



Allen-Bradley

***Bulletins
2100 & 2400
CENTERLINE®
Units & Structures***

**NEMA/EEMAC
& Application Rated**

Recommended General Specifications



Important User Information

Allen-Bradley Company has produced quality Motor Control Centers since 1948, meeting the requirements of all types of industries. We sincerely believe that we can satisfy your exacting requirements.

This specification has been written to assist you in preparing bids for Allen-Bradley CENTERLINE® Motor Control Centers. Use in conjunction with Publication 2100-2.0.1, Specifications Checklist.

The following standards may be referred to in this document:

ANSI – American National Standards Institute

CSA – Canadian Standards Associates

EEMAC – Electrical & Electronic Manufacturers Association
Canada

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical & Electronic Engineers

NEC – National Electrical Code

NEMA – National Electrical Manufacturers Association

OSHA – Occupational Safety & Health Act

UL – Underwriters Laboratories

The following acronyms may be referred to in this document:

FCAN – Full Capacity Above Normal (applies to transformers)

FCBN – Full Capacity Below Normal (applies to transformers)

FVNR – Full Voltage Non-Reversing

FVC – Full Voltage Contactor

VFD – Variable Frequency Drive

FVR – Full Voltage Reversing

GFI – Ground Fault Circuit Interrupter (applies to lighting panels)

I/O – Input/Output

KAIC – Thousand Ampere Interrupting Capacity (fault current)

MCB – Main Circuit Breaker

MCC – Motor Control Center

MFD – Main Fusible Disconnect Switch

MLO – Main Lug Only

MTW – Machine Tool Wire

PLC – Programmable Logic Controller

RVAT – Reduced Voltage Autotransformer

S/D – Star Delta or Wye Delta

SMC – Solid State Motor Controller

TS1W – Two Speed 1-Winding

TS2W – Two Speed 2-Winding

TS1WR – Two Speed 1-Winding Reversing

TS2WR – Two Speed 2-Winding Reversing

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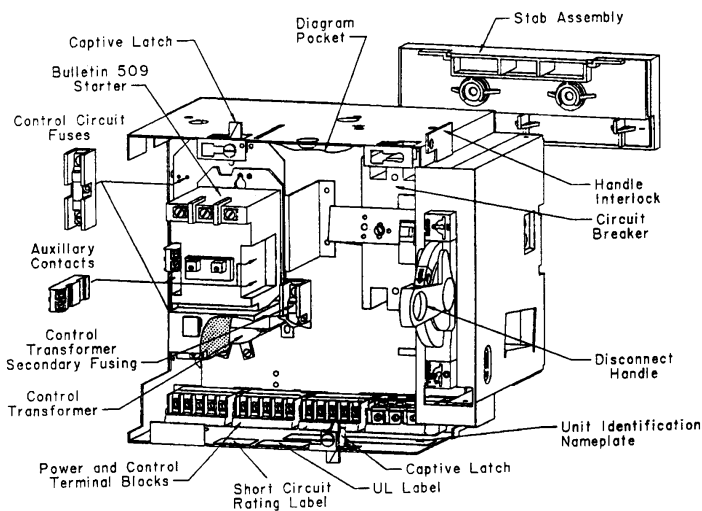
General Description & Typical Construction Drawings

The Motor Control Center (MCC) shall be Allen-Bradley Bulletin 2100 (NEMA) and Bulletin 2400 (Ampere Rated) CENTERLINE[®] consisting of structure or grouping of structures with power bus, feed for power bus, and various types of units and options for the units.

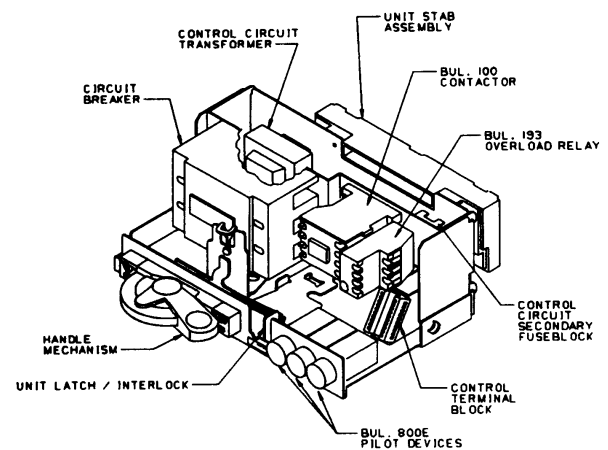
Each MCC shall be of *dead front* construction and shall incorporate horizontal and vertical power bus, plus ground and neutral bus bars as required. The vertical steel plug-in unit ground bus shall be a standard feature.

The MCC shall consist of one or more vertical sections bolted together to form a rigid, free-standing assembly and shall be so designed as to permit future additions of vertical sections and interchanging of units by the user. MCCs shall be constructed to meet or exceed the requirements of the latest published standards of NEMA, EEMAC, IEC, UL and CSA for motor control centers.

Typical Unit Construction

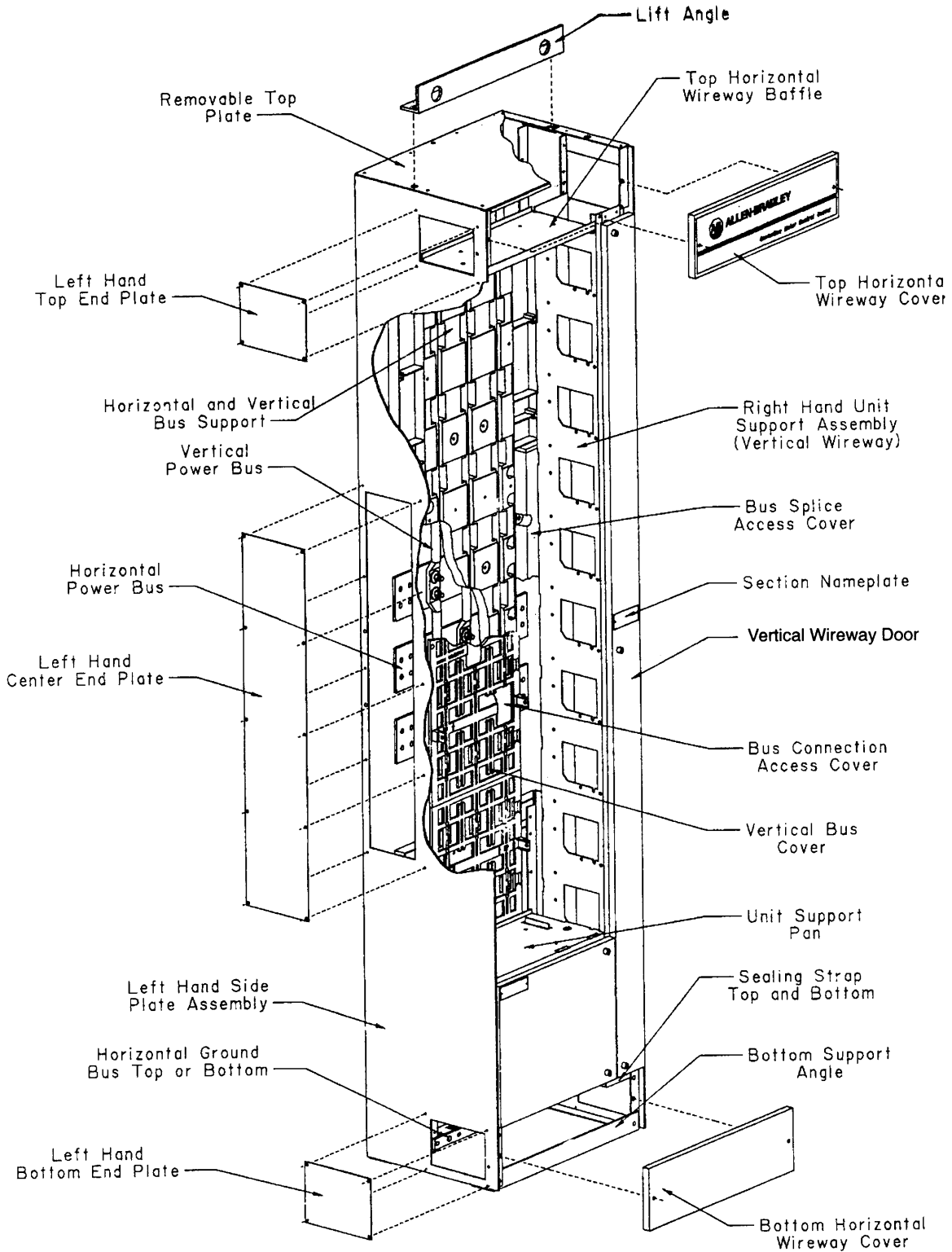


1.0 Space Factor



0.5 Space Factor

Typical Section Construction



Vertical Section Information

Section Information

1. Vertical sections shall be rigid, free-standing structures with heavy duty internal mounting angles running continuous within the shipping block. Two clearance holes shall be provided in each section for bolting or welding to the prepared mounting site. Optional external mounting channels 1-1/2" x 3" (38.1mm x 76.2mm) shall be available. A removable continuous steel lifting means shall be provided on all shipping blocks, except the NEMA/EEMAC Type 3R and NEMA/EEMAC Type 4 designs where lifting means is optional.

2. Standard Structure and Shipping Block Dimensions:

| | Front Only | Back-to-Back |
|--|----------------------------|--|
| Structure Depth | 15" (381mm) 20" (508mm) | 25" (635mm) 30" (762mm) 40" (1016mm) |
| Structure Width | 20" (508mm) | 20" (508mm) |
| Structure Height | 90" (2286mm) | 90" (2286mm) |
| Normal Number of Structures Per Shipping Block | 3 | 3 (6 sections) |
| Maximum Width of Shipping Block | 60" (1524mm) | 60" (1524mm) |

Any section wider than 20" (508mm) will constitute its own shipping block. Sections using the 9" wide vertical wireway are available in a 2-section shipping block.

3. The vertical sections shall be divided into twelve (12) half-space factors, each half-space factor being 6-1/2" (165.1mm) high.
4. Removable end plates shall be used to cover the horizontal power bus and horizontal wireway openings on each end of the MCC.
5. Each section shall be equipped with removable one piece top plate and full metal side sheets (one on each side) to isolate each vertical section.
6. All enclosure metal work will have rounded edges and be tightly fitted with no visible air gaps. Enclosures shall be designed and built according to NEMA/EEMAC standards.
 - NEMA/EEMAC Type 1 shall be available.
 - NEMA/EEMAC Type 1 with gasketing (1G) in the unit insert door areas shall be available.
 - NEMA/EEMAC Type 2 Driphood (placed on top of NEMA/ EEMAC Type 1)

- NEMA/EEMAC Type 12, completely gasketed (closed cell neoprene), with a 2-piece bottom plate, shall be available. Stainless steel NEMA/EEMAC Type 12 enclosures shall also be available.
- The NEMA/EEMAC Type 3R non walk-in enclosure (front only applications) shall be physically built around the standard structure, with a 5" (127mm) open area to the unit door. The single section door will be closed using a vault style handle and will have a 2" (50.8mm) roof overhang. The overall dimensions will be 92-1/2" high × 25-3/8" wide × 20-3/16" deep (2350mm × 645mm × 766mm).
- Stainless steel NEMA/EEMAC Type 4 enclosures shall also be available.

Wireway Information

1. Horizontal wireways of standard sections, both top and bottom, shall extend the full depth of the MCC. Each wireway shall provide a minimum of 90 square inches (580.7 sq cm) of unobstructed wiring space. The horizontal wireway shall be not less than 6" (152.4mm) high and shall extend the length of the control center with a 25 square inch (161.3 sq cm) opening between sections. A single opening is supplied in 15" depth (381mm), and two openings are supplied in 20" depth (508mm) sections. The wireways shall be isolated from all bus. Horizontal wireways of back-to-back sections shall allow complete access from the front section through to the back section. Horizontal wireways shall have removable covers held closed by captive screws.

The horizontal wireway of an incoming line section shall be 6" high and 7" deep (152mm and 178mm), i.e., shall extend across the incoming line lug section and be isolated from the incoming line compartment with a barrier.

2. A full height vertical wireway shall be provided in each standard vertical section and shall be isolated from the horizontal and vertical bus. Vertical wireways shall be an integral part of each section and shall be independent of plug-in units. The minimum dimensions of the wireway shall be 4-3/8" wide and 7" deep (111mm and 178mm). An optional 9" (228mm) wide vertical wireway shall be available in a 25" (635mm) wide section. A removable hinged door with 1/4 turn pawl type latches shall cover the vertical wireway and provide access to wiring without disturbing energized control units. In each section the vertical and horizontal wireways shall open to the front to allow wires to be laid in place. Vertical wireway tie bars shall be an available option.

3. All structural metal parts shall undergo a multi-step cleaning, rinsing, and painting process resulting in complete paint coverage of uniform thickness. This process shall be maintained and controlled by rigid quality control standards.
4. Surfaces shall be painted in accordance with the following:
 - Standard – Unless otherwise specified, all interior and exterior surfaces shall be painted ANSI 49 medium light gray. The vertical wireways and unit back plates shall be painted high visibility gloss white.
 - Custom – When specified, all external surfaces except the handle assembly surfaces and other door mounted equipment shall be painted to the custom color requirement.
5. All unpainted parts shall be plated for corrosion resistance.
6. NEMA Type 3R MCCs shall have the exterior cabinet parts finished with ANSI 49 medium light gray, ultraviolet resistant, which is UL recognized for outdoor use.
7. Stainless steel enclosure parts are not painted.

Bus Information

The power bus system shall be either aluminum or copper, supported, braced and isolated by a bus support molded of a high strength, non-tracking glass polyester material. Horizontal and vertical buses shall be fastened together with a bus clamp assembly. Minimum bus bracing of 42kA rms symmetrical shall be standard with options available for 65kA and 100kA rms symmetrical.

Horizontal Bus Information

The horizontal bus shall be mounted near the horizontal center line of the structure to provide optimum heat distribution, power distribution and ease of maintenance and splicing. It shall be mounted on-edge in a vertical plane to provide maximum resistance to magnetic stresses. It shall be mounted in recessed channels of the bus support molding to protect against accumulation of dust and tracking between phases. The horizontal bus shall be continuously braced within each section and shall be continuous in each shipping block.

- The 25" (635mm) back-to-back motor control center shall have a common horizontal power bus.
- The 30" (762mm) and 40" (1016mm) back-to-back motor control center line-ups shall have separate horizontal buses. The horizontal power buses are joined by a factory installed U-shaped bus splice assembly.
 - The horizontal power bus ampere rating shall include:
 - Tin plated aluminum 600A and 800A in 15" and 20" deep front only, plus 30" and 40" deep back-to-back.

- Tin or silver plated copper 600A, 800A, 1200A, 1600A, 2000A, 2500A, and 3000A (20" deep or 40" deep back-to-back) sizes shall be available in 15" or 20" deep front only, as well as 30" or 40" deep back-to-back. In the 25" deep back-to-back design, 1200A, 1600A, 2000A and 2500A bus shall be available.

Vertical Bus Information

1. Each vertical bus bar shall be cylindrical to provide optimum contact with the unit plug-in stab. The vertical bus shall be continuously braced and sandwiched in a high strength, non-tracking glass polycarbonate molded cover. It shall be isolated from the other phases and the horizontal power bus.
 - Back-to-back structures shall be supplied with separate vertical bus in both the front and rear sections providing the same phasing on the units, both front and back. There shall be a full twelve (12) space factor capability, both front and back standard sections.
2. The vertical power bus ampere rating shall include:
 - Tin or silver plated copper tube rated 300A above and below the horizontal power bus for an effective rating of 600A as standard.
 - Tin or silver plated copper rod rated 600A above and below the horizontal bus for an effective rating of 1200A as an option.

Ground Bus Information

1. The optional horizontal ground bus shall be unplated copper or tin plated copper and can be located in the top and/or bottom horizontal wireway.
 - The horizontal ground bus shall be 1/4" × 1" (6.35mm x 25.4mm) with a 500A continuous rating or 1/4" × 2" (6.35mm) × 50.8mm) with a 900A continuous rating.
 - A pressure type mechanical lug shall be mounted on the ground bus in the incoming line section.
2. The vertical plug-in zinc-plated steel ground bus shall be supplied in each standard section (unplated copper or tin plated copper vertical plug-in ground bus shall be available options). The vertical ground bus shall be connected to the horizontal ground bus to form a complete internal grounding system.

The vertical ground bus in combination with the unit ground stab shall establish unit insert grounding before the plug-in power stabs engage the power bus. Then, as the unit is withdrawn, grounding shall be maintained until after the plug-in power stabs are disengaged. The vertical ground bus dimensions shall be 3/16" × 3/4" (4.75mm × 19.05mm).

3. The optional vertical unit load ground bus shall be unplated copper or tin plated copper and be connected to the horizontal ground bus. The vertical load ground bus in combination with the unit load ground connector, shall provide a termination point for the load ground cable at the unit. This fixed connection shall not have to be removed when the unit is withdrawn from the MCC. The bus dimensions shall be $3/16'' \times 3/4''$ (4.76mm \times 19.05mm).

Neutral Bus Information

The neutral bus when specified in four wire systems shall be provided across the full width of the MCC. The horizontal neutral bus shall be located above or below the horizontal bus determined by the application. Connection to the neutral shall be made through neutral connection plates in the various sections. A neutral termination plate shall also be available for neutral terminations at the MCC.

Incoming Line and Metering Compartment Information

Line Lug Compartment (MLO)

1. The main incoming line lug compartment shall be available in either top or bottom entry and shall utilize mechanical or crimp compression lugs.

NEMA/EEMAC 2-hole spacing and lugs for either aluminum or copper conductor shall be used. Dimensions: 1-3/4" (44.45mm) between hole centers.

2. Incoming line lug compartments for 300A, 600A, 800A, 1200A, 1600A, 2000A, 2500A, and 3000A (20" deep front or 40" deep back-to-back) shall be accessible from the front in front only structure and 30" (762mm) and 40" (1016mm) back-to-back structures with the following space factor requirements:
 - Top wireway: 600A with pullbox (top entry only, lugs in rear portion of partitioned top horizontal wireway).
 - 1.0 space factor: 300A and 600A
 - 1.0 space factor: 800A and 1200A with pullbox (top entry only, lugs in rear portion of partitioned top horizontal wireway).
 - 1.5 space factors: 600A, 800A.
 - 2.0 space factors: 800A, 1200A.
 - 6.0 space factors: 600A, 800A, 1200A, 1600A, 2000A, 2500A, 3000A.
3. Where space is at a premium, two additional incoming line lug compartments shall be made available.
 - A 6.0 space factor 10" (254mm) wide incoming line lug compartment with crimp style lugs only. For front only motor control centers (1200A maximum).
 - Placement of the incoming lugs in a corner section (2000A maximum).

Main Fusible Disconnect (MFD)

1. The main fusible disconnect compartment shall consist of a heavy duty switch and fuse block assembly. It shall be front accessible and have a removable protective barrier to reduce the possibility of accidental contact with line terminals.
 - Main fusible disconnect switches rated through 400A shall be supplied with a heavy duty disconnect switch with visible blade type movable contacts and fuse blocks.
 - Mains rated 600, 800 and 1200A shall incorporate a bolted pressure contact switch with visible blades and viewing window.
 - Main fusible disconnects shall be available for 1600, 2000, 2500 and 3000 amperes and shall require a full 30" (750mm) wide section.
 - Main fusible disconnect switches rated through 800A shall be suitable for service entrance equipment and will be located in the top most or bottom most unit space. Mains rated 1200A may require ground fault for service entrance labeling.
2. The main fusible disconnect compartments through 600A shall be supplied with either Class J, R, or H fuse blocks, and compartments above 600A shall be supplied with Class L fuse blocks.

Main Circuit Breaker (MCB)

The main circuit breaker shall be inverse time (thermal magnetic or solid state) type. It shall be front accessible and have a removable protective barrier to reduce the possibility of accidental contact with line terminals.

Mains rated through 1200A will be located in the top most or bottom most unit space. The 1600A, 2000A, and 2500A breakers will require a 30" wide full section.

Metering Compartment

Metering shall be available either in separate metering unit compartments or as optional in a line lug compartment. Ammeter, voltmeter and watt-hour metering shall be available as analog devices, with or without local switching. Digital metering or digital meter system units shall also be available, as shall power monitor systems, for either 3-phase, 3-wire or 3-phase, 4-wire systems.

Unit Information

(General Information applying to all units.)

Mounting

1. Plug-in units shall consist of a unit assembly, unit support pan and unit door assembly.
2. Each plug-in unit shall be supported and guided by a removable unit support pan, so that different unit arrangements are easily accomplished. The rearrangement of a unit support pan from one location to another shall be accomplished without the use of tools.

Specific to 0.5 space factor plug-in units:

After insertion, each plug-in unit shall be held in place by a single latch / interlock mechanism requiring no tools to operate. The latch / interlock mechanism shall have two (2) locked positions for the unit: Normal operating – where the power stabs engage the vertical bus, and service position – where the power stabs are disconnected from the vertical bus, but separate control power can still be connected. Padlocking shall be possible in the service position.

Specific to 1.0 through 5.0 space factor plug-in units:

After insertion, each plug-in unit shall be held in place by two (2) or more multi-turn latches, located at the front of the unit. At least one latch shall be located at the top of the insert and one at the bottom, for front accessibility and installation convenience. A test position is provided with the unit supported in the structure but disengaged from the bus. Padlocking is possible in this position.

3. Both NEMA/EEMAC Bulletin 500 apparatus and application rated Bulletin 100 apparatus use the same structure without modification.

Power Stabs

1. The unit plug-in power stab assemblies shall be tin plated copper for a low resistance connection and designed to tighten during heavy current surges.
2. The stabs shall be backed by stainless steel spring clips to provide and maintain a high pressure four point connection to the vertical bus. They shall be free floating and self aligning during plug-in. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed at the rear of the unit. The power cable termination at the plug-in stab shall be a maintenance free crimp

type and shall be mounted in a two piece support assembly. This support shall provide a separate isolated pathway for each phase minimizing the possibility of a unit fault condition reaching the power bus system.

3. Starter and contactor units requiring less than six (6) space factors shall be plug-in. NEMA/EEMAC units sizes 1 through 5 and ampere rated units 18A through 304A shall be plug-in units. Stab assemblies shall be sized to match the rating of the units, with a dual stab arrangement being used on NEMA/EEMAC Size 5 and application rated larger than 180A.
4. The stab openings shall consist of two rectangular openings per phase. Each opening shall be 1/2" wide \times 1-1/2" long (13mm \times 39mm).
5. Manual or automatic shutters or protective caps shall be available for isolation of unused stab openings.

Handle

1. An industrial, heavy duty, flange mounted handle mechanism shall be supplied for the control of each disconnect switch or circuit breaker. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of unit door position.
2. The operator handles shall pivot in the horizontal plane in one-half space factor units and in the vertical plane in one space factor and larger units. The on-off condition of the disconnecting means shall be indicated by the handle position, red and green colored indicators (which include the words ON and OFF), and the international symbols I and O along with a pictorial indication of the handle position. It shall be possible to lock the handle in the OFF position with up to three (3) 3/8" (9.5mm) diameter shackle padlocks. All operating handles shall be of a non-conductive material.

Trip indication on circuit breaker handles (circuit breakers rated through 1200A) shall be included.

3. The operator handle of all units shall be interlocked with the unit door so that the disconnect means cannot be switched to the ON position unless the unit door is closed. A means shall be provided for purposely defeating this interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the OFF position. An externally operated defeater requiring the use of a tool shall provide access to the unit without interrupting service.
4. The operator handle shall be interlocked with the unit so that the unit cannot be inserted or withdrawn with the operator handle in the ON position.

NEMA/EEMAC Wiring Class

The MCC shall be wired in accordance with the required NEMA/EEMAC Class and Type as defined by NEMA Standard ICS 2-322.

1. NEMA/EEMAC Class I – Standard wiring diagrams for individual units shall consist of drawings that identify electrical devices, connections, and terminal numbering designations. Individual unit diagrams are supplied for each unit.
2. NEMA/EEMAC Class II – Similar to Class I but includes interwiring between units, i.e. electrical interlocking, etc., as specifically described in an overall interconnection diagram supplied by the purchaser. A chart indicating factory interconnections shall be supplied.
3. NEMA/EEMAC Class IS & IIS – Similar to Class I and Class II except custom drawings with special terminal numbering designations instead of manufacturer's diagrams.
4. NEMA/EEMAC Type A – User's power and control connections shall be made directly to the devices within the unit (available only in Class I wiring).
5. NEMA/EEMAC Type B – Pull-apart terminal blocks shall be supplied for user control terminations.
 - Type B user field load wiring for combination motor control units size 3 or smaller shall be designed as B-D or B-T, according to the following:
 - B-D connects directly to the device terminals, which are located immediately adjacent and readily accessible to the vertical wireway.
 - B-T connects directly to a load terminal block in or adjacent to the unit.
 - Type B user field load wiring for combination motor control units larger than size 3, and for feeder tap units, shall connect directly to unit device terminals.
6. NEMA/EEMAC Type C – All features of NEMA/EEMAC Type B shall be furnished, in addition to track mounted non pull-apart terminals in a master terminal board compartment, located in the top or bottom most unit space.

NEMA/EEMAC Rated Controllers (Bulletin 2100)

Disconnecting

1. Fusible disconnect switches shall be available in combination starter units.
 - These disconnects shall have blade type contacts and shall be supplied with either Class J, R, H, L, HRCII-C, CC fuse clips as dictated by available fuse size.
 - Unit disconnect requirements above 400A shall utilize a bolted pressure contact switch with visible blade disconnect mechanism.
2. Circuit breakers shall be available in combination starter units.
3. Circuit breaker type combination starter units shall be provided with instantaneous circuit breakers (HMCP/GMCP) or with inverse time (thermal magnetic or solid state) circuit breakers.
 - The NEMA/EEMAC unit withstand at 480V when the HMCP circuit breaker disconnecting means is used through Size 5 starters will be up to 100kA rms symmetrical. The rating is without the use of a limiter attachment.

Combination Starters

Starters and contactors shall be available in FVC, FVNR, FVR, TS1W, TS2W, and RVAT using NEMA/EEMAC Bulletin 500 components to meet specified requirements, in the standard vertical space factor configuration. Available also in NEMA/EEMAC 0.5 space factor Size 1 horizontal design.

1. Magnetic starters and contactors shall be Allen-Bradley Bulletin 500 components to meet specified requirements. They shall be UL Listed and CSA Certified and meet basic internal codes as practical.
 - Coils on all contactors shall be easy to inspect.
 - Starter units for use with Bulletin 500 contactors shall be supplied with Bulletin 592 overload relays which are directly heated eutectic alloy ratchet type and utilize class 20 ambient insensitive type W heater elements.

- Solid state overload relay:
SMP-1™ shall provide basic overcurrent and phase loss protection;
SMP-2™ shall provide SMP-1 features plus selectable ground fault and jam protection and adjustable trip class;
SMP-3™ shall provide SMP-2 features plus communication capabilities and trip cause indication.
SMP-1 and SMP-2 shall provide 1 N.O. and 1 N.C. isolated auxiliary contact, and SMP-3 provides 1 N.C. auxiliary contact and 1 N.O. triac output.
 - Available to all overload relays shall be a normally open isolated alarm contact.
2. Control wiring (16 AWG) shall be 90°C minimum, machine tool wire (MTW), VW-1 rated copper with 14 AWG (2.1mm²) wire as optional. Power wiring shall be 90°C minimum, VW-1 rated copper conductor size number 10 AWG (6.0mm²) minimum.
 3. Unit control power shall be provided by a control circuit transformer, separate control source, or common control.
 - The control circuit transformer shall be mounted within the unit with a VA of at least twice the sealed VA of the starter. The secondary side of the control circuit transformer shall have one leg fused and the other leg grounded. Primary protection shall be provided by an inherently protected control circuit transformer or by the use of primary fusing.
 - The separate control source shall have available an auxiliary contact on the disconnecting means with an option for a separate control fuse.
 - The common control source shall operate at line voltage with an option for common control fusing.
 4. Terminal blocks, when specified, shall be mounted within the unit insert located in front for easy accessibility. Control terminal blocks shall be pull-apart on plug-in units for easy removal of the unit from the structure. Terminal blocks on non plug-in factory mounted units shall be fixed type.
 - 1.0 space factor and larger units shall have a pull-apart terminal block assembly consisting of a male and female component held together with captive screws. The assembly shall be designed to withstand the effects of vibration, yet able to be pulled apart without difficulty. The terminals of both portions of the assembly shall be recessed to isolate them from accidental contact when withdrawn. Terminal marking shall be provided identifying terminations.
 - 0.5 space factor units, control pull-apart blocks shall be 10-pole rated 10A, 300V, and 90°C with #14 AWG maximum wire size (2.5mm²).

- Power pull-apart blocks shall be 3-pole rated, 60A, 600V, 90°C and shall be supplied on NEMA/EEMAC Size 1 and 2 starters with a maximum wire size of #4 AWG (21.15mm²). A non pull-apart block rated 195A, 600V shall be supplied for Size 3 starters 90°C with 1/0 AWG (53.48mm²) maximum wire size. Power terminal blocks are not supplied on Size 4 and larger starter units.
5. Each unit shall be provided with a removable door mounted on removable pin type hinges which allow the door to swing open at least 110°. Doors shall be removable from any location in the center without disturbing any other doors. The unit doors shall be fastened to the stationary structure so that it can be closed to cover the unit space when the insert has been removed. The unit doors shall be held closed with a minimum of a single 1/4 turn pawl type latch designed to resist forces during fault conditions. Each starter door shall be provided with an external low profile overload reset button.
- Units shall be furnished with Allen-Bradley Bulletin 800T 30.5mm type 4/13 water tight/ oiltight pushbuttons, selector switches or pilot lights shall be mounted using a through the door approach on one-half space factor units and mounted in a door mounted control station which is easily removable using captive screws for one space factor and larger units. Dual function units may be utilized.
 - A full line of Allen-Bradley accessory equipment including auxiliary contacts, relays, timers, solid-state relays, motor winding heaters, and ground fault devices shall be available.

Application Rated Controllers (Bulletin 2400)

Disconnecting

1. Fusible disconnect switches shall be available in combination starter units.
 - These disconnects shall have blade type contacts and shall be supplied with either Class J and HRCII–C fuse clips as dictated by available fuse size.
2. Circuit breakers shall be available in combination starter units.
3. Circuit breaker type combination starter units shall be provided with instantaneous circuit breakers (HMCP/GMCP) or with inverse time (thermal magnetic or solid state) circuit breakers.
 - The ampere rated unit withstand at 480V when the HMCP circuit breaker disconnecting means is used through 304A starters will be up to 42kA rms symmetrical. The rating is without the use of a limiter attachment.
 - The ampere rated unit withstand at 480V, when the type GMCP magnetic circuit breaker disconnecting means is used through 75A, shall be up to 25kA rms symmetrical. Applications greater than 75A will use HMCP circuit breakers to meet the available fault current.

Combination Starters

Starters and contactors shall be available in FVC, FVNR, FVR types using application rated Bulletin 100 components to meet specified requirements.

1. Magnetic starters and contactors shall be Allen-Bradley Bulletin 100 components to meet specified requirements. Both types shall be UL Listed and CSA Certified and meet basic internal codes as practical.
 - Coils on all contactors shall be easy to inspect.
 - Starter units for use with Bulletin 100 contactors shall be supplied with 3-pole Bulletin 193 overload relays, which are ambient compensated, have single phase sensitivity, and offer class 10 tripping characteristics.

- Solid state overload relay:
SMP-1 shall provide basic overcurrent and phase loss protection;
SMP-2 shall provide SMP-1 features plus ground fault and jam protection and adjustable trip class;
SMP-3 shall provide SMP-2 features plus communication capabilities and trip cause indication.
SMP-1 and SMP-2 shall provide 1 N.O. and 1 N.C. isolated auxiliary contact, and SMP-3 provides 1 N.C. auxiliary contact and 1 N.O. triac output.
 - Available to all overload relays shall be a normally open isolated alarm contact.
2. Control wiring (18 AWG) shall be 90°C minimum, 18 AWG (1mm²) machine tool wire (MTW), VW-1 rated copper with 16 AWG (1.31mm²) wire as optional. Power wiring shall be 90°C minimum, VW-1 rated copper conductor size number 10 AWG (6.0mm²) minimum.
 3. Unit control power shall be provided by a control circuit transformer, separate control source, or common control.
 - The control circuit transformer shall be mounted within the unit with a VA of at least twice the sealed VA of the starter. The secondary side of the control circuit transformer shall have one leg fused and the other leg grounded. Primary protection shall be provided by an inherently protected control circuit transformer or by the use of primary fusing.
 - The separate control source shall have available an auxiliary contact on the disconnecting means with an option for a separate control fuse.
 - The common control source shall operate at line voltage with an option for common control fusing.
 4. Terminal blocks, when specified, shall be mounted within the unit insert located in front for easy accessibility. Control terminal blocks shall be pull-apart on plug-in units for easy removal of the unit from the structure.
 - 1.0 space factor and larger units shall have a pull-apart terminal block assembly consisting of a male and female component held together with captive screws. The assembly shall be designed to withstand the effects of vibration, yet able to be pulled apart without difficulty. The terminals of both portions of the assembly shall be recessed to isolate them from accidental contact when withdrawn. Terminal marking shall be provided identifying terminations.
 - 0.5 space factor units, control pull-apart blocks shall be 10-pole rated 10A, 300V, and 90°C with #14 AWG maximum wire size (2.5mm²).
 - Power terminal blocks shall not be supplied on Bulletin 2400 units.

-
5. Each unit shall be provided with a removable door mounted on removable pin type hinges which allow the door to swing open at least 110°. Doors shall be removable from any location in the center without disturbing any other doors. The unit doors shall be fastened to the stationary structure so that it can be closed to cover the unit space when the insert has been removed. The unit doors shall be held closed with a minimum of a single 1/4 turn pawl type latch designed to resist forces during fault conditions. Each starter door shall be provided with an external low profile overload reset button.
- Units furnished with pushbuttons, selector switches or pilot lights shall be mounted using a through-the-door approach on one-half space factor units and mounted in a door mounted control station which is easily removable using captive screws for one space factor and larger units. Dual function units may be utilized.
 - For application rated units: Pushbuttons, selector switches and pilot lights will be 22.5mm IEC style with a minimum rating of NEMA/EEMAC Type 13, IEC 144/IP65 protection.
 - A full line of Allen-Bradley accessory equipment including auxiliary contacts, relays, timers, solid-state relays, motor winding heaters, and ground fault devices shall be available.

Units Used in Both NEMA/EEMAC and Application Rated Design

Feeders

1. Fusible disconnect switches shall be available from 30 to 1200 amperes.
 - These disconnects shall be blade type contacts and supplied with either Class J, or L fuse clips as dictated by available fuse size.
 - Unit disconnect requirements above 400A shall utilize a bolted pressure contact switch with visible blade disconnect mechanism.
 - Dual 30, 60, or 100A in any combination are available in a single unit.
2. Circuit Breakers shall be available from 150 to 1200A frames.
 - Feeder circuit breakers shall be thermal magnetic circuit breakers. The interrupting rating of thermal magnetic circuit breakers shall meet or exceed the specified available fault current.
 - Vertical mounted with vertical handles can be dual mounted (two feeders in one unit) through 150A.
 - Horizontal mounted with horizontal handle in 0.5 space factors shall be available through 150A.

Programmable Logic Controllers

The complete line of Allen-Bradley programmable controllers shall be available including Bulletin 1771 equipment and Bulletin 1745 SLC 500™.

1. I/O racks shall be available in 4, 8, and 16 slot configurations as:
 - Basic unit – no plug-in stabs, Basic unit – with plug-in stabs (8 slot I/O card maximum) with disconnecting means and control transformer.
 - Viewing windows in the door to permit visual verification of the I/O status indicators shall be provided.
 - System processors, power supplies, auxiliary power supplies, rack mounted power supplies and a full line of input and output cards can be provided.
 - The I/O rack shall be capable of accepting an adapter module allowing it to function with a remote processor through a single communications cable.

- When I/O racks are factory wired and have an I/O rack in each shipping split, interconnections between I/O racks shall be through a single communications cable, thereby eliminating the need to reconnect large bundles of control wires at the jobsite.
- A 40" (1016mm) wide two-door enclosure shall be available for housing up to (3) 16-slot I/O racks and associated peripheral equipment.
- Terminal connection points shall be made available.

AC Drives

Variable frequency AC drives shall be available from 1 to 200Hp. All drives will incorporate a disconnecting means, overload protection, and a means to view drive indicators and shall be manufactured by Allen-Bradley.

Solid State

The Allen-Bradley Bulletin 150 SMC-2™ and SMC PLUS™ controllers shall be available. Integral to the controller will be the disconnecting means, isolation contactor and fusing for SCR and branch circuit protection.

- Solid state controllers through 400HP at 480V for standard duty applications shall be available.
- Solid state controllers through 300HP at 480V for heavy duty applications shall be available.

Transformers

Lighting Transformers shall be available. Insulation will be Class H for 80°C rise.

1. Single phase transformers through 50kVA shall be available. Three phase transformers through 45kVA shall be available.
2. Tap arrangement on all three phase transformers shall be two (2) 2-1/2% FCAN, while the single phase transformers above 37-1/2kVA will have two (2) 2-1/2% taps and four (4) 2-1/2% taps FCAN and FCBN, respectively.

Lighting Panels

Lighting Panels shall be available in single phase 3 wire and three phase 4 wire with or without main breaker.

1. Branch breaker shall have an interrupting capacity of 10,000 or 22,000A rms symmetrical.
2. All branch breakers shall be bolt-on type with a maximum of 42 one pole breakers.
3. Available breakers shall include one, two and three pole breakers and single pole GFIs.
4. Power panels shall be available in 480/277V 3-phase 3- or 4-wire with or without main breaker, with a configuration of 1, 2 and 3 pole branch breakers as required with interrupting rating up to 65kA.

Nameplates

1. Master nameplate, when specified, shall be 6" × 2" (152.4mm × 50.8mm), white with black engraved characters. Available letter sizes shall be 1" (25.4mm), 1/2" (12.7mm), 3/8" (9.53mm) or 1/4" (6.35mm) Number of lines and characters are dependent upon letter size.
2. Unit nameplates shall be provided. Dimensions shall be 3-5/8" × 1-1/8" (92.07mm × 28.57mm). Engraved characters shall be 3/16" (4.76mm) high.
 - Blank cardholder shall be available for customer insert of printed card. They shall be clear.
 - Engraved acrylic nameplates shall be available for 3 lines of 15 characters per line. They shall be white with black characters or black with white characters.
 - Engraved phenolic nameplates shall be available for 3 lines of 15 characters per line. They shall be white with black characters, black with white characters, or red with white characters.
3. Nameplates shall be attached using two steel self-tapping screws. Stainless steel screws shall be optional.
4. Units shall have an identification label, indicating either a catalog number or serial number description, and shall be located inside of the unit compartment.
5. Each vertical section shall have a stamped metallic identification nameplate, indicating serial number, bus rating and vertical section reference numbering. The nameplate shall be externally mounted near the center of the vertical wireway door of each section.

Applying Ampere Rated Contactors

The ampere rated performance philosophy is an integral part of the selection procedure. The user must first identify the utilization category of the specific application, then tentatively choose a product that has a capability for handling the intended load in that utilization category. Finally, the user must check that the manufacturer's listed contact life in the appropriate utilization category is adequate for the specific application. In some instances, proper selection of an ampere rated contactor means a contactor that is one or two sizes larger than what may be initially indicated on a ratings table must be selected in order to give the desired contact life.

Ampere rated standards dictate that manufacturers show ratings and performance capabilities under different utilization categories. The most common utilization categories for AC contactors are listed in the table below.

| Utilization Category | Typical Duty |
|----------------------|--|
| AC1 | Non-inductive or slightly inductive loads |
| AC2 | Starting of slip-ring motors |
| AC3 | Starting of squirrel cage motors and switching off only after the motor is up to speed |
| AC4 | Starting of squirrel cage motors with inching and plugging duty |

NOTE: In an AC3 application, the contactor will never interrupt more than the motor's full load current. If the application requires interruption of current greater than motor FLC, it is an AC4 application.

AC3 and AC4 categories are the most important for someone applying contactors to standard industrial motors, so these will be addressed in more depth. It is important to remember when looking at these utilization categories that AC3 and AC4 are pure, laboratory test conditions. Users should not make the incorrect assumption that AC3 means "normal duty," while AC4 is "heavy duty." AC3 and AC4 relate to the different tests that a contactor must pass in order for a manufacturer to claim a specific rating or contact life. The test conditions within ampere rated only simulate the currents that would be encountered in specific applications, and as a result, relating these test conditions to actual application requirements may not always be valid.

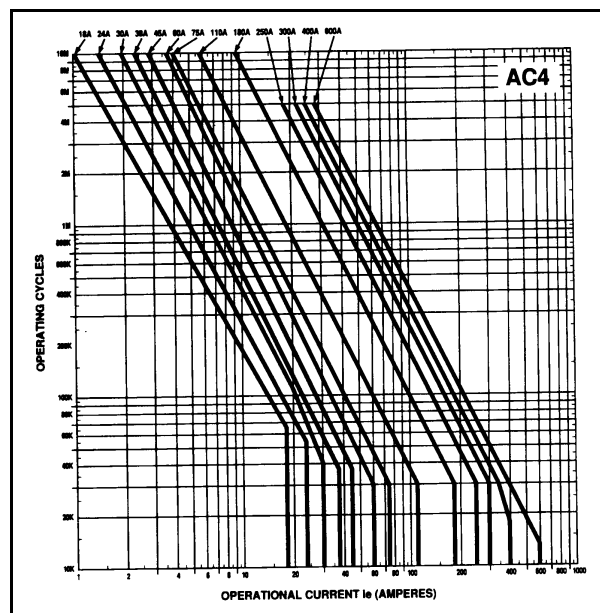
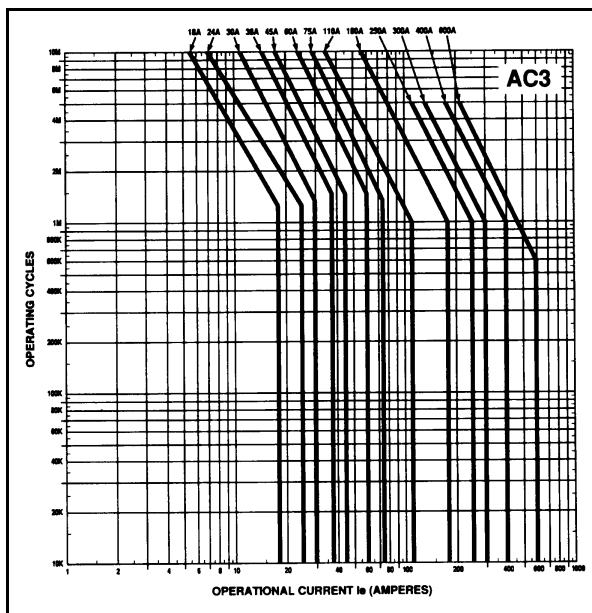
Manufacturers typically show contactor performance information in the form of curves on a graph with contact life on one axis and operational current on the other. Users will use these life-load curves to help determine if the contactor selected from a ratings table has an estimated contact life that the user feels is adequate for the application. If it does not, the life-load curves will be used to select an appropriate larger size contactor which will provide this life.

Since ampere rated based devices are generally rated closer to their ultimate capabilities than NEMA based products, use of the curves is necessary for users to achieve the same application confidence level with ampere rated based products that normally is achieved with NEMA based devices automatically. Users should be careful, however, not to read more into the curves than is intended. The curves are a manufacturer's report of performance achieved under laboratory test conditions. Actual application contact life will often vary because in practice, pure AC3 and AC4 applications are not common.

Life-Load Curves

The Bulletin 100 ampere rated based contactors used in Bulletin 2400 MCC units are designed for superior performance in a wide variety of applications. When selecting IEC based products, the user must give consideration to the specific load, utilization category, and required electrical life of the application. The life-load curves shown here are based on Allen-Bradley tests according to the requirements as defined in IEC 158-1. Since contact life in application conditions is dependent upon environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown. To find the contactor's estimated electrical life, follow these guidelines:

1. Choose the appropriate graph for the utilization category. A chart showing typical duty for each category is shown below.
2. Locate the intersection of the life-load curve of the appropriate contactor with the application's operational current (I_e) found on the horizontal axis.
3. Read the estimated contact life in millions of operations along the vertical axis.



**Bulletin 100 / Bulletin 500
Comparison by Horsepower**

| Bulletin 100 Catalog Number | Bulletin 100 Current Ratings | 3 Phase Horsepower Ratings | | | | NEMA Size |
|--------------------------------------|------------------------------------|----------------------------|------|------|------|--------------|
| | | 200V | 230V | 460V | 575V | |
| A18N*3 | 18A | 5 | 5 | 10 | 10 | Size 1 |
| A18N*3 | 18A | – | – | – | 15 | Size 2 |
| A24N*3 | 24A | – | 7.5 | 15 | 20 | |
| A30N*3 | 30A | 7.5 | 10 | 20 | 25 | |
| A38N*3 | 38A | 10 | – | 25 | 30 | Size 3 |
| A45N*3 | 45A | – | 15 | 30 | 40 | |
| A60N*3 | 60A | 15 | 20 | 40 | 50 | |
| A75N*3 | 75A | 20 | 25 | 50 | – | Size 4 |
| B110N*3 | 110A | 25 | 30 | – | 60 | |
| B110N*3 | 110A | 30 | 40 | 75 | 100 | |
| B180N*3 | 180A | 40 | 50 | 100 | 125 | Size 5 |
| B180N*3 | 180A | 60 | 60 | 150 | 150 | |
| B250N*3 | 250A | 75 | 75 | 175 | 200 | |
| B250N*3 | 250A | – | 100 | 200 | 250 | Size 6 |
| B300N*3 | 300A | 100 | – | 250 | 300 | |
| B400N*3 | 300A | 125 | 150 | 350 | 400 | |
| B600N*3 | 600A | 150 | 200 | 400 | – | Size 7 |
| B600N*3 | 600A | 200 | 250 | – | 600 | |

**NEMA/EEMAC Type
IP Rating Rating**

| NEMA/EEMAC Type | IP Rating |
|--------------------|--------------|
| Type 1 | IP 40 |
| Type 1 with gasket | IP 40 |
| Type 3R | IP 65 |
| Type 4 | IP 43 |
| Type 12 | IP 54 |

**Advantages of the
Allen-Bradley Bulletin 2100 and 2400
CENTERLINE® Motor Control Center**

Forward:

It is our belief that the Allen-Bradley CENTERLINE® Motor Control Centers are designed and manufactured with quality and customer convenience in mind.

| Structure | |
|---|--|
| <i>Features</i> | <i>Benefits</i> |
| Full depth horizontal wireways. | All wires lay flat. |
| Restricted access between vertical wireways and units. | Side of unit enclosed for ease of wiring. |
| State-of-the-art painting process. | Passes the 250 hour salt spray test. |
| Internal mounting angles. | Completely enclosed at the floor level. |
| Full side sheet separates adjacent sections. | Enhanced structural integrity and fault containment. |
| Independently removable unit doors. | No need to remove doors above or below. |
| Bus | |
| <i>Features</i> | <i>Benefits</i> |
| The vertical bus completely enclosed by insulating material. | Minimize possible contact of cable pullers and fish tapes. |
| Manual and automatic shutters or protective caps. | Total dead front construction and provides complete isolation of vertical bus. |
| Individual stab connection holes for each phase. | Minimize possible contact with the power bus by users and maintenance personnel. |
| Front accessibility of all bus bar connections. | Can be mounted against the wall. Rear access not required. |
| Vertical bus effective current rating of 600A. (1200A effective current rating optional.) | Reduces concerns of overloading of vertical bus. |
| Horizontal power bus located in the center of the section. | –Even heat distribution. –Accomplishment of splicing without standing on a ladder. –Ease of maintenance. –Maximize space available for cable connections and interwiring. |
| Ground bus can be mounted on top and/or bottom of section. | Ease of customer/user wiring. |
| Steel vertical ground strap and unit ground stab. Standard copper available. | Engagement of grounding path before vertical power bus is engaged and disengagement after vertical power us. |
| Copper vertical load ground bus available. | Reduces wiring time. |

| Units | |
|---|--|
| <i>Features</i> | <i>Benefits</i> |
| Unit disconnect handle | Handle always in control of the disconnect. |
| Horizontal pivot on all IEC disconnect handles and vertical pivot on all NEMA disconnect handles. | Trip indication with circuit breakers through 400A. Clear ON and OFF indication. Can tell position from every angle. |
| Self-aligning stabs. | Assures proper alignment of unit stabs on vertical power bus. |
| Units are interchangeable. | Can be utilized in existing MCCs. |
| Unit installation. | Innovative single point latch design. No need to tighten any screws, results in faster installation. |
| Unit lockable positions. | Both in the normal and service positions. |
| Handle position indication. | Red (ON) green (OFF) indicators marked with international symbols. |
| Support pan bushing. | Prevents unit from being plugged in or removed with the operating handle in ON position. |
| Utilizing Bulletin 100 line or equivalent Allen-Bradley devices. | Proven under application use starting and contactors. |
| Control terminals are pull-apart type. | Reduces disconnecting time when unit is removed or replaced. |
| Isolated bus stab assembly. | No exposed wires outside of unit. |
| Control terminals are located inside the unit. | No intrusion into the vertical wireway. |
| Starters with a withstand rating up to the project requirements. | Problem free solution to withstand capacity specification. |
| Nameplates with black characters on a white background. | Easy cleaning feature. |
| High density packaging. | Up to twelve (12) 24A full voltage non-reversing and feeder circuit breakers or fusible disconnect switches per section. |

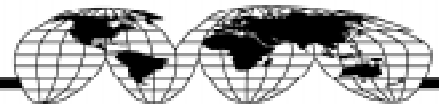
Additional benefits:

Notes:



Rockwell Automation helps its customers receive a superior return on their investment by bringing together leading brands in industrial automation, creating a broad spectrum of easy-to-integrate products. These are supported by local technical resources available worldwide, a global network of system solutions providers, and the advanced technology resources of Rockwell.

Worldwide representation.



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