Power Capacitors
Catalog Data
CA230006EN

Effective November 2016
Supersedes August 2015

COOPER POWER SERIES

Metal-enclosed, pad-mounted capacitor banks

General

Eaton's metal-enclosed, pad-mounted capacitor banks, a Cooper Power™ series product, are self-contained devices which offer a simple and economical approach to reactive power compensation of underground distribution systems up to 25 kV and 150 kV-BIL. Metal-enclosed, pad-mounted capacitor banks come pre-assembled and ready to be installed and "plugged-in" resulting is substantial labor savings over an open-style capacitor bank.

Eaton's pad-mounted capacitor banks are designed to meet or exceed all applicable ANSI®, IEEE®, NEMA®, and IEC standards.

This fully integrated modular system solution can improve the economical operation of power systems for both distribution utilities and industrial power customers by providing the following benefits:

- Power factor improvement
- Voltage improvement
- Increased power flow capability
- System capacity release
- Loss reduction

Eaton's pad-mounted capacitor banks combine several time-proven products from its Cooper Power series product line: capacitor units, current-limiting fuses, surge arresters, capacitor controls, capacitor switches (oil and vacuum), circuit breakers and cable accessories.

Eaton's pad-mounted capacitor banks include the following key features:

- Small foot print
- Ease of installation and maintenance
- Increased reliability and availability
- Increased safety
- Environment friendly
- Aesthetically pleasing
- Weather-proofed construction

Eaton brings over 70 years of experience in the design, manufacture and application of power capacitors to provide a comprehensive range of pad-mounted capacitor banks. Standard models support a maximum voltage of 25 kV and a reactive power 3,600 kvar.

Powering Business Worldwide

Customers may also select among options of oil/vacuum switches, capacitor controls, arresters, instrument transformers, control-powered transformers, reactors, current-limiting fuses, dead-front connectors, neutral current sensor, IEEE®, IEC, and CSA® standards, enclosure material, enclosure finish color, etc. Eaton's experts make every metal-enclosed bank based on 3-D CAD drawings to ensure proper component fit and the most economic design. For highly customized models, please contact your Eaton representative for details.

Available special configurations include:

- Multi-step banks
- Live-front enclosures
- Voltages higher than 24.94 kV and BIL greater than 150 kV
- Non-standard combinations of kvar and voltage
- Non-standard controls
- Internally fused capacitors
- Unbalance protection
- More than two (2) capacitor units per phase

Enclosure

The tamper-resistant enclosure is an all-welded, self-supporting structure manufactured of 12-gauge mild steel. 304L stainless steel is an available option. Enclosures meet the enclosure security requirements of IEEE Std C57.12.28™ standard which minimizes animal related outages and protects the public. Each enclosure is finished in Guardian Green conforming to Munsell 7.0GY3.29/1.5. Other colors are available. The coating conforms to the following specifications: IEEE Std C57.12.28™ and IEEE Std C57.12.29™ standards, ASTM B1117 1000-hour 5% salt spray corrosion test, ASTM D2247 1000-hour humidity test, ASTM G53 500-hour ultraviolet accelerated weathering test, and ASTM D2794 impact test. Certified test data is available on request.

The standard equipment front section is dead-front which will provide access to the group fuses and the capacitor switches. The dead-front enclosure provides provides a high level of safety for both the operator and the general public and also comes standard with a clear polycarbonate barrier and optionally with red GPO-3 barrier. The deadfront enclosure includes 200 A bushing wells or 600 A bushings per IEEE Std 386™ standard for medium voltage connections to the bank and are mounted a minimum of 24 inches above the pad. Loadbreak elbows must not be used to break capacitive current. With the addition of disconnect and ground switches, circuits can be isolated and grounded without disconnecting or moving terminations.

The equipment rear section, providing access to the capacitor units and individual unit fuses, if applicable, comes standard with a clear polycarbonate barrier and, optionally, with a GPO-3 barrier.

The access doors are three-point self-latching. The standard offering is a pad-lockable, pentahead-bolt door with a pull handle. Other options for a turn-handle and for key interlock provisions are available. Each door has a stainless steel door stop to securely hold it open during maintenance and inspections. A phase diagram of the pad-mounted metal-enclosed capacitor bank is located on the inside of the door.

The medium voltage bus is aluminum and the ground bus is bare copper. The wire connecting the capacitor units is copper. Options for tin-plated and silver-plated copper medium voltage bus and ground bus are also available.

All hardware is stainless steel.

All enclosures comes standard with removable lifting plates with blind mounting holes.

Standard enclosure sizes are 60"L x 60"W x 60"H and 80"L x 80"W x 60"H.

Capacitor units

Three or six capacitor units are mounted for easy access in each pad-mounted capacitor bank. Eaton's exclusive all-film, extended foil/mechanically connected capacitors provide:

- Low total losses (0.10 watt/kvar)
- Superior electrical performance and reliability
- Environmentally friendly Edisol® VI, Non-PCB dielectric fluid

Two capacitor duty options are provided depending on the your application needs:

- Heavy-duty capacitor
  - Meets or exceeds the requirements of IEEE Std 18™ standard
  - Meets or exceeds the requirements of CSA C22.2 NO. 190
  - 125% continuous overvoltage capability
  - 10 kA tank rupture curve coordination
- Extreme-duty capacitor
  - Meets all of the requirements of IEEE Std 18™ standard
  - Meets all of the requirements of CSA C22.2 NO. 190
  - Meets or exceeds the requirements of IEC 60871-1, 2 for -55 °C to +60 °C
  - 125% continuous overvoltage capability
  - Eaton's exclusive 15 kA tank rupture curve coordination
  - 15% higher routine test voltages

Construction features of Eaton's power capacitors include:

- Mechanical crimping connection system (exclusive to Eaton). Provides solderless internal connections that eliminate localized heating and cold solder joints. The EX® crimping system also allows 100% inspection during assembly assuring integrity of internal connections and maximizes operational safety.
- Stainless steel tank with light gray finish for resistance to severely corrosive atmospheres. Tank is finished with an epoxy primer and a urethane topcoat coating system. This system has been tested to IEEE Std C57.12.31™ and IEEE Std C57.12.29™ standards.
- High stacking factor design (exclusive to Eaton) utilizing aluminum foil electrodes with a laser-cut or folded active edge. The region of the dielectric exposed to the highest electric field stress is located at the active edge of the electrode. The high stacking factor and laser-cut / folded active edge shapes and reduces the electric field stress thereby significantly increasing the discharge inception voltage (DIV). Eaton's capacitors are designed to have the highest safety margin to DIV in the industry.

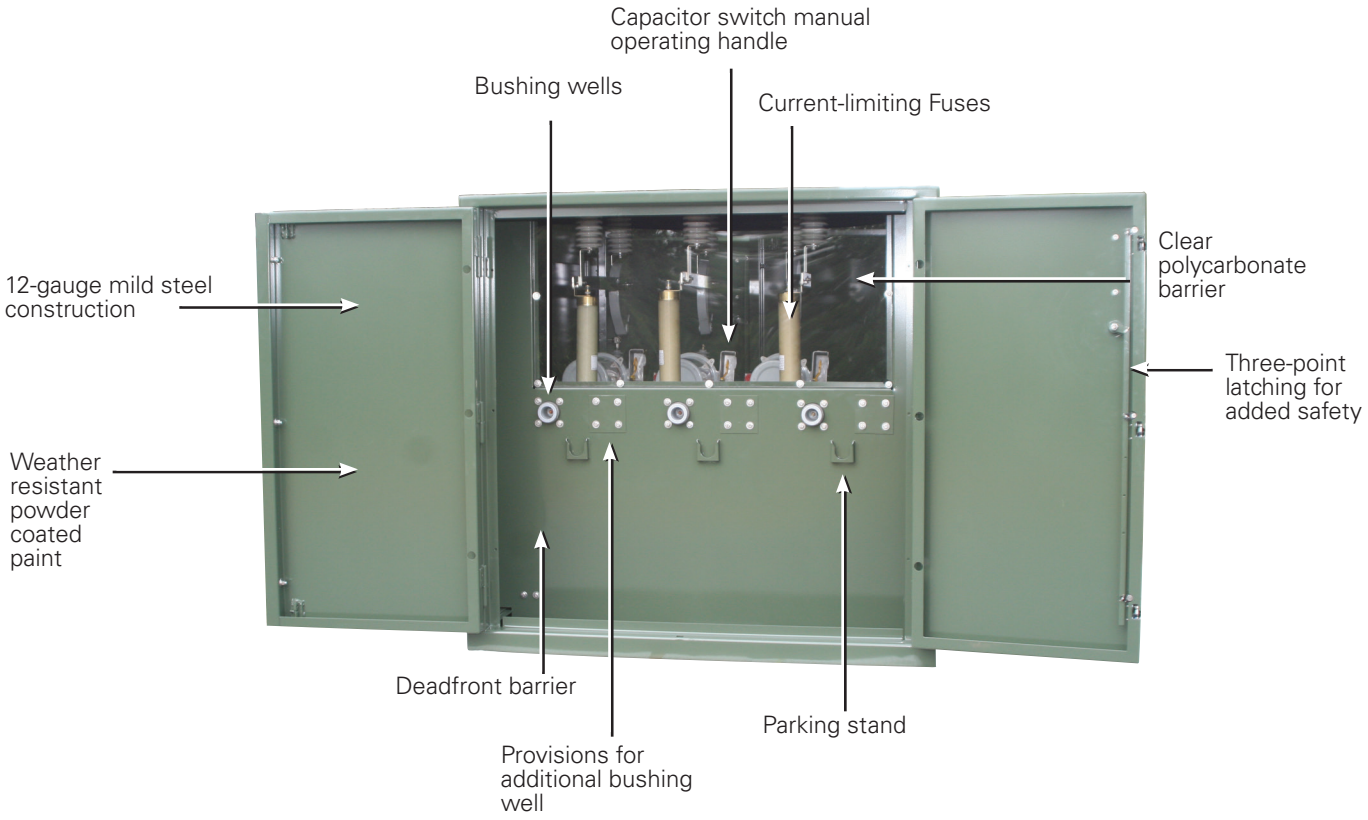

Figure 1. Typical pad-mounted capacitor bank equipment front section.

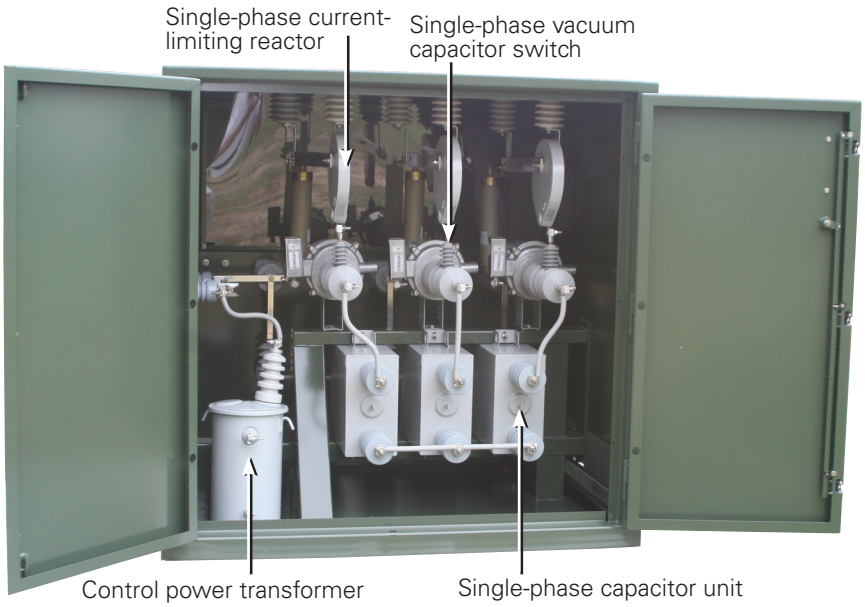

Figure 2. Typical pad-mounted capacitor bank equipment rear section.

Bank connection

The capacitors may be configured as follows:

- Grounded wye
- Ungrounded wye
- Delta

Please see the **Fusing** section and the selection tables for available ratings.

Fusing

Each pad-mounted capacitor bank comes standard with current-limiting fuses for fusing the capacitors. Group fusing and/or individual capacitor fusing are available for most ratings.

Group fusing is standard for all grounded wye banks where available current-limiting fuses coordinate with the capacitor tank rupture curves. These fuses are electrically mounted at the inside terminal of the bushing well or bushing for the deadfront option or at the incoming NEMA® terminal for the livefront option. The fuses protect all equipment in the pad-mounted capacitor bank with the exception of optional arresters which are connected to the source side of the group fuse and optional control power transformers which will be protected with their own fuse. For grounded wye bank ratings that cannot be group fused, the bank will be configured with 2 capacitor units per phase and each capacitor individually fused.

In an ungrounded wye connected bank, the faulting of a capacitor unit to a short circuit, results in an increase in phase current by a factor of 3. At this relatively low current, a fuse selected for group fusing may take several minutes to clear and during this time, the capacitor units in the other two phases are experiencing a 1.73 PU overvoltage as they are now connected lie-to-line and the shorted capacitor unit is experiencing three (3) times nominal phase current. It is highly desirable to minimize the duration of this overvoltage and overcurrent. Therefore, for ungrounded wye banks, Eaton's standard offering will use individual fusing and two (2) capacitor units per phase. In the standard configurations with only two (2) capacitor units per phase, there is a 20% increase in voltage on a capacitor when the fuse on the other capacitor unit in the same phase operates. The heavy-duty and extreme-duty capacitors offer an advantage for ungrounded wye capacitor banks due to their ability to handle a 125% continuous overvoltage.

Group fusing is standard for all delta connected banks. Individual capacitor fusing is not offered as a standard option for delta connected banks.

When individual capacitor unit fuses are applied, the rest of the equipment between the capacitor fuses and the inside terminal of the bushing well or bushing for the deadfront option or at the incoming NEMA® terminal for the livefront option should be protected by fuses or other overcurrent protection devices such as a circuit breaker. Group fuses may be added in the pad-mounted metal-enclosed capacitor bank in addition to the individual capacitor fusing if suitable overcurrent protection outside of the pad-mounted capacitor bank is not available.

Control power transformer

Control power may be supplied by the customer or by an optional control power transformer (CPT) with a 120 V secondary. Options include an oil-insulated CPT with an internal weak-link and an external fuse or a dry-type CPT with an external fuse. In order to maintain control power in the event of a group fuse operation, the CPT will be fused separately and connected to the source side of any group fuses (see Figure 3). The CPT may be used for sensing voltage for the capacitor control. If the bank is connected grounded wye, the CPT will be connected line-to-ground. If the bank is connected ungrounded wye or delta, the CPT will be connected line-to-line.

Capacitor switches

Four standard options for capacitor switches are offered as follows:

1. Single-phase, oil-interruption switch (Eaton's Cooper Power series Type NR oil switch)
2. Single-phase, vacuum-interruption switch (Eaton's Cooper Power series Edison® capacitor switch)

For frequent switching, switching devices with vacuum interruption are recommended. Contact the factory if the bank will be switched back-to-back with another capacitor bank so we may size the switching device and any necessary reactors.

Surge arresters

Surge arresters are optional on the pad-mounted capacitor bank. The standard offering is an Eaton's Cooper Power series UltraSIL® Polymer-Housed VariSTAR® surge arrester. The arresters are electrically connected to the internal connection of the bushing well or bushing for the deadfront option or at the incoming NEMA® terminal for the livefront option.

An optional Eaton's Cooper Power series Storm Trapper® secondary surge arrester is also available to protect the secondary circuit.

Capacitor control

A capacitor control or provisions for a control (optional) may be installed either inside or outside of the enclosure. On the outside of the enclosure, the mounting will be on a customer specified meter socket. On the inside of the enclosure, the control can be surface mounted or meter socket mounted. If mounted inside the enclosure, it will be located in the equipment front section.

For single step banks, the standard option for the capacitor control is Eaton's Cooper Power series CBC-8000 capacitor bank control.

Current limiting reactors

Current limiting reactors, pancake type, are optional on the pad-mounted capacitor bank. Reactors can provide protection for the capacitor units and capacitor switches from excessive inrush currents caused by capacitor bank switching.

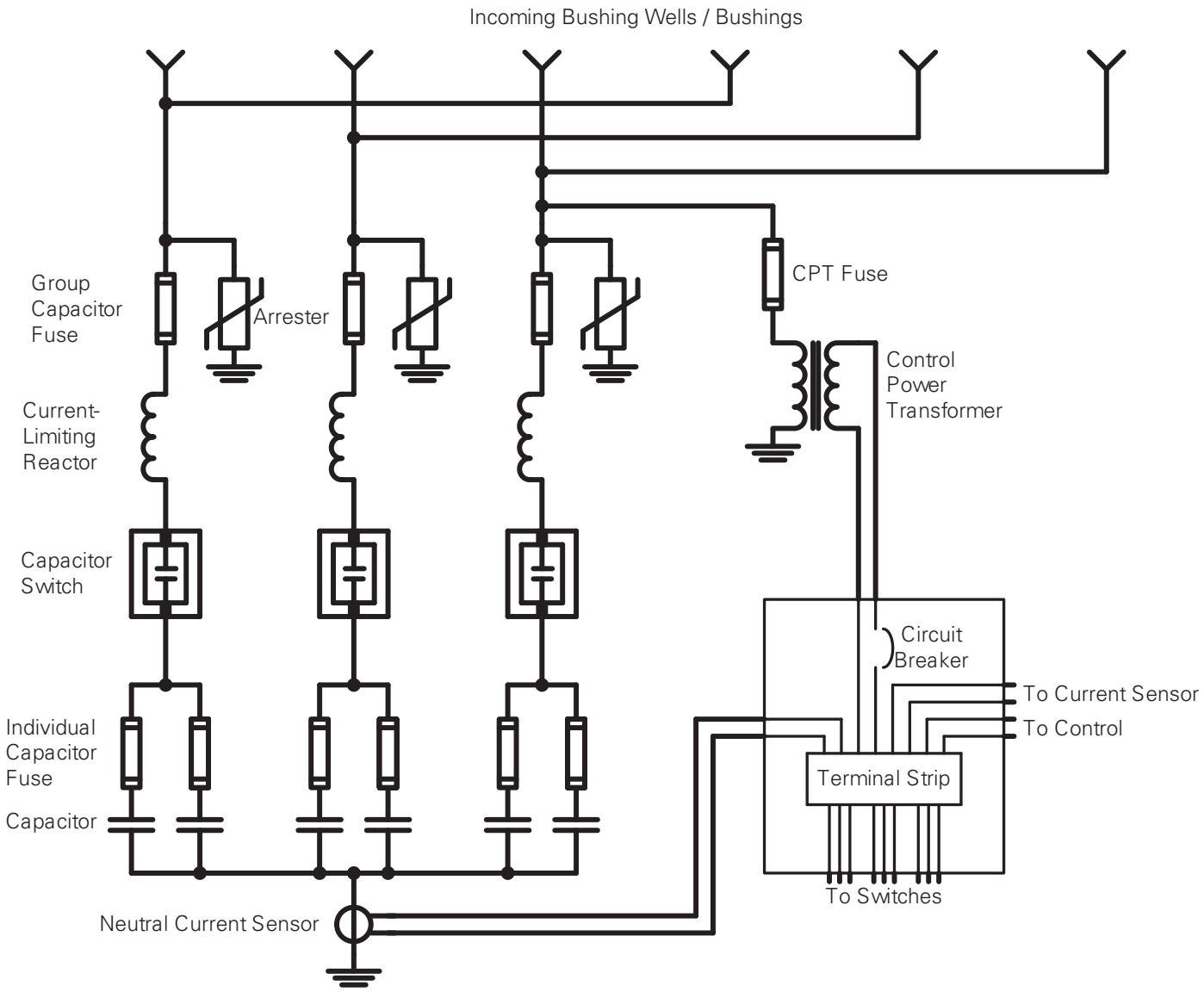

Figure 3. Typical pad-mounted capacitor bank schematic.

Ordering information

Metal-enclosed, Pad-mounted, Capacitor Bank Ordering Guide

System information	
System Voltage (kV)	
Maximum system voltage (kV)	
System frequency (Hz)	
System BIL (kV)	
System fault current (kA)	
System grounding	☐ Grounded ☐ Ungrounded

Capacitor bank information	
Compliance standard	☐ IEEE ☐ IEC ☐ CSA
Bank rated voltage	
Bank rated kVAr	
Bank rated BIL (kV)	
Bank connection	☐ Grounded wye ☐ Ungrounded wye ☐ Delta
Bank type	☐ Fixed ☐ Switched
Type of capacitor fusing	☐ Group fused ☐ Individually fused
Capacitor switch type	☐ Vacuum ☐ Oil
Capacitor bank controller	☐ Cannon CBC8000 ☐ Other:

Accessories	
Surge arresters	☐ MCOV:
Current limiting reactors	☐
Control power transformer	☐
	☐
	☐
	☐
	☐
	☐

General information
Altitude (Feet)
Maximum temperature (°C)
Minimum temperature (°C)
Wind load (MPH)
Seismic level
Pollution level

Capacitor unit information		
Number of capacitor units installed in each phase.	☐ One ☐ Two	Note: Ungrounded banks must have two units per phase.
Unit rated voltage		
Unit rated kVAr		
Unit rated BIL (kV)		
Number of capacitor unit bushings	☐ One ☐ Two	

Dead-front enclosure	
Enclosure color	☐ Munsell 7GY 3029/1.5 Green ☐ ANSI 70 Gray
Enclosure material type	☐ Mild Carbon Steel ☐ Stainless Steel, Type 304L
Bushing wells	☐ 200 amp ☐ 600 amp
Bushing well configuration	☐ Radial Feed - 3 Bushings ☐ Loop Feed - 6 Bushings

Special requirements

Please supply the following additional information with your request for proposal:

- Maximum fault current at the site of the installation
- Any abnormal service conditions in accordance with IEEE Std 18™ standard.
- Are there any capacitor banks connected to the bus that the new bank will be installed on?

  1. If yes, how many capacitor banks are currently installed on the bus?
  2. What are the kvar sizes of the existing capacitor banks?
  3. Do any of the existing banks have current limiting reactors installed? If yes, what are the reactor ratings?
  4. How close together are the existing capacitor banks?

Additional information

Refer to the following reference literature for application recommendations:

MN230009EN	Pad-mounted, Metal-enclosed Capacitor Banks Installation Instructions
CA230002EN	Edison Single-Phase Capacitor Switch
CA230007EN	Type NR Oil Switch
MN230007EN	Edison single-phase vacuum capacitor switch installation and operation instructions
MN230008EN	Type NR oil switch installation and operation instructions
CA916001EN	CBC-8000 Capacitor bank control
MN916001EN	CBC-8000 Control installation manual

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Power Systems Division
2300 Badger Drive
Waukesha, WI 53188
United States
Eaton.com/cooperpowerseries

Powering Business Worldwide

Printed in USA
Publication No. CA230006EN

For Eaton's capacitor product information call 1-877-277-4636 or visit: www.eaton.com/cooperpowerseries.