# GENERAL

## SECTION INCLUDES

### The following section is used to define the requirements for 600VAC low voltage motor control centers (LV MCCs). The Contractor shall furnish and install the MCCs as specified in this section and as shown on the contract drawings.

### This section includes mechanical, electrical and system design features that are being specified for the procurement of safe and reliable MCCs to meet the specific needs of the project.

***Specifier note: Optional selections shown in [ ] throughout document.***

## REFERENCES

### The equipment and components in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted).

### ANSI/NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

### ANSI/NFPA 70, National Electrical Code

### CSA C22.2 No. 254-05 General Requirements of Canadian Electrical Code, Part II

### CSA C22.2 No. 14, Industrial Control Equipment

### MIL SPEC TT-C-490, Rev. D, Cleaning Methods for Ferrous Surfaces and Pretreatment for Organic Coatings

### NEMA ICS 1, Industrial Control and Systems: General Requirements

### NEMA ICS 2, Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

### NEMA ICS 6, Industrial Control and Systems: Enclosures

### NEMA ICS 18- 2001, Motor Control Centers

### NEMA ST 20, Dry Type Transformers for General Applications

### UL 508a Industrial Control Equipment (only for devices included in specification)

### UL 845, Motor Control Centers

### IBC 2021, International Building Code

### CBC 2022, California Building Code

## SYSTEM DESCRIPTION

### The MCC shall be rated at industry standard voltages up to 600V [choose system voltage for specific application][208] [220][240][380][400][415][440][460][575][600] 480 volt, three phase, [3] [4] wire, [60] [50] Hertz power system having a short circuit availability [65] [100] kilo-amperes RMS symmetrical.

***Specifier Note: It is recommended that all MCCs within any one project be designed at the same fault current rating so starters and other components may be interchanged within the facility.***

### Wiring shall be NEMA Class [ I ] [ II ], Type [ BD ] [ BT ] [ C ]. Where Type C wiring is required, the master terminal blocks shall be located at the top of the vertical section. Combination starter units shall be wired out to split type terminal blocks for easy removal of the starter unit without disturbing either factory or field installed wiring. All control terminal boards shall be accessible from the front.

## SUBMITTALS

### Approval Submittals: Manufacturer shall provide electronic copies of the following documents to owner for review and evaluation in accordance with general requirements of Division [1] [01] and Division [16] [26] regarding Electrical equipment:

#### Wiring diagrams

#### Unit summaries which include details of starter and feeder units including disconnect type, amperage and size.

#### List of deviations from contract documents and requests for clarifications of specification documents and/or drawings.

#### Elevation drawings with conduit entry space availability including enclosure types and system ratings

#### Recommended spare parts list

### Record Drawings: Manufacturer shall provide electronic copies of the following documents to owner for review and evaluation in accordance with general requirements of Division [1] [01] and Division [16] [26] regarding Electrical equipment:

#### [As an option, the manufacturer shall provide a copy of the drawings that reflect the “as-built” state of the equipment when shipped from the factory.]

#### The drawings shall be in [.pdf] as standard. For CAD drawings, [dwg] is offered for a charge.

#### The final drawing package shall be marked as “for-installation”.

#### Field modifications by Contractor not authorized by manufacturer’s warranty, shall be the responsibility of the Contractor. Contractor shall document all changes made during installation and commissioning. Any manufacturer errors or omissions found during commissioning shall be documented by the manufacturer. If drawing changes are required by Manufacturer, the contractor shall be responsible for ensuring those are provided.

#### [Certified Factory test reports shall be provided with “for-construction” documentation upon request at an additional charge]

#### [A Certificate of Compliance for UL 845 shall be provided with for-construction documentation]

## INSTALLATION, OPERATION AND MAINTENANCE DATA

### Manufacturer shall provide [3] [digital] copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division [1] [01] and Division [16] [26].

## QUALITY ASSURANCE (QUALIFICATIONS)

### Manufacturer shall have specialized in the manufacture and assembly of low voltage motor control centers for over [30] years.

### Low voltage motor control centers shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.02 of this specification.

### Vertical sections and individual units shall be UL Labeled

### When required, [Motor control centers shall be qualified for use in seismic areas as follows]:

**Specifier’s note: Refer to IBC/CBC certificate 1089-315 for components that are listed within manufacturer’s compliance**

#### IBC-2021 & CBC-2022, Sds = 2.0g, Ip = 1.5, for all z/h equal to 1 and Sds =2.50, Ip = 1.5, for all z/h equal to 0 in accordance with 2015-ICC-ES-AC156.

#### Seismic compliance shall be qualified only through shake table testing. Compliance by calculation is not acceptable.

## DELIVERY, STORAGE, AND HANDLING

### Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.

### Manufacturer shall ship no more than three motor control sections in individual shipping splits for ease of handling, with maximum length of 60 inches. Contractor shall coordinate with manufacturer the shipping splits required for the equipment and manufacturer shall show the location of shipping splits on factory drawings.

### Each shipping split shall be mounted on shipping skids and wrapped for protection and be equipped with removable shipping eyes to aide in lifting.

### Contractor shall inspect and report concealed damage to carrier within 48 hours regardless of the contractual shipping terms.

### If storage is necessary, Contractor shall store in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. It is the responsibility of the Contractor to heat enclosures to prevent condensation during storage as required to protect equipment.

### Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish. Lift only by installed lifting eyes.

### For international shipping by air or by boat, Contractor must properly export pack the MCC to avoid damage during transit.

### MCC should never be placed on its side, back or any other position other than floor standing upright. Doing so could jeopardize the integrity of the bus and bus bracing.

## PROJECT CONDITIONS (SITE ENVIRONMENTAL CONDITIONS)

### Contractor shall order MCC enclosure to match the existing conditions and equipment protection required for the environment at the site of the installation.

### Motor control centers shall be located in well-ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Ambient temperature of area will be between minus 20 and plus 40 degrees C. MCC shall be protected to prevent moisture from entering enclosure.

## WARRANTY

### Manufacturer shall warrant equipment to be free from defects in materials and workmanship for 1 year from date of energizing or 18 months from date of shipment, whichever occurs first.

## FIELD MEASUREMENTS

### Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

### If MCC is replacing existing equipment, Contractor shall provide manufacturer with drawings for the existing installed equipment, location of existing conduit locations and field measurements where required to ensure a functional replacement. Add to existing MCC shall be provided by the same manufacturer as the original equipment. Unless the original manufacturer indicates in writing it is not possible, connections between new and older installed sections shall be via hard bus and not cabled.

# PRODUCTS

## MANUFACTURER

### ABB products have been used as the basis for design. Other manufacturers' products of equivalent quality, dimensions and operating features may be acceptable, at the Engineer's discretion, if they comply with all requirements specified or indicated in these Contract documents. The following equipment shall be provided:

### ABB ReliaGear LV MCC

### \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Ratings

***Specifier Note: Above 1200A main bus neutral bus limited to 50%.***

#### Power shall be distributed by means of a continuous horizontal bus with a current rating of [600] [800] [1200] [1600] [2000] [2500] [3200] amperes.

#### A neutral bus shall be furnished when shown on the plans. The neutral bus shall be [100%] [50%] of main bus amperes. Lugs of the proper current rating shall be furnished.

#### The main bus shall be [tin-plated] [silver-plated] copper.

#### The main bus shall be braced for [65,000][100,000] amperes RMS symmetrical.

#### The main bus shall be isolated by barriers from wire troughs, starters, and other areas.

#### There shall be double bolt connections on main bus joints and splice connections. Main bus splicing between shipping splits shall be accomplished with no structural disassembly. For easier access, top cover shall be removable.

#### The main bus shall be fully rated and arranged for future extension.

#### The vertical bus in each section shall be rated [300] [600/850] amperes and shall be [tin-plated] [silver-plated].

**Specifier Note: 850A vertical bus requires 1200A or greater main bus.**

#### The vertical bus shall have a flame-retardant polyester-glass insulation / isolation system. This system shall insulate the vertical bus front and rear. In addition, the barrier shall isolate each phase bus. Openings in the vertical bus insulation/isolation system shall permit the entry of unit stabs. Unused openings shall have plugs or covers to prevent the entry of foreign objects.

#### [The openings in the vertical bus used for starter connections shall be covered, with an optional automatic shutter mechanism. The shutters shall automatically cover the openings when the starter is removed.]

#### The vertical bus shall be braced to the same short circuit rating as the main horizontal bus.

#### A copper [bare] [tin-plated] ground bus shall extend the full width of the motor control center. The ground bus shall be rated [300] [600] amperes. The ground bus shall be drilled for [6] or [\_\_\_] mounting holes for ground lugs. Lugs shall be furnished as specified.

#### [An optional vertical copper ground bus can be installed in each section. The ground bus shall be accessible to a bus stab mounted in the unit compartment area and arranged so that the unit ground stab engages before the power stabs engage the vertical bus.] [A motor load ground lug shall be mounted in the starter unit and used for terminating the ground of multi-conductor cables.]

### Construction

#### Refer to Contract Drawings for actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; interrupting and withstand ratings of devices, buses, and components; and other required details.

#### Enclosure

##### Indoor enclosures shall be NEMA Type [1] [1-Gasketed] [2] [12].

##### Outdoor enclosures, where indicated on drawings, shall be NEMA 3R Non-Walk-In. Wind load shall be qualified through 130 mph.

##### Each motor control center shall consist of the required number of vertical sections of heavy gauge sheet steel bolted together to form a rigid self- supporting assembly. A removable lifting eyes shall be mounted to the motor control center at the top. Removable bottom channel sills shall be mounted front and rear of the vertical sections and shall extend the width of the lineup.

##### Vertical sections shall be nominally 90-inch high [with optional 1.5-inch floor sills] and [20] [13]-inch deep. For 1600A and 2000A: 2-inch bus bar requires 22-inch deep section, 1.5-inch bus bar requires 20-inch deep. Alternate section widths with vertical bus may be 24-inches or 30-inches wide when required. When there is no vertical bus, the maximum width shall be 36-inches.

***Specifier Note: Alternate heights available starting at 78-inches within empower.***

##### Each vertical section shall be equipped with vertical side barriers to prevent faults from traveling easily between adjacent sections.

#### Wireways

***Specifier Note: When loads exit the bottom, a 12-inch bottom wireway is recommended.***

##### Each vertical section shall contain a minimum 12-inch high top horizontal wireway and a 6-inch bottom wireway. A removable hinged door with ¼ turn latches shall cover the horizontal wireway.

##### A separate 4” wide vertical wiring trough shall be furnished in each vertical section adjacent to plug-in unit. The wire trough shall permit the installation of field wiring and shall isolate this wiring from the adjacent unit. No terminal blocks shall be located in the vertical wireway. Cable tie supports shall be furnished in the vertical wireway to hold cable and wiring in place. A removable hinged door shall cover the vertical wiring trough. [Vertical wireway can be increased by 4-inches to expand spacing for wires.]

##### [If communication wiring is required, a metal shielding shall be added in the vertical wiring trough to provide isolation from power and control wiring within the vertical wiring trough.]

#### Incoming Power / Main Protective Device

##### Incoming power to the motor control center shall be [cable] [ReliaGear busway].

###### [Incoming power cables shall enter the [top] [bottom] of the motor control center.] [Incoming cables shall be of the size and number shown on the plans.]

###### [Incoming bus duct shall enter the top of the motor control center and shall have a current rating as shown on the plans.]

##### The main protective device indicated on the drawings or schedules shall be a [molded case circuit breaker for current ratings up to 1200A] [insulated case UL489 circuit breaker for current ratings 1200A – 2000A] [air circuit breaker for concurrent ratings 800A - 3200A]. The main device shall have a current rating as shown on the plans and shall have an interrupting rating equal to or greater than the available short circuit current. Provide main device as specified in the appropriate part of this article below.

###### The MCC design shall have an ability to reduce the incident energy at the main section during maintenance in one of the following ways:

Circuit breaker trip unit or switch control relay unit shall implement a maintenance switch function that allows an instantaneous protection setting, separately adjustable, to be set via an external signal to the circuit breaker trip. The function shall be implemented such that it operates from a separately mounted three position switch. The switch positions shall be “Normal or Off” (maintenance instantaneous disabled), “Test” (used to test control power circuitry and signal wiring), and “ON” (which is used to enable the maintenance instantaneous protection). The switch shall include indicating light(s) to indicate that the test function is working properly, and that the additional protection has been enabled at the trip unit (positive feedback). When the maintenance instantaneous protection is turned “off” the protection shall delay at least 15 seconds before it goes back to normal protection. If the trip unit or relay does not provide that delay, a separate timing control shall be installed to provide at least a 15 second off delay for the maintenance switch function. If a main fusible switch is shown on the one line diagram and the manufacturer cannot provide a UL 977 listed switch that is able to implement the maintenance instantaneous function, then a circuit breaker per articles 3.a or 3.b above shall be provided with additional class L current limiting fuses downstream of the circuit breaker per the fuse requirements of the one line diagram and coordination study.

Or approved equal

#### Where indicated on the drawings, the motor control center shall be provided with an incoming transition section for close coupling with ABB switchgear, switchboard or transformer.

### User Metering

#### Provide a UL listed and digital multifunction power meter. The meter case shall be fully enclosed and shielded

#### The meter shall accept a voltage metering range of up to 600 volts, phase to phase.

##### The meter shall withstand 200% rated current continuously. It shall withstand 10X rated current for at least 3 seconds. Isolation shall be no less than 2500V AC.

##### Surge withstand shall conform to IEEE C37.90.1,62.41 and IEEE 1000-4

##### Shall have a standard ANSI C39.1 case mount.

#### The meter shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral; real power, reactive power, apparent power, power factor and frequency.

##### The meter must be capable of providing readings for both instantaneous and average readings.

##### The meter must also be capable of providing all single phase real, apparent, reactive power and power factor values.

##### The meter shall record and store total bi-directional energy. It shall include separate registers for positive and negative energy.

##### The meter shall record and store total bi-directional accumulated energy and total accumulated apparent energy.

##### The meter shall monitor max/min average demand values for all current and power readings. The demand interval shall be user programmable. [Maximum and minimum values shall be stored with a date/time stamp.]

***Specifier Note: Please find more information regarding additional metering options below:***

#### [[PQMII](https://www.gegridsolutions.com/multilin/catalog/pqmii.htm)] [[RGM2200] [RGM 6000] [RGM 6010] [RGM 7000]](https://www.electroind.com/power-metering-products/)

### Units

#### Combination motor controller and feeder units shall employ molded case circuit breakers for branch circuit protection. Circuit breaker disconnects for combination motor starters shall be either Type A, Type C, or Type D configurations.

#### All combination starter and feeder units of plug-in construction shall utilize a positive guidance system to insure positive connection of the unit stabs to the section vertical bus. Insertion and removal of each unit shall not require the use of special tools.

#### Unit shelves shall be of a lift out design, so that the shelf may be removed without the use of special tools.

#### Connection from the power stabs to the unit disconnect shall be a direct connection.

#### Each circuit breaker starter unit size 1 through size 5 shall be of plug-in construction. Each feeder breaker rated 600A or less shall be plug-in construction.

#### Each unit compartment shall be equipped with a flange-formed pan type door. The door shall be mounted on the vertical section with removable hinge pins.

#### Each unit shall be equipped with an operating handle. The handle shall be connected to the disconnect operator using a direct drive and requiring no adjustments of linkage.

#### The handle shall be mechanically interlocked with the door preventing it from opening with disconnect closed. The interlock shall also prevent disconnect being closed with door open. The interlock shall be capable of being defeated by qualified personnel, allowing the door to be opened with disconnect closed or disconnect closed with the door open.

#### The unit handle shall have provision to padlock in the off position. On circuit breaker units the handle shall have a "tripped" position in addition to OFF/ ON.

#### Each unit shall be capable of being padlocked in a partially withdrawn position. In this position, the unit power stabs are disengaged from the vertical bus and no power can enter the unit.

#### Combination starter units specified with Type B or C wiring shall be supplied with split-type control terminal blocks. The terminal blocks shall be front mounted and shall allow the removal of the unit without disconnecting any of the control wiring. Combination starter units up to size 5 shall be plug-in construction and shall be capable of being removed without disconnecting any control leads from their terminal blocks.

***SPECIFIER NOTE: Include the following section if Engineer requires additional safety features associated with IEEE 1683 guidelines. Arc Flash Mitigation (AFM) shall be designed to provide safety features in attempt to decrease the likelihood of maintenance personnel coming in contact with live parts or being exposed to an arc flash event. Available units shall include but are not limited to FVNR, FVR, VFD, and Feeder units. Units shall have the following features:***

#### Retractable stabs: All units shall be constructed so that each unit can be inserted and withdrawn from the vertical bus while the unit door is closed.

##### Closed door shutter position indication

###### Green indicating that the stabs are mechanically withdrawn and not engaged into the vertical bus.

###### Red indicating that the stabs are mechanically inserted into the vertical bus and voltage is likely to be present at the stabs.

##### Closed door visual indication of the position of the stabs within the unit shall be provided.

***Specifier Note: A door mounted voltage indicating device is recommended, but optional. If desired the article below describes it. Delete if not desired.***

##### [A door mounted sensing device that indicates voltage present at the load side of the circuit breaker, motor protector or switch and/or at the unit stab shall be provided. Device as provided by Panduit, Voltage Vision, Grace or equal].

##### Mechanical Safety Interlocks:

###### Safety interlocks that prevent the unit from being inserted into or removed from the structure when the stab is in the extended or engaged position.

###### Safety interlocks that prevent the unit from being racked in or out of the structure with the disconnect in the “on” position.

###### Additional provision for padlocking shall be available to prevent the unit from insertion into the connected position during maintenance.

***Specifier Note: A remote racking device is recommended, but optional. If desired the article below describes it. Delete if not desired.***

##### Remote Racking

###### A separate remote racking device shall be available to allow the units to be racked in and out of the vertical bus from 40 feet away. Quantity \_\_\_\_\_\_\_ of these racking devices shall be included in [each MCC] [project]. The remote racking device shall be operated at 110Vac.

#### Infrared scanning ports at section

##### [Infrared scanning ports shall be available for each vertical section for infrared scanning of the main horizontal bus joints and where the vertical bus connects to the horizontal bus. ]

##### Infrared scanning ports shall be available at each unit to view [load side of circuit breaker terminals] or [load side of overload terminals].

### Combination Motor Starter Units

#### Overload relays shall be: (Specifier: Please select one of the following)

##### [Bimetallic, non-ambient compensated]

##### [Bimetallic, ambient compensated]

##### [Solid-state, ambient insensitive, self-powered, including adjustable FLA, phase unbalance, phase loss protection, selectable overload class (10, 20, 30), with 2% accuracy and repeatability, built-in thermal memory to prevent hot motor starts, isolated 1NO and 1 NC auxiliary contacts.]

##### [Advanced microprocessor-based motor protection as described in Article 2.03. I.]

#### Control power for starter units shall be from: (select one)

##### [Individual control power transformers shall be furnished in each starter unit. One secondary lead shall be furnished with a fuse and the other lead shall be grounded. Control power primary fuses are required].

##### [A separate source (common control) Two-wire terminal points shall be provided. One leg shall be wired through normally open auxiliary contacts in each disconnect and a control power fuse rated 1 amp shall be provided.

#### Starter units can be provided with the following optional auxiliary devices:

##### [auxiliary starter interlocks, \_\_\_\_\_\_ N/O, \_\_\_\_\_\_N/C].

##### [control / timing relays (as shown on the drawings)].

##### [door mounted pilot devices shall be 30mm heavy duty:

###### start-stop pushbutton

###### H-O-A selector switch

###### Indicating lights (quantity and color). Indicating lights shall be [full voltage] [reduced voltage transformer] [push to test] LED type.

### Air Circuit Breaker, UL 1066, for use as mains for frame rating 1600A and larger and feeders rated 1200A and higher, ABB Type SACE Emax 2

#### Circuit breakers shall be fixed or draw out type Emax 2 with Ekip electronic trip units in 3 pole version. Interrupting rating shall be available up to 100 kAIR RMS amperes without fuses. Emax 2 circuit breakers shall be available in [2000] [2500 without fans construction], [3200] A frame sizes.

### Insulated Case UL 489 Circuit Breakers, for use as mains and ties with frame rating up to 2500A, ABB by GE Type PowerBreak II.

#### Stored Energy, UL 489, circuit breakers shall be individually mounted.

#### Main and tie breakers shall be [manually] [electrically] operated, stationary mounted.

#### Circuit breakers shall be constructed of a high dielectric strength, glass reinforced insulating case. The interrupting mechanism shall be arc chutes. Steel vent grids shall be used to suppress arcs and cool vented gases. Interphase barriers shall isolate completely each pole.

#### Circuit breakers shall contain a true two-step stored energy operating mechanism which shall provide quick make, quick break operation with a maximum five cycle closing time. Circuit breakers shall be trip free at all times. All poles shall trip together.

#### Stored Energy circuit breakers shall be rated to carry 100 percent of their frame ampacity continuously.

#### A charging handle, close push-button, open push-button, and Off/On/Charge indicator shall be located on the circuit breaker escutcheon and shall be visible with the circuit breaker compartment door closed.

#### Circuit breaker digital electronic trip units shall be as described in Article 2.03G.

### Molded Case Circuit Breakers for use as mains, ties and feeders rated 400A and larger, up to 1200A. ABB Tmax XT.

#### Main circuit breaker shall be connected to the vertical bus by bolted connections.

#### Feeder circuit breakers up to 600A shall be provided in a plug-in unit for connection to the MCC vertical bus.

#### Molded case circuit breakers shall have insulation between the live power parts (excluding the terminals) and the front of the apparatus where the operator works during normal operation of the device. The placement of each electrical accessory shall be completely segregated from the power circuit, preventing any risk of contact with live parts

#### Circuit breaker plug-in units shall be provided with an external operating handle which shall have ON and OFF position clearly marked on the outside of the circuit breaker enclosure.

#### Circuit breakers shall include factory installed mechanical lugs. Lugs shall be UL listed and rated 75 or 60/75 degrees C as appropriate. Circuit breakers shall be 80 percent rated.

#### [Each main or feeder circuit breaker with a frame size larger than 600 amps shall have digital electronic trip units as described in Article 2.03.H.] [Circuit breaker digital electronic trip units shall be as described in Article 2.03H.]

#### Trip Unit for Molded Case Circuit Breakers

##### Molded case circuit breakers with ratings starting from 15 amperes up to 600 amperes shall be equipped with thermal magnetic or electronic trip units. Molded case circuit breakers with ratings greater than 600 amperes shall be equipped with electronic trip units.

##### The trip units shall not increase the overall circuit breaker volume.

#### Thermal magnetic (600A frame and below).

##### Basis of Design: Molded case circuit breakers equipped with thermal magnetic trip unit.

##### Thermomagnetic trip units shall be fitted with protection threshold against overload (whose thermal element must consist of a bimetal) and with protection threshold against short circuit.

##### For 80A and greater, the protection threshold against overload must be continuously adjustable starting from 0.7 times the rated current of the trip unit and up to its rated value. For less than 80A, the protection threshold against overload must be fixed.

##### The reference temperature for setting the thermal element of the protection trip unit is 40°C and temperature performance of the trip unit must be indicated as the temperature varies.

##### Molded case circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature.

#### Basic Electronic Trip Units for Molded Case Circuit BreakersBasis of design: Ekip DIP

* 1. Electronic trip unit must be unaffected by electromagnetic interference in compliance with the EMC directive and Annex F of IEC 60947-2.
  2. MCCB trip unit shall be electronic adjustable with true RMS sensing and thermal memory.
  3. The standard electronic trip unit shall be fitted with a dip switch interface to ensure accuracy while adjusting protection settings.
  4. The basic electronic trip unit shall have adjustable protection for Long-Time, Short-Time, [Instantaneous], [and Ground Fault]. This protection is commonly referred to as LSI, LIG, LS/I or LSIG. All protective elements (LSIG) shall be independent of each other. Trip units with tracking short-time are not approved. Short circuit protection may be either Instantaneous type (function I) or, alternatively, with intentional delay (function S). The ability to disable the adjustable instantaneous trip is required. The adjustable instantaneous shall be capable of being disabled; an instantaneous override shall provide protection.
     1. (L) protection shall be adjustable from 40% to 100% **In** at increments of 4% **In**where **In** is the nominal current rating of the MCCB.
     2. (S) protection pickup shall allow fifteen settings from 1 to 10 times **In**.
     3. Both (L) and (S) protection shall be available in two different time delay curves.
     4. (I) protection pickup shall allow fifteen settings from 1 to 10 times **In**.
  5. Ground fault protection, (G) shall be provided where indicated on drawings or required by the NEC.
  6. Accuracy of electronic trip units shall not be affected by ambient temperature.

#### Electronic trip units must include:

##### Basis of design: Ekip Touch & Ekip Hi-Touch

##### The electronic overcurrent trip units must be self-supplied and must be able to guarantee correct operation of the protection functions even in the presence of a single phase supplied with a current value equal to 20% of the phase current; XT2 and XT4 < 100A current value is equal to 30% of the phase current.

##### Electronic trip unit must be unaffected by electromagnetic interference in compliance with the EMC directive and Annex F of IEC 60947-2

##### Circuit breaker trip system shall be an electronic trip unit with true RMS sensing.

##### Electronic trip unit shall be fitted with a [touch] [Hi-touch] interface in order to ensure the best accuracy in tuning the protection thresholds.

##### The basic electronic trip unit shall be fitted with protection functions against overload (L function) and against short-circuit. These functions can either be of the instantaneous type (function I) or, alternatively, with intentional delay (function S). The ability to exclude instantaneous trip function must be a feature.

##### The trip thresholds on electronic trip units shall not be affected by ambient temperature; temperature derating of circuit breaker may apply.

##### Electronic trip units shall be suitable for use on AC circuits only and they shall be available from a minimum rated current of 40A up to 1200A.

##### All electronic trip units must include thermal memory function.

##### The trip unit will allow parameterization of the trip thresholds and timing locally via front panel.

##### [The test unit for checking functioning of the tripping coil.]

##### [A trip signaling unit of the protections.]

##### [A test and configuration unit which allows the electronic trip unit protections to be tested and configured.]

##### [A battery unit which allows trip unit testing when the circuit breaker is deenergized.]

##### Bluetooth communication.

#### As a minimum, the Touch/Hi-Touch trip unit shall have the following protective functions:

##### Current setting or long time pickup, adjustable from 40% to 100% of the rating plug value.

##### Adjustable long time delay with typical inverse time characteristics (minimum of 10 bands).

##### Instantaneous pickup, where indicated or required by code, adjustable from 1.5 to 10x In on 250A – 600A frames and 1.5 to 15x In on 800 – 1200A frames in 0.1 increments.

##### Short time pickup and delay. Short time pickup shall be adjustable from .6 to 10x In in 0.1 increments with an OFF option. Provide minimum of 12 short time delay bands with three selectable I2t bands.

##### Adjustable ground fault pickup and delay, where indicated or required by code. Ground fault pickup shall be adjustable from 0.1 to 1.0x In in 0.001 increments.

***SPECIFIER NOTE: NEUTRAL PROTECTION MAY BE ADVISABLE IN 120/208V APPLICATION OR OTHER APPLICATIONS WHERE EXCESSIVE TRIPLEN HARMONICS MAY BE ENCOUNTERED. TRIPLEN HARMONICS CAN CAUSE NEUTRAL CURRENTS TO EXCEED 150% OF THE PHASE CURRENT. IF THE NEUTRAL CONDUCTORS, INCLUDE EQUIPMENT BUS AND TERMINATIONS ARE NOT SUITABLY SIZED THIS COULD RESULT IN OVERLOADED CONDUCTORS OR EQUIPMENT.***

##### [Neutral Protection: Trip shall provide ability to protect against neutral conductor overload. Protection shall be the same as that for the phase conductors with settings at 50%, 100% or 200% of phase conductor protection settings for long time and short time pickups and delays. Sensing shall be provided via a neutral current sensor or from a summation calculation using phase current sensor signals.]

***SPECIFIER NOTE: ALSO KNOWN AS A MAINTENANCE SWITCH OR ALTERNATE SETTING GROUP. CALLED A Reduced Energy Let-Through (RELT) OR 2I SETTING IN ABB LITERATURE. A 3-POSITION SWITCH WILL BE PROVIDED THAT ALLOWS TESTING OF CONTROL POWER AND INDICATES TRIP PROTECTIVE STATUS VIA A CONTACT CLOSURE PROVIDED BY THE TRIP UNIT.***

##### [Reduced Energy Let-Through (RELT) or 2I instantaneous trip. When specified, this feature shall be provided on circuit breakers with a 1200A frame and above to provide a temporary setting for the instantaneous trip setting of the circuit breaker. Setting shall be adjustable down to 1.5x In and shall be enabled through a switch mounted on front of the switchboard. The switch shall be combined with an indicating light that positively indicates that the Reduced Energy Let-Through or 2I is enabled or disabled.]

#### The Touch/Hi-Touch trip unit shall display rms current, each phase, on the front display.

### Trip Unit for Air Circuit Breakers (Emax)

#### Trip unit shall have the ability to be upgraded via downloadable software packages.

#### Circuit breaker trip system shall be an EKIP electronic trip unit.

#### All trip units shall be removable to allow for field upgrades.

#### Trip units shall incorporate “True RMS Sensing” and have LED long-time pickup indications.

#### Trip unit shall provide local trip indication; information about which protection function tripped shall be readable at any time after the trip.

#### **Standard** trip unit protection against short circuit delay shall allow fifteen settings from 0.6 to 10 times. Delays shall be in four options from 0.1 to 0.4 seconds.

#### **Standard** trip unit protection against ground-fault shall allow for seven settings from 0.1 to 1 times ln. UL Breakers are limited to 1200A max setting. Delays shall be in three options from 0.1 to 0.8 seconds.

### Smart Overload Protection for MCCs

#### [Solid State Universal Motor Controller UMC100.3](https://new.abb.com/low-voltage/products/motor-controllers/universal-motor-controllers/umc100-3)

##### The overload protection shall be ABB type UMC100.3, trip classes 5, 10, 20, 30, and 40 and provide comprehensive motor protection including phase failure detection, adjustable motor protection for stalled motors during startup or normal operation, configurable current limits to generate trips and warnings.

##### The solid-state overload shall:

###### Provide integrated thermistor motor protection (PTC)

###### Provide integrated Ground Fault detection with an optional zero sequence CT.

###### Provide a minimum of 6 digital input and 3 relay outputs (24VDC) up to 14 digital inputs and 9 outputs with expansion modules

###### Provide power (power factor and energy) and voltage-based protection functions with voltage measuring expansion module

###### Supervise network quality (Total Harmonic Distortion) with voltage measuring expansion module

###### Supports standard configurations for direct starter, reversing starter, star-delta starter, actuator and inching mode.

###### Allow function blocks for signal adjustment, Boolean logic, timers, and counters.

###### Provide metering, monitoring and diagnosis

###### Fully graphic multi-language LCD panel to allow configuration and control and monitoring.

###### Provide support for multiple communication standards:

Modbus TCP / IP EtherNet

Modbus RTU

ProfiNet

Profibus DP

EtherNet / IP

DeviceNet

Specifier Note: Motor control centers can include lighting and power transformers up to 37.5 kVA single phase or 45 kVA three phase.

#### [Lighting and Power transformers]

#### [Lighting panelboards, type RQ for 240V applications and type RE for 480V applications.]

#### ***Specifier Note: Please see*** [***https://electrification.us.abb.com/products/softstarters/pstx-open-softstarters***](https://electrification.us.abb.com/products/softstarters/pstx-open-softstarters) ***for more information on the PSTX Softstarter.***

### [Reduced Voltage Solid State]

#### Provide reduced voltage solid state starters where indicated on drawings. Reduced solid state starters shall be ABB type PSTX solid state starters or pre-approved equal that complies with all the following.

#### Starter shall be provided with a built-in bypass to reduce energy consumption at full speed and increase the lifetime of soft-starter.

#### The soft-starter shall have built-in Modbus RTU for communication.

#### The soft-starter shall be equipped with one analog output

#### The soft-starter shall have a minimum of 3 signal relays Output for Run, Bypass (Top of Ramp) and Event signal.

#### User interface

##### The soft-starter shall support multiple languages in both the manual and HMI, including: English, Swedish, German, French, Italian, Spanish, Portuguese, Dutch, Polish, Russian, Finish, Turkish, Czech, Chinese and Arabic.

##### The soft-starter shall have a detachable keypad with graphical LCD display. The keypad shall have start and stop buttons, information button for access to a built-in manual and an USB-port for connection to a PC.

#### The soft-starter shall have coated PCBAs to withstand harsh environments

#### Motor Start/Stop Operation

##### The soft-starter shall have pre-start functions:

###### Stand still brake, to keep the load still before start

###### Motor heating, to keep the motor well-tempered before start

##### The soft-starter shall have the following start ramps available:

###### Voltage start ramp

###### Torque start ramp

###### Full voltage start

##### The soft-starter shall have the following stop ramps available:

###### Voltage start ramp

###### Torque start ramp

###### Dynamic brake

##### The soft-starter shall have possibility for slow speed forward and backward operation for positioning of a motor load.

##### The soft-starter shall have Torque Control and pump cleaning feature, to eliminate water hammering and prolong lifetime of the pump system.

##### The soft-starter shall include a kick start feature to be able to start heavy loads.

##### The soft-starter shall have the following three types of current Limit:

###### Current Limit

###### Dual Current Limit

###### Current Ramp

##### The soft-starter shall have a limp mode feature to allow the soft-starter to operate even with shorted thyristors in one phase.

##### The soft-starter shall have possibility for sequence start of up to 3 different motors.

##### The soft-starter shall be capable of an automatic restart.

#### Motor Protection

##### The soft-starter shall integrate motor and load protections, which shall under no circumstances be disabled when the integrated bypass is used. The soft-starter shall also be able to present a warning before tripping for each protection.

##### The soft-starter shall have the following motor protections available:

###### Electronic Overload Protection, class 10A, 10, 20, 30

###### Locked Rotor Protection

###### Motor Underload Protection, both current and power factor.

###### Current Imbalance Protection

###### Voltage Imbalance Protection

###### Overvoltage and Under Voltage Protection

###### Phase Reversal Protection

###### Earth-fault Protection (UL ground-fault protection)

##### Provide an input for PTC and PT100.

#### Diagnostics. The soft-starter shall have the following diagnostics features:

##### THD(U)-Total Harmonic Distortion

##### Counted number of start sequences

##### Motor runtime measurement

##### Thyristor runtime measurement

##### Auto phase sequence detection

##### Electricity metering

##### Voltage sags detection

##### Time to trip estimation

##### Time to cool estimation

#### Fault detection. The soft-starter shall provide the following fault detection, to protect both the starting equipment, the load and the soft-starter itself

##### Phase loss

##### High current

##### Low control supply voltage

##### Fault connection

##### Bad network quality

##### Thyristor overload

### [Variable Frequency Drives]

#### The ABB ACS580 series variable frequency drive shall be solid state, with a Pulse Width Modulated (PWM) output. It shall be NEMA rated.

#### Input voltage ratings shall be MCC VAC +10% and –15%.c. Input frequency shall be 50Hz +/- 4% and 60Hz +/- 5%.

#### Output voltage and current ratings shall match the adjustable frequency operating requirements of standard NEMA design A or NEMA design B motors.

#### Ramp times shall be programmable from 1 - 1800 seconds.

#### The output voltage may be switched on and off an unlimited amount of times.

#### The Drive shall be capable of a minimum of 100% rated current in continuous operation in accordance with the requirements of NEC Table 430-150.

#### The Normal Duty overload current capacity shall be 110% of rated current for one (1) minute out of ten (10) minutes. The Heavy Duty overload current capacity shall be 150% of rated current for one (1) minute out of ten (10) minutes.

#### The VFD shall be equipped with a front mounted operator control panel consisting of a four- (4) line back-lit alphanumeric LCD display that is 240x160 pixels. Configurable displays showing, bar graph and meter. Keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.

#### All parameter names, fault messages, warnings and other information shall be displayed in complete American English words or standard American English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

#### During normal operation, one (1) line of the control panel shall display the speed reference and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:

##### Speed/torque in percent (%), RPM or user-scaled units

##### Output frequency, voltage, current and torque

##### Power and kilowatt hours

##### Heatsink temperature and DC bus voltage

##### Status of discrete inputs and outputs

##### Values of analog input and output signals

##### Values of PID controller reference, feedback and error signals

### Finish

#### The Motor Control Center steel parts shall be cleaned and sprayed in controlled cleaning solutions by a 7-stage spray washer. The operation shall produce an iron phosphate coating of a minimum of 150 milligrams per square foot to meet MIL Specification TT-C-490. The primed metal parts shall be electrostatically coated with powder paint consisting of 670-011 ANSI-61 Acrylic Paint (Light Gray) with a gloss of 60 plus or minus 5 and thickness of 2.5 mils. The exterior paint finish shall withstand a minimum of 1000 hours salt spray test.

#### Unpainted steel parts shall be zinc plated.

#### Interior of units shall be painted white for better visibility.

### Testing

#### Electrical tests completed before shipment shall include:

#### Power circuit phasing

#### Control circuit wiring

#### Instrument transformers

#### Meters

#### Device electrical operation

#### AC Dielectric tests (per NEMA ICS 1-109-21) of:

#### Power circuits

#### Control circuits

# EXECUTION

## EXAMINATION

### The following procedures shall be performed by the Contractor.

#### Examine installation area to assure there is enough clearance to install MCC.

#### Check concrete pads for uniformity and level surface.

#### Verify that equipment is ready to install.

#### Verify field measurements are as [{shown on Drawings] [instructed by manufacturer}].

#### Verify that required utilities are available, in proper location and ready for use.

#### Beginning of installation means installer accepts conditions.

## INSTALLATION

Specifiers Note: Additional provisions and editing may be required for this part.

### Installation shall be performed by the Contractor.

#### Install per manufacturer's instructions.

#### Install required safety labels.

## FIELD QUALITY CONTROL

***Specifiers Note: Additional provisions, editing or reference to appropriate contract clauses may be required for this part. Manufacturer’s testing agency recommended over independent third party agencies.***

### To be provided by manufacturer’s field testing and commissioning organization

#### All control and power wiring shall be verified.

#### All devices shall be verified to be in proper working order, properly set for protection per the coordination study. Metering, diagnostic and control adjustments shall be made and documented as required for proper operation of the motor control centers.

#### All communicating devices shall be verified to be properly addressed and communicating within the networks they are intended to interact with.

#### Any adjustment of safety functions or devices such as maintenance switch settings, arc flash relays or other devices shall be made, controls verified and documented.

#### A commissioning report shall document that all the listed actions have been performed and verified.

## ADJUSTING

***Specifiers Note: Additional provisions, editing or reference to appropriate contract clauses may be required for this part. Manufacturer’s testing agency recommended over independent third party agencies.***

### To be provided by equipment manufacturer’s field service organization

#### All protective devices shall be set per the coordination study

#### All metering and diagnostic devices or functions shall be set to ensure they are in proper working order for the system within which they are being used.

#### Documentation shall be provided in the commissioning report that all adjustments have been made, including by whom, and when.

## CLEANING

***Specifiers Note: Additional provisions, editing or reference to appropriate contract clauses may be required for this part.***

### To be provided as required by installing contractor

#### Project to be left in proper working order by installing contractor per all other requirements in contract documents have been fulfilled, at the end of the project.

#### Project site and equipment shall be maintained clean during the project as appropriate for the construction stage.

#### Cleaning shall be provided at end of the project and during the project to ensure the site and equipment is available to personnel in a professional workmanship like manner at all times.

#### At no time during construction shall live conductors be left unterminated or unprotected.

END OF SECTION