

E-1000 SERIES

FOUR CHANNEL RACK MOUNT DETECTOR



Engineering Excellence!



- Back-lit LCD screen displays complete detector status and function settings:
 - Eliminates guess work and provides critical information necessary for proper detector setup.
 - Provides accurate, direct visual feedback of channel frequency and sensitivity settings.
 - Allows easy access to built-in detector diagnostic features.
- Audible detect signal (buzzer) facilitates loop and / or detector troubleshooting.
- Upgrades or addition of user specific options are easily accomplished by changing the socket mounted processor.
- Push button programming ensures long term reliability by eliminating switch contacts.
- All programmed detector parameters are stored in non-volatile memory.
- Directional logic capability.
- Model E/2 available with single width (1.12" wide) faceplate.

Overview:

The Model E-1000 series consists of detectors designed to meet or exceed NEMA Standards TS 2-1992 for Type D detectors. These units are downward compatible to NEMA Standards TS 1-1989. In addition, the Model E-1000 series includes a version that is designed for use in Type 332 / 170 applications. The E-1000 detector is a four channel, card rack type loop detector with individual channel detect and loop fail indications provided via four high intensity red LEDs and an easy to read LCD screen. All detector settings and parameters are configured using a set of four pushbuttons and the LCD screen. The E-1000 offers advanced features providing built-in diagnostic capabilities all of which are viewable by means of the LCD screen. These include 1.) real-time loop frequency, 2.) loop inductance, and $-\Delta L/L\%$, 3.) a bargraph indication of relative inductance change (which ensures proper selection of sensitivity level), 4.) a record of accumulated loop failures, and 5.) a timer countdown of programmed timing functions.

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E-1000 SERIES SPECIFICATION

This is a basic performance specification and is not intended to be used as operating instructions.

GENERAL CHARACTERISTICS:

Loop Frequency: The LCD screen displays the actual loop operating frequency for each channel which makes it easy to quickly identify and eliminate crosstalk in the most difficult to configure intersections. There are eight (8) selectable loop frequency settings per channel (normally in the range of 20 to 100 kilohertz). The actual loop operating frequency is a function of the loop / lead-in network and the components of the loop oscillator circuit.

Sensitivity: A unique bar graph displayed on the LCD makes it easy to quickly set sensitivity at the ideal level for any loop / lead-in network situation. There are nine (9) selectable sensitivity levels per channel, plus settings for Continuous-Call and Channel-Off. See "SENSITIVITY, $-\Delta L/L$, & RESPONSE TIME" table.

Continuous-Call: When set to the Continuous-Call state, the channel output is continuously in the Call state regardless of the presence or absence of vehicles over the loop. The loop oscillator is disabled when in the Continuous-Call state. This state is indicated by "CALL" flashing on the LCD. This option is selected from the Sensitivity menu in Program Mode and is useful for checking controller response and other troubleshooting activities.

Channel-Off: When set to the Channel-Off state, the channel output is continuously in the No-Call state regardless of the presence or absence of vehicles over the loop. The loop oscillator is disabled when in the Channel-Off state. This state is indicated by "OFF" flashing on the LCD. This option is selected from the Sensitivity menu in Program Mode and is useful for checking controller response and other troubleshooting activities.

Call Delay: Each channel's Call Delay is adjustable from 0 to 255 seconds in 1-second steps. Call Delay time begins when a vehicle enters the loop detection zone. The remaining Call Delay time is continuously displayed on the LCD. Whenever a Phase Green Input (call delay override) signal (pin 1, 2, 3, or 10) is active (low state), the Call Delay function for that channel is aborted and the Call Delay time is forced to zero.

Call Extension: Each channel's Call Extension is adjustable from 0 to 25.5 seconds in 0.1-second steps. Extension time begins when the last vehicle clears the loop detection zone. The remaining Extension time is continuously displayed on the LCD. Any vehicle entering the loop detection zone during the Extension time returns the channel to the Detect state, and later, when the last vehicle clears the loop detection zone, the full Extension time starts counting down again. NOTE: See Option 3, Call Extension Control for an alternate mode of operation for Call Extension.

Presence / Pulse: One of two mutually exclusive modes of operation for each channel can be selected in Program Mode:

Presence Mode: Provides a minimum Call hold time of at least 4 minutes (regardless of vehicle size) and typically 1 to 3 hours for an automobile or truck.

Pulse Mode: A single output Pulse of 125 \pm 10 milliseconds duration is generated for each vehicle entering the loop detection zone. Each detected vehicle is instantly tuned out if it remains in the loop detection zone longer than 2 seconds. This enables detection of subsequent vehicles entering the loop detection zone. After each vehicle leaves the loop detection zone, the channel resumes full sensitivity within 0.5 seconds.

Max Presence Timer: Each channel's Max Presence timer is adjustable from 1 to 999 seconds in 1-second steps, plus OFF. The Max Presence function is used to limit presence time by automatically resetting a channel. If this function is enabled (on), the Max Presence timer begins counting down when a Call is initiated and the remaining time is continuously displayed on the LCD. If the loop becomes vacant before the Max Presence timer reaches zero, the Call is dropped and no automatic reset occurs. If the End-Of-Green (EOG) function is not enabled (off) and the Call is still present when the Max Presence timer reaches zero, the channel is then automatically reset. If the EOG function is enabled (on) and the Call is still present when the Max Presence timer reaches zero, the channel enters a Wait state. The Wait state continues until the loop becomes vacant; or the Phase Green Input signal for the channel (pin 1, 2, 3, or 10) transitions from green to not green with the Call still present. If the loop becomes vacant first, the Call is dropped and no automatic reset occurs. If the Phase Green Input for the channel transitions from green to not green while the channel is in a Wait state, the channel is automatically reset. The phase green signals on pins 1, 2, 3, and 10 are also called Call Delay Overrides.

End-Of-Green (EOG): The EOG function is used to synchronize a channel reset with the termination of the associated phase green. The EOG function is only available when the Max Presence function is set between 1 and 999 seconds. It is not available when the Max Presence function is OFF. When the EOG function is enabled (on), the channel will automatically reset at the time the phase green input signal (pin 1, 2, 3, or 10) transitions from the ON state to the OFF state if the Max Presence Time has counted down to zero and is resting in the Wait state. The phase green signals on pins 1, 2, 3, and 10 are also called Call Delay Overrides. If an out of range loop failure condition exists and is identified (i.e. loop

inductance is less than 20 microhenries or greater than 2500 microhenries) the detector channel will not be reset at End-of Green and the channel will remain in the failed state.

Option 1, Loop Inductance Display: When this option is enabled (on), the LCD screen displays the total loop inductance (actual loop inductance plus actual lead-in inductance) in microhenries for loop inductance values in the range of 20 to 2500 microhenries. NOTE: Enabling this option activates it for all channels. This option is automatically disabled 15 minutes after activation or on loss of power.

Option 2, Loop Inductance $-\Delta L/L$ Display: When this option is enabled (on), the LCD screen displays the percentage of inductance change ($-\Delta L/L$ value) during the Call state. To facilitate viewing of the maximum change in the $-\Delta L/L$ value while traffic is in motion over the detection zone, the detector will hold the peak $-\Delta L/L$ value for a period of 2 seconds. NOTE: Enabling this option activates it for all channels. This option is automatically disabled 15 minutes after activation or on loss of power.

Option 3, Call Extension Control: When this option is enabled (on), the channel will extend calls for the programmed extension time only when the Phase Green Input signal (pin 1, 2, 3, or 10) is active for the channel. When this option is off, the channel extends ALL calls for the programmed extension time. The signals on pins 1, 2, 3, and 10 are also called Call Delay Overrides. NOTE: Each channel can be enabled independently.

Option 4, Noise Filter Disable: When Option 4 is enabled (on), internal noise filtering is disabled thus providing a faster response time. When this option is off, internal noise filtering is utilized. When the detector is used in speed and/or occupancy applications, the noise filter should be disabled (i.e. Option 4 on) to provide the most accurate data possible. It is recommended that this option not be activated. The factory default setting of "Off" provides stable operation in high crosstalk environments. NOTE: Enabling this option activates it for all channels. Changing the setting of this feature will reset the detector. See "SENSITIVITY, $-\Delta L/L$, & RESPONSE TIME" table.

Option 5, Phase Green Loop Compensation: When Option 5 is enabled (on), normal loop compensation is used until the Phase Green Input signal (pin 1, 2, 3, or 10) becomes active. Once the Phase Green Input signal is active, concurrent with a call output, the detector desensitizes the loop by 0.05% ($-\Delta L/L$) over a 15 second period. This desensitization "tunes out" small changes, such as adjacent lane pickup, therefore minimizing the chance of max timing an empty lane. A small motorcycle may also be tuned out following the start of Phase Green. This option is useful in minimizing the effects of false detection from adjacent lane pickup when a channel must be run with a high sensitivity setting to ensure detection of motorcycles. When Option 5 is not enabled (off), normal loop compensation is used. NOTE: Each channel can be enabled independently.

Option 9, Third Car Passage: Option 9 is a "paired channel" option. This means that it takes two channels to implement this feature. Channel 1 is paired with Channel 2 and Channel 3 is paired with Channel 4. When Option 9 is enabled (on), the outputs of the paired channels (1 and 2 and/or 3 and 4) are logically ANDed together. This means that while the loops for both of the paired channels are occupied, a call will appear on both channels. While only one loop is occupied, or neither loop is occupied, a call will not appear on either channel. The first channel with detection will enter a "pending" state while waiting for detection on the other paired channel. While in the pending state, the LCD will show "Pnd" on the display.

The intent of this feature is for use in Protected / Permissive left turns. The expected installation is a stop bar loop for the left turn lane connected to one channel, a queue detection loop for the left turn lane connected to the other channel with a small amount of delay time programmed, and the output of either channel connected to the Vehicle Call input for the protected movement of the traffic controller. NOTE: Refer to the Model E-1000 Series Operation Manual for complete installation and operation details.

Option 10, Directional Logic: Option 10 is a "paired channel" option. This means that it takes two channels to implement this feature. Channel 1 is paired with Channel 2 and Channel 3 is paired with Channel 4. When Option 10 is enabled (on), directional logic is enabled. Directional logic starts with a detection on one of the paired channels. This channel will go into the "pending" state, display "Pnd" on the LCD screen, and NOT output a call. When both of the paired channels have detection, the last channel to have detection will output a Call until the detection for the last channel ends, even if the detection ends for the first channel. None of the timing functions (Delay, Extension, Max Presence, or Detector Disconnect) of the first channel with a detection will time and the first channel will always operate in the Presence Mode regardless of programming for the channel. The second channel with a detection will time all timing functions as programmed.

The intent of this feature is for use in parking lot applications where vehicles can enter or exit from the same lane, freeway ramps for wrong way detection, and left turn lanes where other movements in the intersection tend to clip the detection zone of the left turn. The expected installation is two loops, one after the other in the same lane, spaced anywhere from slightly overlapping to 6 feet apart. NOTE: Refer to the Model E-1000 Series Operation Manual for complete installation and operation details.

Option 11, Audible Detect Signal: When this option is enabled (on), an audible signal will

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be activated whenever the detection zone for the selected channel is occupied. The audible signal indicates actual occupancy of the loop detection zone. Timing and disconnect functions have no effect on the audible signal. This feature allows a technician to watch the detection zone on the street and confirm correct detector operation without having to look at the detector display as well. Only one channel can have this feature active at a given time. Turning this option on for one channel automatically turns it off for all other channels. NOTE: This option is automatically disabled 15 minutes after activation or on loss of power.

Option 12.0, Detector Disconnect: The Detector Disconnect feature requires that the Phase Green Inputs for each channel be connected to the proper controller phase. When the Phase Green Input is not active (high), the detector shall operate normally. When the Phase Green Input is active (low), at the end of each detection, the extension timer will start to count down. If this timer reaches zero before the next detection, this channel will no longer output a Call until the phase green input is not active. Because the extension timer is used as a disconnect timer while in this mode, two different disconnect types are available:

Option 12.1 OFF: Extension timing occurs and the extension timer also serves as the disconnect timer during phase green. This will cause the Call output to remain in the Call state until disconnect occurs. This may allow the user to use gap times appropriate for the advanced loops without considering the effects on the stop bar loops.

Option 12.1 ON: Extension timing is disabled and the extension timer is used as the disconnect timer. This will cause the Call output to follow the occupancy of the loop detection zone until disconnect occurs.

The intent of this feature is for use in applications where a loop at the stop bar is not needed after any waiting queue in the associated traffic lane is moving during the green. Note: Refer to the Model E-1000 Series Operation Manual for complete installation and operation details.

SPECIFICATIONS (PHYSICAL):

Weight: 7 oz (199 gm).

Size: Model E (full width faceplate) - 4.50 inches (11.43 cm) high x 2.00 inches (5.08 cm) wide x 6.875 inches (17.46 cm) deep (including connector, excluding handle). Model E/2 (half width faceplate) - 4.50 inches (11.43 cm) high x 1.12 inches (2.84 cm) wide x 6.875 inches (17.46 cm) deep (including connector, excluding handle). Handle adds 1.00 inch (2.54 cm) to depth measurement.

Operating Temperature: -40°F to +180°F (-40°C to +82°C).

Circuit Board: Printed circuit boards are 0.062 inch thick FR4 material with 2 oz. copper on both sides and plated through holes. Circuit boards and components are conformal coated with polyurethane.

Connector: 2 x 22 contact edge card connector with 0.156 inch (0.396 cm.) contact centers. Key slots located between pins B / 2 & C / 3, E / 5 & F / 6, and M / 11 & N / 12. See "PIN ASSIGNMENTS" table.

Loop Feeder Length: Up to 5000 feet (1500 m) maximum with proper feeder cable and appropriate loops.

SPECIFICATIONS (ELECTRICAL):

Power: 10.8 to 30 VDC, 120 mA maximum, 2.1 Watts maximum.

Loop Inductance Range: 20 to 2500 microhenries with a Q factor of 5 or greater.

Loop Inputs: Transformer isolated. The minimum capacitance added by the detector is 0.068 microfarads.

Lightning Protection: The detector can tolerate, without damage, a 10 microfarad capacitor charged to 2,000 volts being discharged directly into the loop input terminals, or a 10 microfarad capacitor charged to 2,000 volts being discharged between either loop terminal and earth ground.

Reset: Meets and/or exceeds NEMA TS 1 and TS 2 detector specifications. Application of a 30-millisecond low state (0 to 8 VDC) to pin C resets all channels. The detector can also be reset by removing and reapplying power or by changing the setting of Option 4 (Noise Filter Disable). Each detector channel can be independently reset by pressing the CHAN button until the desired channel is selected, then holding the CHAN button for 3 seconds. Also, changing either the sensitivity or loop frequency of a channel will reset that channel. NOTE: Resetting a channel or changing the setting of Option 4 does not disable any selectable diagnostic functions. If any diagnostic option(s) (Option 1, Option 2, or Option 11) has (have) been activated, it (they) will remain activated following the channel reset or change of Option 4 setting. Resetting the detector by applying a 30-millisecond low state to pin C or removing and reapplying power disables all selectable diagnostic features.

Phase Green Inputs: Also known as Call Delay Overrides. Meets and/or exceeds all NEMA TS 1 and TS 2 requirements. Application of a low state voltage (0 to 8 VDC) to pin 1 (Ch. 1), pin 2 (Ch. 2), pin 3 (Ch. 3), and/or pin 10 (Ch. 4) causes the delay timer for the channel to abort the delay timing function and also provides control for Phase Green Loop

Compensation, Max Presence Timing (End-of-Green), Extension Timing, and Detector Disconnect, if the features are programmed.

Fail-Safe Outputs: Per NEMA TS 2, a conducting state indicates detection output. Each detector channel output defaults to a Call state for any loop failure condition or loss of power.

Channel Status Outputs: Per NEMA TS 2, each channel has an output to communicate the status states of the channel as follows:

Normal operation	Continuous Low or On State.
Detector failure	Continuous High or Off State.
Open loop50 ms On time, 50 ms Off time.
Shorted loop50 ms On time, 100 ms Off time.
Excessive inductance change (±25%)50 ms On time, 150 ms Off time.

Solid State Output Ratings: Optically coupled field effect transistors. 30 VDC maximum drain to source. 50 mA maximum current. 1.2 VDC maximum transistor saturation voltage. The output transistor is protected with a 33-volt zener diode connected between the drain and source.

SPECIFICATIONS (OPERATIONAL):

Display: The LCD backlighting illuminates whenever any pushbutton is pressed. The backlighting will extinguish 15 minutes after the last actuation of any pushbutton.

Detect Indicators: Each channel has a super-high-intensity, red, light-emitting-diode (LED) to indicate a Call output, Delay Timing, Extension Timing, Pending state, or failed loop.

Response Time: Meets or exceeds NEMA TS 1 and TS 2 response time specifications. See "SENSITIVITY, -ΔL/L, & RESPONSE TIME" table for actual response times.

Self-Tuning: The detector automatically tunes and is operational within 2 seconds after application of power or after being reset. Full sensitivity and hold time require 30 seconds of operation.

Environmental & Tracking: The detector is fully self-compensating for environmental changes and loop drift over the full temperature range and the entire loop inductance range.

Grounded Loop Operation: The loop isolation transformer allows operation with poor quality loops (which may include one short to ground at a single point).

Loop (Fail) Monitor: If the total inductance of the channel's loop input network goes out of the range specified for the detector, or rapidly changes by more than ±25%, the channel will immediately enter the Fail-Safe mode and display "LOOP FAIL" on the LCD screen. The type of loop failure will also be displayed as "L lo" (for -25% change or shorted loop conditions) or "L hi" (for +25% change or open loop conditions). This will continue as long as the loop fault exists. **However, if the detector is reset, or power is momentarily lost, the detector will return if the loop inductance is within the acceptable range. If any type of loop failure occurs in one (or more) loop(s) in a group of two or more loops wired in parallel, the detector will not respond with a fail-safe output following any type of reset. It is essential that multiple loops wired to a common detector channel always be wired in series to ensure fail-safe operation under all circumstances.** The Fail-Safe mode generates a continuous call in Presence Mode or in Pulse Mode. At the time of a loop failure, the channel's LED will begin repeating a burst of three flashes each one second. The LED will continue these bursts until the channel is manually reset or power is removed. If the loop "self heals", the "LOOP FAIL" message on the LCD will extinguish and the channel will resume operation in a normal manner; except the LED will continue the bursts thus providing an alert that a Loop Fail condition occurred. Each loop failure for the channel is counted and accumulated into the Loop Fail Memory. The total number of loop failures written into the Loop Fail Memory (since the last power interruption or manual reset) is viewed by stepping through the channel's functions in Program Mode to the "LOOP FAIL" message.

Full Restore To Factory Defaults: Pressing all four front panel switches simultaneously and continuously for 5 seconds resets the detector and restores all the factory default settings. The countdown of the 5-second period is displayed on the LCD screen. Releasing any of the switches before the countdown ends will abort the Full Restore operation. See "FACTORY DEFAULT SETTINGS" table.

Display Test: Pressing any two of the front panel switches simultaneously will display all possible symbols and messages on the LCD screen.

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TABLES

SENSITIVITY, $\Delta L/L$, & RESPONSE TIME:

Sensitivity	$\Delta L/L$	Response Time Noise Filter Enabled (Option 4 Off)	Response Time Noise Filter Disabled (Option 4 On)
OFF	-----	-----	-----
1	0.64%	160 \pm 50 milliseconds	35 \pm 7 milliseconds
2	0.32%	160 \pm 50 milliseconds	35 \pm 7 milliseconds
3	0.16%	160 \pm 50 milliseconds	35 \pm 7 milliseconds
4	0.08%	160 \pm 50 milliseconds	35 \pm 7 milliseconds
5	0.04%	160 \pm 50 milliseconds	35 \pm 7 milliseconds
6*	0.02%	160 \pm 50 milliseconds	48 \pm 10 milliseconds
7	0.01%	160 \pm 50 milliseconds	79 \pm 17 milliseconds
8	0.005%	160 \pm 50 milliseconds	138 \pm 28 milliseconds
9	0.0025%	160 \pm 50 milliseconds	261 \pm 51 milliseconds
CALL	-----	-----	-----

* Denotes factory default.

Note: Entries in this table are based on the assumption that all detector channels are set to the same sensitivity. To achieve the exact response times listed above, the Sensitivity of all channels must be set the same. To approximate response times for a detector with channels set to different sensitivities, look up the response time for each channel and divide it by four, then add these times together.

FACTORY DEFAULT SETTINGS:

Function	Channel 1	Channel 2	Channel 3	Channel 4
Frequency	2	4	6	8
Sensitivity	6	6	6	6
Delay Time	0	0	0	0
Extension Time	0	0	0	0
Max Presence Time	OFF	OFF	OFF	OFF
Presence / Pulse Mode	Presence	Presence	Presence	Presence
End-Of-Green (EOG)	OFF	OFF	OFF	OFF
Option 1 - Loop Inductance Display	OFF	OFF	OFF	OFF
Option 2 - Loop Inductance $\Delta L/L$ Display	OFF	OFF	OFF	OFF
Option 3 - Call Extension Control	OFF	OFF	OFF	OFF
Option 4 - Noise Filter Disable	OFF	OFF	OFF	OFF
Option 5 - Phase Green Loop Compensation	OFF	OFF	OFF	OFF
Option 9 - Third Car Passage	OFF	OFF	OFF	OFF
Option 10 - Directional Logic	OFF	OFF	OFF	OFF
Option 11 - Audible Detect Signal	OFF	OFF	OFF	OFF
Option 12.0 - Detector Disconnect	OFF	OFF	OFF	OFF
Option 12.1 - Detector Disconnect Type	OFF	OFF	OFF	OFF

PIN ASSIGNMENTS:

E-1100 Series - 332 / 170 Type

Pin	Function	Pin	Function
A	DC (-) Common	1	No Connection
B	DC (+) Power	2	No Connection
C	Reset Input	3	No Connection
D	Channel 1 Loop Input	4	Channel 1 Loop Input
E	Channel 1 Loop Input	5	Channel 1 Loop Input
F	Channel 1 Output, Drain	6	No Connection
H	Channel 1 Output, Source	7	No Connection
J	Channel 2 Loop Input	8	Channel 2 Loop Input
K	Channel 2 Loop Input	9	Channel 2 Loop Input
L	Chassis Ground	10	No Connection
M	No Connection	11	No Connection
N	No Connection	12	No Connection
P	Channel 3 Loop Input	13	Channel 3 Loop Input
R	Channel 3 Loop Input	14	Channel 3 Loop Input
S	Channel 3 Output, Drain	15	No Connection
T	Channel 3 Output, Source	16	No Connection
U	Channel 4 Loop Input	17	Channel 4 Loop Input
V	Channel 4 Loop Input	18	Channel 4 Loop Input
W	Channel 2 Output, Drain	19	No Connection
X	Channel 2 Output, Source	20	No Connection
Y	Channel 4 Output, Drain	21	No Connection
Z	Channel 4 Output, Source	22	No Connection

PIN ASSIGNMENTS:

E-1200 Series - NEMA TS 1 / TS 2 Type

Pin	Function	Pin	Function
A	DC (-) Common	1	Channel 1 Phase Green Input
B	DC (+) Power	2	Channel 2 Phase Green Input
C	Reset Input	3	Channel 3 Phase Green Input
D	Channel 1 Loop Input	4	Channel 1 Loop Input
E	Channel 1 Loop Input	5	Channel 1 Loop Input
F	Channel 1 Output, Drain	6	No Connection
H	Channel 1 Output, Source	7	Channel 1 TS 2 Status Output
J	Channel 2 Loop Input	8	Channel 2 Loop Input
K	Channel 2 Loop Input	9	Channel 2 Loop Input
L	Chassis Ground	10	Channel 4 Phase Green Input
M	No Connection	11	No Connection
N	No Connection	12	No Connection
P	Channel 3 Loop Input	13	Channel 3 Loop Input
R	Channel 3 Loop Input	14	Channel 3 Loop Input
S	Channel 3 Output, Drain	15	No Connection
T	Channel 3 Output, Source	16	Channel 3 TS 2 Status Output
U	Channel 4 Loop Input	17	Channel 4 Loop Input
V	Channel 4 Loop Input	18	Channel 4 Loop Input
W	Channel 2 Output, Drain	19	No Connection
X	Channel 2 Output, Source	20	Channel 2 TS 2 Status Output
Y	Channel 4 Output, Drain	21	No Connection
Z	Channel 4 Output, Source	22	Channel 4 TS 2 Status Output

MODEL NUMBERS:

Model	Description
E-1100-SS	332 / 170 Type, Solid State Outputs, 2.00" wide faceplate
E-1200-SS	TS 1 / TS 2 Type, Solid State Outputs, 2.00" wide faceplate
E/2-1200-SS	TS 1 / TS 2 Type, Solid State Outputs, 1.12" wide faceplate

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