Voltage Regulators
Catalog Data
**CA225003EN**

Effective September 2017
Supersedes October 2016

COOPER POWER SERIES

# CL-7 Microprocessor-Based Voltage Regulator Control and Accessories


## General

Eaton's Cooper Power™ series CL-7 is the latest voltage regulator control. The CL-7 control maintains the easy to use interface of previous CL controls. Advance features enable easy integration into a smart grid enabled network because the CL-7 voltage regulator control is designed with communications and smart grid features in mind. The versatile CL-7 comes as standard equipment on Eaton's voltage regulators, but easily integrates to operate nearly any voltage regulator in service today.

### Familiar features

The CL-7 control employs the same easy to use features of previous CL controls. It utilizes most of the same function codes and all of the same easy-to-use interface features. Field technicians familiar with earlier regulator control models will already know how to use the CL-7 control. This translates to lower training costs.

### Common platform

Eaton's common control platform means shared components and a familiar look and feel between controls. This will reduce inventory of components and lead to a distribution system that is easier to maintain. Whenever possible, items like communications cards and I/O modules are shared between controls.

### Focus on smart grid

The CL-7 control is designed to integrate easily into smart-grind communications networks. Communications features are available to simplify installation include integrated communications modules, multiple protocol availability, communications battery backup, dc power supply and auxiliary ac power supply. The control contains the resident communications protocols of DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP.

### Multi-phase control

The CL-7 voltage regulator control multi-phase option is unique in the industry. It provides the first of its kind multi-phase voltage regulation: two or three regulators can be operated with the use of a single control. This provides a single point of contact for communications, true multi-phase metering and fewer controls to program and maintain. The advanced DeltaCalc feature enables new delta system features, like reverse power on a closed delta system, without the need for an inter-phase PT.

### Advanced software

Eaton's Cooper Power series ProView™ NXG interface software simplifies the programming of the entire line of common platform controls. This reduces the need for multiple software packages to interface with multiple controls. Control parameters can be programmed with a personal computer in the office using ProView NXG software. Programming files can then be loaded onto the control using a USB cable connection or through the front panel USB data port.

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## Ordering information

When ordering a voltage regulator with a CL-7 voltage regulator control, construct the control catalog number using Table 1. Select the appropriate digits of the catalog number based upon control feature requirements.

**Table 1. Base CL-7 Microprocessor-Based Voltage Regulator Control**

| Description | Catalog Number |
|---|---|
| **Base Letters For a CL-7 Voltage Regulator Control** | **CL7** |
| **Specify Control Usage Option (Replace "X")** | CL7**X** |
| **1** = Single-phase | |
| **2** = Multi-phase (Two Regulators) | |
| **3** = Multi-phase (Three Regulators) | |
| **Specify Language Option (Replace "X")** | CL7X**X** |
| **E** = English | |
| **N** = Spanish | |
| **P** = Portuguese | |
| **F** = French Canadian | |
| **S** = Other Language (Contact Factory) | |
| **Specify Communications Interface, Port 1* (Replace "X")** | CL7XX**X** |
| **0** = Standard; None | |
| **1** = RS-232 DB9 | |
| **2** = Serial Fiber ST | |
| **3** = RS-485 TB, Isolated | |
| **4** = Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC | |
| **5** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ | |
| **6** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST | |
| **7** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC | |
| **8** = Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 | |
| **P** = Provisions for Future Communications Interface (Communications Base Board Only) | |
| **Specify Communications Protocols, Port 1* (Replace "X")** | CL7XXX**0** |
| **0** = DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP | |
| **Specify Communications Interface, Port 2* (Replace "X")** | CL7XXXX**X** |
| **0** = Standard; None | |
| **1** = RS-232 DB9 | |
| **2** = Serial Fiber ST | |
| **3** = RS-485 TB, Isolated | |
| **4** = Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC | |
| **5** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ | |
| **6** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST | |
| **7** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC | |
| **8** = Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 | |
| **Specify Communications Protocols, Port 2* (Replace "X")** | CL7XXXXX**0** |
| **0** = DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP | |
| **Specify I/O Option (Replace "X")** | CL7XXXXXX**X** |
| **0** = No Universal Contacts Required | |
| **1** = One Set of Universal Contacts, 4 In/4 Out, 10-250 Vac, 10-125 Vdc, Max 12-Gauge Wire | |
| **2** = Two Sets of Universal Contacts, 8 In/8 Out, 10-250 Vac, 10-125 Vdc, Max 12-Gauge Wire | |

* Refer to the following for communications protocol and communications interface compatibility rules:

- DNP Serial is compatible with Communications Interface options 1-3.
- DNP TCP/IP is compatible with Communications Interface options 4-8.
- IEC 60870-5-101 is compatible with Communications Interface options 1-3.
- IEC 60870-5-104 is compatible with Communications Interface options 4-8.
- Cooper 2179 and MODBUS Serial are compatible with Communications Interface options 1-3.
- MODBUS TCP/IP is compatible with Communications Interface options 4-8.

**Table 1. Base CL-7 Microprocessor-Based Voltage Regulator Control, continued**

| Description | Catalog Number |
|---|---|
| **Specify Auxiliary Power and Battery Options** (Replace "X")** | CL7XXXXXXX**X** |
| **0** = None | |
| **1** = 13.5 Vdc, 14 W Continuous, 20 W Peak Power Module | |
| **2** = 13 A-Hr, 24 Vdc Battery Backup | |
| **3** = 48/125 Vdc Substation Battery Power Provisions | |
| **4** = 120 V, 6 A Max Auxiliary Power | |
| **5** = 230 V, 6 A Max Auxiliary Power | |
| **6** = 240 V External Source | |
| **7** = 13.5 Vdc Power Module and 13 A-Hr Battery Backup | |
| **8** = 13.5 V Power Module and 48/125 Vdc Substation Battery Power Provisions | |
| **9** = 13.5 Vdc Power Module and 120 V Customer Voltage | |
| **A** = 13.5 Vdc Power Module and 230 V Customer Voltage | |
| **B** = 13.5 Vdc Power Module and 240 V External Voltage | |
| **C** = 13 A-Hr Battery Backup and 120 V Customer Voltage | |
| **D** = 13 A-Hr Battery Backup and 230 V Customer Voltage | |
| **E** = 13 A-Hr Battery Backup and 240 V External Voltage | |
| **F** = 48/125 Vdc Substation Battery Power Provisions and 120 V Customer Voltage | |
| **G** = 48/125 Vdc Substation Battery Power Provisions and 230 V Customer Voltage | |
| **H** = 48/125 Vdc Substation Battery Power Provisions and 240 V External Source | |
| **J** = 230 V Customer Voltage and 240 V External Source | |
| **L** = 13.5 Vdc Power Module, 13 A-Hr Battery Backup, and 120 V Customer Voltage | |
| **M** = 13.5 Vdc Power Module, 13 A-Hr Battery Backup, and 230 V Customer Voltage | |
| **N** = 13.5 Vdc Power Module, 13 A-Hr Battery Backup, and 240 V External Source | |
| **P** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions, and 120 V Customer Voltage | |
| **Q** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Provisions, and 230 V Customer Voltage | |
| **R** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions, and 240 V External Source | |
| **T** = 13.5 Vdc Power Module, 230 V Customer Voltage, and 240 V External Source | |
| **U** = 13 A-Hr Battery Backup, 230 V Customer Voltage, and 240 V External Source | |
| **V** = 48/125 Vdc Substation Battery Power Provisions, 230 V Customer Voltage, and 240 V External Source | |
| **W** = 13.5 Vdc Power Module, 13 A-Hr Battery Backup, 230 V Customer Voltage, and 240 V External Source | |
| **X** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions, 230 V Customer Voltage, and 240 V External Source | |
| **S** = Other Battery/Power Option (Contact Factory) | |
| **Specify Control Box Type/Material Option (Replace "X")** | CL7XXXXXXXX**X** |
| **0** = Mild Steel Standard Control Box | |
| **1** = Stainless Steel Standard Control Box | |
| **2** = Mild Steel Long Control Box | |
| **3** = Stainless Steel Long Control Box | |
| **4** = NEMA® 3 Mild Steel Standard Control Box | |
| **5** = NEMA® 3 Stainless Steel Standard Control Box | |
| **6** = NEMA® 3 Mild Steel Long Control Box | |
| **7** = NEMA® 3 Stainless Steel Long Control Box | |
| **9** = Stainless Steel Double Size Control Box | |

** Auxiliary Power and Battery Options Explanations:
0 = No auxiliary power or battery options are provided.
1 = A 13.5 Vdc power module is provided in the control to supply power to radio equipment. Power capacity: Max output: 1.48 A, 1 second; Max Power: 14 W continuous, 20 W peak.
2 = A 13 A-Hr, 24 Vdc backup battery module and battery are provided to power the control during a power outage.
3 = Provisions to power control from 48-125 Vdc customer provided supply.
4 = A 120 Vac auxiliary winding is wound into the main coil; contacts are provided in the control box to power auxiliary equipment.
5 = A 240 Vac auxiliary winding is wound into the main coil; contacts are provided in the control box to power auxiliary equipment.
6 = The control is equipped for the application of 240 Vac to externally power the control.
7 through X = These options are combinations of options 2 through 6.

**Table 1. Base CL-7 Microprocessor-Based Voltage Regulator Control, continued**

| Description | Catalog Number |
|---|---|
| **Specify Cable Length/Shielded/Armor Option*** (Replace "X")** | CL7XXXXXXXXX**X** |
| **0** = Standard 54" Control Cable | |
| **1** = 10 ft. (3 m) Control Cable | |
| **2** = 20 ft. (6.1 m) Control Cable | |
| **3** = 30 ft. (9.1 m) Control Cable | |
| **4** = 40 ft. (12.2 m) Control Cable | |
| **5** = 50 ft. (15.2 m) Control Cable | |
| **6** = 60 ft. (18.3 m) Control Cable | |
| **7** = 80 ft. (24.4 m) Control Cable | |
| **8** = 100 ft. (30.5 m) Control Cable | |
| **9** = 120 ft. (36.6 m) Control Cable | |
| **A** = Standard 54" Control Cable Shielded | |
| **B** = 10 ft. (3 m) Control Cable Shielded | |
| **C** = 20 ft. (6.1 m) Control Cable Shielded | |
| **D** = 30 ft. (9.1 m) Control Cable Shielded | |
| **E** = 40 ft. (12.2 m) Control Cable Shielded | |
| **F** = 50 ft. (15.2 m) Control Cable Shielded | |
| **G** = 60 ft. (18.3 m) Control Cable Shielded | |
| **H** = 80 ft. (24.4 m) Control Cable Shielded | |
| **J** = 100 ft. (30.5 m) Control Cable Shielded | |
| **K** = 120 ft. (36.6 m) Control Cable Shielded | |
| **L** = Standard 54" Control Cable with Full Length Armor | |
| **M** = 10 ft. (3 m) Control Cable with 8 ft. of Armor at Control End | |
| **P** = 20 ft. (6.1 m) Control Cable with 8 ft. of Armor at Control End | |
| **Q** = 30 ft. (9.1 m) Control Cable with 8 ft. of Armor at Control End | |
| **R** = 40 ft. (12.2 m) Control Cable with 8 ft. of Armor at Control End | |
| **T** = 50 ft. (15.2 m) Control Cable with 8 ft. of Armor at Control End | |
| **U** = 60 ft. (18.3 m) Control Cable with 8 ft. of Armor at Control End | |
| **V** = 80 ft. (24.4 m) Control Cable with 8 ft. of Armor at Control End | |
| **W** = 100 ft. (30.5 m) Control Cable with 8 ft. of Armor at Control End | |
| **X** = 120 ft. (36.6 m) Control Cable with 8 ft. of Armor at Control End | |
| **N** = None – No Control Cable | |
| **S** = Other Cable Length and/or type (Consult Factory) | |
| **Base Feature Code for Standard CL-7 Control Configuration** | CL7XXXXXXXXX**0000** |
| **Specify Tap-Changer Capacitor Type**** (Replace "X")** | CL7XXXXXXXXX0000**X** |
| **3** = 12 µF (60 Hz QD3 Tap-Changer) | |
| **4** = 15 µF (50 Hz QD3 Tap-Changer) | |
| **5** = 50 µF (QD5 & QD8 Tap-Changer) | |

*** For multi-phase controls, all cables will be the same length. If different cable lengths are required, select Option "S" and consult factory.

**** Refer to the following rules for selecting the correct tap-changer capacitor:

- 50 Hz Systems
  - Select the 15 µF capacitor for 14.4 kV and below voltage regulators rated 219 A and below.
  - Select the 15 µF capacitor for 15 kV-21 kV voltage regulators rated 150 A and below.
- 60 Hz Systems
  - Select the 12 µF capacitor for 14.4 kV and below voltage regulators rated 219 A and below.
  - Select the 12 µF capacitor for 15 kV-21 kV voltage regulators rated 150 A and below.
- Both 50 Hz and 60 Hz Systems
  - Select the 50 µF capacitor for 14.4 kV and below voltage regulators rated 220 A and above.
  - Select the 50 µF capacitor for 15 kV-21 kV voltage regulators rated 151 A and above.
  - Select the 50 µF capacitor for 22 kV and above voltage regulators.

When ordering a CL-7 Control Replacement Assembly (CRA), construct the control catalog number using Table 2. Select the appropriate digits of the catalog number based upon control feature requirements. A CRA includes a CL-7 control with accessories installed in a control box.

**Table 2. Base CL-7 Voltage Regulator Control Panel Replacement (CRA)**

| Description | Catalog Number |
|---|---|
| **Base Letters For a CL-7 Control Replacement Assembly (CRA)** | **577** |
| **Specify Control Usage Option (Replace "X")** | 577**X** |
| **1** = Single-Phase | |
| **2** = Multi-Phase (Two Regulators)* | |
| **3** = Multi-Phase (Three Regulators)* | |
| **Specify Regulator Manufacturer Option (Replace "X")** | 577X**X** |
| **1** = Cooper/McGraw-Edison® – 10-Pin Internal Capacitor (Single-Phase) | |
| **2** = Cooper/McGraw-Edison – 12-Pin Internal Capacitor (Single-Phase) | |
| **3** = Cooper/McGraw-Edison – 12-Pin External Capacitor (Single-Phase) | |
| **4** = Cooper/McGraw-Edison – 13-Pin External Capacitor (Single-Phase) | |
| **5** = Cooper/McGraw-Edison – 14-Pin External Capacitor (Single-Phase) | |
| **6** = Siemens/Allis-Chalmers/GE/Howard/Cooper-McGraw-Edison Without Quick-Disconnect, (Single-Phase) | |
| **A** = Siemens/Allis-Chalmers/GE/Howard – 12-Pin Internal Capacitor (Multi-phase) | |
| **B** = Siemens/Allis-Chalmers/GE/Howard – 13-Pin Internal Capacitor (Multi-phase) | |
| **C** = Siemens/Allis-Chalmers/GE/Howard – 14-Pin Internal Capacitor (Multi-phase) | |
| **D** = Cooper/McGraw-Edison – 10-Pin Internal Capacitor (Multi-phase) | |
| **E** = Cooper/McGraw-Edison – 12-Pin Internal Capacitor (Multi-phase) | |
| **F** = Cooper/McGraw-Edison – 12-Pin External Capacitor (Multi-phase) | |
| **G** = Cooper/McGraw-Edison – 13-Pin External Capacitor (Multi-phase) | |
| **H** = Cooper/McGraw-Edison – 14-Pin External Capacitor (Multi-phase) | |
| **S** = Special | |
| **Specify Communications Interface, Port 1*** (Replace "X")** | 577XX**X** |
| **0** = Standard; None | |
| **1** = RS-232 DB9 | |
| **2** = Serial Fiber ST | |
| **3** = RS-485 TB, Isolated | |
| **4** = Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC | |
| **5** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ | |
| **6** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST | |
| **7** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC | |
| **8** = Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 | |
| **P** = Provisions for Future Communications Interface (Communications Base Board Only) | |
| **Specify Communications Protocols, Port 1*** (Replace "X")** | 577XXX**0** |
| **0** = DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP | |
| **Specify Communications Interface, Port 2*** (Replace "X")** | 577XXXX**X** |
| **0** = None | |
| **1** = RS-232 (DB9) | |
| **2** = Serial Fiber ST | |
| **3** = RS-485 | |
| **4** = Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC | |
| **5** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ | |
| **6** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST | |
| **7** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC | |
| **8** = Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 | |

* The multi-phase CRAs will interface only with a standard Eaton Cooper Power series quick-connect control cable. If the regulator is not equipped with such an interface, one must be installed. See the document CA225006EN for more information on multi-phase control application.

*** Refer to the following for communications protocol and communications interface compatibility rules:

- DNP Serial is compatible with Communications Interface options 1-3.
- DNP TCP/IP is compatible with Communications Interface options 4-8.
- IEC 60870-5-101 is compatible with Communications Interface options 1-3.
- IEC 60870-5-104 is compatible with Communications Interface options 4-8.
- Cooper 2179 and MODBUS Serial are compatible with Communications Interface options 1-3.
- MODBUS TCP/IP is compatible with Communications Interface options 4-8.

**Table 2. Base CL-7 Voltage Regulator Control Panel Replacement (CRA), continued**

| Description | Catalog Number |
|---|---|
| **Specify Communications Protocols, Port 2*** (Replace "X")** | 577XXXXX**0** |
| **0** = DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP | |
| **Specify I/O Option (Replace "X")** | 577XXXXXX**X** |
| **0** = None | |
| **1** = One Set of Universal Contacts, 4 In/4 Out, 10-250 Vac, 10-125 Vdc, Max 12-Gauge Wire | |
| **2** = Two Sets of Universal Contacts, 8 In/8 Out, 10-250 Vac, 10-125 Vdc, Max 12-Gauge Wire | |
| **Specify Auxiliary Power and Battery Options* (Replace "X")** | 577XXXXXXX**X** |
| **0** = None | |
| **1** = 13.5 Vdc, 14 W Continuous, 20 W Peak Power Module | |
| **2** = 13 A-Hr, 24 Vdc Battery and Cabinet Battery Module | |
| **3** = 48/125 Vdc Substation Battery Power | |
| **4** = 120 V, 6 A Max Auxiliary Power** | |
| **5** = 230 V, 6 A Max Auxiliary Power** | |
| **6** = 240 V External Source | |
| **7** = 13.5 Vdc Power Module and 13 A-Hr Battery and Cabinet Battery Module | |
| **8** = 13.5 Vdc Power Module and 48/125 Vdc Substation Battery Power | |
| **9** = 13.5 Vdc Power Module and 120 V Auxiliary Power** | |
| **A** = 13.5 Vdc Power Module and 230 V Auxiliary Power** | |
| **B** = 13.5 Vdc Power Module and 240 V External Voltage | |
| **C** = 13 A-Hr Battery and Cabinet Battery Module and 120 V Auxiliary Power** | |
| **D** = 13 A-Hr Battery and Cabinet Battery Module and 230 V Auxiliary Power** | |
| **E** = 13 A-Hr Battery and Cabinet Battery Module and 240 V External Voltage | |
| **F** = 48/125 Vdc Substation Battery Power Provisions and 120 V Auxiliary Power** | |
| **G** = 48/125 Vdc Substation Battery Power Provisions and 230 V Auxiliary Power** | |
| **H** = 48/125 Vdc Substation Battery Power Provisions and 240 V External Source | |
| **J** = 230 V Customer Voltage and 240 V External Source | |
| **L** = 13.5 Vdc Power Module, 13 A-Hr Battery and Cabinet Battery Module and 120 V Auxiliary Power** | |
| **M** = 13.5 Vdc Power Module, 13 A-Hr Battery and Cabinet Battery Module and 230 V Auxiliary Power** | |
| **N** = 13.5 Vdc Power Module, 13 A-Hr Battery and Cabinet Battery Module and 240 V External Source | |
| **P** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions and 120 V Auxiliary Power** | |
| **Q** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions and 230 V Auxiliary Power** | |
| **R** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions and 240 V External Source | |
| **T** = 13.5 Vdc Power Module, 230 V Auxiliary Power** and 240 V External Source | |
| **U** = 13 A-Hr Battery and Cabinet Battery Module, 230 V Auxiliary Power** and 240 V External Source | |
| **V** = 48/125 Vdc Substation Battery Power Provisions, 230 V Auxiliary Power** and 240 V External Source | |
| **W** = 13.5 Vdc Power Module, 13 A-Hr Battery and Cabinet Battery Module, 230 V Auxiliary Power** and 240 V External Source | |
| **X** = 13.5 Vdc Power Module, 48/125 Vdc Substation Battery Power Provisions, 230 V Auxiliary Power**, and 240 V External Source | |
| **S** = Other Battery/Power Option (Contact Factory) | |
| **Specify Control Box Type/Material Option (Replace "X")** | 577XXXXXXXX**X** |
| **0** = Mild Steel Standard Control Box | |
| **1** = Stainless Steel Standard Control Box | |
| **2** = Mild Steel Long Control Box | |
| **3** = Stainless Steel Long Control Box | |
| **4** = NEMA® 3 Mild Steel Standard Control Box | |
| **5** = NEMA® 3 Stainless Steel Standard Control Box | |
| **6** = NEMA® 3 Mild Steel Long Control Box | |
| **7** = NEMA® 3 Stainless Steel Long Control Box | |
| **9** = Stainless Steel Double Size Control Box | |

* See Auxiliary Power and Battery Options Explanations note for Table 1.

** The 120 V and 240 V Auxiliary Power options require existing windings in the main coil. The control ordering options only provides auxiliary contacts for the existing windings.

*** Refer to the following for communications protocol and communications interface compatibility rules:

- DNP Serial is compatible with Communications Interface options 1-3.
- DNP TCP/IP is compatible with Communications Interface options 4-8.
- IEC 60870-5-101 is compatible with Communications Interface options 1-3.
- IEC 60870-5-104 is compatible with Communications Interface options 4-8.
- Cooper 2179 and MODBUS Serial are compatible with Communications Interface options 1-3.
- MODBUS TCP/IP is compatible with Communications Interface options 4-8.

**Table 2. Base CL-7 Voltage Regulator Control Panel Replacement (CRA), continued**

| Description | Catalog Number |
|---|---|
| **Specify Cable Length/Shielded/Armor Option (Replace "X")** | 577XXXXXXXXX**X** |
| **0** = Standard 54" Control Cable | |
| **1** = 10 ft. (3m) Control Cable | |
| **2** = 20 ft. (6.1m) Control Cable | |
| **3** = 30 ft. (9.1m) Control Cable | |
| **4** = 40 ft. (12.2m) Control Cable | |
| **5** = 50 ft. (15.2m) Control Cable | |
| **6** = 60 ft. (18.3m) Control Cable | |
| **7** = 80 ft. (24.4m) Control Cable | |
| **8** = 100 ft. (30.5m) Control Cable | |
| **9** = 120 ft. (36.6m) Control Cable | |
| **A** = Standard 54" Control Cable Shielded | |
| **B** = 10 ft. (3m) Control Cable Shielded | |
| **C** = 20 ft. (6.1m) Control Cable Shielded | |
| **D** = 30 ft. (9.1m) Control Cable Shielded | |
| **E** = 40 ft. (12.2m) Control Cable Shielded | |
| **F** = 50 ft. (15.2m) Control Cable Shielded | |
| **G** = 60 ft. (18.3m) Control Cable Shielded | |
| **H** = 80 ft. (24.4m) Control Cable Shielded | |
| **J** = 100 ft. (30.5m) Control Cable Shielded | |
| **K** = 120 ft. (36.6m) Control Cable Shielded | |
| **L** = Standard 54" Control Cable with Full Length Armor | |
| **M** = 10 ft. (3m) Control Cable with 8 ft. of Armor at Control End | |
| **P** = 20 ft. (6.1m) Control Cable with 8 ft. of Armor at Control End | |
| **Q** = 30 ft. (9.1m) Control Cable with 8 ft. of Armor at Control End | |
| **R** = 40 ft. (12.2m) Control Cable with 8 ft. of Armor at Control End | |
| **T** = 50 ft. (15.2m) Control Cable with 8 ft. of Armor at Control End | |
| **U** = 60 ft. (18.3m) Control Cable with 8 ft. of Armor at Control End | |
| **V** = 80 ft. (24.4m) Control Cable with 8 ft. of Armor at Control End | |
| **W** = 100 ft. (30.5m) Control Cable with 8 ft. of Armor at Control End | |
| **X** = 120 ft. (36.6m) Control Cable with 8 ft. of Armor at Control End | |
| **N** = None – No Control Cable (Default) | |
| **S** = Special | |
| **Base Feature Code for Standard Aftermarket Control Configuration** | 577XXXXXXXXX**0000** |
| **Specify Tap Changer Capacitor Type* (Replace "X")** | 577XXXXXXXXX0000**X** |
| **3** = 12 µF (60 Hz QD3 Tap Changer) | |
| **4** = 15 µF (50Hz QD3 Tap Changer) | |
| **5** = 50 µF (QD5 & QD8 Tap Changer) | |
| **0** = None - Provisions | |

* Refer to the following rules for selecting the correct tap-changer capacitor:

- 50 Hz Systems
  - Select the 15 µF capacitor for 14.4 kV and below voltage regulators rated 219 A and below.
  - Select the 15 µF capacitor for 15 kV-21 kV voltage regulators rated 150 A and below.
- 60 Hz Systems
  - Select the 12 µF capacitor for 14.4 kV and below voltage regulators rated 219 A and below.
  - Select the 12 µF capacitor for 15 kV-21 kV voltage regulators rated 150 A and below.
- Both 50 Hz and 60 Hz Systems
  - Select the 50 µF capacitor for 14.4 kV and below voltage regulators rated 220 A and above.
  - Select the 50 µF capacitor for 15 kV-21 kV voltage regulators rated 151 A and above.
  - Select the 50 µF capacitor for 22 kV and above voltage regulators.

When ordering a CL-7 Panel Replacement Assembly (PRA), construct the control catalog number using Table 3. Select the appropriate digits of the catalog number based upon control feature requirements. A PRA includes a CL-7 control with accessories, but is not installed in a control box.

**Table 3. Base CL-7 Voltage Regulator Control Panel Replacement Assembly (PRA)**

| Description | Catalog Number |
|---|---|
| **Base Letters For a CL-7 Panel Replacement Assembly (PRA)** | **577P** |
| **Specify Regulator Manufacturer (Replace "X")** | 577P**X** |
| **0** = Panel Only | |
| **1** = CL-6/CL-7 Dead-front Back Panel | |
| **2** = Pre-CL-6 & Universal Live-front Back Panel | |
| **3** = Siemens Corporation®/Allis-Chalmers | |
| **4** = GE® – Fork-type Terminal | |
| **5** = GE® – Pin-type Terminal | |
| **6** = GE® – Universal | |
| **7** = Howard Industries® | |
| **S** = Special | |
| **Specify Communications Interface, Port 1* (Replace "X")** | 577PX**X** |
| **0** = Standard; None | |
| **1** = RS-232 DB9 | |
| **2** = Serial Fiber ST | |
| **3** = RS-485 TB, Isolated | |
| **4** = Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC | |
| **5** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ | |
| **6** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST | |
| **7** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC | |
| **8** = Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 | |
| **P** = Provisions for Future Communications Interface (Communications Base Board Only) | |
| **Specify Communications Protocols, Port 1* (Replace "X")** | 577PXX**0** |
| **0** = DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP | |
| **Specify Communications Interface, Port 2* (Replace "X")** | 577PXXX**X** |
| **0** = Standard; None | |
| **1** = RS-232 DB9 | |
| **2** = Serial Fiber ST | |
| **3** = RS-485 TB, Isolated | |
| **4** = Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC | |
| **5** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ | |
| **6** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST | |
| **7** = Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC | |
| **8** = Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 | |
| **Specify Communications Protocols, Port 2* (Replace "X")** | 577PXXXX**0** |
| **0** = DNP, IEC 60870-5, 2179, MODBUS Serial, and MODBUS TCP/IP | |
| **Specify I/O Option (Replace "X")** | 577PXXXXX**X** |
| **0** = None | |
| **1** = One Set of Universal Contacts, 4 In/4 Out, 10-250 Vac, 10-125 Vdc, Max 12-Gauge Wire | |

**Table 3. Base CL-7 Voltage Regulator Control Panel Replacement Assembly (PRA), continued**

| Description | Catalog Number |
|---|---|
| **Specify Auxiliary Power and Battery Options** (Replace "X")** | 577PXXXXXX**X** |
| **0** = None | |
| **1** = 13.5 Vdc, 14 W Continuous, 20 W Peak Power Module | |
| **6** = 240 V External Source | |
| **B** = 13.5 Vdc Power Module and 240 V External Voltage | |
| **S** = Special | |
| **Base Feature Code for Standard CL-7 Control Configuration** | 577PXXXXXXX**0000000** |

* Refer to the following for communications protocol and communications interface compatibility rules:
- DNP Serial is compatible with Communications Interface options 1-3.
- DNP TCP/IP is compatible with Communications Interface options 4-8.
- IEC 60870-5-101 is compatible with Communications Interface options 1-3.
- IEC 60870-5-104 is compatible with Communications Interface options 4-8.
- Cooper 2179 and MODBUS Serial are compatible with Communications Interface options 1-3.
- MODBUS TCP/IP is compatible with Communications Interface options 4-8.

** See Auxiliary Power and Battery Options Explanations note for Table 1.

Select from the available accessories for CL-7 voltage regulator control.

**Table 4. CL-7 Control Accessories List**

| Description | Part Number |
|---|---|
| **Communications Module Accessories** | |
| RS-232 DB9 (no Base Board) | 57E0003X22G10 |
| RS-232 DB9 with Base Board | 57E0003X22G10B |
| Serial Fiber ST (no Base Board) | 57E0003X24G10 |
| Serial Fiber ST with Base Board | 57E0003X24G10B |
| Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 (no Base Board) | 57E0003X20G10 |
| Ethernet 10BASE-T/100BASE-TX (Copper) RJ45 with Base Board | 57E0003X20G10B |
| Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST (no Base Board) | 57E0003X21G13 |
| Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) ST with Base Board | 57E0003X21G13B |
| RS-485 TB, Isolated (no Base Board) | 57E0003X23G10 |
| RS-485 TB, Isolated w/ Base Board | 57E0003X23G10B |
| Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC (no Base Board) | 57E0003X21G11 |
| Ethernet 100BASE-LX10 Single-Mode (Fiber-Optic) LC with Base Board | 57E0003X21G11B |
| Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ (no Base Board) | 57E0003X21G10 |
| Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) MT-RJ with Base Board | 57E0003X21G10B |
| Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC (no Base Board) | 57E0003X21G12 |
| Ethernet 100BASE-FX Multi-Mode (Fiber-Optic) SC with Base Board | 57E0003X21G12B |
| Communication Module Base Board Only | 57E0001X05G10 |
| **Control Retrofit Kits** | |
| CL-7 Retrofit Mounting kit, Eaton's Cooper Power series Universal Replaces All Pre-CL-7 Controls | 57A64327910H |
| CL-7 Retrofit Mounting kit, Siemens | 57A64327910J |
| CL-7 Retrofit Mounting kit, GE (Fork-type Terminal) | 57A64327910L |
| CL-7 Retrofit Mounting kit, GE (Pin-type Terminal) | 57A64327910M |
| CL-7 Retrofit Mounting kit, Howard | 57A64327910K |
| CL-7 Retrofit Mounting kit, GE Universal | 57A64327910N |
| **Control Cable Interface Assemblies** | |
| Quick Connect Assembly (QCA), Siemens/Allis-Chalmers/Howard (12-conductor Connection) | 575044887B01 |
| Quick Connect Assembly (QCA), GE (fork-type) (12-conductor Connection) | 575044887B02 |
| Quick Connect Assembly (QCA), GE (pin-type) (12-conductor Connection) | 575044887B03 |
| Quick Connect Assembly (QCA), Siemens/Allis-Chalmers/Howard (13-conductor Connection) | 575044887B04 |
| Quick Connect Assembly (QCA), GE (fork) (13-conductor Connection) | 575044887B05 |
| Quick Connect Assembly (QCA), GE (pin) (13-conductor Connection) | 575044887B06 |

**Table 4. CL-7 Control Accessories List, continued**

| Description | Part Number |
|---|---|
| Quick Connect Assembly (QCA), Siemens/Allis-Chalmers/Howard (14-conductor Connection) | 575044887B07 |
| Quick Connect Assembly (QCA), GE (fork) (14-conductor Connection) | 575044887B08 |
| Quick Connect Assembly (QCA), GE (pin) (14-conductor Connection) | 575044887B09 |
| **Battery and Power Accessories** | |
| 13.5 Vdc Power Module | 57E0003X09G10 |
| 13 A-Hr Battery and Cabinet Battery Module | 57E0003X00G124 |
| 13 A-Hr Battery, Cabinet Battery Module and Front Panel Interface Module (Multi-phase) | 57E0003X00G124A |
| 13 A-Hr Battery, Cabinet Battery Module and Front Panel Interface Module (Single-phase) | 57E0003X00G124B |
| 13 A-Hr Battery Front Panel Interface Module Only (Multi-phase) | 57E0003X49G10 |
| 13 A-Hr Battery Front Panel Interface Module Only (Single-phase) | 57E0003X49G10A |
| 48/125 Vdc Substation Battery Power (Single-Phase Back Panel) W/Din Rail | 57A61313400D |
| 48/125 Vdc Substation Battery Power (Multi-Phase Back Panel) W/O Din Rail | 57A61313400E |
| Single 13 A-Hr Battery Charger | 57E0003X00G161 |
| Spare 13 A-Hr Batteries | 57F500134001 |
| **Input/Output Module Accessories** | |
| I/O Option - One Set of Universal Contacts, 4 In/4 Out, 10-250 Vac, 10-125 Vdc (Single-Phase) | 57E0001X03G10 |
| I/O Option - One Set of Universal Contacts, 4 In/4 Out, 10-250 Vac, 10-125 Vdc (Multi-Phase) | 57E0001X03G12 |
| I/O Option - Second Set of Universal Contacts, 8 In/8 Out, 10-250 Vac, 10-125 Vdc (Single- or Multi-Phase) | 57E0001X03G13 |
| **Data Transfer Accessories** | |
| 6 ft. USB Type A to Type B Programming Cable | 57A64311100D |
| 4 Gb Eaton's Cooper Power series USB Jump Drive | 57A64311100J |
| **Voltage Regulator Simulators** | |
| Voltage Regulator MS-3 Simulator | 57A64285900B |
| CL-7 Single-Phase, MS-3 Simulator and Case Demo Kit | 57A64285900C |
| CL-7 Multi-Phase, MS-3 Simulator and Case Demo Kit | 57A64285900D |
| CL-7 Panel and Simulator Demo Case Only (includes just the case) | 57B643079002 |

## Control features

### Control security

The CL-7 voltage regulator control has multiple programmable security codes to limit control programming and viewing function access to authorized personnel. The CL-7 control is capable of supporting strong passwords containing letters (upper and lower case), numbers and symbols. The front panel Human-Machine Interface (HMI) includes a user-selected security code to access the settings. Plus, the ProView NXG interface software has its own security levels for multiple-user access.

### Metering

The CL-7 control comes equipped with a full complement of metering capabilities, which include instantaneous, demand, demand peak, and energy metering. The control is capable of the following metering values and more:

- Present tap position and percent regulation – per-phase and average
- Primary and secondary load and source voltage – per-phase and average
- Compensated voltage – per-phase and average
- Real and reactive power – per-phase and total
- Real and reactive currents – per-phase and average
- Instantaneous frequency
- Forward and reverse energy – per-phase basis and total
- Power factor – per-phase and total
- Total and time-period operations counters
- Current and voltage harmonics per-phase

### Duty cycle monitor (DCM)

DCM calculates the life used for each arcing surface contact on Eaton's Cooper Power series Quik-Drive tap-changers. The control uses metering values such as current, voltage, power factor, and tap position along with detailed data on the internal design of the voltage regulator to calculate the interrupting current and recovery voltage. This information is compared with actual test data for the appropriate Quik-Drive tap-changer to estimate contact wear. DCM works exclusively on voltage regulators equipped with Quik-Drive tap-changer.

### Sequence of events (SOE) recorder

The SOE recorder is capable of capturing discrete events such as raise and lower operations, tap at neutral, mechanism failures and many other options. The SOE places an accurate time stamp and analog information on the events and stores them in non-volatile memory so they won't be lost in the event that the control loses power. The SOE recorder is capable of maintaining up to 1000 events and can record up to 46 different event types.

### Data profiler

A fully configurable data profiler is available which allows the user to collect information by sampling data at selectable intervals. These time-stamped values can then be viewed to determine weekly load profiles, daily harmonic disturbances, or hourly voltage fluctuations. The number of days of information the data profiler can provide depends upon configuration parameters. A Trend Time displays the days, hours and minutes of data that will be collected before the oldest data is overwritten.

### Leader/follower feature

The CL-7 voltage regulator control can be operated as a member of an assigned operating group of up to three connected voltage regulators. When single-phase regulator controls are used, the Leader/Follower operation is dependent on a physical communications connection using the LoopShare Communications protocol between all members of the operating group. Enhanced Leader/Follower modes enable two types of group coordination. Leader/Follower modes include:

- **Lead-Phase** – A connected regulators remain on the same tap position as the lead regulator;
- **Voltage Averaging** – The average load voltage is determined and used as the basis for regulation.
- **Max Deviation** – Regulators operate independently within a set number of steps.

### Multi-phase operation

The CL-7 control with the optional multi-phase module is capable of operating up to three voltage regulators with the use of a single control. The voltage regulators can be set to operate independently or to utilize one of the Leader/Follower operating modes detailed above. A single control utilized in this configuration has several advantages over three individual controls:

- Lower initial costs
- Less inventory
- Single access point communications
- Three-phase metering
- Simplified Leader/Follower (no communications required)
- Fewer controls to program and maintain

### Battery backup

The CL-7 voltage regulator control has two available battery backup options. A battery backup allows the control to remained powered during an outage and to maintain communication links.

**Option 1** – An onboard 13 A/hour, 24 Vdc battery located in an auxiliary box attached to the main control box. A battery charger module is included with the regulator control.

**Option 2** – Power the control with a 48 to 125 Vdc substation battery. For this option, auxiliary contacts are provided to connect the power source.

### Auxiliary power options

The CL-7 control is able to provide auxiliary power for communications and other equipment. A 13.5 Vdc (Max output: 1.48 A, 1 second; Max Power: 14 W continuous, 20 W peak) option is available to meet the dc power requirements of most currently available communications equipment. If ac power is needed, a 120 Vac, 25 VA maximum load can be supplied using the PT winding of the regulator. If more power is required, optional auxiliary windings are can be added to provide 120 or 240 Vac (6 amp maximum) power.

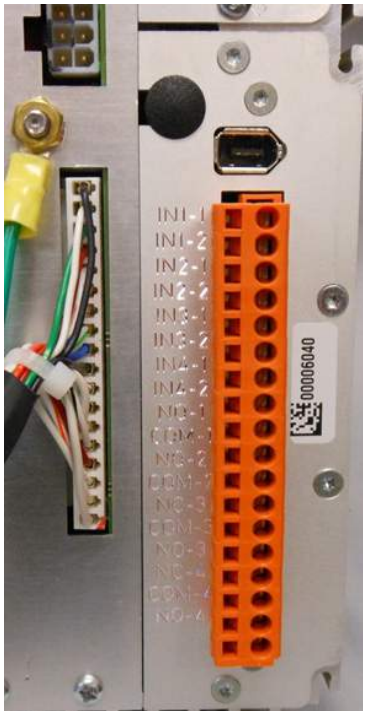


**Figure 1. Contact I/O module**

### Contact input/output (I/O) module option

The CL-7 control is designed with three General Purpose Input contacts. The optional I/O module is available to provide additional input and output contacts. The Contact I/O Module option (Figure 1) permits connection of contact-type input devices (switches, relays) and discrete indicating devices (relays, LEDs, lamps) to the CL-7 control to effect local discrete input/output. The I/O module accessory is used for supplementing normal local controls and status indicators for Contact I/O functions.

The initial Contact I/O Module option contains four factory-set inputs and four outputs for Contact I/O functions. Each CL-7 control can accommodate two Contact I/O modules. Additional modules require user programming via the software.

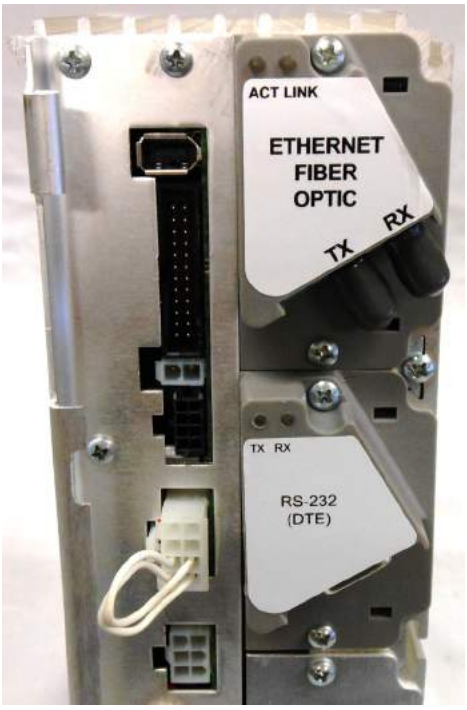



**Figure 2. Side-panel communication ports**

### Communications

The CL-7 voltage regulator control is designed with communications in mind. It is equipped with two communication-board accessory expansion slots offering versatile support for communication connections.

Five distinct communication options are available, providing two-way, real time digital communications with a remote terminal unit (RTU), wireless, telephone modem, Ethernet network, or other communication devices. Any combination of two communication boards can be installed.

The following options are available (see Figure 3):

- RS-232 (isolated) Serial communication card
- RS-485 (isolated) Serial communication card
- Fiber-optic-based Serial communication card with ST Connectors
- 10BASE-T/100BASE-TX Ethernet communication card with RJ-45 connector
- 100BASE-FX Ethernet communication card with three connector options (ST, MT-RJ, and SC) supporting multi-mode fiber Ethernet
- 100BASE-LX10 Ethernet communication card with LC connector supporting single-mode fiber Ethernet

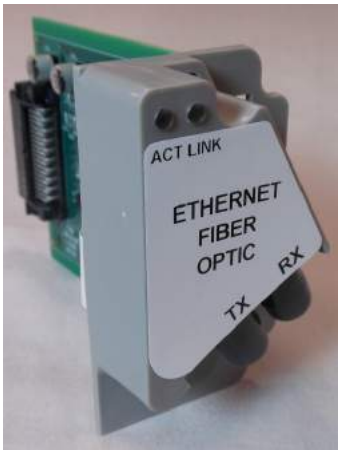
The expansion slot-based Communication Board Accessory concept offers high versatility with respect to communication medium and protocol support. Contact your Eaton representative for the latest information regarding particular media and communication protocol support.


Serial RS-232
57E0003X22G10

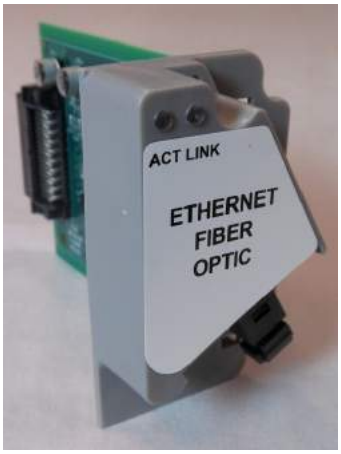

Serial RS-485
57E0003X23G10

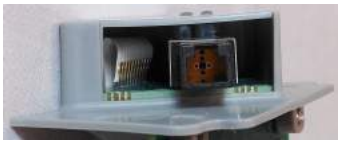

Serial FO
57E0003X24G10


Ethernet RJ-45
57E0003X20G10

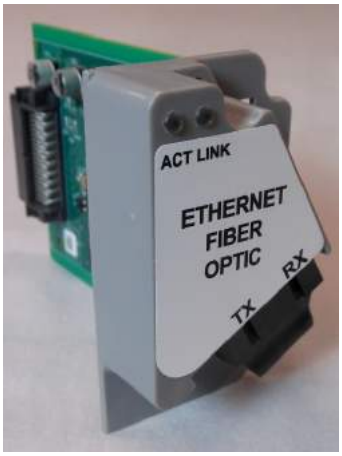



Ethernet FO ST
57E0003X21G13

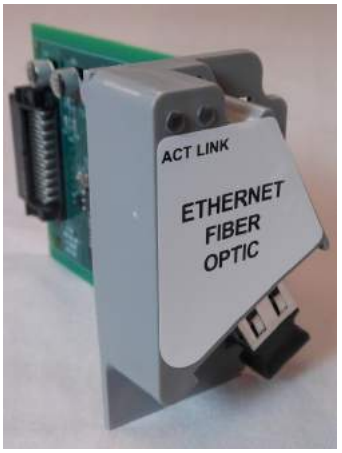


Ethernet FO MT-RJ
57E0003X21G10




Ethernet FO SC
57E0003X21G12




Ethernet FO LC
57E0003X21G11

**Figure 3. The eight available communications modules for the CL-7 control**

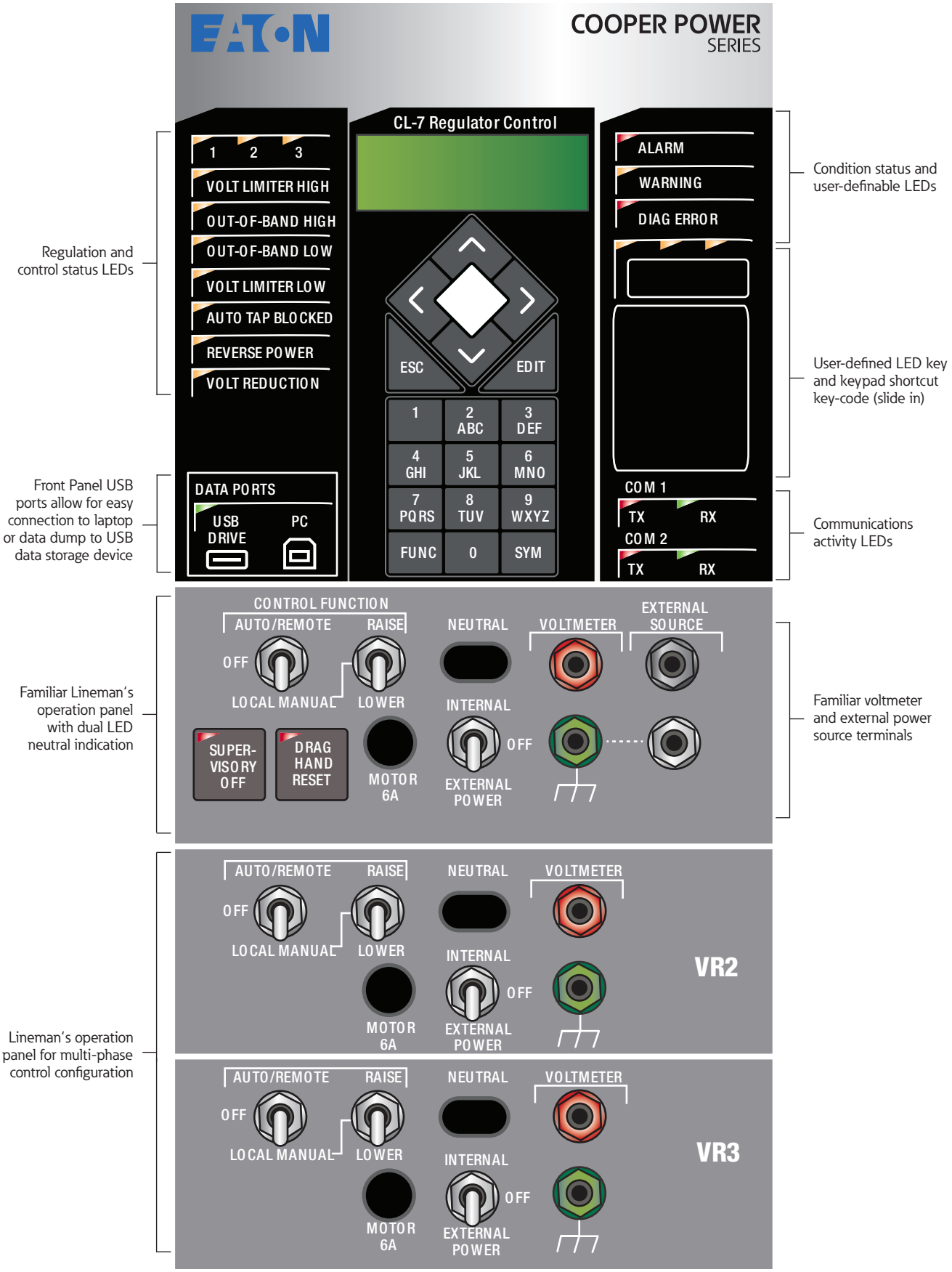



**Figure 4. Front panel features**

### Front panel Human-Machine Interface (HMI)

The CL-7 voltage regulator control employs an intuitive HMI (Figure 5) that is designed to simplify control interface and minimize training costs.

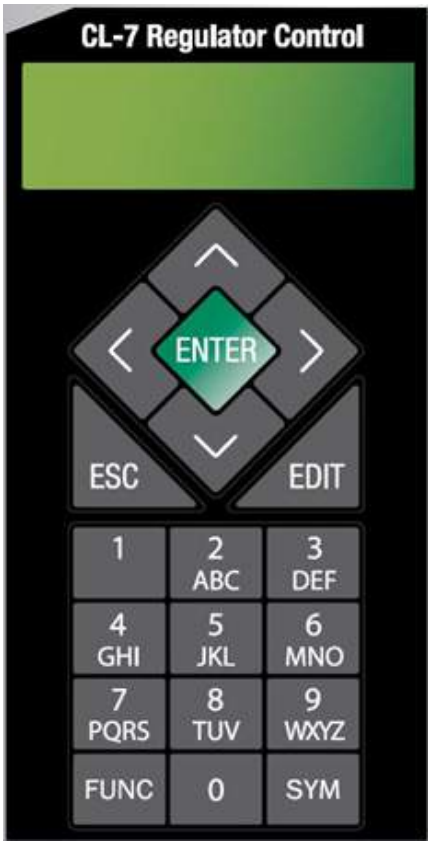



**Figure 5. Front panel HMI**

### Keypad – user configurable

The keypad is configurable to enable one-touch Hot Key access to the most commonly accessed menu features, MeteringPLUS™ screens and settings. Slide in tabs display the Hot Key setup.

### Display LCD module

- Four lines of 20 characters with backlighting
- LCD display panel contrast is field-adjustable to allow for various mounting heights and applications.
- Designed with a 'cell phone' look and feel operation
- Automatic backlight shut off after 15 minutes of inactivity

### User interface and LED indicators

The status indicator LEDs (Figure 6) provide instant notification on the control and voltage regulation status.

- **1, 2, 3** – Indicates which voltage regulator in a multi-phase configuration has data displayed on the LCD
- **VOLTAGE LIMITER HIGH/LOW** – Indicates when load voltage is near or has reached the limit setting
- **OUT OF BAND HIGH/LOW** – Indicates an out-of-band condition
- **AUTO TAP BLOCKED** – Indicates that automatic voltage regulation has been blocked
- **REVERSE POWER** – Reverse power indication
- **VOLT REDUCTION** – Indicates voltage reduction is in effect
- **ALARM** – Configurable to flash an alarm condition
- **WARNING** – Configurable to flash a warning condition
- **DIAG ERROR** – Indicates a self-test diagnostic error condition
- **USER-DEFINED** – Configurable to meet customer requirements
- **COM 1/2**- Indicates communications activity

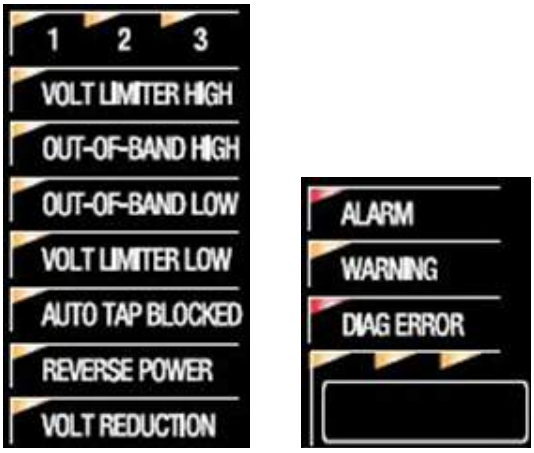



**Figure 6. Status-indicator LEDs**

### Data ports

The DATA PORTS section (Figure 7) on the front operating panel allows for direct connection to a personal computer or USB memory drive.

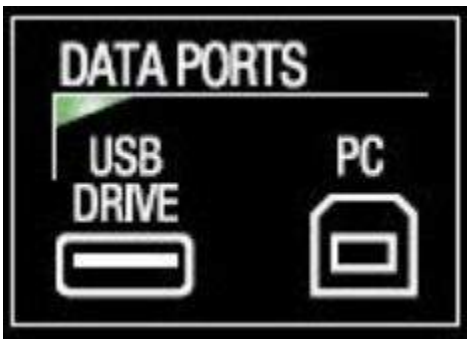



**Figure 7. DATA PORTS on front operating panel**

## Operating panel

The lower portion of the control (Figure 8) features the familiar operating panel layout.

- **CONTROL FUNCTION** – Select regulator operation: AUTO/REMOTE, OFF and LOCAL MANUAL
- **SUPERVISORY OFF** – Restrict SCADA control
- **DRAG-HAND RESET**
- **NEUTRAL** – Dual LED neutral indication
- **MOTOR 6A** – Motor fuse, 6 amp, 125 volt
- **POWER** – INTERNAL, OFF, EXTERNAL
- **VOLTMETER** – Measure control input voltage
- **EXTERNAL SOURCE** – Run control and tap changer for setup and testing

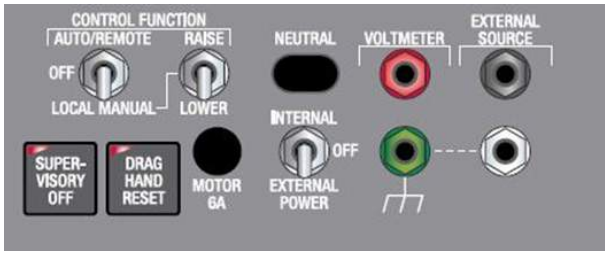



**Figure 8. Operating panel**

**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. CA225003EN



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