

# Medium Voltage Metal Enclosed Capacitor & Harmonic Filter Banks



## Product Selection & Application Guide

### Product Description

GE's Medium Voltage Metal Enclosed Capacitor and Harmonic Filter Banks are designed for industrial, commercial, and utility power systems requiring medium voltage automatic power factor correction. Standard designs are available for placement in outdoor or indoor substations (an enclosure integrity option can be added to allow for placement in publicly accessible areas) for power factor correction, loss reduction, and voltage support. The banks come fully assembled and ready for interconnection.

GE's standard banks can be modified in most circumstances to meet your specific requirements. Contact GE to discuss your requirements and obtain a price quote.

GE can provide Power System Studies, Engineering Studies, System Design and Start-up/ Commissioning services.



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# Medium Voltage Metal Enclosed Capacitor Banks

## Product Scope

- Voltages from 2.4kV through 38 kV
- Reactive power ratings to 40,000 kVar in a single enclosure
- Short circuit ratings to 61 kA
- Up to 15 Capacitor Steps in a single bank
- Banks come fully assembled, tested and ready for interconnection
- Integral air-disconnect/ground switch or roll-out circuit breaker
- Integral protection and control system
- Compliant with ANSI, IEEE, IEC, CSA, NEC and NESC codes and standards
- Banks are "labeled" per the requirements and definitions of articles 100 and 110 of the NEC by an OSHA® approved NRTL confirming compliance with C37.20.3-2001 standard for metal-enclosed switchgear. GE also holds a similar certificate that meets Canada's code requirement showing compliance with CSA's C22.2 No. 190-M1985+G11 + G12 (R2004)

## Standard Features

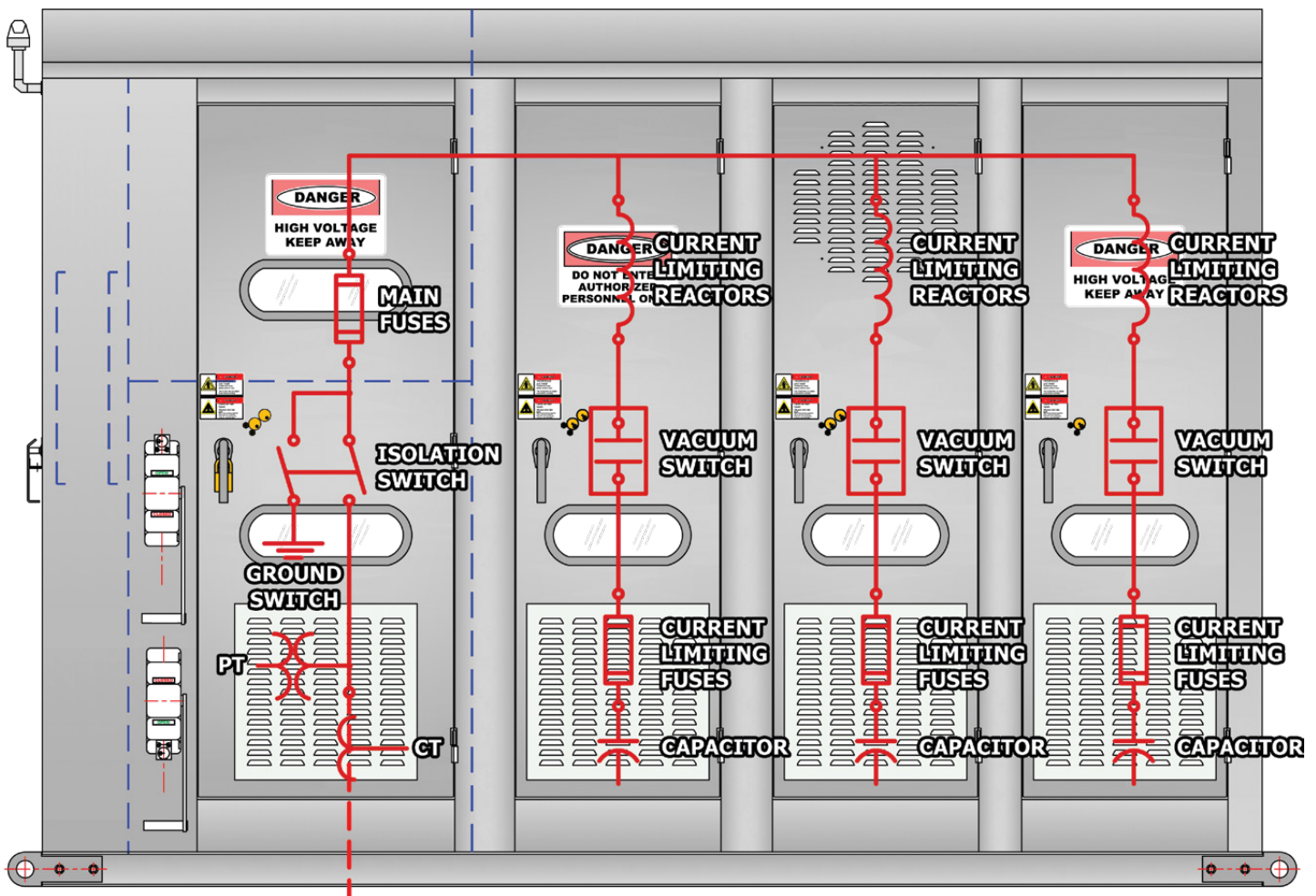


Figure 1- Typical Three Stage Automatic Capacitor Bank showing location of isolated compartments and bank features.

# Medium Voltage Metal Enclosed Capacitor Banks

## Standard Features

### Enclosure

Free standing, compartmentalized, all welded, 11 gauge galvanized steel construction with 3 point pad-lockable latching handles and stainless steel hinges. The enclosure is painted with a corrosion resistant ANSI gray-61 epoxy paint. NEMA 3R construction is standard; NEMA 12 and 4X are available as an option. Base of enclosure as well as capacitor supports are formed from C4 structural steel. Door stays and windows are standard.

### Load Interrupter Air Disconnect Switch

The externally operated air-disconnect switch provides the "visible-break" required by the NEC. The switch is located in a separate compartment that allows the main fuses and other components located within the capacitor compartment to be maintained without having to disconnect power to the bus feeding the bank.

### Capacitors

Low loss, double bushing capacitors can meet or exceed IEC 871, IEEE 18 and CSA standards. Capacitors are connected ungrounded-wye as standard. Grounded banks are provided on request or for reasons of application. Internal discharge resistors reduce the residual voltage to less than 50 volts within 5 minutes of de-energization. The dielectric fluid is environmentally friendly, biodegradable, non PCB, with low toxicity. Internally fused capacitors are available upon request.

### Key Interlock System

Key Interlock system dictates a safe sequence of operation and entry into the capacitor bank.

### Blown Fuse Detection System

Various types of blown fuse detection systems are provided by GE. Based on GE's experience, the most suitable and cost effective system will be recommended. In general, every stage receives its own blown fuse detection system. This allows for the highest level of reliability.

### Ground Switch

An interlocked ground switch is provided to ground the load-side terminals of the incoming air-disconnect switch and/or capacitors for safety during maintenance.

### Main Incoming Fuses or Circuit Breaker

Main incoming fuses provide main bus protection and backup protection for capacitors.

### Lightning Arresters

Bank is protected from lightning and switching transients with heavy duty distribution class lightning arresters.

### Transient Inrush Rectors

GE's TI-Reactors™ are provided on each stage to limit the frequency and magnitude of inrush currents from back-to-back capacitor bank switching.

### Vacuum Switches

Each stage is controlled by long life low maintenance vacuum switches or vacuum contactors (for voltage less than 6.6kV). For switching at 25kV and higher, SF<sub>6</sub> switches with or without pre-insertion resistors can be provided.

### Individual Capacitor Fusing

To improve bank reliability and protect against case-rupture, each capacitor is individually fused with current limiting fuses.

### Power Termination

Designed to accept NEMA standard single hole or two hole compression lugs.

### Control Power Transformer

A control power transformer is provided for protection, control and operation of the bank.

### Ground and Phase Bus

A 1/4" X 2" Tin plated ground bus is provided through the width of the enclosure to assist in grounding during maintenance. All phase bus is also Tin plated and rated at a minimum of 135% of the bank nominal current rating.

### Automatic Capacitor Bank Controller

Capacitor stages are automatically controlled by one of a variety of controllers that can switch stages on or off based upon current, var load, power factor, temperature, time-of-day, metering pulses, or voltage. Power Factor Control is standard.

### Ancillary Controls

On/Off/Auto Switches are standard with stage on and off indicators. Enclosure lights are provided in the control, main-incoming fuse, and capacitor compartments. A convenience outlet is provided in the control compartment.

### Warranty

See GE's standard warranty statement, ES104 for more details.

## Optional Features

### Digital Power Meter

A highly advanced digital power meter, suited to many power and control applications can be supplied as an option. This Intelligent Electronic Device (IED) can take the place of numerous transducers, meters, and control circuits to meet your power monitoring requirements.

### Roof Bushings

Roof Bushings facilitate connection to over-head bus in substations.

### Zero-Voltage Closing Vacuum Switches

Zero-Voltage Closing Vacuum Switches or SF6 Switches with Pre-insertion Resistors. Zero-Voltage Closing Controls or Pre-insertion Resistors can be provided to reduce capacitor bank switching transients.



60 MVAR, 38kV, 5-stage 2 section Metal-Enclosed Capacitor Bank being installed at solar plant



Small Multi-stage Capacitor Banks for commercial and industrial power factor correction.

### NEMA 12/4X Construction

NEMA 12 or 4X (stainless steel) construction can be provided as an option.

### Current Transformer

Automatic banks can be shipped with a properly sized medium voltage or low voltage current transformer.

### Roll-Out Circuit Breaker

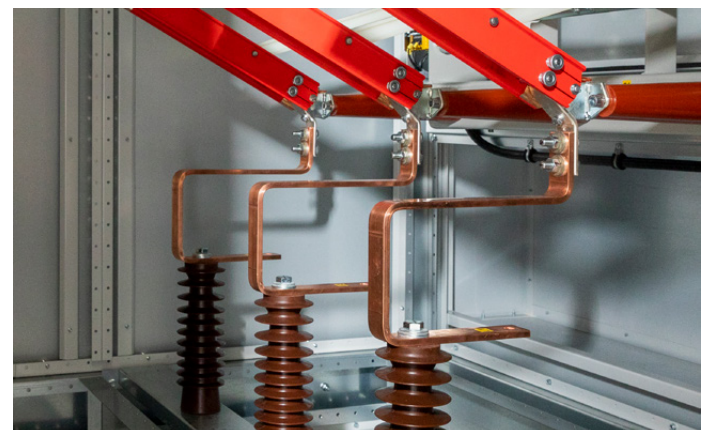
An integral roll-out vacuum circuit breaker can be supplied for disconnecting the capacitor bank from the power system.

### Exhaust Fan or Air Conditioning

An exhaust fan or air conditioning can be supplied for forced ventilation of the enclosure.



Bank with AC-unit



Load interrupter with visible-break

# Medium Voltage Metal Enclosed Capacitor Banks

## Typical Three-Line Diagram

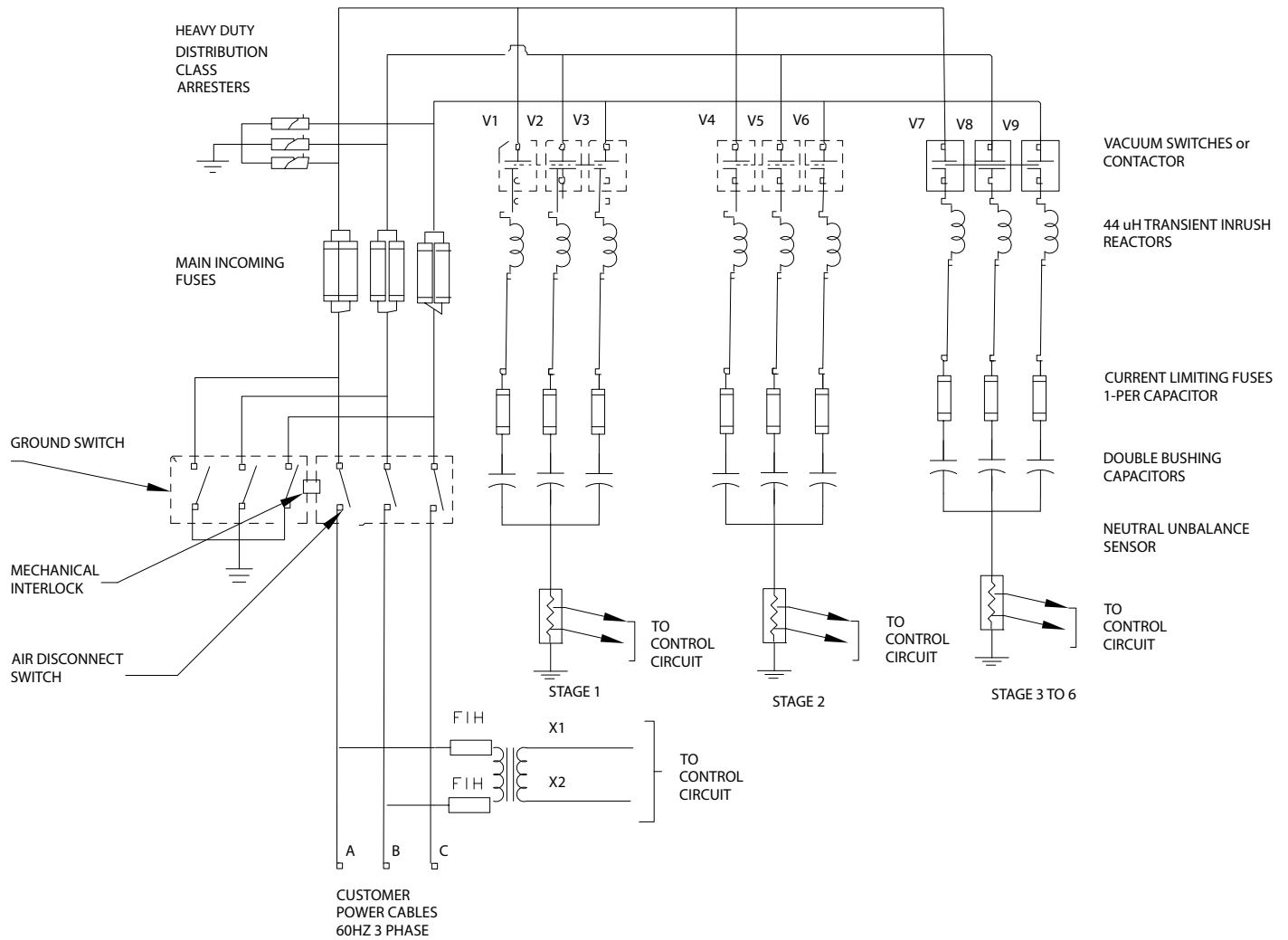


Figure 2 – Number of stages, ratings and specific bank configuration and components are dependent on voltage rating and customer requirements.



# Medium Voltage Metal Enclosed Harmonic Filter Capacitor Banks

## Product Scope

- Voltages from 2.4kV through 38 kV
- Reactive power ratings to 40,000 kVar in a single enclosure
- Short circuit ratings to 61 kA
- Up to 15 Filter Steps in a single bank
- Banks come fully assembled, tested and ready for interconnection
- Integral air-disconnect/ground switch or roll-out circuit breaker

## Application Information

GE's medium voltage harmonic filter banks are designed for commercial, industrial, and utility power systems requiring power factor correction, harmonic control, IEEE 519 compliance, reduced system capacity, and improved voltage regulation.

Both indoor and outdoor designs are available with a host of options and accessories to fit the requirements and desired configurations of virtually all installations. Single stage and multi-stage, single tuned or multi-tuned filter banks, with or without high-pass configurations are available.

GE's medium voltage harmonic filter banks are designed to be connected anywhere in the electrical system. Typically, they are connected at the medium voltage service point between the utility supply and the customer.

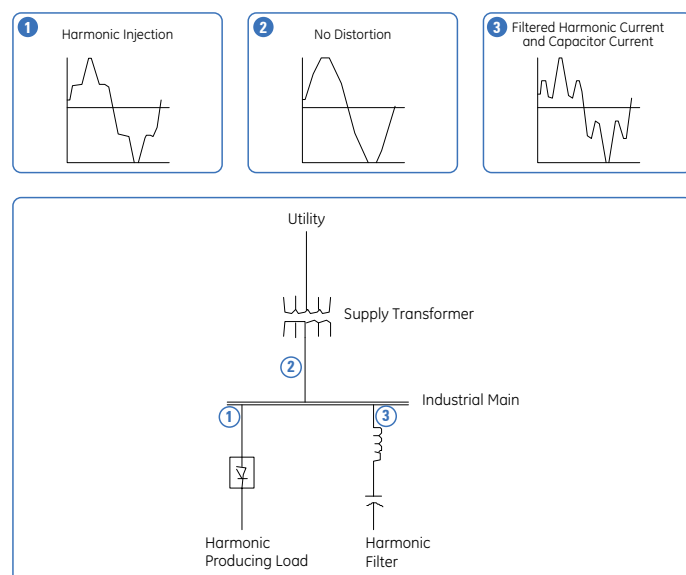


Figure 3- Harmonic Filters reduce harmonic voltage and current distortion while correcting power factor.

- Integral protection and control system
- Compliant with ANSI, IEEE, IEC, CSA, NEC and NESC codes and standards
- Banks are "labeled" per the requirements and definitions of articles 100 and 110 of the NEC by an OSHA approved NRTL confirming compliance with C37.20.3-2001 standard for metal-enclosed switchgear. GE also holds a similar certificate that meets Canada's code requirement showing compliance with CSA's C22.2 No. 190-M1985+G11 + G12 (R2004)

Figure 3 shows a typical location for the installation of a harmonic filter bank. Note that the harmonic producing load current is absorbed by the harmonic filter bank and the current flowing back toward the utility is virtually harmonic free. In addition to reducing distortion, the filter bank produces reactive power to improve power factor and reduce reactive demand and power factor penalties.

With GE's Engineering staff, a harmonic filter bank can be designed to meet specific system requirements. GE provides this service as part of an equipment order.

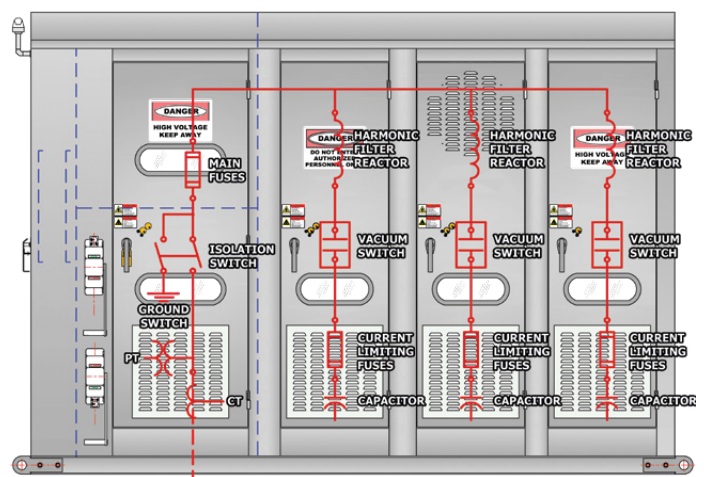


Figure 4- Typical Three Stage Medium Voltage Automatic Harmonic Filter Bank showing location of isolated compartments and bank features.

# Medium Voltage Metal Enclosed Harmonic Filter Capacitor Banks

## Standard Features

### Enclosure

Free standing, compartmentalized, all welded, 11 gauge galvanized steel construction with 3 point pad-lockable latching handles and stainless steel hinges. The enclosure is painted with a corrosion resistant ANSI gray-61 epoxy paint. NEMA 3R construction is standard, NEMA 12 and 4X with 12 gauge stainless steel is available as an option. Base of enclosure as well as capacitor supports are formed from C4 structural steel. Door stays and windows are standard.

### Load Interrupter Air Disconnect Switch

The externally operated air-disconnect provides the “visible-break” required by the NEC. The switch is located in a separate compartment that allows the main fuses and other components located in the filter bank compartment to be maintained without having to disconnect power to the bus feeding the bank.

### Capacitors

Low loss, double bushing harmonic filter rated capacitors that can meet or exceed IEC 871, IEEE 18 and CSA standards. Capacitors are connected ungrounded-wye as standard. Internal discharge resistors reduce the residual voltage to less than 50 volts within 5 minutes of de-energization. The dielectric fluid is non PCB, with low toxicity. Internally fused capacitors are available upon request.

### Blown Fuse Detection System

Various types of blown fuse detection systems are provided by GE. Based on GE’s experience, the most suitable and cost effective system will be recommended. In general, every stage receives its own blown fuse detection system. This allows for the highest level of reliability. Blown Fuse Detection System Various types of blown fuse detection systems are provided by GE. Based on GE’s experience, the most suitable and cost effective system will be recommended. In general, every stage receives its own blown fuse detection system. This allows for the highest level of reliability.

### Key Interlock System

Key Interlock system dictates safe operation and entry into the harmonic filter bank.

### Ground Switch

An interlocked ground switch is provided to ground the load-side terminals of the incoming air-disconnect switch and/or capacitors for safety during maintenance.



*Iron-core harmonic filter reactors used in a 7 MVAR 5th harmonic filter bank. Note extensive use of plated bus for connection of reactors to capacitors.*

### Main Incoming Fuses

Main incoming fuses or circuit breaker provide main bus protection and backup protection for Capacitors and filter reactors.

### Lightning Arresters

Bank is protected from lightning and switching transients with heavy duty distribution class lightning arresters. Intermediate and station class arresters are available as an option.

### Harmonic Filter Reactors

Iron-Core filter reactors provide the necessary reactance to tune the capacitor bank to the desired frequency. In addition to tuning, the reactors significantly reduce the frequency and magnitude of inrush currents from back-to-back capacitor bank switching.

### Vacuum Switches

Each stage is controlled by long life low maintenance vacuum switches or SF6 switches control each stage.

### Individual Capacitor Fusing

Each capacitor is individually fused with 40kA current limiting fuses. Fuses are equipped with blown fuse indicators.

### Power Termination

Designed to accept NEMA standard single hole or two hole compression lugs.

### Control Power Transformer

A control power transformer is provided for protection, control and operation of the bank.



## Ground and Phase Bus

A 1/4" X 2" Tin plated ground bus is provided through the width of the enclosure to assist in grounding during maintenance. All phase bus is also Tin plated and rated at a minimum of 135% of the bank nominal current rating.

## Automatic Capacitor Bank Controller

Capacitor stages are automatically controlled by one of a variety of controllers that can switch stages on an off based upon current, var load, power factor, temperature, time-of-day, metering pulses, or voltage. Power Factor Control is standard.

## Optional Features

### Digital Power Meter

A highly advanced digital power meter, suited to many power and control applications can be supplied as an option. This Intelligent Electronic Device (IED) can take the place of numerous transducers, meters, and control circuits to meet your power monitoring requirements.

### Roof Bushings

Roof Bushings facilitate connection to over-head bus in substations.

### Zero-Voltage Closing Vacuum Switches

Zero-Voltage Closing Vacuum Switches or SF6 Switches with Pre-insertion Resistors. Zero-Voltage Closing Controls or Pre-insertion Resistors can be provided to reduce capacitor bank switching transients.

### NEMA 12/4X Construction

NEMA 12 or 4X (stainless steel) construction can be provided as an option.

### Current Transformer

Automatic banks can be shipped with a properly sized medium voltage or low voltage current transformer.

## Ancillary Controls

On/Off/Auto Switches are standard with stage on and off indicators. Enclosure lights are provided in the control, main-incoming fuse, and capacitor compartments. A convenience outlet is provided in the control compartment.

## Warranty

See GE's standard warranty statement, ES104 for more details.



*Typical Three-Phase 34.5KV Single-Step 7 MVAR 5th Harmonic Filter Bank.*

## Roll-Out Circuit Breaker

An integral roll-out vacuum circuit breaker can be supplied for disconnecting the capacitor bank from the power system.

## Exhaust Fan or Air Conditioning

An exhaust fan or air conditioning can be supplied for forced ventilation of the enclosure.

# Medium Voltage Metal Enclosed Harmonic Filter Capacitor Banks

## Typical Three-Line Diagram

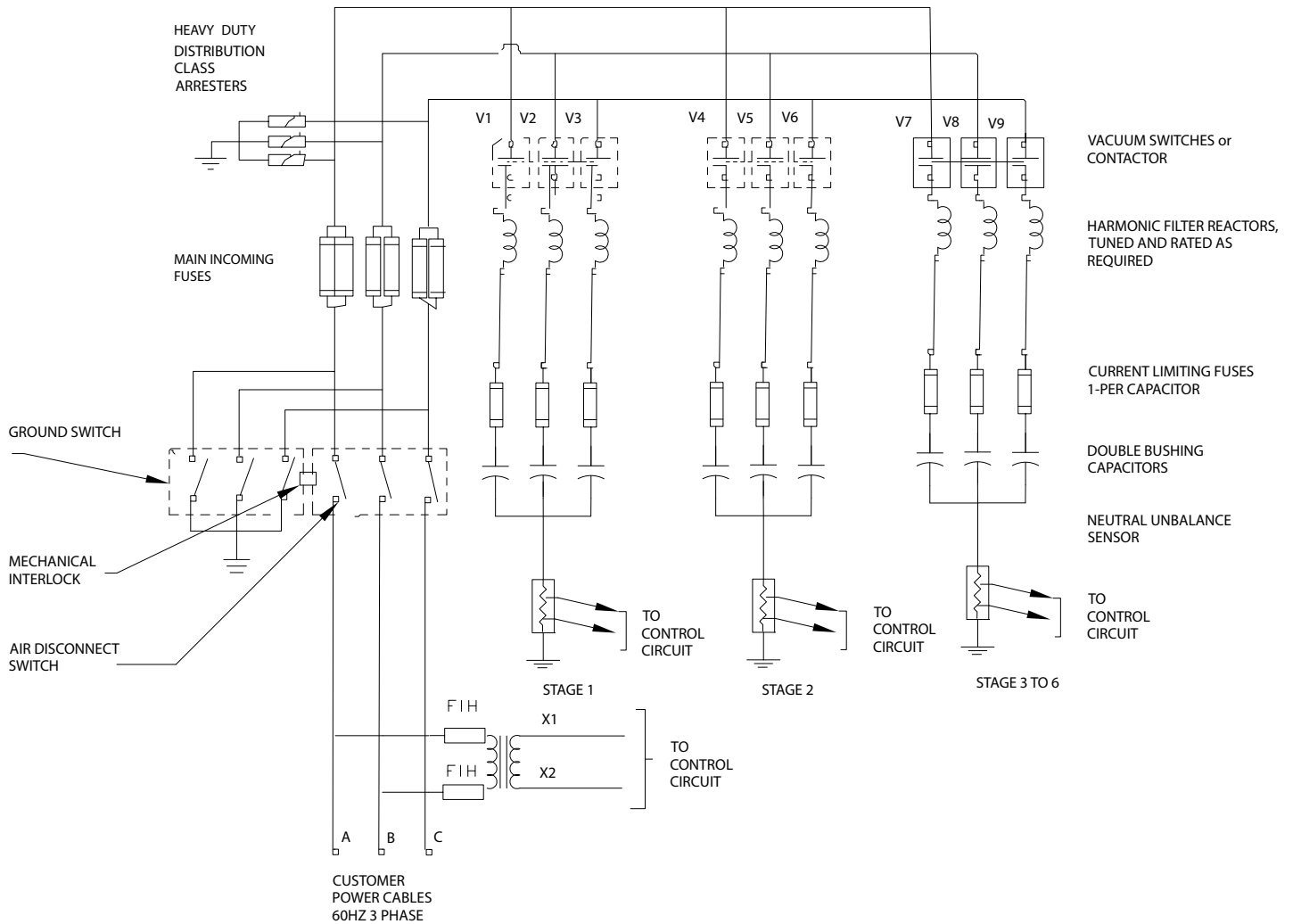


Figure 5 – Typical Three-Line Diagram of a Metal-Enclosed Harmonic Filter Bank. Number of stages, ratings, and specific bank configuration and components are dependent upon voltage rating and customer requirements.

# Ordering Guide

GE's metal enclosed capacitor banks are built in accordance with the standard and optional features as previously listed. Alternate designs that meet your specific requirements and site conditions can easily be accommodated. Please contact GE for a quote or to discuss your specific application.

Submit supply GE with the following information:

## Medium Voltage Metal Enclosed Capacitor Banks

System Voltage (kV) \_\_\_\_\_

Total kvar requirements \_\_\_\_\_

Three-Phase System Short  
Circuit Level (Symmetrical Amps) \_\_\_\_\_

Desired KVar per step \_\_\_\_\_

Desired number of stages \_\_\_\_\_

Desired number of steps \_\_\_\_\_

### Optional Features:

- |                                                                 |                                                                                          |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Digital Power Meter                    | <input type="checkbox"/> Zero-Voltage Closing Vacuum Switches or Pre-Insertion Resistors |
| <input type="checkbox"/> NEMA 12 Construction                   |                                                                                          |
| <input type="checkbox"/> Medium Voltage Current Transformer     | <input type="checkbox"/> Low Voltage Current Transformer                                 |
| <input type="checkbox"/> Roof Bushings                          | <input type="checkbox"/> Exhaust Fans                                                    |
| <input type="checkbox"/> NEMA 4X construction (Stainless Steel) | <input type="checkbox"/> Air Conditioning                                                |
| <input type="checkbox"/> Roll-Out Circuit Breaker               |                                                                                          |

Other requirements or constraints:

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## Medium Voltage Metal Enclosed Harmonic Filter Capacitor Banks

System Voltage (kV) \_\_\_\_\_

Total kvar requirements \_\_\_\_\_

Three-Phase System Short  
Circuit Level (Symmetrical Amps) \_\_\_\_\_

Desired KVar per step \_\_\_\_\_

Desired number of stages \_\_\_\_\_

Desired number of steps \_\_\_\_\_

### Optional Features:

- |                                                                 |                                                                                          |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Digital Power Meter                    | <input type="checkbox"/> Zero-Voltage Closing Vacuum Switches or Pre-Insertion Resistors |
| <input type="checkbox"/> NEMA 12 Construction                   |                                                                                          |
| <input type="checkbox"/> Medium Voltage Current Transformer     | <input type="checkbox"/> Low Voltage Current Transformer                                 |
| <input type="checkbox"/> Roof Bushings                          | <input type="checkbox"/> Exhaust Fans                                                    |
| <input type="checkbox"/> NEMA 4X construction (Stainless Steel) | <input type="checkbox"/> Air Conditioning                                                |
| <input type="checkbox"/> Roll-Out Circuit Breaker               |                                                                                          |

Other requirements or constraints:

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For more information please contact  
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