

E3 and E3 Plus Electronic Overload Relays

Catalog Number Explanation/Product Selection

Catalog Number Explanation

193 – EC1 B B
 a b c

a

Type	
Code	Description
EC1	E3
EC2	E3 Plus with internal ground fault sensor
EC3	E3 Plus with external ground fault sensor
EC4	E3 Plus current monitor relay with external ground fault sensor
EC5➤	E3 Plus with voltage monitoring

b

Adjustment Rating [A]	
Code	Description
P	0.4...2.0
A	1...5
B	3...15
C	5...25
D	9...45
E	18...90
F	28...140
G	42...210
H	60...302
J	84...420
K	125...630
L	172...860
Z	9...5000

c

Bulletin 100 Contactor Size	
Code	Description
B	C09...C23
D	C30...C43
E	C60...C85
F	D95...D180
G	D210...D420
H	D630...D860
Z	Panel mount*

* Only available for Cat. Nos. 193-EC1ZZ, 193-EC3ZZ, and 193-EC4ZZ. For all other cat. nos., order Cat. No. 193-ECPM_ separately.

➤ Voltage input module and ribbon cable are included with Cat. No. 193-EC5.

Product Selection

Direct Contactor Mount

Bulletin 193-EC1 Electronic Motor Protection Relays

- 2 inputs
- 1 output

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09...100-C23	0.4...2	193-EC1PB
	1...5	193-EC1AB
	3...15	193-EC1BB
	5...25	193-EC1CB
100-C30...100-C43	1...5	193-EC1AD
	3...15	193-EC1BD
	5...25	193-EC1CD
	9...45	193-EC1DD
100-C60...100-C97	9...45	193-EC1DE
	18...90	193-EC1EE
100-D105...100-D180	28...140	* 193-EC1FF
	42...210	* 193-EC1GF
100-D210...100-D420	42...210	* 193-EC1GG
	60...302	* 193-EC1HG
	84...420	* 193-EC1JG
100-D630...100-D860	125...630	* 193-EC1KH
	172...860	* 193-EC1LH

* Does not include terminal lugs. See Accessories, page 2-228.

Bulletin 193-EC2 Electronic Motor Protection Relay

- 4 Inputs
- 2 Outputs
- PTC thermistor input
- DeviceLogix (series B and higher)
- Internal ground fault sensor

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09...100-C23	0.4...2	193-EC2PB
	1...5	193-EC2AB
	3...15	193-EC2BB
	5...25	193-EC2CB
100-C30...100-C43	1...5	193-EC2AD
	3...15	193-EC2BD
	5...25	193-EC2CD
	9...45	193-EC2DD
100-C60...100-C85	9...45	193-EC2DE
	18...90	193-EC2EE

Bulletin 193-EC3 Electronic Motor Protection Relay

- 4 inputs
- 2 outputs
- PTC thermistor input
- DeviceLogix (series B)
- External ground fault sensor input

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09...100-C23	0.4...2.0	193-EC3PB
	1...5	193-EC3AB
	3...15	193-EC3BB
	5...25	193-EC3CB
100-C30...100-C43	1...5	193-EC3AD
	3...15	193-EC3BD
	5...25	193-EC3CD
	9...45	193-EC3DD
100-C60...100-C97	9...45	193-EC3DE
	18...90	193-EC3EE
100-D105...100-D180	28...140	* 193-EC3FF
	42...210	* 193-EC3GF
100-D210...100-D420	42...210	* 193-EC3GG
	60...302	* 193-EC3HG
	84...420	* 193-EC3JG
100-D630...100-D860	125...630	* 193-EC3KH
	172...860	* 193-EC3LH

* Does not include terminal lugs. See Accessories, page 2-228.

E3 and E3 Plus Electronic Overload Relays

Overview/Product Selection

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**Bul. 193/592-EC1 Overload Relays:**

- 0.4...5000 A current range
- DeviceNet™ ready (ODVA Conformance Tested)
- LED indicators
- Test/Reset button
- Adjustable trip class 5...30
- Ambient temperature compensation
- True RMS current sensing (20...250 Hz)
- Protection for single- and three-phase motors
- Integrated I/O (2 In/1 Out)
- Programmable trip and warning settings
- Diagnostic functions (history of last five trips and warnings)
- Node address switches (series B)

Bul. 193/592-EC2/EC3 Overload Relays:

- Features of Bul. 193/592-EC1
- Integrated I/O (4 In/2 Out)
- EC2: Low-level (1...5 A) internal ground fault protection
- EC3: High-level (20 mA...5 A) external ground fault protection
- PTC thermistor monitoring
- DeviceLogix™ component technology (series B)
- Two-speed motor protection (series B)

Bul. 193-EC4 Current Monitor Relay:

- Current monitoring for three independent channels

Bul. 193/592-EC5 Overload Relays with Voltage Monitoring:

- Features of Bul. 193/592-EC3
- Integrated I/O (6 In/2 Out)
- High-level (20 mA...5 A) external ground fault protection
- DeviceLogix™ component technology
- Two-speed motor protection
- Voltage protection, including:
 - Undervoltage
 - Overvoltage
 - Phase failure
 - Voltage unbalance
 - Phase rotation mismatch
 - Frequency
- Power protection and energy metering, including:
 - Real power (kW)
 - Reactive power (kVAR)
 - Apparent power (kVA)
 - Power factor (PF)
 - Real energy (kWh)
 - Reactive energy (kVARh)
 - Apparent energy (kVAh)
 - kW demand

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Standards Compliance

EN 60947-4-1
 CSA C22.2 No. 14
 UL 508, UL1053 (class 1)

Certifications

ABS
 CE
 cULus Listed (File No. E14840,
 Guide NKCR, NKCR7; File No.
 E53935, Guide KDAX)
 C-tick
 CCC

NOTE: Your order must include 1) the Cat. No. of overload relay selected, and 2) if required, Cat. No. of any accessories.

Product Overview

The E3 Overload Relay is available in two configurations: the E3 and E3 Plus. The following table illustrates the functional differences between the two configurations.

Feature	E3	EC Plus			
	193/592-EC1	193/592-EC2	193/592-EC3	193-EC4	193/592-EC5
Inputs*	2	4	4	4	6
Outputs	1	2	2	2	2
PTC Thermistor Input		✓	✓		
Ground Fault Protection		Internal 1...5 A	External 20 mA... 5 A†	External 20 mA... 5 A†	External 20 mA... 5 A†
DeviceLogix		✓	✓	✓	✓
Heat Trace				✓	
Voltage Monitoring					✓

* Inputs are rated 24V DC.

† Requires the use of an external ground fault sensor, Cat. No. 193-CBCT_.

Thermal Overload**Thermal Utilization**

The E3 Overload Relay provides overload protection through true RMS current measurement of the individual phase currents of the connected motor. Based on this information, a thermal model that simulates the actual heating of the motor is calculated. Percent of thermal capacity utilization (%TCU) reports this calculated value and can be read via the DeviceNet network. An overload trip occurs when the value reaches 100%.

Adjustable Settings

Thermal overload protection setup is accomplished simply by programming the motor's full load current (FLC) rating and the desired trip class (5...30). Programming of the actual values through software programming ensures the accuracy of the protection.

Thermal Memory

The E3 Overload Relay includes a thermal memory circuit designed to approximate the thermal decay for a trip class 30 setting. This means that the thermal model of the connected motor is maintained at all times, even if the supply power is removed.

Time to Trip

During an overload condition, the E3 Overload Relay provides an estimated time to trip that is accessible via the DeviceNet network. This allows corrective action to be taken so that production may continue uninterrupted.

Time to Reset

Following an overload trip, the E3 Overload Relay will not reset until the calculated percentage of thermal capacity utilization falls below the reset level. As this value decays, the time to reset, which is accessible via the DeviceNet network, is reported.

Thermal Warning

The E3 Overload Relay provides the capability to alert in the event of an impending overload trip. A thermal warning bit is set in the Warning Status when the calculated percentage of thermal capacity utilization exceeds the programmed thermal warning level, which has a setting range of 0...100% TCU.

Two-Speed Protection

The E3 Plus Overload Relay offers a second FLA setting for 2-speed motor protection. What used to require two separate overload relays - one for each set of motor windings - can now be accomplished with one device. Improved protection is delivered as thermal utilization is maintained in one device during operation in both speeds.

Phase Loss

The E3 Overload Relay offers configurable phase loss protection in allowing the installer to enable or disable the function plus set a time delay setting, adjustable from 0.1...25.0 seconds. The trip level is factory-set at a current imbalance measurement of 100%.

Ground (Earth) Fault

The E3 Plus Overload Relay incorporates zero sequence (core balance) sensing into its design through the 90 A rating for low level (arcing) ground fault detection. Trip and warning settings are adjustable from 20 mA...5.0 A. For devices rated greater than 90 A and for ground fault detection less than 1.0 A, the external core balance current transformer accessory is required. Class I protection is provided as defined by UL1053. Series B or later devices provide a trip-inhibit setting, offering flexibility to prevent tripping when the ground fault current magnitude exceeds 10 A. This can be useful to guard against the opening of the controller when the fault current could potentially exceed the controller's interrupting capacity rating.

Note: The E3 Plus Overload Relay is **not** a Ground Fault Circuit Interrupter for personnel protection as defined in article 100 of the U.S. National Electric Code.

Stall

Stall is defined as a condition where the motor is not able to reach full-speed operation in the appropriate amount of time required by the application. This can result in motor overheating as current draw is in excess of the motor's full load current rating.

The E3 Overload Relay provides user-adjustable stall protection. The trip setting has a range of 100...600% FLA, and the enable time is adjustable up to 250 seconds.

Jam (Overcurrent)

The E3 Overload Relay can respond quickly to take a motor off-line in the event of a mechanical jam, thereby reducing the potential for damage to the motor and the power transmission components. Trip adjustments include a trip setting adjustable from 50...600% FLA and a trip delay time with a range of 0.1...25.0 seconds. A separate warning setting is adjustable from 50...600% FLA.

Underload (Undercurrent)

A sudden drop in motor current can signal conditions such as

- Pump cavitation
- Tool breakage
- Belt breakage

For these instances, rapid fault detection can help minimize damage and aid in reducing production downtime.

Additionally, monitoring for an underload event can provide enhanced protection for motors that are coded by the medium handled (e.g., submersible pumps that pump water). Such motors can become overheated despite being underloaded. This can result from an absence or an insufficient amount of the medium (due to clogged filters, closed valves, etc.).

The E3 Overload Relay offers underload trip and warning settings adjustable from 10...100% FLA. The trip function also includes a trip delay time with a range of 0.1...25.0 seconds.

Over-temperature Protection

The E3 Plus Overload Relay provides motor over-temperature protection with the added provisions for terminating and monitoring of stator windings embedded positive temperature coefficient (PTC) thermistors. PTC thermistors are semiconductors that exhibit a large increase in resistance when the rated response temperature is exceeded. When the monitored PTC thermistor resistance exceeds the response level of the E3 Plus Overload Relay (3400 Ω), it can be set to trip immediately or programmed to set the PTC bit of the Warning Status word.

Current Imbalance (Asymmetry)

The E3 Plus Overload Relay offers current imbalance trip and warning settings adjustable from 10...100%. The trip function also includes a trip delay time with a range of 0.1...25.0 seconds.

Remote Trip

The remote trip function allows an external device such as a vibration sensor to induce the E3 Overload Relay to trip. External device relay contacts are wired to the E3 Overload Relay discrete inputs. The discrete inputs are configurable with an option for assigning the remote trip function.

Current Monitoring Functions

The E3 Overload Relay allows the user to monitor the following operational data over the DeviceNet network:

- Individual phase currents (in amperes)
- Individual phase currents (as a percentage of motor full load current)
- Average current (in amperes)
- Average current (as a percentage of motor full load current)
- Percentage of thermal capacity utilized
- Current imbalance percentage
- Ground fault current (E3 Plus)

Diagnostic Functions

The E3 Overload Relay allows the user to monitor the following diagnostic information over the DeviceNet network:

- Device status
- Trip status
- Warning status
- Time to an overload trip
- Time to reset after an overload trip
- History of past five trips
- History of positive warnings
- Hours of operation
- Number of starts
- Trip snapshot

Status Indicators

The E3 Overload Relay provides the following LED indicators:

- **Network Status** — This green/red LED indicates the status of the network connection.
- **TRIP/WARN** — This LED flashes an amber code under a warning condition and a red code when tripped.
- **OUT A & B** — These amber LEDs illuminate when the output contacts are commanded closed.
- **IN 1 - 4** — These amber LEDs illuminate when the user-connected device contact is closed.:
Note: IN3 and 4 and OUT B are available only on the E3 Plus Overload Relay.

Inputs/Outputs

Inputs allow the connection of such devices as contactor and disconnect auxiliary contacts, pilot devices, limit switches, and float switches. Input status can be monitored via the network and mapped to a controller's input image table. Inputs are rated 24V DC and are current sinking. Power for the inputs is sourced from the DeviceNet network connection with convenient customer terminations at control terminals 5 and 6. Relay contact outputs can be controlled via the network or DeviceLogix function blocks for performing such tasks as contactor operation.



E3 and E3 Plus Electronic Overload Relays

Product Overview

Test/Reset Button

The Test/Reset button, located on the front of the E3 Overload Relay, allows the user to perform the following:

- **Test** — The trip relay contact will open if the E3 Overload Relay is in an untripped condition and the Test/Reset button is pressed for 2 seconds or longer.
- **Reset** — The trip relay contact will close if the E3 Overload Relay is in a tripped condition, supply voltage is present, and the Test/Reset button is pressed.

Single/Three-Phase Operation

The E3 Overload Relay can be applied to three-phase as well as single-phase applications. A programming parameter is provided for selection between single- and three-phase operation. Straight-through wiring is afforded in both cases.

DeviceNet Communications

The E3 Overload Relay is a Group 2 “slave only” device and supports the following:

- Unconnected Message Manager (UCMM) messages
- Polled I/O messaging
- Change-of-state/cyclic messaging
- Explicit messaging
- Group 4 — Off-line node recovery messaging
- Full parameter object support
- Auto-baud network rate identification
- Configuration consistency value

For more information on operation and maintenance of this product, please reference the user manual, publication 193-UM002*.

DeviceLogix

The E3 Plus offers increased control flexibility with DeviceLogix capabilities. Using RSNetWorx for DeviceNet (version 3.0 or later), function block programs can be configured and saved to an E3 Plus Overload Relay to operate single logic routines. The function blocks are programmed using standard Boolean operators (e.g., AND, OR, XOR, and NOT) and plus timers, counters, and latches. In addition to allowing the use of the integral discrete inputs, protection functions can also be used as inputs to trigger outputs. For example, the Ground Fault Protection function could be used to control Output A of the E3 Plus Overload Relay for operation of a circuit breaker short-trip mechanism.

AC Input Interface Module Accessory

The AC Input Interface Module conveniently allows the E3 Overload Relay to be retrofitted or applied in new applications that require 110/120V AC control circuitry. This new accessory simply plugs into the E3 Overload Relay's existing input terminals, optimizing panel space utilization. The module accepts termination of up to four external devices, making it compatible with the E3 and E3 Plus versions of the E3 overload relay. Optical isolation is provided between the AC input wiring and the internal 24V circuitry of the E3.

Voltage Protection (model EC5 only)

The E3 Plus model EC5 will provide the user with enhanced current-based motor protection just like the E3 Plus model, EC3, with the addition of voltage protection. With this product, users can protect against voltage issues e.g., undervoltage, voltage unbalance, phase loss, frequency, and phase rotation) before the contactor coil is energized.

Power Protection (model EC5 only)

While the motor is powering a load, the E3 Plus model, EC5, will also protect the motor based on power. This product will monitor and protect for excessive real power (kW), reactive power (kVAR), apparent power (kVA), and power factor for a specific application (e.g., pump applications).

Motor Energy Consumption (model EC5 only)

The E3 Plus model, EC5, can be included in a company's energy management system. This product will provide voltage, current, power (kW, kVAR, and kVA), energy (kWh, kVARh, kVAh, kW Demand, kVAR Demand, and kVA Demand), and power quality (power factor, frequency, and phase rotation) information down at the motor level.

DeviceNet™ Configuration Terminal (for use with E1 Plus overload relays, E3 and E3 Plus overload relays, ArmorStart® distributed motor controllers, and Bulletin 825-P modular protection systems)

The DeviceNet Configuration Terminal (**Cat. No. 193-DNCT**) is a handheld device that can be used to commission, configure, program, and monitor devices on your DeviceNet network. The 193-DNCT allows you to increase productivity and ease troubleshooting with easy access to information and diagnostics of your system. The 193-DNCT can be used with any DeviceNet devices and has DeviceLogix, metering, graphing, and auto-display capabilities. These capabilities can help ease troubleshooting by commissioning devices online through your network.

Network Who

- Terminal searches for all devices on the network and provides device address, device name, and status of a device.

CopyCat™

- Used to upload, store, and download device configurations and DeviceLogix™ programs for DeviceNet devices via your network
- User can easily replace and reconfigure scan lists of DeviceNet scanners (minus the Automatic Device Replacement configuration)
- Parameters can be accessed as either groups or as a numbered list of all parameters, and can be monitored and edited

Diagnostics

- Simplifies troubleshooting
- Can present DeviceNet diagnostics, network utilization, and make network statistics available to include baud rate, bus voltage, percentage of bus loading, and CAN errors

DeviceLogix

- Terminal allows the user to enable, monitor, edit, or delete DeviceLogix programs.

Parameter Monitoring and Editing

- If the selected device supports the full parameter object, parameters can be accessed as either groups or as a numbered list of all parameters
- Parameter screen displays all information for a single parameter
- Values can be monitored, edited, or copied from the parameter screen

EtherNet/IP Communication Auxiliary

(for use with E3 and E3 Plus overload relays and Bulletin 825-P modular protection systems)

The EtherNet/IP Communications Auxiliary (**Cat. Nos. 193-DNENCAT and -DNCATR**) allows users of DeviceNet-based intelligent electronic overload relays to seamlessly communicate on an EtherNet/IP network without the need for using RSNetWorx for DeviceNet for network configuration. The communication auxiliary acts as a linking device to pass through EtherNet-based CIP explicit and I/O messages to the DeviceNet-based devices. Upon a configuration request, the communication auxiliary polls the DeviceNet network for the first 6 devices. For devices that support the full parameter object, parameters will be made available through an internal Web page for the user to view real-time information and configure each device when the user has the appropriate security privileges.

- Users will be able to view and configure parameters using a text file via the internal web page
- Allows users to read information into the programmable logic or automation controller
- Allows users to use RSLinx Classic or RSLinx Enterprise to serve device Parameters via Microsoft OPC (OLE, Object Linked Element, for Process Control) to SCADA systems and/or historical data collection systems such as FactoryTalk View, FactoryTalk Historian, and RSEnergyMetrix
- Option to allow users to connect to a DLR (Device Level Ring) network topology
 - allows the network to choose another physical communication path in the event that the physical link between two EtherNet devices is broken.
- ADR (Automatic Device Replacement) capabilities
 - the ADR recognizes when one of the six DeviceNet-based devices has been replaced with a new device, and it will automatically download the previous configuration parameters and node address to the new replacement device

Bulletin 193-EC5 Voltage Monitor Relay*



- 6 inputs
- Voltage monitoring capabilities
- External ground fault sensor input
- 2 outputs
- DeviceLogix

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09...100-C23	0.4...2.0	193-EC5PB
	1...5	193-EC5AB
	3...15	193-EC5BB
	5...25	193-EC5CB
100-C30...100-C43	5...25	193-EC5CD
	9...45	193-EC5DD
100-C60...100-C85	9...45	193-EC5DE
	18...90	193-EC5EE
100-D95...100-D180	28...140	193-EC5FF
	42...210	193-EC5GF
100-D210...100-D420	42...210	193-EC5GG
	60...302	193-EC5HG
100-D630...100-D860	84...420	193-EC5JG
	125...630	193-EC5KH
	172...860	193-EC5LH

* Does not include terminal lugs. See Accessories, page 2-228.

Panel Mount Devices

Panel Mount Devices for use with External Current Transformers§

Description	Adjustment Range [A]	Cat. No.
• 2 Inputs • 1 Output	9...5000	193-EC1ZZ
• 4 Inputs • 2 Outputs • Ground Fault Sensor Input • PTC Thermistor Input • DeviceLogix	9...5000	193-EC3ZZ
• 4 Inputs • 2 Outputs • Ground Fault Sensor Input • DeviceLogix		193-EC4ZZ
• 6 Inputs • 2 Outputs • Ground Fault Sensor Input • Voltage Monitor Input • DeviceLogix	9...5000	193-EC5ZZ

§ Current transformers supplied by customer. Refer to Bulletin 1411 Current Transformers and the CT Ratio to FLA chart below for proper current transformer selection.

Bulletin 193-EC4 Current Monitor Relay*

- 4 inputs
- External ground fault sensor input
- 2 outputs
- DeviceLogix

Mounts to Contactor	Adjustment Range [A]	Cat. No.
100-C09...100-C23	0.4...2.0	193-EC4PB
	1...5	193-EC4AB
	3...15	193-EC4BB
	5...25	193-EC4CB
100-C30...100-C43	9...45	193-EC4DD
100-C60...100-C97	18...90	193-EC4EE

* Does not include terminal lugs. See Accessories, page 2-228.

CT Ratio to FLA Setting Range Correlation

CT Ratio	FLA Setting Range (A)	CT Ratio	FLA Setting Range (A)	CT Ratio	FLA Setting Range (A)
50:5	9...45	300:5	60...302	1200:5	240...1215
100:5	18...90	500:5	84...420	2500:5	450...2250
150:5	28...140	600:5	125...630	5000:5	1000...5000
200:5	42...210	800:5	172...860	—	—