00 (1524.0)	10X	60.00 (1524.0)	10X
5	75	100	150	200	200	400	72.00 (1828.8)	12X	72.00 (1828.8) ⑦	12X
Two-Speed Two Winding—Fusible							Type F954		Type F954	
1	7.5	7.5	10	10	10	30	24.00 (609.6)	4X	24.00 (609.6)	4X
2	10	15	25	25	25	60	24.00 (609.6)	4X	30.00 (762.0)	5X
3	— 25	— 30	— 50	— 50	30 50	60 100	30.00 (762.0)	5X	36.00 (914.4)	6X
4	— 40	— 50	— 75	— 100	60 100	100 200	60.00 (1524.6)	10X	54.00 (1371.6) ⑧	10X
5	75	100	150	200	200	400	72.00 (1828.8)	12X	72.00 (1828.8) ⑦	12X
Reduced Voltage Autotransformer—Fusible							Type F604		Type F604	
2	10	15	25	25	25	60	36.00 (914.4)	6X	36.00 (914.4)	7X
3	25	30	50	50	50	100	54.00 (1371.6)	9X	60.00 (1524.0)	10X
4	40	50	75	100	100	200	72.00 (1828.8)	12X	72.00 (1828.8) ⑨	12X
5	75	100	150	200	200	400	72.00 (1828.8)	12X	72.00 (1828.8) ⑦	12X
6	150	200	300	400	400	600	72.00 (1828.8)	12X	72.00 (1828.8) ⑩	12X

<sup>①</sup> Combination fused starter units rated 100 kAIC short-circuit current.<sup>②</sup> 7X (42.00-inch [1066.8 mm]) unit size with solid-state overloads.<sup>③</sup> Certain items in unit option Groups B and C may require additional space. See Page 29.1-40.<sup>④</sup> Fixed assemblies, no RotoTract.<sup>⑤</sup> For bottom entry of motor cables.<sup>⑥</sup> For top entry of motor cables.<sup>⑦</sup> Requires 28.00-inch (711.2 mm) wide structure.<sup>⑧</sup> Add 12.00-inch (304.8 mm) space for low speed fuses.<sup>⑨</sup> Bottom 24.00-inch (609.6 mm) space in rear is unusable.<sup>⑩</sup> Requires 28.00-inch (711.2 mm) wide and 21.00-inch (533.4 mm) deep structure.

## Layout and Technical Data

**Table 29.1-13. Combination Starters with Fusible Switches (Continued)**

NEMA Size	Maximum Horsepower					Switch Rating ①	Freedom 2100		Freedom FlashGard	
							Unit Size		Unit Size	
	208V	240V	380V	480V	600V		Inches (mm)		X Space	Inches (mm)
Reduced Voltage Part Winding—Fusible							Type F704		Type F704	
1PW	10	10	15	15	15	60	36.00 (914.4)	6X	24.00 (609.6)	5X
2PW	—	15	25	30	40	60	36.00 (914.4)	6X	24.00 (609.6)	5X
	20	25	40	40	—	100	36.00 (914.4)	6X	24.00 (609.6)	5X
3PW	—	—	—	50	60	100	40.00 (1016.0)	8X	48.00 (1219.2)	9X
	40	50	75	75	75	200	40.00 (1016.0)	8X	48.00 (1219.2)	9X
4PW	50	—	100	100	150	200	60.00 (1524.0)	10X	54.00 (1371.6)	10X
	75	75	150	150	—	400	60.00 (1524.0)	10X	54.00 (1371.6)	10X
5PW	100	100	200	250	300	400	72.00 (1828.8) ②	12X ②	72.00 (1828.8) ②	12X ②
	150	150	250	350	350	600				
Reduced Voltage Wye Delta Open Transition—Fusible							Type F804		Type F804	
2YD	15	15	30	40	40	60	30.00 (762.0)	5X	36.00 (914.4)	6X
	20	25	40	—	—	100				
3YD	25	30	50	60	75	100	54.00 (1371.6)	9X	54.00 (1371.6)	9X
	40	50	75	75	—	200				
4YD	50	60	100	125	150	200	72.00 (1828.8) ②	12X ②	72.00 (1828.8) ②	12X ②
	60	75	150	150	—	400				
5YD	100	125	200	250	300	400	72.00 (1828.8) ②	12X ②	72.00 (1828.8) ②	12X ②
	150	150	250	300	—	600				
6YD	—	—	—	—	350	400	72.00 (1828.8) ③	12X ③	72.00 (1828.8) ③	12X ③
	—	200	350	400	500	600				
	250	250	400	500	700	800				
	300	350	500	700	700	1200				
	—	—	—	—	—	—				
Reduced Voltage Wye Delta Closed Transition—Fusible							Type F894		Type F894	
2YD	15	15	30	40	40	60	42.00 (1066.8)	7X	48.00 (1219.2)	8X
	20	25	40	—	—	100				
3YD	25	30	50	60	75	100	66.00 (1676.4)	11X	66.00 (1676.4)	12X
	40	50	75	75	—	200				
4YD	50	60	100	125	50	200	72.00 (1828.8) ②	12X ②	72.00 (1828.8) ②	12X ②
	60	75	150	150	—	400	72.00 (1828.8) ②	12X ②	72.00 (1828.8) ②	12X ②
5YD	100	125	200	250	300	400	72.00 (1828.8) ②	12X ②	72.00 (1828.8) ②	12X ②
	150	150	250	300	—	600				
6YD	—	—	—	—	350	400	72.00 (1828.8) ③	12X ③	72.00 (1828.8) ③	12X ③
	—	200	350	400	500	600				
	250	250	400	500	700	800				
	300	350	500	700	700	1200				
	—	—	—	—	—	—				

① Combination fused starter units rated 100 kAIC short-circuit current.

② Requires 28.00-inch (711.2 mm) wide structure.

③ Requires 28.00-inch (711.2 mm) wide and 21.00-inch (533.4 mm) deep section.



## Layout and Technical Data

**Intelligent Technologies /T. S811 Solid-State  
Reduced Voltage Starter—Fusible Switch**

Eaton's /T. S811 solid-state reduced voltage starter uses SCRs when starting and a low impedance run circuit during operation. The /T. S811 solid-state starter has five 24 Vdc inputs and two relay outputs. /T. soft start units include a disconnect, a starter, 24 Vdc power supply and 100 VA CPT.

**Motor Service Factor (SF) Effect on /T. Starter Selection**

- A 1.0 service factor motor may draw up to 1.00 x full load amperes
- A 1.15 service factor motor may draw up to 1.15 x full load amperes (15% more current)
- /T. starters are current rated devices. In some cases, a larger /T. SSRV starter must be supplied for 1.15 SF motors. See the maximum horsepower chart below

**Table 29.1-14. Standard-Duty Ratings—Fusible** ①②③

Ampere Rating	/T. Width (mm)	Maximum Horsepower (kW)										Switch Rating	Freedom 2100 Unit Size		FlashGard Unit Size	
		208V		240V		380V		480V		600V			Inches (mm)	X Space	Inches (mm)	X Space
		1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF					
37 66	65	10 15	10 20	10 20	10 20	15 30	18.5 30	20 40	25 50	30 50	30 60	30/60 100	18.00 (457.2)	3X	24.00 (609.6)	4X
105 135	110	30 40	30 40	30 40	40 50	45 55	55 75	60 75	75 100	75 100	100 125	200 200	30.00 (762.0)	5X	36.00 (914.4)	6X
180 240 304 304	200	50 60 — 75	60 75 — 100	60 75 — 100	60 75 — 100	75 110 — 132	90 132 — 160	125 150 — 200	150 200 — 250	150 200 — 250	150 200 — 300	400 400 400 600	60.00 (1524.0)	10X	60.00 (1524.0)	10X
304	200	75	100	—	—	132	160	200	250	250	300	600	60.00 (1524.0) ④	10X	60.00 (1524.0) ④	10X
360 420 420 500	290	125 — — 150	100 — — 125	125 — — 150	150 — — 200	160 200 — 250	200 220 — 250	— — 300 350	— — 350 400	300 — 350 450	350 — 450 500	600 600 800 800	72.00 (1828.8) ④	12X	72.00 (1828.8) ④	12X
650 720 850	290	200 200 —	200 250 —	200 250 300	250 300 350	315 — 375	375 — 500	450 500 600	500 600 700	600 600 700	600 700 900	1200 1200 1200	72.00 (1828.8) ④	12X	72.00 (1828.8) ④	12X
1000	290	—	—	350	400	500	560	700	800	900	1000	1200	72.00 (1828.8) ④⑤⑥	12X	72.00 (1828.8) ④⑤⑥	12X

① Standard-duty ampere rating. See Table 29.1-16 below.

② Option adds 6.00 inches (152.4 mm) (1X) to 37 and 66A units.

③ Standard duty ratings reflect the maximum starting duty that these units are designed to supply. If starting duty listed is to be exceeded, reference severe duty Table 29.1-9 on Page 29.1-28.

④ Fixed assemblies, no RotoTract.

⑤ Consult factory for unit width.

⑥ Bottom exit only. Top exit unit is 24.00 inches (609.6 mm) wide (rear is unusable).

**Note:** Most motors used in industrial applications are 1.15 Service Factor (SF).

**Table 29.1-15. Control Options**

Extra 50 VA Control Power Transformer ⑦
24 Vdc Control ⑦
Line or Load MOV Protection ⑦
Pump Control Option ⑦
DeviceNet Communications Module ⑦

⑦ Option fits in standard unit space.

**Table 29.1-16. Standard-Duty Ratings**

Ramp Current % of FLA	Ramp Time	Starts Per Hour	Similar to Starting Method
300%	30 Seconds	3	Soft start
500%	10 Seconds	3	Full voltage
350%	20 Seconds	3	Wye delta
480%	20 Seconds	2	80% RVAT
390%	20 Seconds	3	65% RVAT
300%	20 Seconds	4	50% RVAT

**Table 29.1-17. Option Sizing for Isolating Contactor and Bypass Starter**

/T. Width (mm)	Fused Switch Type (Amperes)	Starter Size	Option Unit Size Inches (mm) ⑧	FlashGuard Unit Size Inches (mm)	Structure Width Inches (mm)
65	30/60/100	1, 2, 3	36.00 (914.4)	36.00 (914.4)	20.00 (508.0)
110	100	3	42.00 (1066.8)	42.00 (1066.8)	20.00 (508.0)
110	200	4	54.00 (1371.6)	54.00 (1371.6)	20.00 (508.0)
200	400/800	5, 6	72.00 (1828.8) ⑨	72.00 (1828.8) ⑨	32.00 (812.8)
290	600/800	6	72.00 (1828.8) ⑨	72.00 (1828.8) ⑨	36.00 (914.4)
290	800/1200	7	72.00 (1828.8) ⑨	72.00 (1828.8) ⑨	64.00 (1625.6)

⑧ Unit size includes space for /T. starter and option.

⑨ Fixed assemblies, no RotoTract.

## Layout and Technical Data

Intelligent Technologies *IT*. S811 Solid-State  
Reduced Voltage Starter—Fusible

Eaton's *IT*. S811 solid-state reduced voltage starter uses SCRs when starting and a low impedance run circuit during operation. The *IT*. S811 solid-state starter has five 24 Vdc inputs and two relay outputs. *IT*. soft start units include a disconnect, a starter, 24 Vdc power supply and 100 VA CPT.

Motor Service Factor (SF) Effect on *IT*. Starter Selection

- A 1.0 service factor motor may draw up to 1.00 x full load amperes
- A 1.15 service factor motor may draw up to 1.15 x full load amperes (15% more current)
- *IT*. starters are current rated devices. In some cases, a larger *IT*. SSRV starter must be supplied for 1.15 SF motors. See the maximum horsepower chart below

Table 29.1-18. Severe-Duty Ratings—Fusible ①②③

Ampere Rating	IT Width (mm)	Maximum Horsepower (kW)										Switch Rating	Freedom 2100 Unit Size		FlashGard Unit Size	
		208V		240V		380V		480V		575V			Inches (mm)	X Space	Inches (mm)	X Space
		1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF	1.15 SF	1.0 SF					
22 42 42	65	5 10 —	5 10 —	5 — 10	7.5 — 15	7.5 — 18.5	11 — 22	10 — 25	15 — 30	15 — 30	20 — 40	30/60 30/60 100	18.00 (457.2)	3X	24.00 (609.6)	4X
65 80	110	15 20	20 25	20 25	20 30	22 37	30 37	40 50	50 60	50 60	60 75	200 200	30.00 (762.0)	5X	36.00 (914.4)	6X
115 115 150 192	200	— 30 40 50	— 40 50 60	— 30 50 60	— 40 50 75	— 55 55 90	— 55 75 90	75 100 75 125	75 100 — 150	100 100 125 150	100 — 150 200	200 400 400 400	60.00 (1524.0)	10X	60.00 (1524.0)	10X
240 305 365 420 480 480 525	290	60 75 100 125 — — —	75 100 125 150 — — —	— 100 125 150 — 150 —	— 100 150 — 200 —	110 132 160 200 220 —	132 160 200 220 250 —	150 200 250 300 350 350	200 250 300 350 400 450	— 250 300 350 450 —	— 300 350 450 500 —	600 600 800 800 1200 1200	72.00 (1828.8) ④	12X	72.00 (1828.8) ④	12X
600	290	—	—	—	—	—	—	450	500	500	600	1200	72.00 (1828.8) ④⑤⑥	12X	72.00 (1828.8) ④⑤⑥	12X

① Severe-duty ampere rating. See Table 29.1-20 below.

② Option adds 6.00 inches (152.4 mm) (1X) to 37 and 66A units.

③ Severe-duty ratings listed reflect the maximum starting duty these units are designed to supply. For higher ratings, please contact factory.

④ Fixed assemblies, no RotoTract.

⑤ Consult factory for width of unit.

⑥ Bottom exit only. Top exit unit is 24.00 inches (609.6 mm) wide (rear is unusable).

**Note:** Most motors used in industrial applications are 1.15 Service factor (SF).

Table 29.1-19. Control Options

Extra 50 VA Control Power Transformer ⑦
24 Vdc Control ⑦
Line or Load MOV Protection ⑦
Pump Control Option ⑦
DeviceNet Communications Module ⑦

⑦ Option fits in standard unit space.

Table 29.1-20. Severe-Duty Ratings

Ramp Current % of FLA	Ramp Time	Starts Per Hour	Similar to Starting Method
450%	30 seconds	4	Soft start
500%	10 seconds	10	Full voltage
350%	65 seconds	3	Wye delta
480%	25 seconds	4	80% RVAT
390%	40 seconds	4	65% RVAT
300%	60 seconds	4	50% RVAT

Table 29.1-21. Option Sizing for Isolating Contactor and Bypass Starter

<i>IT</i> . Width (mm)	Fused Switch Type (Amperes)	Starter Size	Option Unit Size Inches (mm) ⑧	FlashGard Unit Size Inches (mm)	Structure Width Inches (mm)
65	30/60/100	1, 2, 3	36.00 (914.4)	36.00 (914.4)	20.00 (508.0)
110	100	3	42.00 (1066.8)	42.00 (1066.8)	20.00 (508.0)
110	200	4	54.00 (1371.6)	54.00 (1371.6)	20.00 (508.0)
200	400/800	5, 6	72.00 (1828.8) ⑧	72.00 (1828.8) ⑧	32.00 (812.8)
290	600/800	6	72.00 (1828.8) ⑧	72.00 (1828.8) ⑧	36.00 (914.4)
290	800/1200	7	72.00 (1828.8) ⑧	72.00 (1828.8) ⑧	64.00 (1625.6)

⑧ Unit size includes space for *IT*. starter and option.

⑨ Fixed assemblies, no RotoTract.

## Layout and Technical Data

SVX9000 1–30 hp at 480V Plug-in  
Adjustable Frequency Drive Units

All Eaton's standard units include a disconnect, an AC choke, an output reactor and a door-mounted keypad. All plug-in units have a built-in dynamic braking circuit, M3 frame. Standard unit drives do not include a CPT.

**Note:** Output reactor not included on 240V units. Standard on 380–500V drives up to 125 hp (CT rating).

**CT ( $I_H$ ):** High overload drives are capable of producing 200% starting torque for 10 seconds and are rated 150% overload for one minute. Essentially a constant torque drive.

**VT ( $I_L$ ):** Low overload drives are capable of producing 200% starting torque for 10 seconds and are rated 110% overload for one minute. Essentially a variable torque drive.

Table 29.1-22. Freedom 2100 SVX9000 Adjustable Frequency Drives  
—Dimensions in Inches (mm)

I <sub>H</sub> /I <sub>L</sub> Amperes	Nominal hp I <sub>H</sub> /I <sub>L</sub>	CB Type ①		Standard Unit Space		Typical Options Unit Space		Max. Option Unit Space	
		HMCP	MCCB	Dim.	(X)	Dim. ①	(X)	Dim.	(X)
200–240V									
3.6	.75	7	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
4.7	1	15	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
5.6	1.5	15	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
7	2	15	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
10	3	15	25	24.00 (609.6)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
16	5	30	40	24.00 (609.6)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
22	7.5	50	50	24.00 (609.6)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
30	10	50	70	36.00 (914.4)	7X	48.00 (1219.2)	8X	54.00 (1371.6)	9X
43	15	100	100	36.00 (914.4)	7X	48.00 (1219.2)	8X	54.00 (1371.6)	9X
57	20	100	125	36.00 (914.4)	7X	48.00 (1219.2)	8X	54.00 (1371.6)	9X
380–500V									
2.2	1	7	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
3.3	1.5	7	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
4.3	2	7	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
5.6	3	15	15	18.00 (457.2)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
7.6	5	15	15	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
12	7.5	30	25	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
16	10	30	35	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
23	15	30	50	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
31	20	50	60	36.00 (914.4)	6X	48.00 (1219.2)	8X	54.00 (1371.6)	9X
38	25	50	80	36.00 (914.4)	6X	48.00 (1219.2)	8X	54.00 (1371.6)	9X
46	30	100	100	36.00 (914.4)	6X	48.00 (1219.2)	8X	54.00 (1371.6)	9X

<sup>①</sup> For fusible disconnect, use typical option unit.

**Note:** Drive units fit into a standard 20.00-inch (508.0 mm) wide MCC structure.

Table 29.1-23. SVX9000 Adjustable Frequency Drives in NEMA 3R MCCs  
—Dimensions in Inches (mm) <sup>②</sup>

$I_H$ Amperes	Nominal hp $I_H$ <sup>③</sup>	$I_L$ Amperes	Nominal hp $I_L$	CB Type <sup>④</sup>		Unit Space (Typ./Max)	
				HMCP	MCCB	Dim.	(X)
2.2	1.0	3.3	1.5	7	15	30.00 (762.0)	5X
3.3	1.5	4.3	2.0	7	15	30.00 (762.0)	5X
4.3	2.0	5.6	3.0	7	15	30.00 (762.0)	5X
5.6	3.0	7.6	5.0	15	15	30.00 (762.0)	5X
7.6	5.0	12.0	7.5	15	15	30.00 (762.0)	5X
12.0	7.5	16.0	10.0	30	25	72.00 (1828.8)	12X
16.0	10.0	23.0	15.0	30	35	72.00 (1828.8)	12X
23.0	15.0	31.0	20.0	30	50	72.00 (1828.8)	12X
31.0	20.0	38.0	25.0	50	60	72.00 (1828.8)	12X
38.0	25.0	46.0	30.0	50	80	72.00 (1828.8)	12X
46.0	30.0	61.0	40.0	100	100	72.00 (1828.8)	12X

<sup>②</sup> This table is common for both Freedom 2100 and Freedom FlashGard MCC.

<sup>③</sup> A separate CPT bucket is provided for all AFDs (1–5 hp) listed in the table.

<sup>④</sup> For fusible disconnect, use typical option unit.

**Note:** Drive units fit into a standard 20.00-inch (508.0 mm) wide structure.

## Layout and Technical Data

**Table 29.1-24. Freedom FlashGard Adjustable Frequency Drives—Dimensions in Inches (mm)**

I <sub>H</sub> /I <sub>L</sub> Amperes	Nominal hp I <sub>H</sub> /I <sub>L</sub>	CB Type ①		Standard Unit Space		Typical Options Unit Space		Max. Option Unit Space	
		HMCP	MCCB	Dim.	(X)	Dim. ①	(X)	Dim.	(X)
200–240V									
3.6	.75	7	15	24.00 (609.6)	4X	30.00 (762.0)	5X	36.00 (914.4)	6X
4.7		15	15	24.00 (609.6)	4X	30.00 (762.0)	5X	36.00 (914.4)	6X
5.6		15	15	24.00 (609.6)	4X	30.00 (762.0)	5X	36.00 (914.4)	6X
7		15	15	24.00 (609.6)	4X	30.00 (762.0)	5X	36.00 (914.4)	6X
10	3	15	25	30.00 (762.0)	5X	36.00 (914.4)	6X	42.00 (1066.8)	7X
16	5	30	40	30.00 (762.0)	5X	36.00 (914.4)	6X	42.00 (1066.8)	7X
22	7.5	50	50	30.00 (762.0)	5X	36.00 (914.4)	6X	42.00 (1066.8)	7X
30		50	70	30.00 (762.0)	5X	48.00 (1219.2)	8X	54.00 (1371.6)	9X
43	15	100	100	42.00 (1066.8)	7X	54.00 (1371.6)	9X	60.00 (1524.0)	10X
57	20	100	125	42.00 (1066.8)	7X	54.00 (1371.6)	9X	60.00 (1524.0)	10X
380–500V									
2.2	1	7	15	24.00 (609.6)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
3.3	1.5	7	15	24.00 (609.6)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
4.3	2	7	15	24.00 (609.6)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
5.6	3	15	15	24.00 (609.6)	3X	30.00 (762.0)	5X	36.00 (914.4)	6X
7.6	5	15	15	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
12	7.5	30	25	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
16	10	30	35	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
23	15	30	50	30.00 (762.0)	4X	36.00 (914.4)	6X	42.00 (1066.8)	7X
31	20	50	60	42.00 (1066.8)	7X	54.00 (1371.6)	8X	60.00 (1524.0)	10X
35	25	50	80	42.00 (1066.8)	7X	54.00 (1371.6)	8X	60.00 (1524.0)	10X
46	30	100	100	42.00 (1066.8)	7X	54.00 (1371.6)	8X	60.00 (1524.0)	10X

<sup>①</sup> For fusible disconnect, use typical option unit.

**Note:** Drive units fit into a standard 20.00-inch (508.0 mm) wide MCC structure.

**Table 29.1-25. Plug-in Options**

Plug-in Options	
<b>Option Boards <sup>②</sup></b>	
I/O Expander	③
Encoder Expander	③
Interbus S Communications	③
Modbus Communications	③
PROFIBUS DP Communications	③
LonWorks Communications	③
Can Open (Slave) Communications	③
DeviceNet Communications	④
Johnson Controls N2 Communications	③
PROFIBUS DP (D9 Connector)	③
EtherNet/IP Communications	③
Modbus TCP Communications	③
Modbus (D9 Connector)	③
<b>Plug-in Control Relays</b>	
One relay	⑤
Two relays	⑤
Three relays	⑥
<b>Other Options</b>	
Automatic bypass circuit	⑦
Bypass drive test switch	⑦
Seven relay 120V control with CPT	⑤
Isolated signal processor	③
3–15 PSIG interface	③
Dynamic breaking resistors	⑧
Graphics keypad	④
Line fuses	③⑤
RFI filter	④
Deduct to remove output filter	⑨
KLC 2000 ft (610m) Dv/Dt filter	⑥
Output contactor	③
Dual overloads	③⑥
Three contactor bypass	③⑥

<sup>②</sup> Up to five option boards may be selected. Please see **Tab 31** for detailed information.

<sup>③</sup> All options will fit in typical and maximum option unit.

<sup>④</sup> This option will fit in all units.

<sup>⑤</sup> One of these options will fit in 5–30 hp CT at 480V frame standard units, 1–30 hp CT at 480V typical and maximum option units.

<sup>⑥</sup> All options will fit in maximum option unit.

<sup>⑦</sup> Use with bypass option.

<sup>⑧</sup> DB resistors are to be mounted by the customer external to the MCC.

<sup>⑨</sup> Not available for 240V units.

**Note:** Output reactor or Dv/Dt filter not required for motor lead lengths shorter than 100 feet (30.4m)—30 feet (9.1m) for 2 hp and below).

**Note:** Maximum motor lead length is 160 feet (48.8m) for 1.5 hp and below, 330 feet (100.6m) for 2 hp and 400 feet (121.9m) for 3 hp and larger when using a standard output reactor.

**Note:** Motor lead lengths up to 2000 feet (609.6m) can be achieved by using the KLC Dv/Dt filter.



## Layout and Technical Data

**SVX9000 30–200 hp at 480V  
Non-Plug-in Adjustable  
Frequency Drive Units**

All Eaton's standard units include a disconnect, a line reactor, an output reactor and a door-mounted keypad. Standard units of 9X unit space must be located in the bottom of the MCC and there is no vertical bus in the lower 48.00 inches (1219.2 mm). There is no vertical bus for 12X units.

**Note:** Output reactor not included on 200–240V units. Standard on 380–690V drives up to 125 hp (CT rating).

**CT (I<sub>H</sub>):** High overload drives are capable of producing 200% starting torque for 10 seconds and are rated 150% overload for one minute. Essentially a constant torque drive.

**VT (I<sub>L</sub>):** Low overload drives are capable of producing 200% starting torque for 10 seconds and are rated 110% overload for one minute. Essentially a variable torque drive.

**Table 29.1-26. Freedom 2100 SVX9000 Adjustable Frequency Drives  
—Dimensions in Inches (mm)**

I <sub>H</sub> Amperes	Nominal hp I <sub>H</sub>	I <sub>L</sub> Amperes	Nominal hp I <sub>L</sub>	CB Type ①		Standard Unit Space		Drive Option Space	
				HMCP	MCCB	Dim.	(X)	Dim.	(X)
200–240V									
—	—	70	25	100	125	54.00 (1371.6)	9X	72.00 (1828.8)	12X
70	25	83	30	100	175	54.00 (1371.6)	9X	72.00 (1828.8)	12X
83	30	113	40	100	200	54.00 (1371.6)	9X	72.00 (1828.8)	12X
113	40	139	50	150	150	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
139	50	165	60	—	—	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
165	60	200	75	—	—	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
200	75	264	100	—	—	72.00 (1828.8) ②	12X	72.00 (1828.8) ④	12X
380–500V, 50/60 Hz									
—	—	61	40	100	125	54.00 (1371.6)	9X	72.00 (1828.8)	12X
61	40	72	50	100	150	54.00 (1371.6)	9X	72.00 (1828.8)	12X
72	50	87	60	100	175	54.00 (1371.6)	9X	72.00 (1828.8)	12X
87	60	105	75	150	225	54.00 (1371.6)	9X	72.00 (1828.8)	12X
105	75	140	100	150	300	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
140	100	170	125	250	400	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
170	125	205	150	400	500	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
205	150	—	—	—	—	72.00 (1828.8) ②	12X	72.00 (1828.8) ④	12X
—	—	261	200	400	600	72.00 (1828.8) ②	12X	72.00 (1828.8) ④	12X
245	200	300	250	400	600	72.00 (1828.8) ②	12X	72.00 (1828.8) ④	12X

① Drives with fusible disconnects require drive with option space.

② 28.00-inch (711.2 mm) wide, 21.00-inch (533.4 mm) deep enclosure with built-in panel.

③ 32.00-inch (812.8 mm) wide, 21.00-inch (533.4 mm) deep enclosure built-in panel.

④ 40.00-inch wide (1016.0 mm), 21.00-inch (533.4 mm) deep enclosure with built-in panel.

**Table 29.1-27. SVX9000 Adjustable Frequency Drives in NEMA 3R MCCs  
—Dimensions in Inches (mm) ⑤**

I <sub>H</sub> Amperes	Nominal hp I <sub>H</sub> ⑥	I <sub>L</sub> Amperes	Nominal hp I <sub>L</sub>	CB Type ②		Unit Space (Typ./Max)	
				HMCP	MCCB	Dim.	(X)
2.2	1.0	3.3	1.5	7	15	30.00 (762.0)	5X
3.3	1.5	4.3	2.0	7	15	30.00 (762.0)	5X
4.3	2.0	5.6	3.0	7	15	30.00 (762.0)	5X
5.6	3.0	7.6	5.0	15	15	30.00 (762.0)	5X
7.6	5.0	12.0	7.5	15	15	30.00 (762.0)	5X
12.0	7.5	16.0	10.0	30	25	72.00 (1828.8)	12X
16.0	10.0	23.0	15.0	30	35	72.00 (1828.8)	12X
23.0	15.0	31.0	20.0	30	50	72.00 (1828.8)	12X
31.0	20.0	38.0	25.0	50	60	72.00 (1828.8)	12X
38.0	25.0	46.0	30.0	50	80	72.00 (1828.8)	12X
46.0	30.0	61.0	40.0	100	100	72.00 (1828.8)	12X
61.0	40.0	72.0	50.0	100	125	72.00 (1828.8)	12X
72.0	50.0	87.0	60.0	100	150	72.00 (1828.8) ⑧	12X
87.0	60.0	105.0	75.0	150	175	72.00 (1828.8) ⑧	12X
105.0	75.0	140.0	100.0	150	225	72.00 (1828.8) ⑧	12X
140.0	100.0	170.0	125.0	250	300	72.00 (1828.8) ⑧	12X
170.0	125.0	205.0	150.0	400	400	72.00 (1828.8) ⑧	12X
205.0	150.0	261.0	200.0	400	600	72.00 (1828.8) ⑧	12X
245.0	200.0	—	—	400	600	72.00 (1828.8) ⑧	12X

⑤ This table is common for both Freedom 2100 and Freedom FlashGard MCC.

⑥ A separate CPT bucket is provided for all AFDs (1–5 hp) listed in the table.

⑦ For fusible disconnect, use typical option unit.

⑧ 32.00-inch (812.8 mm) wide, 21.00-inch (533.4 mm) deep enclosure built-in panel.

**Note:** Drive units fit into a standard 20.00-inch (508.0 mm) wide structure.

## Layout and Technical Data

**Table 29.1-28. Freedom FlashGard SVX9000 Adjustable Frequency Drives**  
—Dimensions in Inches (mm)

I <sub>H</sub> Amperes	Nominal hp I <sub>H</sub>	I <sub>L</sub> Amperes	Nominal hp I <sub>L</sub>	CB Type ①		Standard Unit Space		Drive Option Space	
				HMCP	MCCB	Dim.	(X)	Dim.	(X)
200–240V									
—	—	70	25	100	125	60.00 (1524.0)	10X	72.00 (1828.8)	12X
70	25	83	30	100	175	60.00 (1524.0)	10X	72.00 (1828.8)	12X
83	30	113	40	100	200	60.00 (1524.0)	10X	72.00 (1828.8)	12X
113	40	139	50	150	150	60.00 (1524.0)	10X	72.00 (1828.8) ③	12X
139	50	165	60	—	—	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
165	60	200	75	—	—	72.00 (1828.8)	12X	72.00 (1828.8) ③	12X
200	75	264	100	—	—	72.00 (1828.8) ②	12X	72.00 (1828.8) ④	12X
380–500V, 50/60 Hz									
—	—	61	40	100	125	60.00 (1524.0)	10X	72.00 (1828.8)	12X
61	40	72	50	100	150	60.00 (1524.0)	10X	72.00 (1828.8)	12X
72	50	87	60	100	175	60.00 (1524.0)	10X	72.00 (1828.8)	12X
87	60	105	75	150	225	60.00 (1524.0)	10X	72.00 (1828.8)	12X
105	75	140	100	150	300	72.00 (1828.8)	12X	72.00 (1828.8) ③⑤	12X
140	100	170	125	250	400	72.00 (1828.8)	12X	72.00 (1828.8) ③⑤	12X
170	125	205	150	400	500	72.00 (1828.8)	12X	72.00 (1828.8) ③⑤	12X
205	150	—	—	—	—	72.00 (1828.8) ②⑤	12X	72.00 (1828.8) ④⑤	12X
—	—	261	200	400	600	72.00 (1828.8) ②⑤	12X	72.00 (1828.8) ④⑤	12X
245	200	300	250	400	700	72.00 (1828.8) ②⑤	12X	72.00 (1828.8) ④⑤	12X

- ① Drives with fusible disconnects require drive with option space.  
 ② 28.00-inch (711.2 mm) wide, 21.00-inch (533.4 mm) deep enclosure with built-in panel.  
 ③ 32.00-inch (812.8 mm) wide, 21.00-inch (533.4 mm) deep enclosure with built-in panel.  
 ④ 40.00-inch wide (1016.0 mm), 21.00-inch (533.4 mm) deep enclosure with built-in panel.  
 ⑤ Fixed assemblies, no RotoTract for VFD unit. Breaker disconnect unit for the drive is provided with RotoTract mechanism.

**Table 29.1-29. Non-Plug-in Options**

Non Plug-in Options	
<b>Option Boards ⑥</b>	
I/O Expander	⑦
Encoder Expander	⑦
Interbus S Communications	⑦
Modbus Communications	⑦
PROFIBUS DP Communications	⑦
LonWorks Communications	⑦
Can Open (Slave) Communications	⑦
DeviceNet Communications	⑦
Johnson Controls N2 Communications	⑧
PROFIBUS DP (D9 Connector)	⑧
EtherNet/IP Communications	⑧
Modbus TCP Communications	⑧
Modbus (D9 Connector)	⑧
<b>Plug-in Control Relays</b>	
One relay	⑦
Two relays	⑦
Three relays	⑦
<b>Other Options</b>	
Automatic bypass circuit	⑨
Bypass drive test switch	⑨
Seven relay 120V control with CPT	⑦
Isolated signal processor	⑧
3–15 PSIG interface	⑧
Dynamic breaking resistors	⑩
Graphics keypad	⑦
Line fuses	⑧
RFI filter	⑧
Deduct to remove output filter	⑩
KLC 1000 ft (305m) Dv/Dt filter	⑧
Output contactor	⑧
Dual overloads	⑧
Three contactor bypass	⑧
Dynamic breaking circuit	⑦

- ⑥ Up to five option boards may be selected. Please see **Tab 31** for detailed information.  
 ⑦ This option will fit in all units.  
 ⑧ All options will fit in option unit.  
 ⑨ Use with bypass option.  
 ⑩ DB resistors are to be mounted by the customer external to the MCC.  
 ⑪ Not available for 240V units.

**Note:** Output reactor or Dv/Dt filter not required for motor lead lengths shorter than 100 feet (30.4m)—30.00 feet (9.1m) for 2 hp and below).

**Note:** Maximum motor lead length is 160 feet (48.8m) for 1.5 hp and below, 330 feet (100.6m) for 2 hp and 400 feet (121.9m) for 3 hp and larger when using a standard output reactor.

**Note:** Motor lead lengths up to 2000 feet (609.6m) can be achieved by using the KLC Dv/Dt filter.

**Note:** Fusible units take option unit space. Not all options will fit in fusible units.

## Layout and Technical Data

**SVX9000 250–600 hp at 480V  
Multi-Structure Adjustable  
Frequency Drive Units**

All Eaton's standard units include a disconnect, a line reactor and a door-mounted keypad. Disconnect and drive unit are in separate structures, structures are mechanically interlocked. Structures have no vertical bus. These drives are bottom exit only.

**I<sub>H</sub> (CT):** High overload drives are capable of producing 200% starting torque for 10 seconds and are rated 150% overload for one minute. Essentially a constant torque drive.

**I<sub>L</sub> (VT):** Low overload drives are capable of producing 200% starting torque for 10 seconds and are rated 110% overload for one minute. Essentially a variable torque drive.

**Table 29.1-30. Freedom 2100 SVX9000 Adjustable Frequency Drives**  
—Dimensions in Inches (mm) <sup>①</sup>

I <sub>H</sub> Amperes	Nominal hp I <sub>H</sub>	I <sub>L</sub> Amperes	Nominal hp I <sub>L</sub>	CB Type ②		Standard Unit Space		Drive Option Space	
				HMCP	MCCB	Dim.	(X)	Dim.	(X)
380–500V									
330	250	385	300	400	800	72.00 (1828.8) ③⑤	12X	72.00 (1828.8) ④⑤	12X
385	300	520	400	600	800	72.00 (1828.8) ③⑤	12X	72.00 (1828.8) ④⑤	12X
520	400	590	500	600	1200	72.00 (1828.8) ⑤⑥	12X	⑦	12X
590	500	730	600	1200	1600	72.00 (1828.8) ⑤⑥	12X	⑦	12X
730	600	—	—	1200	1600	72.00 (1828.8) ⑤⑥	12X	⑦	12X

<sup>①</sup> The drives listed in this table are fixed assemblies and not available with RotoTract mechanism.

<sup>②</sup> Drives with fusible disconnects require drive with option space.

<sup>③</sup> 60.00-inch (1524.0 mm) wide unit. Drive is in a 40.00-inch (1016.0 mm) wide structure and disconnect is in a 20.00-inch (508.0 mm) wide structure.

<sup>④</sup> 80.00-inch (2032.0 mm) wide unit. Drive is in a 40.00-inch (1016.0 mm) wide structure and disconnect is in a 40.00-inch (1016.0 mm) wide structure.

<sup>⑤</sup> Fixed assemblies, no RotoTract.

<sup>⑥</sup> 68.00-inch (1727.2 mm) wide unit. Drive is in a 48.00-inch (1219.2 mm) wide structure and disconnect is in a 20.00-inch (508.0 mm) wide structure.

<sup>⑦</sup> Contact factory for sizing.

<sup>⑧</sup> 100.00-inch (2540.0 mm) wide unit. 80.00-inch (2032.0 mm) drive is in (2) 40.00-inch (1016.0 mm) wide structures, disconnect is in a 20.00-inch (508.0 mm) wide structure.

<sup>⑨</sup> 116.00-inch (2946.4 mm) wide unit. 96.00-inch (2438.4 mm) drive is in (2) 48.00-inch (1219.2 mm) wide structures, disconnect is in a 20.00-inch (508.0 mm) wide structure.

**Table 29.1-31. Multi-Structure Options**

Plug-in Options	
<b>Option Boards <sup>⑩</sup></b>	
I/O Expander	⑪
Encoder Expander	⑪
Interbus S Communications	⑪
Modbus Communications	⑪
PROFIBUS DP Communications	⑪
LonWorks Communications	⑪
Can Open (Slave) Communications	⑪
DeviceNet Communications	⑪
Johnson Controls N2 Communications	⑫
PROFIBUS DP (D9 Connector)	⑫
EtherNet/IP Communications	⑫
Modbus TCP Communications	⑫
Modbus (D9 Connector)	⑫

**Plug-in Control Relays**

One relay	⑬
Two relays	⑬
Three relays	⑬

**Other Options**

Automatic bypass circuit	⑭
Bypass drive test switch	⑭
Seven relay 120V control with CPT	⑭
Isolated signal processor	⑭
3–15 PSIG Interface	⑭
Dynamic breaking resistors	⑮
Graphics keypad	⑮
Line fuses	⑮⑯
RFI filter	⑮
Deduct to remove output filter	⑰
KLC 2000 ft (610m) Dv/Dt filter	⑮⑯
Output contactor	⑮⑯
Three contactor bypass	⑮⑯
Dynamic breaking circuit	⑮

<sup>⑩</sup> Up to five option boards may be selected. Please see **Tab 31** for detailed information.

<sup>⑪</sup> This option will fit in all units.

<sup>⑫</sup> All options will fit in Option unit.

<sup>⑬</sup> Use with bypass option.

<sup>⑭</sup> DB resistors are to be mounted by the customer external to the MCC.

<sup>⑮</sup> Dv/Dt filter not available 700 hp and above.

<sup>⑯</sup> Consult factory for sizing and availability.

**Note:** Output reactor or Dv/Dt filter not required for motor lead lengths shorter than 100 feet (30.4m)—30 feet (9.1m) for 2 hp and below).

**Note:** Maximum motor lead length is 160 feet (48.8m) for 1.5 hp and below, 330 feet (100.6m) for 2 hp and 400 feet (121.9m) for 3 hp and larger when using a standard output reactor.

**Note:** Motor lead lengths up to 2000 feet (609.6m) can be achieved by using the KLC Dv/Dt filter.

**Note:** Fusible units take option unit space. Not all options will fit in fusible units.

**Layout and Technical Data**
**CPX9000 Clean Power Drives  
1–500 hp at 480V**

Eaton's CPX9000 Clean Power Drives use advanced 18-pulse, clean-power technology that significantly reduces line harmonics at the drive input terminals, resulting in one of the purest sinusoidal waveforms.

**I<sub>H</sub> (CT):** High overload drives are capable of producing 200% starting torque for 10 seconds and are rated 150% overload for one minute. Essentially a constant torque drive.

**I<sub>L</sub> (VT):** Low overload drives are capable of producing 200% starting torque for 10 seconds and are rated 110% overload for one minute. Essentially a variable torque drive.

**Table 29.1-32. CPX9000 Low Overload Clean Power Drives, Thermal-Magnetic Breaker and Motor Circuit Protector (MCP) Disconnect—Dimensions in Inches (mm) ①**

Low Overload Drive ②		High Overload Drive ②		CB Type ③		Standard Unit Space Dimensions Inches (mm) ④			
I <sub>L</sub> Amperes	Nominal hp I <sub>L</sub>	I <sub>H</sub> Amperes	Nominal hp I <sub>H</sub>	HMCP	MCCB	Width	Height	Depth	(X)
34	25 ⑤	27	20 ⑤	50	80	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
40	30 ⑤	34	25 ⑤	100	100	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
52	40 ⑤	40	30 ⑤	100	125	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
65	50 ⑤	52	40 ⑤	100	150	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
77	60 ⑤	65	50 ⑤	100	175	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
96	75 ⑤	77	60 ⑤	150	225	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
124	100 ⑤	96	75 ⑤	150	300	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
156	125 ⑤	124	100 ⑤	250	400	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
180	150 ⑤	156	125 ⑤	400	400	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
240	200	180	150	600	600	60.00 (1524.0)	90.00 (2286.0)	21.00 (533.4)	12X
302	250	240	200	600	600	60.00 (1524.0)	90.00 (2286.0)	21.00 (533.4)	12X
361	300 ⑥	302	250 ⑥	600	600	68.00 (1727.2)	90.00 (2286.0)	21.00 (533.4)	12X
414	350 ⑥	361	300 ⑥	600	600	68.00 (1727.2)	90.00 (2286.0)	21.00 (533.4)	12X
477	400 ⑥	414	350 ⑥	600	600	68.00 (1727.2)	90.00 (2286.0)	21.00 (533.4)	12X
515	450 ⑥	477	400 ⑥	1200	1200	106.00 (2692.4)	90.00 (2286.0)	28.00 (711.2)	12X
590	500 ⑥	515	450 ⑥	1200	1200	106.00 (2692.4)	90.00 (2286.0)	28.00 (711.2)	12X

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

② The CPX9000 drive uses the term Low Overload (I<sub>L</sub>) in place of the term "Variable Torque" and High Overload (I<sub>H</sub>) in place of the term "Constant Torque."

③ CPX9000 Drives in MCCs are available in thermal-magnetic breaker, motor circuit protector and fused disconnect configurations.

④ A minimum clearance of 4.00 inches (101.6 mm) should be provided at the back of CPX9000 Drive MCC section for ventilation.

⑤ Add 32.00 inches (812.8 mm) of width for bypass.

⑥ Requires 4.00 inches (101.6 mm) in rear for ventilation.

**Table 29.1-33. CPX9000 Low Overload Clean Power Drives, Fusible Switch Disconnect—Dimensions in Inches (mm) ⑦**

Low Overload Drive ⑧		High Overload Drive ⑧		Fuse Switch		Standard Unit Space Dimensions Inches (mm) ⑨			
I <sub>L</sub> Amperes	Nominal hp I <sub>L</sub>	I <sub>H</sub> Amperes	Nominal hp I <sub>H</sub>	Fuse	Switch	Width	Height	Depth	(X)
34	25 ⑩	27	20 ⑩	50	60	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
40	30 ⑩	34	25 ⑩	60	60	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
52	40 ⑩	40	30 ⑩	80	100	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
65	50 ⑩	52	40 ⑩	100	100	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
77	60 ⑩	65	50 ⑩	100	100	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
96	75 ⑩	77	60 ⑩	100	100	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
124	100 ⑩	96	75 ⑩	175	200	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
156	125 ⑩	124	100 ⑩	200	200	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
180	150 ⑩	156	125 ⑩	250	400	40.00 (1016.0)	90.00 (2286.0)	21.00 (533.4)	12X
240	200	180	150	350	600	60.00 (1524.0)	90.00 (2286.0)	21.00 (533.4)	12X
302	250	240	200	450	600	60.00 (1524.0)	90.00 (2286.0)	21.00 (533.4)	12X
361	300 ⑪	302	250 ⑪	600	600	68.00 (1727.2)	90.00 (2286.0)	21.00 (533.4)	12X
414	350 ⑪	361	300 ⑪	600	600	68.00 (1727.2)	90.00 (2286.0)	21.00 (533.4)	12X
477	400 ⑪	414	350 ⑪	600	600	68.00 (1727.2)	90.00 (2286.0)	21.00 (533.4)	12X
515	450 ⑪	477	400 ⑪	800	1200	106.00 (2692.4)	90.00 (2286.0)	28.00 (711.2)	12X
590	500 ⑪	515	450 ⑪	800	1200	106.00 (2692.4)	90.00 (2286.0)	28.00 (711.2)	12X

⑦ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑧ The CPX9000 product uses the term Low Overload (I<sub>L</sub>) in place of the term "Variable Torque" and High Overload (I<sub>H</sub>) in place of the term "Constant Torque."

⑨ A minimum clearance of 4.00 inches (101.6 mm) should be provided at the back of CPX9000 Drive MCC section for ventilation.

⑩ Add 32.00 inches (812.8 mm) of width for bypass.

⑪ Requires 4.00 inches (101.6 mm) in rear for ventilation.



## Layout and Technical Data

## Option Groups for AC Combination Starters, AC Drives

**Note:** Option groups are common to both Freedom 2100 and Freedom FlashGard MCCs.

## Option Group A

Table 29.1-34. Wiring Class

Description
NEMA Class IA <sup>①</sup> NEMA Class IC
NEMA Class IIB NEMA Class IIC NEMA Class IS (includes 1B wiring and 2B schematics)

<sup>①</sup> Control terminal blocks and device panels not included with NEMA 1A wiring.

Table 29.1-35. 100 kA Circuit Breaker Starter Interrupting Capacity

Starter Type	Voltage
Starters with HMCPs Starters with thermal-magnetic circuit breakers	480 480
Starters with HMCPs Starters with thermal-magnetic circuit breakers	600 <sup>②</sup> 600 <sup>②</sup>

<sup>②</sup> Current limiter attachments are used. Add 6.00 inches (152.4 mm) to all size 3 and 4 starters.

Table 29.1-36. Control Circuit Transformers—Typical Sizing <sup>③</sup>

Starter Size
1, 2 (100 VA)—includes extra 50 VA 3, 4 (150 VA)—includes extra 50 VA 5, 6 (250 VA)—includes extra 50 VA
Extra 50 VA, size 1, 2 Extra 100 VA, size 3, 4 Extra 150 VA, size 5, 6

<sup>③</sup> Refer to **Table 29.1-86** for actual ratings.

**Note:** Price includes one secondary and two primary fuses.

Table 29.1-37. Control Circuit Fusing

Description
Control fuse and auxiliary switch Control fuse Blown fuse indicator

**Note:** Required in accordance with NEC for all starter units with control wiring external to the MCC. See NEC, General for exceptions.

Table 29.1-38. Motor Starter Auxiliary Contacts

Description
1NO or 1NC (sizes 1–4) 1NO or 1NC (sizes 5–6)
Maximum of eight on each contactor <sup>④</sup> Maximum of four on each contactor

<sup>④</sup> Maximum of four per contactor on multi-contactor starters and 6.00-inch (152.4 mm) units.

Table 29.1-39. Interlock for Switch or Breaker Operator

Description
1NO–1NC 2NO–2NC

**Note:** For use when control circuit is fed from an external source.

Table 29.1-40. Internal Circuit Breaker Options

Description
Alarm contact Auxiliary 1NO–1NC Auxiliary 2NO–2NC 120V shunt trip 50°C (thermal-magnetic)

Table 29.1-41. Terminal Blocks

Description
Side mounted <sup>⑤</sup> (Will accept stripped wire or ring/spade wire lug—12 AWG bare/14 AWG ring/spade)
Front rail—pressure connector Front rail—pull apart Front rail—utility/accepts ring wire lug.
Additional 6.00-inch (152.4 mm) space required for Freedom starters sizes 1–4

<sup>⑤</sup> Use Burndy YAEV10-L36 for #10 AWG compression termination.

Table 29.1-42. Control Wire Options

Description
#16 AWG (standard) #14 AWG Wire markers Spade wire terminals Ring wire terminals <sup>⑥</sup> Wiring to common CPT
SIS power wire—substitution SIS control wire—substitution Starter Class 2 interwiring/per wire

<sup>⑥</sup> Freedom Starter control terminals only available with spade wire terminals.

Table 29.1-43. Miscellaneous Options

Description
Mini ammeter and CT <sup>⑦</sup> Mini voltmeter Mini elapsed time meter
Panel elapsed time meter <sup>⑧</sup> Operations counter Wiring diagram on door Coil surge suppressor
CT for remote metering (requires additional 6.00-inch (152.4 mm) space) Heater packs installed Device labels Blank device panels

<sup>⑦</sup> May add 6.00 inches (152.4 mm) to unit size. Consult factory.

<sup>⑧</sup> May add 6.00 inches (152.4 mm). Consult factory.

Table 29.1-44. Vacuum Contactors in Lieu of Air Break

Starter Type
FVNR FVR, 2S2W, PW RVAT, 2S1W, YD-Open YD-Closed
Available sizes 4–6

Table 29.1-45. Ground Fault Protection—Instantaneous or Adjustable

Description
D64 relay (with zero sequence CT)
Requires additional 6.00-inch (152.4 mm) space

## Layout and Technical Data

**Note:** Option groups are common to both Freedom 2100 and Freedom FlashGard MCCs.

Table 29.1-46. Power Fuses—R, J Type

Ampere Rating	
30	Optional
60	Optional
100	Optional
200	Optional
400	Optional
600	Optional

Table 29.1-47. Power Factor Capacitor Options

Description
Blown power fuse indicator (set of three—one per phase)

Table 29.1-48. Current Limiter Attachment for HMCP

Description	
Size 1–2	—
Size 3	Requires additional 6.00-inch (152.4 mm) space
Size 4	Requires additional 6.00-inch (152.4 mm) space

## Option Group B

Devices may require extra unit space.

Table 29.1-49. Timing Relays

Type of Relay	Mounting
Solid-state timer Pneumatic—AGASTAT	Panel Panel on or off delay
24-hour motor timer 7-day timer Repeat cycle timer	Panel Panel Door or panel

Table 29.1-50. Control Relays

Number of Poles	Type
Two-pole Four-pole	General purpose Type D7 socket relay N300 fixed contacts
Two-pole Four-pole Six-pole Eight-pole Ten-pole	Type AR machine tool relays N600 convertible contacts
Two-pole Three-pole Four-pole Six-pole ① Eight-pole ①	Type M—D26 relays N600 convertible contacts

① The six- and eight-pole units can be provided with four additional non-convertible NO contacts.

Table 29.1-51. Alternators

Description	
Two-circuit alternator Three-circuit alternator	Panel (additional 6.00-inch (152.4 mm) space required on size 1s and size 2s)

## Option Group C

Devices may require extra unit space.

Table 29.1-52. Monitoring Relays

Type of Relay		
D60LA current sensing voltage transducer	— Price includes 1 PT	Additional 6.00-inch (152.4 mm) space required
AC current sensors with CTs ②	0–5 thru 0–100A 0–50 thru 0–300A 0–300 thru 0–600A	
AC current transducer, 4–20 mA, self-powered with CTs ③	All Ratings	
Phase monitoring relay—three-phase Watt transducer, 4–20 mA, self-powered CTs ③		

② Loop-powered devices—requires 24 Vdc power source, which is typically provided in the PLC.

③ Does not require separate 24 Vdc power source. Suitable for powering analog meters.

Table 29.1-53. Extra Bi-Metallic Overload Relay—Type C306

Description
Size 1—32A overload relay Size 2—75A overload relay Size 3—100A overload relay Size 4—144A overload relay

## Option Group D

Devices may require extra unit space.

Table 29.1-54. Solid-State Overload Relays

Description
C440 solid-state overload with ground fault protection ④ C441 Motor Insight MP-3000 motor protector MP-3000 RTD module

④ Size 4 starters require an additional 6.00-inch (152.4 mm) (1X) space when used with solid-state overloads.

## Layout and Technical Data

**Note:** Option groups are common to both Freedom 2100 and Freedom FlashGard MCCs.

**Option Group E****Table 29.1-55. Oiltight Pushbuttons, Lights, Selector Switches**

Device	Device Type
Pushbuttons 1 unit 2 unit 3 unit	10250T ①②
Selector switches 2 position 3 position 4 position Key operated adder	
Pilot lights Standard transformer 6V bulb Standard transformer LED bulb Push to test transformer 6V bulb Push to test LED bulb	E30 ①②
Pushbuttons 1 unit 2 unit 3 unit	
Selector switches 2 position 3 position 4 position Key operated adder	
Pilot lights Standard transformer 6V bulb Standard transformer LED bulb Push to test Transformer 6V bulb Push to test LED bulb	

① Maximum two devices per starter in dual units.

② Maximum of six devices without increasing compartment space.

**Option Group F****Options for 6.00-Inch (152.4 mm) Starter Units**

- Control terminal blocks are 300V rated and are limited to 12 points maximum
- Standard VA control transformer only

**Table 29.1-56. Oiltight Pushbuttons, Lights, Selector Switches**

Device	Device Type
Pushbuttons 1 unit 2 unit 3 unit	E22 ③
Selector switches 2 position 3 position 4 position Key operated adder	
Pilot lights Standard transformer 6V bulb Standard transformer LED bulb Push to test transformer 6V bulb Push to test LED bulb	

③ On 6.00-inch (152.4 mm) starter units, pilot devices are limited to three E22 devices.

**Option Group G****Table 29.1-57. Remote Racking System**

Description
Wired remote racking system for FlashGard MCC units

**Table 29.1-58. FlashGard Locking Accessory**

Description
Locking accessory for FlashGard MCC

**Option Group I****Optional Safety Accessories****Table 29.1-59. Automatic Insulation Tester**

Description
Automatic insulation tester
Automatic insulation tester with megohm meter (mounted in unit door)

**Table 29.1-60. Voltage Presence Indicator (VoltageVision)**

Description
Voltage presence indicator (mounted on unit door)

**Layout and Technical Data**
**Table 29.1-61. Main Incoming Line and Feeder Circuit Breakers—Molded-Case Circuit Breakers—Dimensions in Inches (mm) ①**

Frames reflect standard circuit breakers. Unit spacings shown include sufficient space to terminate cables on any standard breaker lug. If cable sizes exceed those listed, add 12.00-inch (304.8 mm) space for lug adapters.

Frame Size (Amperes)	Circuit Breaker Frame	Interrupting Capacity (kAIC)			Main Unit Size		Feeder Unit Size		Maximum Cable Size ②
		240V	480V	575V	Inches (mm)	X Space	Inches (mm)	X Space	
125 150	E125H HFD	100 100	65 65	25 25	12.00 (304.8) 18.00 (457.2)	2X 3X	12.00 (304.8) 12.00 (304.8)	1X ③ or 2X 2X	4/0 (one per phase) 4/0 (one per phase)
150 225	FDC HFD	100 100	100 65	35 35	18.00 (457.2) 18.00 (457.2)	3X 3X	12.00 (304.8) 18.00 (457.2)	2X 3X	4/0 (one per phase) 4/0 (one per phase)
225	J250 FDC	100 100	100 100	35 35	18.00 (457.2)	3X	18.00 (457.2)	1X ③ or 3X	4/0 (one per phase)
250	J250 JDC	100 100	65 100	35 35	24.00 (609.6) 30.00 (762.0)	4X 5X	18.00 (457.2)	3X	350 kcmil (one per phase)
400	HKD	100	65	25	30.00 (762.0)	5X	30.00 (762.0)	4X	250 kcmil (two per phase) or 500 kcmil (one per phase)
	KDC	100	100	50					
	CHKD ③④ CKDC ③④	100 100	65 100	25 50					
600	HLD	100	65	35	24.00 (609.6)	4X	30.00 (762.0)	5X	500 kcmil (two per phase)
	LDC	100	100	50					
	CHLD ③⑤ CLDC ③⑤	100 100	65 100	35 50			24.00 (609.6)	4X	
800	NDC	100	100	50	42.00 (1066.8)	7X	42.00 (1066.8)	7X	750 kcmil (three per phase)
	CHND ③ CNDC ③	100 100	65 100	35 50	72.00 (1828.8)	12X	72.00 (1828.8)	12X	
1200	HND ⑥ NDC ⑥	100 100	65 100	35 50	42.00 (1066.8)	7X	42.00 (1066.8)	7X	750 kcmil (three per phase)
	CHND ③⑤ CNDC ③⑤	100 100	65 100	35 50	72.00 (1828.8)	12X	72.00 (1828.8)	12X	
2000	RD ⑥ RDC ⑥ CRD ③ CRDC ③	100 100 100 100	65 100 65 100	50 65 50 65	72.00 (1828.8) ⑦	12X	72.00 (1828.8)	12X	750 kcmil (six per phase)
2500	RD RDC	100 100	65 100	50 65	72.00 (1828.8) ⑦⑧	12X	72.00 (1828.8)	12X	750 kcmil (six per phase)

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

② See circuit breaker terminal data for variations.

③ Digitrip 310 LS is required and included in the price.

④ Fixed assemblies, no RotoTract.

⑤ NEMA 1 gasketed only.

⑥ Digitrip 310 LS is standard and included in the pricing.

⑦ The main breaker requires the complete vertical section. The rear is unusable.

⑧ 24.00-inch (609.6 mm) wide.

⑨ Compact feeder units.

**Table 29.1-62. Main Circuit Breakers—Magnum DS Air Circuit Breakers Manually or Electrically Operated—Fixed Mounted—Dimensions in Inches (mm) ⑩**

Frame Size Amperes	Circuit Breaker Type	Interrupting Capacity (kAIC)			Unit Size	Enclosure Width	Enclosure Depth
		240V	480V	575V			
800	MDS-608 MDS-C08	65 100	65 100	65 100	72.00 (1828.8)	24.00 (609.6)	36.00 (914.4)
1600	MDS-616 MDS-C16	65 100	65 100	65 100			
2000	MDS-620 MDS-C20	65 100	65 100	65 100			
3200	MDS-632 MDS-C32	65 100	65 100	65 100			42.00 (1066.8)

⑩ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

**Note:** A 4.00-inch (101.6 mm) filler section must be added between the main and the rest of the MCC to allow for door opening.

## Layout and Technical Data

**Table 29.1-63. Main Circuit Breakers — Magnum DS Air Circuit Breakers, Manually or Electrically Operated**  
—Drawout Mounted—Dimensions in Inches (mm) ①

Frame Size (Amperes)	Circuit Breaker Type	Interrupting Capacity (kAIC)			Unit Size	Enclosure Width	Enclosure Depth
		240V	480V	575V			
800	MDS-608 MDS-C08	65 100	65 100	65 100	72.00 (1828.8)	24.00 (609.6) ②	42.00 (1066.8) ③
1600	MDS-616 MDS-C16	65 100	65 100	65 100			
2000	MDS-620 MDS-C20	65 100	65 100	65 100			
3200	MDS-632 MDS-C32	65 100	65 100	65 100			

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

② A 4.00-inch (101.6 mm) filler section must be added between the main and the rest of the MCC to allow for door opening.

③ Structure is rear aligned.

**Table 29.1-64. Digitrip Units ④**

Type	Unit Space Inches (mm)
RMS 310–1150	Refer to <b>Page 21.4-10</b> for more details.

**Options**

Tie breaker ⑤ Electrically operated	72.00 (1828.8) or 12X —
--	----------------------------

**Accessories**

UV release-instantaneous	—
Shunt trip (standard on electrically operated breakers)	—
Key interlock on breaker	—
Auxiliary switch (3A/3B)	—
Cell position switch	—
Operations counter	—
Auxiliary power module (to test Digitrip)	—
Portable lift truck	—
Manual close pushbutton cover	—

④ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑤ Tie breaker adds an additional 20.00-inch (508.0 mm) wide bus transition section. Also two 4.00-inch (101.6 mm) filler sections will be added to the MCC if the tie breaker is located in the center of the MCC lineup. If the tie breaker is located between the two main structures, the two 4.00-inch (101.6 mm) fillers are not needed.

**Table 29.1-65. Main-Tie-Main Auto Throw-Over Options ⑥**

Option	Description
AT200	Standard PLC-based control scheme. No operator interface (PanelMate) provided. Sequence of operations and external controls are pre-defined and not subject to customer modifications. Type of voltage sensing device must be chosen. If closed-transition operation is required, a sync-check relay (device 25) must be used.
AT300	Same as AT200, except includes operator interface (PanelMate). ⑦
AT300X	Same as AT200, except customer modifications are acceptable. This is the proper choice for PLC-based systems with special sequences, more than main-tie-main configurations, and/or where special PanelMate page layouts are required.
AT300IQ	Standard Automatic Transfer Control (ATC) controller-based control scheme for main-main configurations. Either or both sources may be generators. Includes manual-auto operation, and generator control switch. If closed-transition operation is required, a sync-check relay (device 25) must be used.

⑥ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑦ PanelMate page layouts are pre-defined and not subject to customer modifications.

**Table 29.1-66. Freedom 2100 Main Incoming Line and Feeder Fusible Switches—Dimensions in Inches (mm)**

Three-pole—250V or 600 Vac. Fuses not included.

Switch Rating ⑧ Amps ⑨	Fuse Clip Size Amps	Unit Space			
		Incoming Line		Feeder	
		Inches (mm)	X Space	Inches (mm)	X Space
30	30	18.00 (457.2)	3X	12.00 (304.8)	2X
60	60	18.00 (457.2)	3X	12.00 (304.8)	2X
30/30 Dual	30/30 Dual	—	—	12.00 (304.8)	2X
30/60 Dual	30/60 Dual	—	—	12.00 (304.8)	2X
60/60 Dual	60/60 Dual	—	—	12.00 (304.8)	2X
100	100	18.00 (457.2)	3X	18.00 (457.2)	3X
200	200	30.00 (762.0)	5X	30.00 (762.0)	5X
400	400	48.00 (1219.2)	8X	42.00 (1066.8)	7X
600	600	54.00 (1371.8) ⑩	9X ⑪	48.00 (1219.2)	8X
800	800	48.00 (1219.2) ⑫	8X ⑬	48.00 (1219.2) ⑭	8X ⑮
1200 ⑯	1200	60.00 (1524.0)	10X	60.00 (1524.0)	10X

⑧ Suitable for 100,000A interrupting if Class RK fuses are used.

⑨ Type of SW K-SW 30–800A.

⑩ High magnetic molded-case switch.

⑪ For bottom cable entry, add 6.00 inches (152.4 mm) or 1X space.

⑫ For bottom entry, add 12.00 inches (304.8 mm) or 2X space.

⑬ For top entry, add 6.00 inches (152.4 mm) or 1X space.

**Table 29.1-67. Freedom FlashGard Main Incoming Line and Feeder Fusible Switches—Dimensions in Inches (mm)**

Three-pole—250 or 600 Vac. Fuses not included.

Switch Rating ⑧ Amps ⑨	Fuse Clip Size Amps	Unit Space			
		Incoming Line		Feeder	
		Inches (mm)	X Space	Inches (mm)	X Space
30	30	18.00 (457.2)	3X	12.00 (304.8)	3X
60	60	18.00 (457.2)	3X	12.00 (304.8)	3X
100	100	18.00 (457.2)	3X	24.00 (609.6)	3X
200	200	30.00 (762.0)	5X	36.00 (914.4)	5X
400	400	48.00 (1219.2)	8X	42.00 (1066.8)	7X
600	600	54.00 (1371.8) ⑩⑪	9X ⑫	48.00 (1219.2) ⑬	8X ⑭
800	800	48.00 (1219.2) ⑮⑯	8X ⑰	48.00 (1219.2) ⑱	8X ⑲
1200 ⑳	1200	60.00 (1524.0) ㉑	10X ㉒	60.00 (1524.0) ㉓	10X ㉔

⑧ Suitable for 100,000A interrupting if Class RK fuses are used.

⑨ Type of SW K-SW 30–800A.

⑩ High magnetic molded-case switch.

⑪ For bottom cable entry, add 6.00 inches (152.4 mm) or 1X space.

⑫ Fixed assemblies, no RotoTract.

⑬ For bottom entry, add 12.00 inches (304.8 mm) or 2X space.

⑭ For top entry, add 6.00 inches (152.4 mm) or 1X space.



## Layout and Technical Data

**Table 29.1-68. Lighting Panelboards**  
**120/240V or 120/208V Lighting Panelboards Type—PL1A** ①

Fixed mounted, main lug only panelboards can be either 120/240V, single-phase, three-wire; 208Y/120V, three-phase, four-wire.

Number of Circuits	Chassis Rating (Amperes)		Unit Space Inches (mm)	
	Single-Phase Three-Wire	Three-Phase Four-Wire	Single-Phase Three-Wire	Three-Phase Four-Wire
18	225	100	24.00 (609.6) or 4X	24.00 (609.6) or 4X
30	225	100	30.00 (762.0) or 5X	30.00 (762.0) or 5X
42	225	225	36.00 (914.4) or 6X	36.00 (914.4) or 6X

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

**Note:** For MCB, back feed panelboard branch circuit breaker, or select separate feeder unit.

**Note:** Bolt-on single-, two-, three-pole breakers only.

**Table 29.1-69. 277/480V or 480/600V Lighting Panelboards Type—PRL3A** ②

Fixed mounted, main lug only panelboards can be either 480 or 600V, three-phase, three-wire or 480Y/277V, three-phase, four-wire. Mounted in bottom portion of structure.

Number of Circuits	Chassis Rating (Amperes)	Unit Space Inches (mm)	
		Three-Phase Three-Wire	Three-Phase Four-Wire
14	100	—	36.00 (914.4) or 6X
18	250	—	—
24	100	36.00 (914.4) or 6X	—
26	250	—	48.00 (1219.2) or 8X
32	100	—	48.00 (1219.2) or 8X
36	250	48.00 (1219.2) or 8X	—
42	100	48.00 (1219.2) or 8X	60.00 (1524.0) or 10X
42	250	60.00 (1524.0) or 10X	60.00 (1524.0) or 10X
12	400/600	36.00 (914.4) or 6X	—
14	400/600	—	48.00 (1219.2) or 8X
30	400/600	48.00 (1219.2) or 8X	60.00 (1524.0) or 10X
42	400/600	60.00 (1524.0) or 10X	72.00 (1828.8) or 12X

② This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

**Note:** For MCB, back feed panelboard branch circuit breaker, or select separate feeder unit.

**Note:** Either plug-in or bolt-on single-, two-, three-pole breakers only.

**Table 29.1-70. Lighting Panelboard Circuit Breakers** ③

Eaton's circuit breakers can be either plug-in or bolt-on, single-, two- or three-pole through 240V. 600V maximum single-, two- or three-pole circuit breakers are bolt-on.

Poles	Maximum Voltage	Plug-in	Bolt-on	Ampere Interrupting Capacity
1/2/3	240	HQP	BAB	10,000
1/2/3	240	QPHW	QBHW	22,000
1/2/3	600	—	EHD	14,000
1/2/3	600	—	HFD	65,000

③ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

**Table 29.1-71. Automatic Transfer Switches—Dimensions in Inches (mm)** ④

Ampere Rating	Switch Type ⑤	Interrupting Rating (kA)	Unit Width	Unit Space
100 ⑥	Eaton MTVX, NTVS	65	20.00 (508.0) ⑥	36.00 (914.4) or 6X
150 ⑥	Eaton MTVX, NTVS	65		—
100	Eaton ATVI	65		48.00 (1219.2) or 8X
150	Eaton ATVI	65		—
225	Eaton ATVI	65	24.00 (609.6) ⑥	72.00 (1828.8) or 12X
300	Eaton ATVI	65		—
400	Eaton ATVI	65		—
600	Eaton ATVI	50	44.00 (1117.6) ⑦	72.00 (1828.8) or 12X
800	Eaton ATVI	50		—
1000	Eaton ATVI	50		—
1000	Eaton ATVISP	100	20.00 (508.0) ⑦	72.00 (1828.8) or 12X
1200	Eaton ATVISP	100		—
1600	Eaton ATVISP	100		—
2000	Eaton ATVISP	100		—
100	ASCO Type 7000	65	28.00 (711.2) ⑦	72.00 (1828.8) or 12X
150	ASCO Type 7000	65		—
260	ASCO Type 7000	65	36.00 (914.4) ⑦	—
400	ASCO Type 7000	35		—
600	ASCO Type 7000	35	40.00 (1016.0) ⑦	—
800	ASCO Type 7000	50		—
1000	ASCO Type 7000	50	—	—
1200	ASCO Type 7000	100		—

④ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑤ ATVI designs include ATC controller door mounted microprocessor-based monitoring device for use in open transition transfer switches where rapid, reliable restoration of power in outage situations is essential. The ATC controller is a microprocessor-based logic controller to be used with Eaton transfer switches. This device provides the operator with an at-a-glance overview of switch status and parameters, as well as key diagnostic data. Real-time values for volts and frequency can be viewed via the front panel LED display, along with an indication of the power source currently in use. The ATC controller continuously monitors either single-phase or three-phase voltages for Source 1, Source 2 and the Load. Depending on the application, the user can customize the ATC controller to meet specific application need.

⑥ Manually operated switch: MTVX = Single handle manual operation. NTVS = Electrically operated non-automatic.

⑦ Requires 42.00-inch (1066.8 mm) deep structure.

## Layout and Technical Data

Table 29.1-72. Dry-Type Distribution Transformers ①

- Transformer 1.0–2.0 kVA will include a circuit breaker and fuses in a standard 2X unit
- Transformers 3.0 kVA and above have taps and electrostatic shields as standard
- Transformers 3.0 kVA and above will include the primary and secondary circuit breakers housed behind a single door

kVA Rating	Unit Space	Primary Breaker (Included in Space Factor)		Secondary Breaker ② (Included in Space Factor)
		230V	480V	

## Single-Phase

0.5	2X	15	15	—
0.75	2X	15	15	—
1	2X	15	15	—
1.5	2X	15	15	—
2	2X	15	15	—
3	4X	15	15	20
5	4X	15	15	30
7.5	4X	20	20	40
10	4X	25	30	60
15	5X	40	40	90
20	5X	50	60	125
25	5X	60	70	150
30	6X	70	80	175
45	7X	100	125	250

## Three-Phase

9	5X	15	15	40
15	5X	20	25	60
25	6X	40	40	90
30	6X	40	50	125
45	6X	60	70	175

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

② Transformers feeding an MCC mounted panelboard require a secondary breaker or main breaker in panelboard.

Table 29.1-73. Power Factor Correction Capacitors ③

PF capacitors are electrolytic type and are optionally available with external line fuses and blown fuse indicators. Capacitors' sizes must be specified by the customer.

**Caution:** Capacitors on the main bus of the MCC may affect solid-state equipment. Please consult factory.

kvar Rating	208V Unit Space		240V Unit Space		600V Unit Space	
	Inches (mm)	X Space	Inches (mm)	X Space	Inches (mm)	X Space
2	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
3	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
4	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
5	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
7.5	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
10	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
15	12.00 (304.8)	2X	12.00 (304.8)	2X	12.00 (304.8)	2X
20	24.00 (609.6)	4X	12.00 (304.8)	2X	12.00 (304.8)	2X
22.5	24.00 (609.6)	4X	12.00 (304.8)	2X	12.00 (304.8)	2X
25	—	—	24.00 (609.6)	4X	12.00 (304.8)	2X
30	—	—	24.00 (609.6)	4X	12.00 (304.8)	2X
40	—	—	—	—	12.00 (304.8)	2X
50	—	—	—	—	24.00 (609.6)	4X
60	—	—	—	—	24.00 (609.6)	4X
75	—	—	—	—	24.00 (609.6)	4X
90	—	—	—	—	24.00 (609.6)	4X
100	—	—	—	—	36.00 (914.4)	6X
120	—	—	—	—	36.00 (914.4)	6X

③ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

Table 29.1-74. SPD (Surge Protective Device) with Circuit Breaker Disconnect ④

Includes SuperVisor Monitoring Display with power quality meter for volts, sag, swell, outage, transient counter, Form C contact, alarm enable and disable, and circuit breaker disconnect.

Description	Unit Space ⑤	
	Inches (mm)	X Space

## Surge Current Per Phase

100 kA SPD-100	18.00 (457.2)	3X
120 kA SPD-120 (recommended branch unit)	18.00 (457.2)	3X
160 kA SPD-160	18.00 (457.2)	3X
200 kA SPD-200	18.00 (457.2)	3X
250 kA SPD-250 (recommended service entrance)	18.00 (457.2)	3X
300 kA SPD-300	18.00 (457.2)	3X
400 kA SPD-400	18.00 (457.2)	3X

④ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑤ Also available in 12.00-inch (304.8 mm) unit (2X) without circuit breaker disconnect.

**Note:** Specify three-phase delta or three-phase wye.

Table 29.1-75. DeviceNet Communications ⑥

DeviceNet-enabled components in MCCs eliminate up to 90% of the control wiring versus traditional hardwired designs. 24 Vdc DeviceNet is prewired throughout the MCC. Trunk cable is provided in the horizontal wireway. Drop cable is provided for vertical wireways and units.

Part Number	Description	Space Requirements
D77D-DNA	QCPort interface to DeviceNet	In power supply buckets
D77D-EMA D77D-EMA	Modbus TCP communications Modbus RTU485	In power supply buckets
MVXDN	MVX adjustable frequency drives DeviceNet interface	—
OPTC7	SVX9000 adjustable frequency drives DeviceNet Interface	—
DN50, DN65	Discrete DeviceNet interface for <i>IT</i> solid-state starters	⑦
PS1	Single 5A power supply	2X
PS2	Dual 5A power supply	2X
PanelMate 1700	Operator interface for DeviceNet system	12.00-inch (304.8 mm)/2X
DN50	DeviceNet I/O module	12.00-inch (304.8 mm)/2X minimum

⑥ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑦ *IT* starters up to 66 amperes require additional 6.00 inches (152.4 mm) when selecting DN50, DN65 DeviceNet interfaces.

## Freedom Communications Choices

The Freedom MCC is capable of communicating on multiple industrial networks connecting to any major brand of PLC or Distributed Control System. The way the communications is designed, it is possible to run multiple segments or even multiple networks through one lineup. The Freedom MCC has direct network connectivity to:

- DeviceNet
- Modbus RTU
- Ethernet/IP
- Modbus TCP
- PROFIBUS DP

**Layout and Technical Data**

The devices capable of being integrated into the MCC on these industrial networks are bi-metal and solid-state overloads (across the line starters), variable speed drives, soft starts and feeder breakers; it is possible to integrate ATS and meters as well depending on the industrial network.


**DeviceNet Wiring**
**Table 29.1-76. Freedom Communications Choices ①**

The type of data available from the devices include but are not limited to the following.

Parameter	C306 Bi Metal Overload	C440 Solid- State Overload	C441 Solid- State Overload	VFD	Soft Start	Breaker
ON/OFF (control and feedback)	■	■	■	■	■	■
Trip indication	■	■	■	■	■	■
Cause of trip		■	■	■	■	
Trip reset		■	■	■	■	
Operating current (three-phase and average)		■	■	■	■	
Operating voltage (three-phase and standard)			■	■	■	
Thermal capacity			■	■	■	
kW			■	■		
Frequency			■			
Motor speed				■		
Four generic inputs			■	■		
Drive specific parameters				■		

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

Each of the Freedom MCCs are factory wired and factory tested prior to shipment with a common point provided for the customer to connect their industrial network to.

**Table 29.1-77. Freedom Communications ②**

Part Number	Description	Space Requirements
OPTC7	SVX DeviceNet interface	No space change
OPTCI	SVX EtherNet/IP and Modbus TCP interface	No space change
OPTC3/OPTC5	SVX PROFIBUS interface	No space change
PS1	Single power supply	2X
PS2	Dual power supply	2X
PanelMate ePro	Operator interface	2X
Network Interface for Freedom starters	DeviceNet, Modbus, Modbus TCP, EtherNet/IP, PROFIBUS	No space change

② This table is common for both *IT* MCC and *IT* FlashGard MCC.

**Power Xpert Gateway**

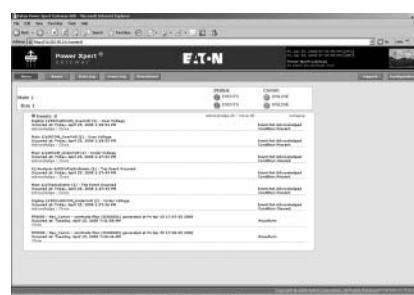
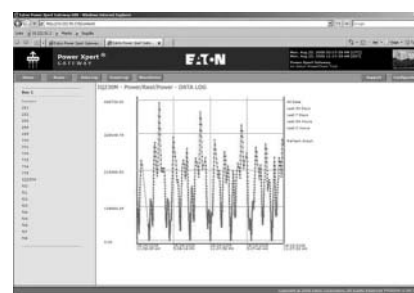
Power Xpert Gateways (PXG) provide a cost-effective method to easily Web-enable Eaton and third-party products.

The gateway consists of an embedded Web server that allows the user to connect to Eaton MCC products, such as breakers, meters starters, VFDs and soft starts. The gateway provides the central connection point for the power metering/monitoring/protective devices, allowing their parameters to be monitored via the Web. Power Xpert Gateways provide data communications to Eaton's Power Xpert Software to facilitate centralizing and gathering data for long-term data archival, analysis and trending features.

The PXG600 allows you to enable preselected parameters to be trended for each supported device. Selecting the trend symbol will generate a real-time graph for that parameter and can be viewed for the past 24 hours, seven days, 30 days or all past history. The PXG600 also offers direct e-mail notifications to up to 10 users. Select from event notifications, data logs and event logs. Information is presented in organized, user-friendly Web pages and the power monitoring equipment listed in **Table 29.1-76**, solid-state overload relays, motor protective relays, solid-state reduced voltage starters, adjustable frequency drives and many more communicating devices. Additionally, the PXG can provide communications to solid-state overload relays, motor protective relays, solid-state reduced voltage starters, adjustable frequency drives and much more.

The PXG has a feature called pass through, which allows a Modbus TCP master to pass data through the PXG and get/set device specific registers, and also allows the Modbus TCP master to control the end device.

The standard Power Xpert Gateway bucket is 2X and includes the PXG and 24 Vdc power supply.

**Power Xpert Gateway Screenshots**

**Home Page**

**Trending Page (PXG600 Only)**

## Layout and Technical Data

Table 29.1-78. Power Metering Equipment

Feature	IQ 130	IQ 140	IQ 150	IQ 250	IQ 260	PXM2250	PXM2260	PXM2270	IQ A6600	PXM4000	PXM6000	PXM8000
<b>Instrumentation</b>												
Current, per phase	■	■	■	■	■	■	■	■	■	■	■	■
Current demand	■	■	■	■	■	■	■	■	■	■	■	■
Calculated neutral current	■	■	■	■	■	■	■	■	■	■	■	■
Voltage, per phase (L-L, L-N)	■	■	■	■	■	■	■	■	■	■	■	■
Min./max, readings I, V	■	■	■	■	■	■	■	■	■	■	■	■
Min./max, readings I, V, PF, F, W, VAR, VA		■	■	■	■	■	■	■	■	■	■	■
Frequency		■	■	■	■	■	■	■	■	■	■	■
View amps and volts; phasors on display									Text only	■	■	■
<b>Power</b>												
Real, reactive and apparent power (W, VAR, VA)		■	■	■	■	■	■	■	■	■	■	■
Power factor, total		■	■	■	■	■	■	■	■	■	■	■
Real, reactive and apparent power demand		■	■	■	■	■	■	■	■	■	■	■
<b>Demand Methods</b>												
Block interval (sliding, fixed)		■	■	■	■	■	■	■	■	■	■	■
<b>Energy</b>												
Real, reactive and apparent energy, total (Wh, VAR, Vah)			■	■	■	■	■	■	■	■	■	■
<b>THD</b>												
% THD amps and volts (to 40th)					■		■	■	To 50th	To 127th	To 127th	To 127th
Interharmonics									■	■	■	■
<b>Communications</b>												
RS-485, Modbus RTU, KYZ output	Option	Option	Option	■	■	■	■	■	Modbus option	KYZ option	KYZ option	KYZ option
DNP 3.0				■	■	■	■	■				
<b>Digital I/O</b>												
Digital input				with I/O card	with I/O card	with I/O card	with I/O card	with I/O card	■	with I/O card	with I/O card	with I/O card
Digital output				with I/O card	with I/O card	with I/O card	with I/O card	with I/O card	■	with I/O card	with I/O card	with I/O card
Load shedding					with I/O card	with I/O card	with I/O card	with I/O card	■	with I/O card	with I/O card	with I/O card
<b>Analog I/O</b>												
Analog output (0–1 mA or 4–20 mA)				with analog card	with analog card	with analog card	with analog card	with analog card	0–20 or 4–20			
<b>Ethernet via Local Area Network</b>												
HTTP (Web pages)				①	①	■	■	■		■ ②	■ ②	■ ②
SMTP (e-mail)				①	①	■	■	■		■ ②	■ ②	■ ②
NTP (time sync)				①	①	■	■	■		■ ②	■ ②	■ ②
Modbus TCP/IP				①	①	■	■	■		■ ②	■ ②	■ ②
Ethernet TCP/IP										■ ②	■ ②	■ ②
Fiber optic Ethernet port										②	②	②
SNMP				①	①	■	■	■		■ ②	■ ②	■ ②
Phasor diagram (Web view—wye connected)				③	③	■	■	■		■ ②	■ ②	■ ②
Live waveform view snapshot				③	③			■		■ ②	■ ②	■ ②
Ind. bar harmonics view								■		■ ②	■ ②	■ ②

① Add Gateway Card Kit (PXM-GCK).

② To obtain this information over LAN rather than the standard Ethernet port, add the extra Communication Module PXCE-B.

③ Via Modbus RS-485.

## Layout and Technical Data

Table 29.1-78. Power Metering Equipment (Continued)

Feature	IQ 130	IQ 140	IQ 150	IQ 250	IQ 260	PXM2250	PXM2260	PXM2270	QA6600	PXM4000	PXM6000	PXM8000
<b>Revenue Accuracy</b>												
ANSI C12.20 (0.5 or 0.2%)	0.50%	0.50%	0.50%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%
<b>Waveform Analysis</b>												
Waveform capture (threshold/input)									■	■	■	■
Volts disturbance, waveform capture trigger									■	■	■	■
Excess Dv/Dt									■	■	■	■
Stores waveform captures									10 (8 cy ea)	2 GB	4 GB	8 GB
Sampling rate, max. samples/cycle									128	4096	4096	100,000
Captured waveform displayed on meter/GUI									■	■	■	■
Comtrade—standard IEEE file format										■	■	■
6 MHz impulse transient capture												■
Transient capture on neutral												■
<b>Power Quality Analysis</b>												
Individual harmonics magnitude									To 50th	To 85th	To 85th	To 85th
Sub-cycle disturbance capturing									■	■	■	■
Number of 9's availability									■	■	■	■
PQ index graph										■	■	■
K-factor									■	■	■	■
Crest factor									■	■	■	■
ITIC performance curve									■		■	■
Flicker											■	■

Table 29.1-79. Incoming Line Metering and Bus Protection <sup>①</sup>

Type	Description	Unit Space Inches (mm) <sup>②</sup>
Switchboard meters <sup>③</sup> 1% accuracy	Ammeter Ammeter with switch Voltmeter Voltmeter with switch	12.00 (304.8) or 2X
	AM/VM AM/VM with switches	
Instrument Transformers	600/800A CT 1000A CT 2000A CT 2500A CT	Consult Eaton
	480/120 PT	6.00 (152.4) or 1X
Signal transducers	Current (add CT) single-phase Voltage (add PT) Watt (add CT and PT) single-phase	6.00 (152.4) or 1X

**Voltage Protection**

SPD (see Table 29.1-74 on Page 29.1-45)	18.00 (457.2) or 3X <sup>④</sup>
Ground detection lights—three-phase underground systems	
System voltage monitor	6.00 (152.4) or 1X
Lightning arrester and surge capacitor	

**Ground Fault Sensing C-HRG "Safe Ground" High Resistance Ground System**

Current	Requires 21.00-inch (533.4 mm) deep, 20.00-inch (508.0 mm) wide structure without a vertical wireway.	72.00 (1828.8) or 12X
Voltage		

<sup>①</sup> This table is common for both Freedom 2100 and Freedom FlashGard MCCs.<sup>②</sup> Two electronic meters will fit in a single 12.00-inch (304.8 mm) (2X) unit.<sup>③</sup> Ammeters require two CTs for three-phase/three-wire systems, and three CTs for three-phase/four-wire systems. Voltmeters require two PTs for three-phase/three-wire systems, and three PTs for three-phase/four-wire systems.<sup>④</sup> Without disconnect 12.00 inches (304.8 mm) or 2X.**Harmonic Correction**Table 29.1-80. Clean Control Center <sup>⑤</sup>

Eaton's Clean Control Center is an integrated power correction system that provides harmonic correction directly on the MCC horizontal bus. The harmonic correction unit senses the load current and dynamically injects into the horizontal bus a synthesized waveform that cancels harmonic content from nonlinear loads such as AC drives. The result is a clean waveform. Clean Control Centers are UL 845 listed.

Harmonic Current (Amperes)	Input Voltage	Disconnect Type	Standard Unit Space <sup>⑥</sup> Inches (mm)	Standard Unit Space (X)
50A active harmonic filter <sup>⑦</sup>	Up to 480V	Molded-case switch	72.00 H x 20.00 W (1828.8 H x 508.0 W)	12X
100A active harmonic filter <sup>⑦</sup>	Up to 480V	Molded-case switch	72.00 H x 20.00 W (1828.8 H x 508.0 W)	12X

<sup>⑤</sup> This table is common for both Freedom 2100 and Freedom FlashGard MCCs.<sup>⑥</sup> Clean Control Center model includes 24.00-inch (609.6 mm) wide MCE structure, current transformers and door-mounted digital interface panel.<sup>⑦</sup> Multiple units can be applied in parallel for additional harmonic correction.



## Standard Structures and Structure Options

Eaton's standard Freedom 2100 Series MCC structure is NEMA 1, gasketed, 90.00-inch (2286.0 mm) high, 20.00-inch (508.0 mm) wide with a depth as shown in Figure 29.1-9. Each standard structure has a 9.00-inch (228.6 mm) high horizontal wireway at the top and at the bottom and a 4.00-inch (101.6 mm) wide full height vertical wireway at the right.

All wireway doors are hinged and secured with 1/4-turn latches. The standard busing is 600A, UL rated, copper horizontal bus and 300A, UL rated, copper vertical bus braced for 65,000 symmetrical amperes. Many other bus sizes and types are available. Also included as standard is a vertical bus isolation barrier.

Table 29.1-81. Standard Structures and Structure Options—Dimensions in Inches (mm) ①

Description	
<b>Standard Structures</b>	
16.00 (406.4) deep structure	Structure 1
21.00 (533.4) deep structure	
Front mounting only	Structure 2
Front and rear mounting	Structure 3
4.00 (101.6) of additional structure width, 32.00 (812.8) maximum	
8.00 (203.2) vertical wireway in lieu of standard 4.00-inch (101.6)	
<b>Special Structures</b>	
Single corner section for "L" configuration of MCC	
Transition section	
Series 2100 to Type W	
10.00 (254.0) wide—front aligned	
Plug-in blank relay mounting space, per 6-inch	Any 6.00 (152.4) height
Fixed-mounted relay back pan, full depth of structure	
20.00 (508.0) structure with wireway, 13.00 (330.2) with usable panel	
24.00 (609.6) structure with wireway, 17.00 (431.8) with usable panel	
28.00 (711.2) structure with wireway, 21.00 (533.4) with usable panel	
20.00 (508.0) structure without wireway, 17.00 (431.8) with usable panel	
24.00 (609.6) structure without wireway, 21.00 (533.4) with usable panel	
28.00 (711.2) structure without wireway, 25.00 (635.0) with usable panel	
32.00 (812.8) with double door	
36.00 (914.4) with double door	
40.00 (1016.0) with double door	
Programmable controller mounting structure	
(per complete structure with full fixed mounting back pan)	
20.00 (508.0) structure with wireway	Complete section
24.00 (609.6) structure with wireway	Complete section
28.00 (711.2) structure with wireway	Complete section
20.00 (508.0) structure without wireway	Complete section
24.00 (609.6) structure without wireway	Complete section
28.00 (711.2) structure without wireway	Complete section
Plexiglass see-through door insert for PLC structure	6.00 (152.4) increments
19.00 (482.6) instrumentation mounting racks installed in PLC structure	Consult Eaton

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

Table 29.1-82. Structure Modifications—Dimensions in Inches (mm) ②

Channel floor sills: 11-gauge, 1.00 x 3.00 (25.4 x 76.2)
NEMA 1 gasket
NEMA 12 dust-proof, includes bottom plate
Bottom plate for NEMA 1 gasketed enclosure
150-watt space heater, per structure
Thermostat for space heater control
Pullbox kit for cable and wiring to be field mounted on top structure
12.00 (304.8) high
18.00 (457.2) high
24.00 (609.6) high
Rear hinged structure door, 72.00 (1828.8) high
NEMA 2 drip shield on top of MCC
NEMA 3R non-walk-in—front-mounted, back-to-back
NEMA 3R walk-in aisle-front mounted
NEMA 3R walk-in tunnel type
NEMA 4X—consult factory
Special reduced height structures
Seismic certification (earthquake qualification)
UL handle extension ③

② This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

③ The standard Freedom 2100 Series structure is designed to comply with the UL 2-meter requirement. Disconnect operating handle is not more than 2 meters [78.00 inches (1981.2 mm)] above the bottom of the MCC. Motor control centers elevated on a raised pad or installed on unembedded channel sills may require operator handle extensions for the uppermost operators. UL handle extension optionally available when required.

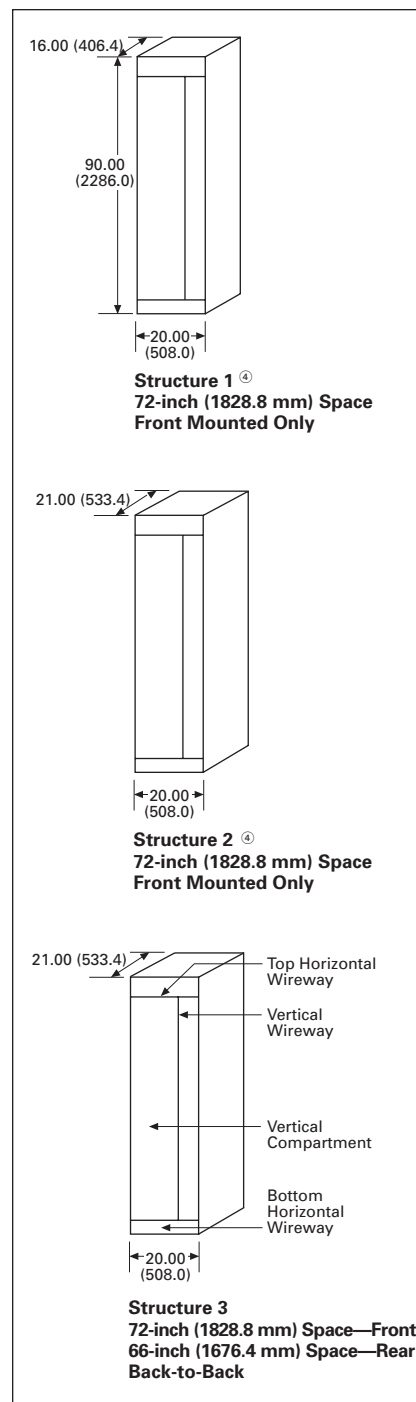


Figure 29.1-9. Structure—Dimensions in Inches (mm)

④ The standard Freedom 2100 Series structure is designed to comply with the UL 2-meter requirement. Disconnect operating handle is not more than 2 meters [78.00 inches (1981.2 mm)] above the bottom of the MCC. Motor control centers elevated on a raised pad or installed on unembedded channel sills may require operator handle extensions for the uppermost operators. UL handle extension optionally available when required.

**Layout and Technical Data**
**Table 29.1-83. Bus Modifications—Dimensions in Inches (mm) ①**

Eaton's Freedom 2100 Series MCCs bear the UL label. Service entrance labeling is available.

Description			Cu—Tin-Plated (Standard)
Main Bus, Per Vertical Structure			
Copper Horizontal Bus Ratings Tin-Plated	50°C	65°C	
600A Size	0.25 x 2.00 (6.4 x 50.8)—Bars/Phase 1	0.25 x 2.00 (6.4 x 50.8)—Bars/Phase 1	—
800A Size	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 1	0.25 x 2.00 (6.4 x 50.8)—Bars/Phase 1	—
1200A Size	0.25 x 2.50 (6.4 x 63.5)—Bars/Phase 2	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 1	—
1600A Size	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 4	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 2	21.00 (533.4) deep ②
2000A Size	0.25 x 2.50 (6.4 x 63.5)—Bars/Phase 6	0.25 x 2.50 (6.4 x 63.5)—Bars/Phase 4	21.00 (533.4) deep ②
2500A Size	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 8	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 6	21.00 (533.4) deep ③
3200A Size	N/A	0.25 x 3.00 (6.4 x 76.2)—Bars/Phase 8	21.00 (533.4) deep ③④
Silver-plated bus main horizontal bus			Optional
Insulated main horizontal bus, per vertical structure (taping)			Optional
Vertical bus, per vertical structure: 300A—copper (tin-plated)			Standard ⑤
Increased bus capacity: rated at 600A (front-mounted only)			Cu only
Rated at 600A (back-to-back)—copper			Standard
Rated at 800A (back-to-back and front)			Cu only
Rated at 1200A			Cu only
Increased mechanical bus bracing, per vertical structure:			
42,000A rms symmetrical short-circuit current			Optional
65,000A rms symmetrical short-circuit current			Standard
100,000A rms symmetrical short-circuit current			Optional
Vertical bus isolation barrier, per vertical structure			Standard
Labyrinth design insulation-isolation vertical bus barrier			Optional Freedom
Ground bus, 300A standard, per vertical structure			Standard Cu
Increased capacity ground bus only, 600A, 1/4- x 2.00-inch (6.4 x 50.8 mm), per vertical structure			Standard Cu
Plug-in grounding system, includes 300A vertical ground bus and unit grounding clips, per vertical structure			Cu
Neutral bus, ungrounded for three-phase, four-wire power, per vertical structure ⑥			Cu
Splice plates			—

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

② Requires 21.00-inch (533.4 mm) deep structure.

③ Requires 21.00-inch (533.4 mm) deep structure. Not available in back-to-back structure.

④ Contact Eaton for 3200A dimensions.

⑤ Vertical bus and unit stabs are tin-plated copper only.

⑥ Neutral is half-rating of horizontal bus.

**Table 29.1-84. Main Lugs Only—Mechanical Lug Compartment (Three-Phase, Three- or Four-wire)—Dimensions in Inches (mm) ⑦**

Provisions for terminating incoming line cables directly onto the MCC bus system. Up to 1200A, all lug landings are bolted to a fully rated vertical bus in that section. MLO sections must be put at the top for top entry cables and at the bottom for bottom entry cables. For smaller cable sizes, cable lugs may also be extended into an optional top hat as shown in this table.

Maximum Cable Size (kcmil)	Bus Rating (Amperes)	Maximum Cables per Phase	Cable Entry (Top or Bottom)	Lug Type	Unit Space	X Space ⑧	Enclosure Width
350	600	2	—	Screw Crimp	12.00 (304.8) 18.00 (457.2)	2X 3X	20.00 (508.0)
		4	Top	Screw	18.00 (457.2)	3X	
			Bottom	Screw Crimp	24.00 (609.6) 36.00 (914.4)	4X 6X	
			18.00-inch (457.2 mm) top hat	Either	—	—	
600	800	2	—	Screw Crimp	18.00 (457.2) 24.00 (609.6)	3X 4X	
		4	—	Screw Crimp	24.00 (609.6) 36.00 (914.4)	4X 6X	
			18.00-inch (457.2 mm) top hat	Either	—	—	
			—	—	—	—	
750	1000	2	—	Screw Crimp	24.00 (609.6) 36.00 (914.4)	4X 6X	
		4	—	Screw Crimp	36.00 (914.4) ⑨ 48.00 (1219.2) ⑨	12X 12X	
1000	1200	2	—	Screw Crimp	30.00 (762.0) 36.00 (914.4)	5X 6X	
1000	2500	8	—	Screw Crimp	72.00 (1828.8) ⑨ 72.00 (1828.8) ⑨	12X 12X	
	3200	—	—	Screw Crimp	72.00 (1828.8) ⑨ 72.00 (1828.8) ⑨	12X 12X	

⑦ This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

⑧ Requires 6.00-inch (152.4 mm) = (1X) unit space.

⑨ Lug landings require the complete vertical section. The rear is unusable.

## Layout and Technical Data

**Bus Duct Entry Sandwich Type to Horizontal Bus or Main Disconnect—Pull Box**

Pull box and pre-fabricated bus connectors are supplied to match the sandwich type bus duct end flange. Bus duct is assumed to enter the top. Bus duct type and orientation to the MCC must be provided.

**Table 29.1-85. Bus Duct Entry to Horizontal Bus or Main Disconnect—Pull Box—Dimensions in Inches (mm) ①**

Horizontal Bus Rating (Amperes)	Pull Box Height
600–1600	18.00 (457.2)
2000–2500 ②	24.00 (609.6)

① This table is common for both Freedom 2100 and Freedom FlashGuard MCCs.

② Contact Eaton for 3200A dimensions.

**Note:** Consult factory for non-segregated bus requirements.

**Table 29.1-86. Typical Heat Loss Data ③**

Description	Current (A)	Loss (W)
<b>Vertical Sections</b> <b>Horizontal Bus and Ampacity</b>	600	200
	800	300
	1200	500
	1600	700
	2000	1000
	2500	1400
	3200	2050
Space heaters (each)		500
FVNR size 1		40
FVNR size 2		60
FVNR size 3		100
FVNR size 4		130
FVNR size 5		230
FVNR size 6		400

③ This table is common for both Freedom 2100 and Freedom FlashGuard MCCs.

**Table 29.1-87. Typical Weights in lbs (kg)**

Description	Weight
16.00-inch (406.4 mm) deep x 20.00-inch (508.0 mm) wide structure ④	200 (91)
21.00-inch (533.4 mm) deep x 20.00-inch (508.0 mm) wide structure ④	260 (118)

**Adder for Horizontal Bus**

800A	10 (5)
1000A	15 (7)
1200A	18 (8)
1600A	24 (11)
2000A	30 (14)
2500A	38 (17)
3200A	49 (22)

**Adder for Vertical Bus**

600A	30 (14)
800A	40 (18)
1200A	60 (27)

**Adder for Units Freedom—Inches (mm)**

12.00 (304.8)	25 (11.4)
18.00 (457.2)	40 (18)
24.00 (609.6)	63 (29)
30.00 (762.0)	77 (35)
36.00 (914.4)	100 (45)

④ Weight for NEMA 1 structure with 600A horizontal and 300A vertical bus.

**Table 29.1-88. Freedom MCC Ratings and Highlights**

Feature	Freedom
Vertical bus barrier	
Communications from starter units	DeviceNet, Modbus, PROFIBUS, EtherNet/IP using E777 solid-state overload relay
Bus bracing	65 kA standard 42 and 100 kA available
Control wire	#16 standard
Horizontal bus material	Copper
Pilot devices	10250T
6.00-inch (152.4 mm) starter compartment	F206 Size 1
FVNR sizes 3 and 4	18.00-inch (457.2 mm) compartment
FVNR size 6	54.00-inch (1371.6 mm) compartment

**Table 29.1-89. Control Power Transformer Data ⑤**

All control power transformers are encapsulated and will deliver rated secondary voltage at full load. Two primary and one secondary fuses are furnished as standard.

NEMA Size Starter	Starter Type	Freedom	
		Standard VA Rating	Maximum ⑥ VA Rating
Size 1	Full voltage non-reversing and reversing	100	150
Size 1 ⑦		100	100
Size 2		100	150
Size 2 ⑦		N/A	N/A
Size 3		150	250
Size 4		200	250
Size 5	Autotransformer	200	350
Size 6		150	250
Size 2		100	150
Size 3		150	250
Size 4		200	250
Size 5		250	350
Size 6		200	350
Size 1	Two-speed One winding	100	200
Size 2		100	200
Size 3		200	250
Size 4		350	500
Size 5		350	500
Size 6		200	350
Size 1	Two-speed Two winding	100	150
Size 2		100	150
Size 3		150	250
Size 4		200	250
Size 5		200	250
Size 6		200	350
Size 1	Part winding	150	150
Size 2		150	150
Size 3		200	250
Size 4		350	500
Size 5		350	500
Size 6		200	350
Size 2	Wye delta (open or closed transition)	200	200
Size 3		350	200
Size 4		350	500
Size 5		200	500
Size 6		200	350

⑤ This table is common for both Freedom 2100 and Freedom FlashGuard MCCs.

⑥ Maximum size without increasing starter space.

⑦ 6.00-inch (152.4 mm) unit.

### Layout and Technical Data

**Table 29.1-90. Starter Sizes Selection Guide** ①

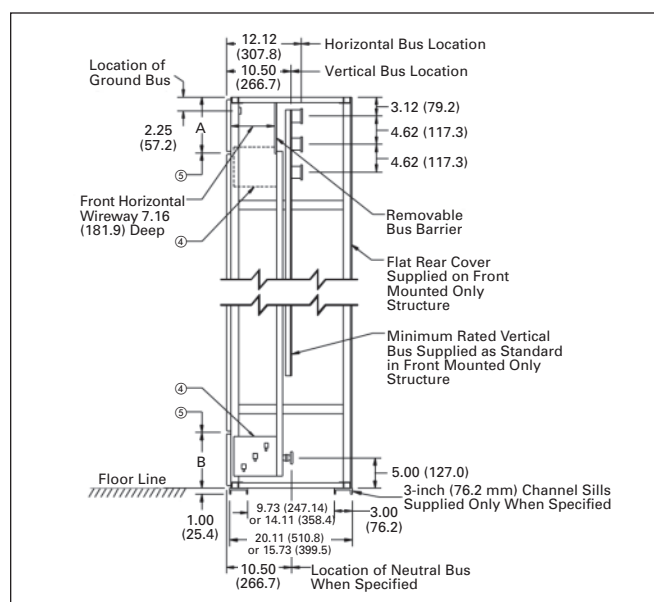
Squirrel-Cage Motor Horsepower	230V, Three-Phase			460V, Three-Phase			575V, Three-Phase		
	Control Center Starter NEMA Size	Full Load Current Amperes ②	Wire Size ③ at 75°C Max. at 40°C Amb.	Control Center Starter NEMA Size	Full Load Current Amperes ②	Wire Size ③ at 75°C Max. at 40°C Amb.	Control Center Starter NEMA Size	Full Load Current Amperes ②	Wire Size ③ at 75°C Max. at 40°C Amb.
1/2	1	2.2	14	1	1.1	14	1	0.9	14
3/4	1	3.2	14	1	1.6	14	1	1.3	14
1	1	4.2	14	1	2.1	14	1	1.7	14
1-1/2	1	6.0	14	1	3.0	14	1	2.4	14
2	1	6.8	14	1	3.4	14	1	2.7	14
3	1	9.6	14	1	4.8	14	1	3.9	14
5	1	15.2	12	1	7.6	14	1	6.1	14
7-1/2	1	22	10	1	11	14	1	9	14
10	2	28	10	1	14	14	1	11	14
15	2	42	8	2	21	10	2	17	12
20	3	54	6	2	27	10	2	22	10
25	3	68	4	2	34	8	2	27	10
30	3	80	3	3	40	8	3	32	8
40	4	104	1	3	52	6	3	41	8
50	4	130	1/0	3	65	4	3	52	6
60	5	154	3/0	4	77	3	4	62	4
75	5	192	4/0	4	96	2	4	77	3
100	5	248	300 kcmil	4	124	1/0	4	99	2
125	6	312	500 kcmil	5	156	3/0	5	125	1/0
150	6	360	2-4/0	5	180	4/0	5	144	2/0
200	6	480	2-300 kcmil	5	240	300 kcmil	5	192	4/0
250	—	—	—	6	302	500 kcmil	6	242	300 kcmil
300	—	—	—	6	361	2-4/0	6	289	400 kcmil

① This table is common for both Freedom 2100 and Freedom FlashGard MCCs.

② Information is based on Table 430.150 of NEC (1999).

③ Information is based on use of copper conductors—Table 310.16 and Tables 1, 4 and 5, Ch. 9 of NEC. If aluminum conductors are used refer to Table 310.16 of NEC (1999).

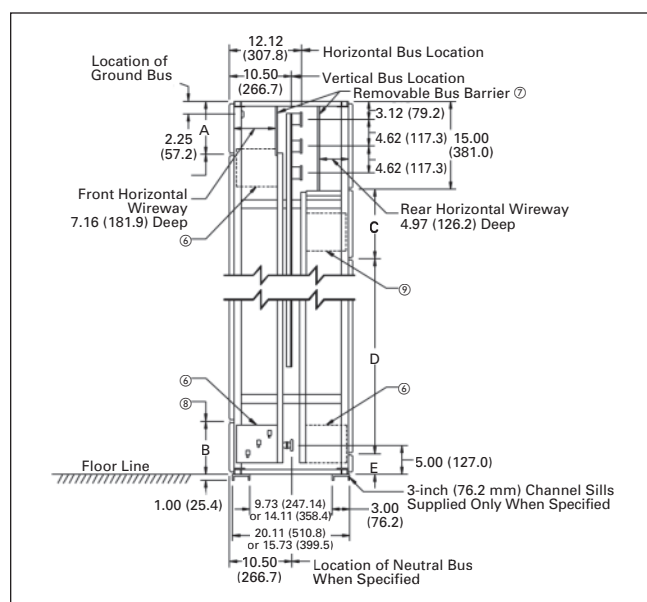
### Dimensions in Inches (mm)



**Figure 29.1-10. Side View A—Front Mounted Only**

④ Master terminal block assembly furnished for Type C wiring only. When location not specified, MTB supplied at the bottom.

⑤ Standard structure arrangement in front  
Without MTB; A and B = 9.00 inches (228.6 mm)  
With MTB at bottom; A and B = 9.00 inches (228.6 mm)  
With MTB at top; A = 15.00 inches (381.0 mm), B = 3.00 inches (76.2 mm)



**Figure 29.1-11. Side View B—Front and Rear Mounted**

⑥ Master terminal block assembly furnished for Type C wiring only. When location not specified, MTB supplied at the bottom.

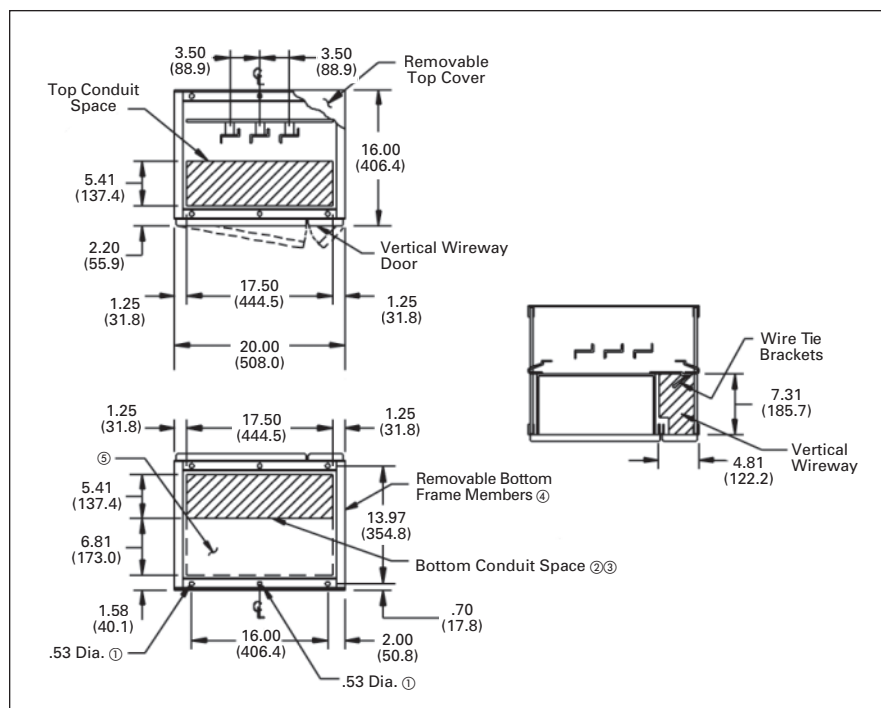
⑦ Rear horizontal bus barrier not supplied with front mounted only structure.

⑧ Standard structure arrangement in front  
Without MTB; A and B = 9.00 inches (228.6 mm)  
With MTB at bottom; A and B = 9.00 inches (228.6 mm)  
With MTB at top; A = 15.00 inches (381.0 mm), B = 3.00 inches (76.2 mm)

⑨ Standard structure arrangement in rear  
Without MTB; C = 9.00 inches (228.6 mm), D = 72.00 inches (1828.8 mm), E = 3.00 inches (76.2 mm)  
With MTB at bottom; C = 0, D = 66.00 inches (1676.4 mm), E = 9.00 inches (228.6 mm)  
With MTB at top; C = 12.00 inches (304.8 mm), D = 60.00 inches (1524.0 mm), E = 3.00 inches (76.2 mm)

**Not to be used for construction purposes unless approved.**

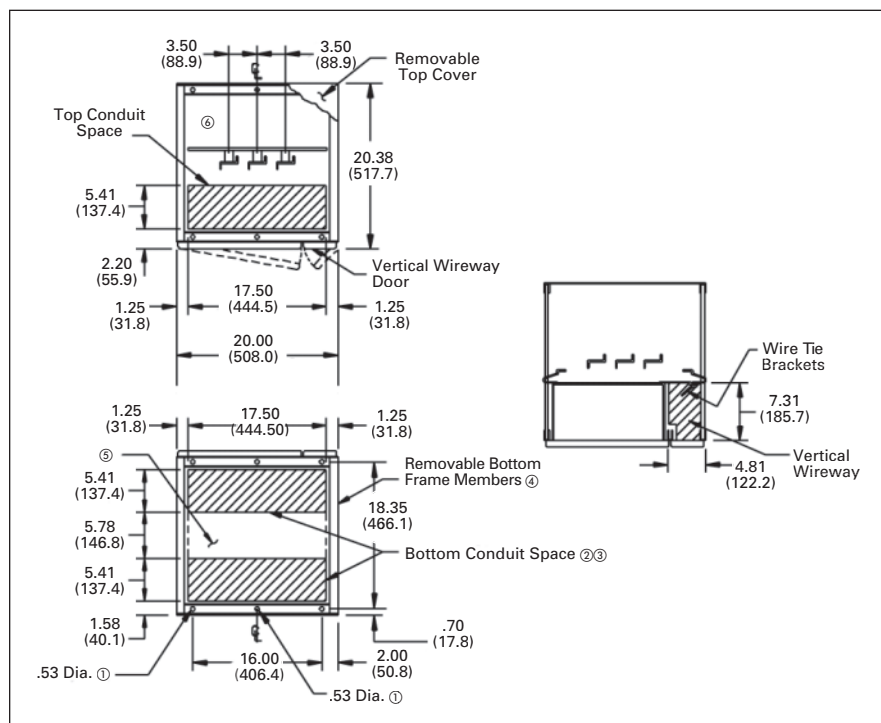
### Dimensions in Inches (mm)



**Figure 29.1-12. 20.00 Inches (508.0 mm) Wide, 16.00 Inches (406.4 mm)—Deep-Front Mounted Only (FMO)**

- ① Minimum length of anchor bolt  
2.00 inches (50.8 mm) 0.36 inches  
(9.1 mm)—16 recommended.
- ② Recommended maximum conduit height  
above floor line 3.50 inches (88.9 mm).
- ③ Maximum conduit space with channel sills  
17.50 x 9.73 inches (444.5 x 247.1 mm).
- ④ For multiple structure assemblies. Either one  
or both of these members are removed to  
provide maximum unrestricted conduit space  
at bottom. Not to be removed for seismic.
- ⑤ This conduit space not recommended when  
neutral bus required. Otherwise available.
- ⑥ Top rear conduit space not recommended  
for conduit entry in FMO structure.

See Side View A **Page 29.1-52** for vertical dimensions.



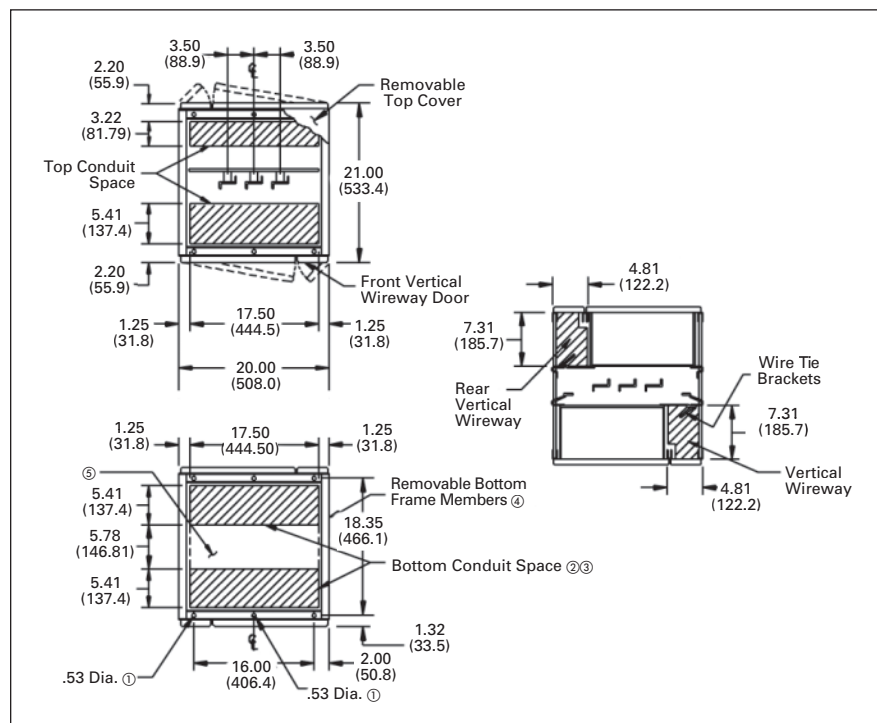
**Figure 29.1-13. 20.00 Inches (508.0 mm) Wide, 21.00 Inches (533.4 mm) Deep-Front Mounted Only (FMO)**

***Not to be used for construction purposes unless approved.***



### Layout and Technical Data

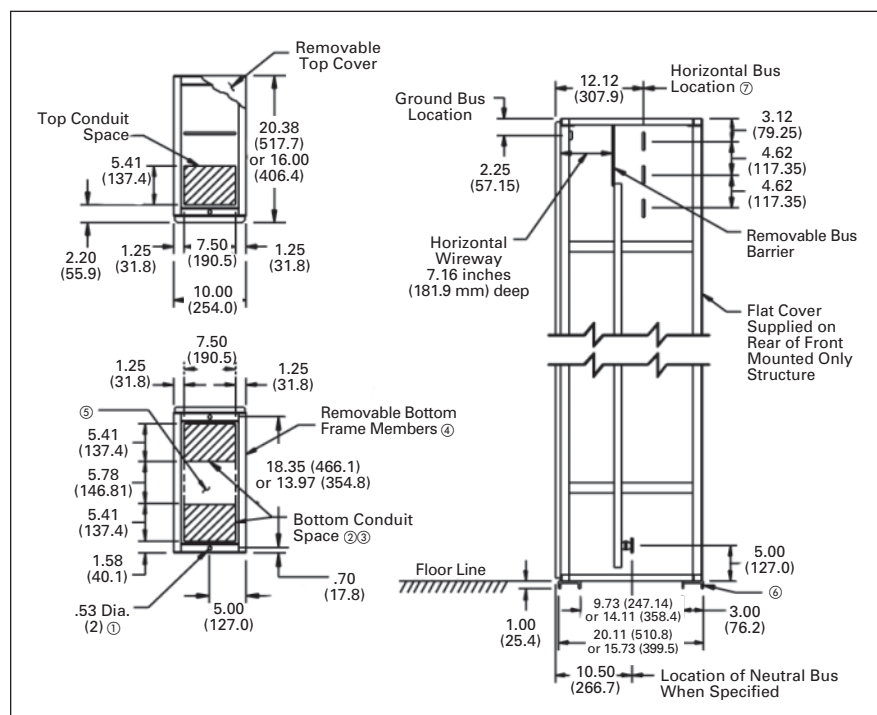
#### Dimensions in Inches (mm)



- ① Minimum length of anchor bolt 2.00 inches (50.8 mm) 0.36 inches (9.1 mm)—16 recommended.
- ② Recommended maximum conduit height above floor line 3.50 inches (88.9 mm).
- ③ Maximum conduit space with channel sills 17.50 x 14.11 (444.5 x 358.4) in 21.00-inch (533.4 mm) deep structure. 7.50 x 9.73 inches (190.5 x 247.1 mm) in 16.00-inch (406.4 mm) deep structure.
- ④ For multiple structure assemblies. Either one or both of these members are removed to provide maximum unrestricted conduit space at bottom. Not to be removed for Seismic.
- ⑤ This conduit space not recommended when neutral bus required. Otherwise available.
- ⑥ Channel sills supplied only when specified. For seismic loads, channel sills if required must be embedded so top of channel sill is still at floor level.

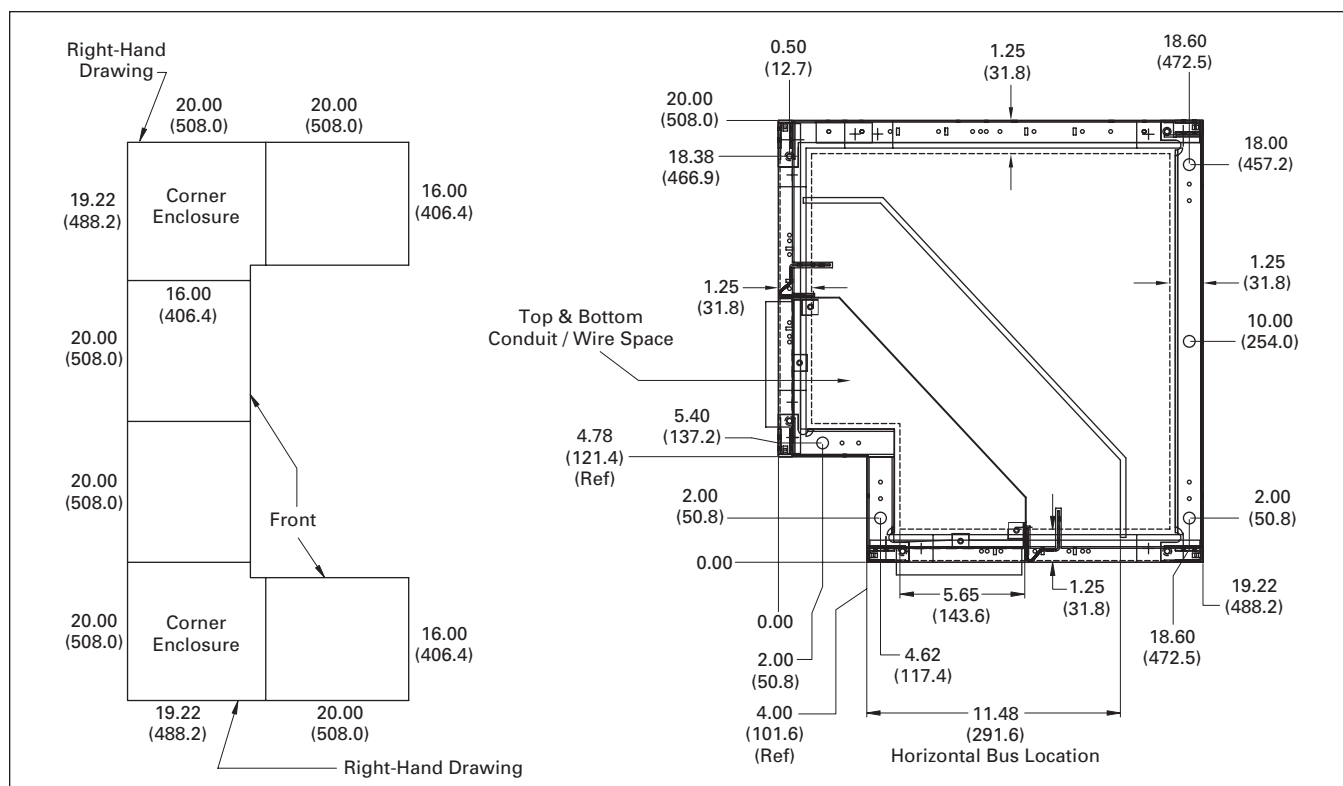
See Side View B Page 29.1-52 for vertical dimensions.

**Figure 29.1-14. 20.00 Inches (508.0 mm) Wide, 21.00 Inches (533.4 mm) Deep—Front- and Rear-Mounted**

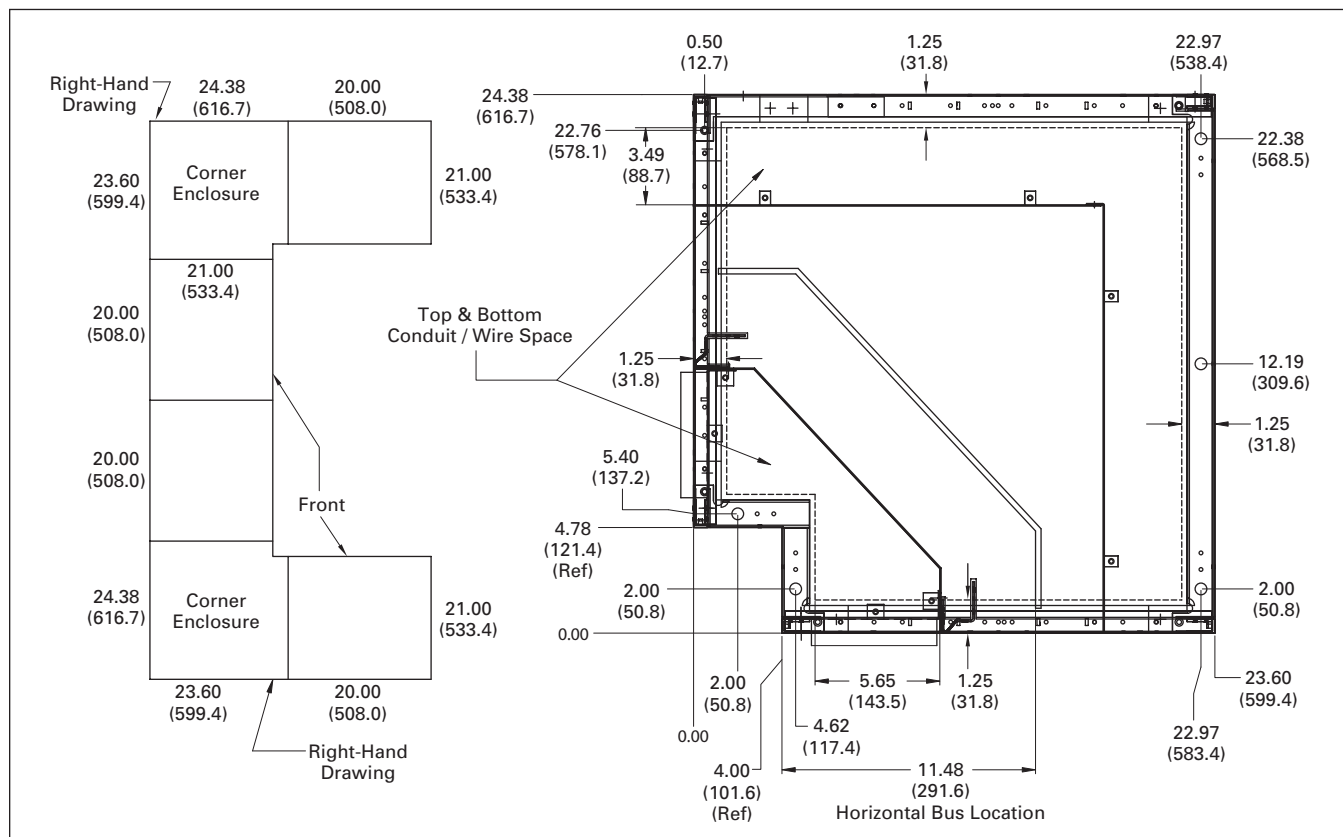


**Figure 29.1-15. 10.00 Inches (254.0 mm) Wide, 16.00 or 21.00 Inches (406.4 or 533.4 mm) Deep—Transition Structure**

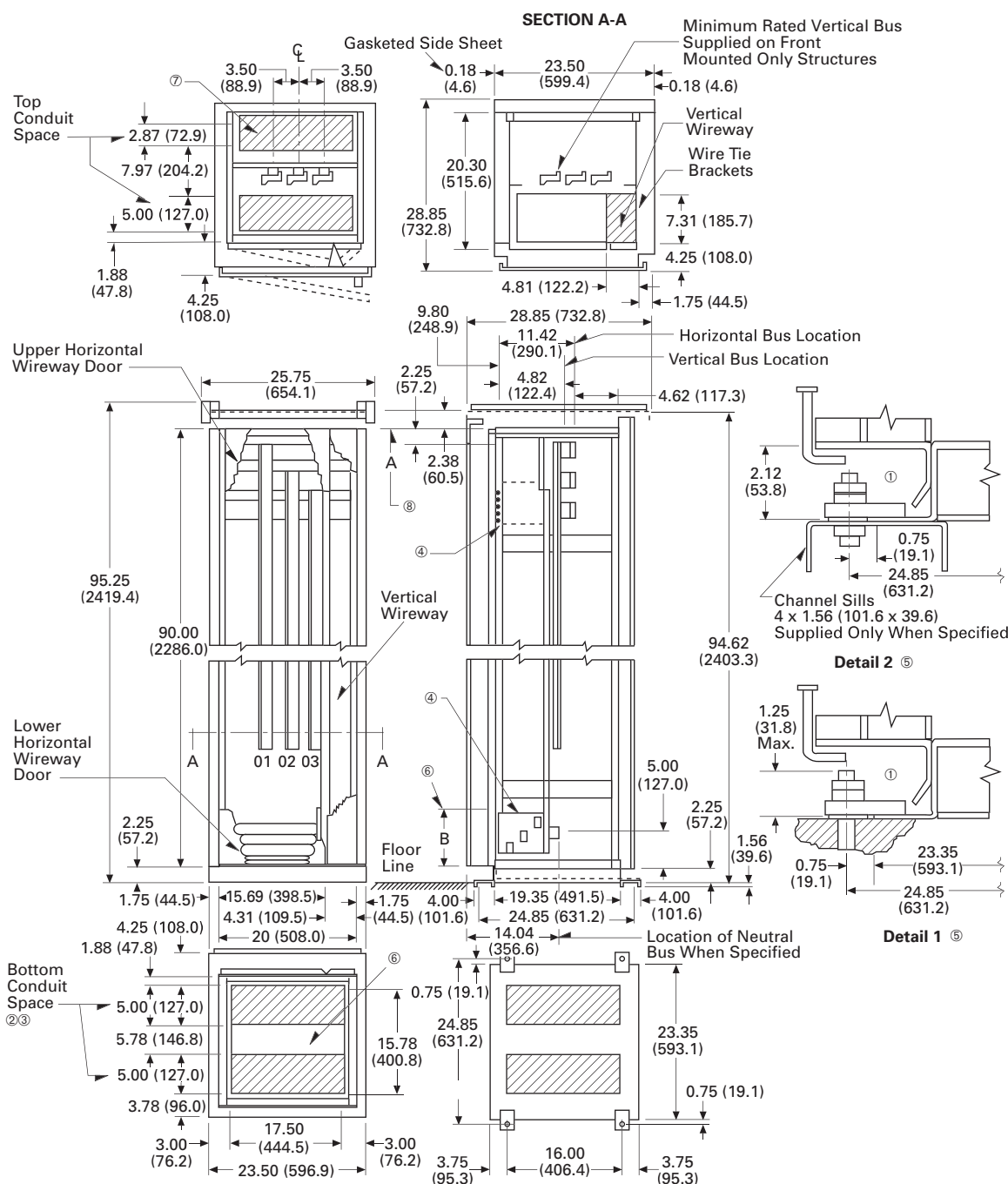
**Not to be used for construction purposes unless approved.**



**Figure 29.1-16. 16.00-Inch (406.4 mm) Deep—Front- and Rear-Mounted Corner Structure**



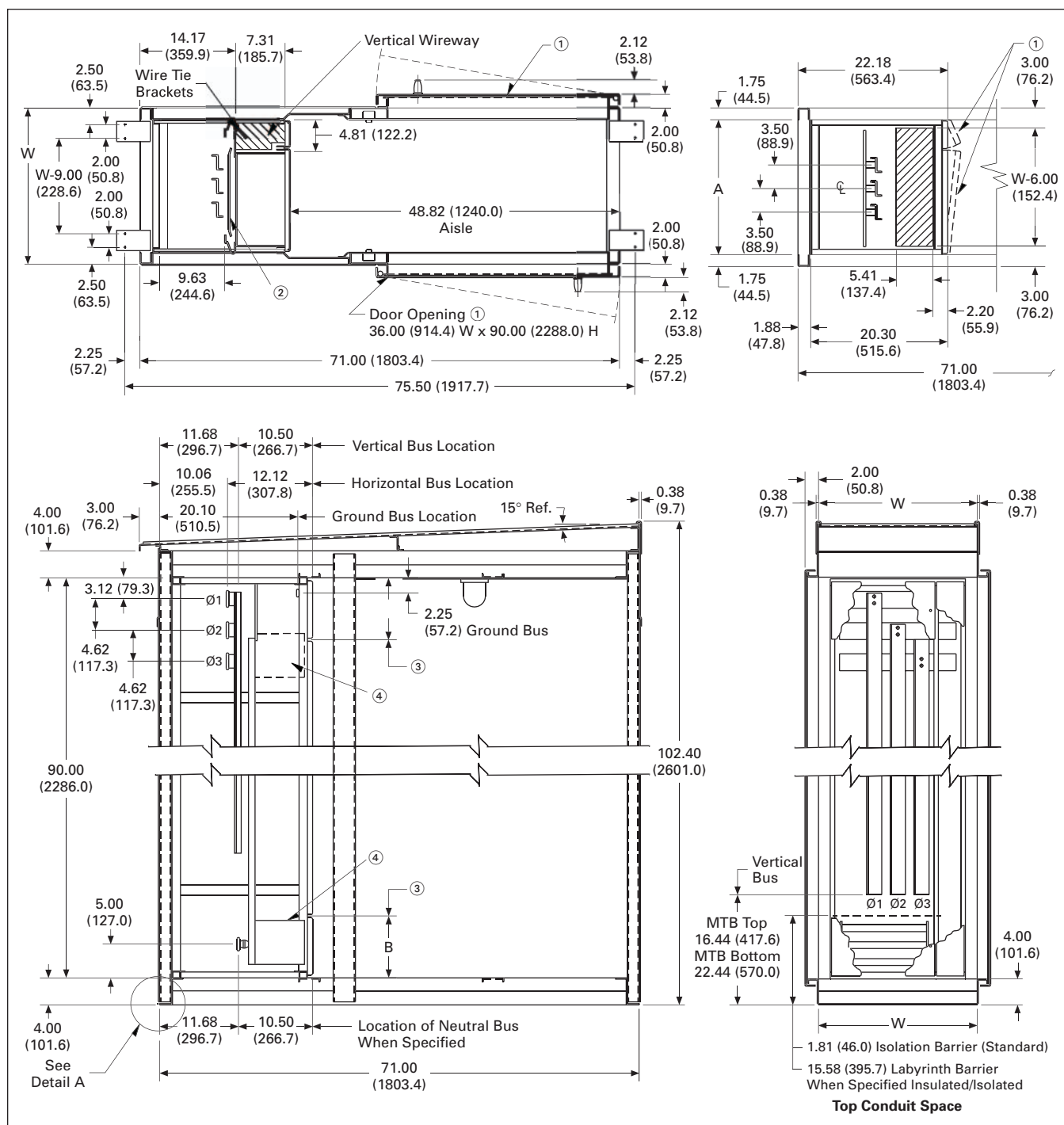
**Figure 29.1-17. 21.00-Inch (533.4 mm) Deep—Front- and Rear-Mounted Corner Structure**



**Figure 29.1-18. Freedom Series 2100 Motor Control Center Outline and Floor Plan NEMA 3R 28.85-Inch (732.8 mm) Deep Structure—Dimensions in Inches (mm)**

- ① Minimum length of anchor bolt 2.00 inches (50.8 mm). 38.00 (9.7 mm)—16 recommended.
- ② Recommended maximum conduit height above floor line 3.50 inches (88.9 mm).
- ③ Maximum conduit space with channel sills 15.78 x 16.6 inches (400.8 x 421.6 mm).
- ④ Master terminal block assembly furnished for type "C" wiring only. When location not specified MTB supplied at the bottom.
- ⑤ Recommended standard anchor bolting for Detail 1. When channel sills are used, see Detail 2.
- ⑥ This conduit space is not recommended when neutral bus is required. Otherwise available.
- ⑦ Top rear conduit space is not recommended for conduit entry in front mounted only structure.
- ⑧ Standard structure arrangement (in front) without master terminal block, A and B—9.00 inches (228.6 mm). With master terminal block at bottom, A and B—9.00 inches (228.6 mm). With master terminal block at top: A—15.00 inches (381.0 mm), B—3.00 inches (76.2 mm).

**Note:** Rear horizontal bus barrier is not supplied with front-mounted only structure.



**Figure 29.1-19. NEMA 3R Walk-In Aisle Structures—Dimensions in Inches (mm)**

- ① All doors open minimum of 105°.
- ② Rear vertical bus barrier not supplied with front-mounted only structure.
- ③ Standard structure arrangement (in front) without master terminal block, A and B—9.00 inches (228.6 mm). With master terminal block at bottom, A and B—9.00 inches (228.6 mm). With master terminal block at top: A—15.00 inches (381.0 mm), B—3.00 inches (76.2 mm).
- ④ Master terminal block assembly furnished for type "C" wiring only. When location is not specified MTB is supplied at the bottom.

**Note:** Minimum rated vertical bus supplied as standard. Rear conduit space not recommended for conduit entry in front mounted only structure. Top rear conduit space not recommended for conduit entry in front mounted only structure.

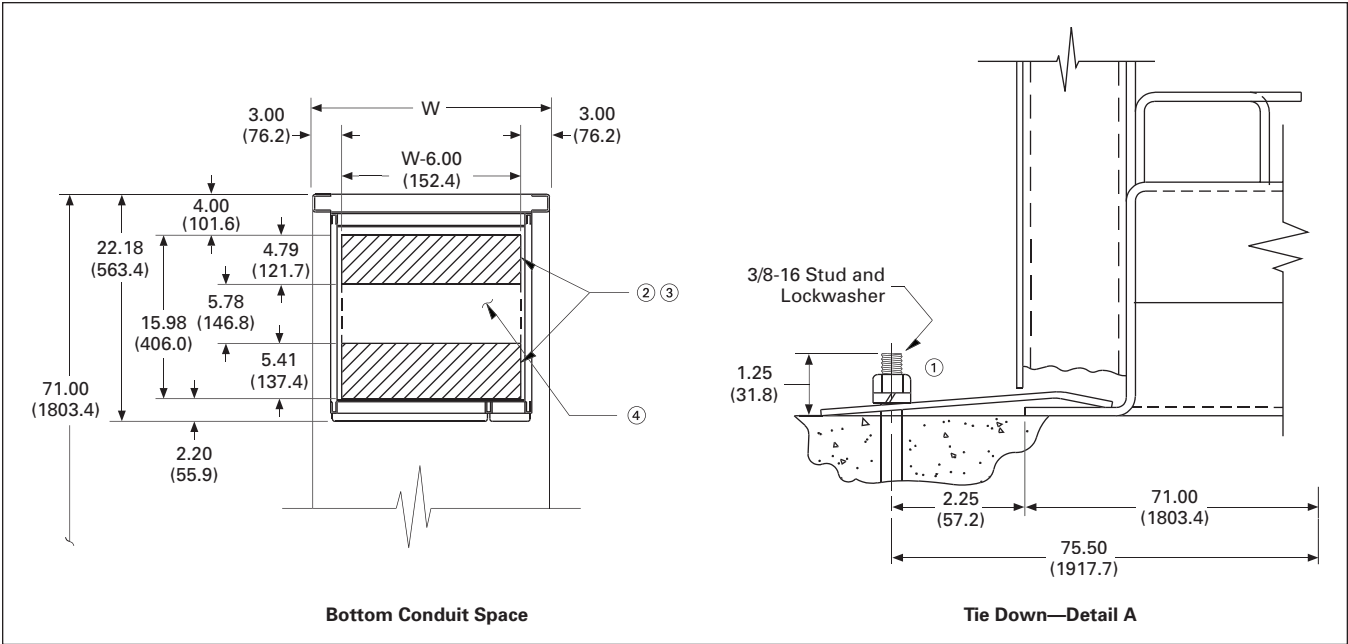


Figure 29.1-20. NEMA 3R Walk-In Aisle Structures—Dimensions in Inches (mm)

- ① Minimum length of anchor bolt above grade 1.25 (31.75) (0.38-16 grade 5 torqued at 31 lb ft (43.4 Nm).
- ② Recommended maximum conduit height above floor line 5.50 inches (139.7 mm).
- ③ Maximum conduit space B.
- ④ This conduit space not recommended when a neutral bus is required. The space is otherwise available.

Table 29.1-91. Dimensions in Inches (mm)

Outdoor Structure Width (W)	Indoor Structure Width (A)	Maximum Conduit Space (B)
23.50 (596.9)	20.00 (508.0)	17.50 x 15.98 (444.5 x 405.9)
27.50 (698.5)	24.00 (609.6)	21.50 x 15.98 (546.1 x 405.9)
31.50 (800.1)	28.00 (711.2)	25.50 x 15.98 (647.7 x 405.9)
35.50 (901.7)	32.00 (812.8)	29.50 x 15.98 (749.3 x 405.9)