

# MAXI-AMP™ CD Series

Programmable Modulated Amplifier and Control Modules  
for use with SP12 Series Preamplified Remote Photoelectric Barrel Sensors



- Modulated photoelectric amplifier, power supply, output relay, and versatile timing logic (CD5 models) in one compact, stand-alone package
- 120 or 240V ac or 12-28V dc operation; requires only the addition of a Banner SP12 preamplified opposed mode sensor pair to create a powerful sensing system
- CD5 models are easily programmed for any of twelve delay, one-shot, and latch functions (either single or dual timing); interrogation schemes are possible using auxiliary input
- Exceptionally high immunity to ambient light and electrical noise; no false pulse on power-up
- Rugged, 15-turn potentiometers for precise timing and sensitivity adjustment; tough Noryl® housing
- Includes Banner's exclusive AID™ alignment system

CD Series MAXI-AMP modules combine power supply, modulated photoelectric amplifier, timing logic (in CD5 models) and output switch in a single compact, cost-saving module. CD Series modules work together with Banner SP12 Series preamplified remote sensors. These sensors offer small size and high power, and are built to operate in highly demanding sensing environments. Their preamplified design gives them exceptionally high immunity to electrical noise (see Banner product data sheet P/N 34466 for further information). MAXI-AMP modules themselves are also ruggedly built for dependable industrial duty.

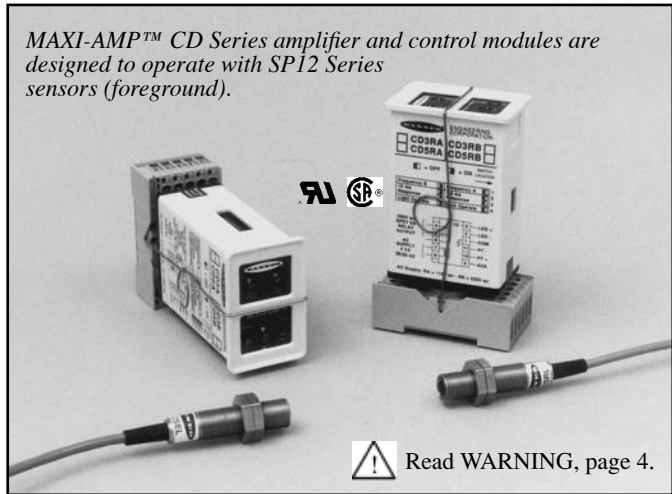
CD Series MAXI-AMP modules contain a state-of-the-art Banner CMOS modulator/demodulator/amplifier circuit that offers high immunity to both ambient light and electrical interference plus reliable sensor performance. All models have Banner's exclusive, patented Alignment Indicating Device (AID™) system\*, which lights an LED indicator whenever the receiver sees a "light" condition, and pulses the LED at a rate proportional to the received light signal strength. MAXI-AMP modules operate from a variety of voltages (see tables at right).

All CD Series modules are programmable for LIGHT or DARK operate. Module input response time may be set at either 1.5 or 15 milliseconds. The 15-millisecond response mode offers maximum sensing power (excess gain) with SP12 Series sensors. CD Series modules also feature selectable sensor modulation frequencies ("A" and "B"). This makes it possible to operate two high-powered SP12 Series sensor pairs using different modulation frequencies (at the same response time setting) in close proximity to each other without optical crosstalk.

CD5 models include a versatile multi-function timing logic circuit that is programmable for 12 popular and useful delay, one-shot, and latch functions. Each timing function has a choice of three time ranges. Timing and sensitivity adjustments use rugged 15-turn potentiometers for very accurate settings. CD Series module circuit design prevents false outputs on system power-up.

The output circuit for CD3A, 3B, 5A, and 5B modules consists of two SPST solid-state switches: one for ac loads of up to 250V ac (3/4 amp), and a second for dc loads of up to 30V dc (50 mA). Models CD5RA and CD5RB have a 5-amp SPDT electromechanical relay. CD3RA and CD3RB modules have a 5-amp SPDT electromechanical relay plus an NPN transistor solid-state switch. For more information on output circuit load capability, refer to the tables (right) and the Specifications section on the next page.

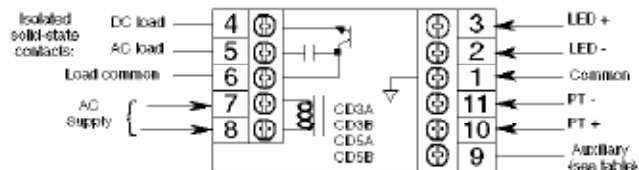
\*US patent no. 4356393



MODEL	SUPPLY VOLTAGE	OUTPUT	LOGIC
CD3RA	105 to 130V ac, or 12 to 28V dc	SPDT electro-mechanical relay, plus NPN transistor solid-state switch	ON/OFF
CD3RB	210 to 250V ac, or 12 to 28V dc		
CD5RA	105 to 130V ac, or 12 to 28V dc	SPDT electro-mechanical relay (5 amp contact rating)	12 timing functions
CD5RB	210 to 250V ac, or 12 to 28V dc		

MODEL	SUPPLY VOLTAGE	OUTPUT	LOGIC
CD3A	105 to 130V ac, or 12 to 28V dc	SPST solid-state contact for switching AC loads up to 250V ac and 3/4 amp, plus solid-state contact for switching DC loads up to 30V dc and up to 50mA.	ON/OFF
CD3B	210 to 250V ac, or 12 to 28V dc		
CD5A	105 to 130V ac, or 12 to 28V dc		12 timing functions
CD5B	210 to 250V ac, or 12 to 28V dc		

### Generalized Hookup: models with solid-state output



# MAXI-AMP™ CD Series Modules Specifications

**SUPPLY VOLTAGE:** Models CD3(R)A, CD5(R)A: 105 to 130V ac, 50/60Hz (4 VA), or 12 to 28V dc\* at 70mA. Models CD3(R)B, CD5(R)B: 210 to 250V ac, 50/60Hz (4 VA), or 12 to 28V dc\* at 70mA.  
 \*NOTE: do not connect ac power when using external dc power.

**OUTPUT CONFIGURATION:**

**CD3A, CD3B, CD5A, CD5B:** Two solid-state SPST switches, one for ac loads of up to 250V ac and up to 3/4 amp, the other for dc loads of up to 30V dc and up to 50mA. **CD3A and CD3B also have a logic level current sinking NPN transistor switch at pin #9, maximum load 20mA at 12V dc max.**

**CD3RA and CD3RB:** SPDT electromechanical relay (see specifications, below) plus an NPN transistor solid-state logic-level dc switch (at pin #9, maximum load 20mA at 12V dc max.).

**CD5RA and CD5RB:** SPDT electromechanical relay (specs below).

**SPDT Electromechanical Relay Specifications:**

**CONTACT RATING:** 250V ac max, 24V dc max, 5 amps max. (resistive load), 1/10 H.P. at 240V ac. Install a transient suppressor (MOV) across contacts that switch inductive loads.

**CLOSURE TIME:** 10 milliseconds max.

**RELEASE TIME:** 10 milliseconds max.

**MAXIMUM SWITCHING SPEED:** 20 operations/second

**MECHANICAL LIFE:** 20,000,000 operations

**AMPLIFIER:**

**RESPONSE SPEED:** Programmable for 1.5 or 15 milliseconds. NOTE: use 15 millisecond setting for maximum sensor excess gain.

**MODULATION FREQUENCY:** selectable, "A" or "B".

**SENSOR LEAD LENGTH:** 100 feet (30 m) maximum, each sensor. When splicing, use separate cable for emitter and receiver, or order sensors with extended cable length.

**SENSOR HOOKUP:** One SP12 Series opposed mode sensor pair per amplifier module. Additionally, one self-contained sensor may be connected at pin #9 (CD5 models) to provide a RESET or INHIBIT signal. +15V dc power for this one additional sensor is available at module pin #3 (40mA maximum load).

**TIMERS (CD5 models only):**

**Timing ranges:** LOW range - 10 to 150 milliseconds  
 MIDDLE range - 0.1 to 1.5 seconds  
 HIGH range - 1 to 15 seconds

**Repeatability:** +/-2% of set time over all extremes of supply voltage and temperature

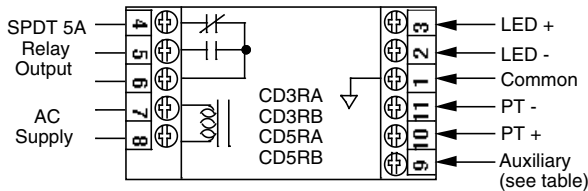
**ADJUSTMENTS:** Miniature switches are provided for programming of LIGHT/DARK operate, amplifier response time, modulation frequency, normally open or normally closed output and timing function (CD5 models). 15-turn clutched potentiometer for gain (sensitivity) and time settings (CD5 models).

**OPERATING TEMPERATURE:** 0 to 50°C (+32 to 122°F).

**INDICATOR LEDs:** Two LEDs. A red indicator LED is "ON" when the module output is energized. Exclusive Banner Alignment Indicating Device (AID™) system lights another red LED indicator whenever the receiver "sees" its own modulated light source, and pulses it at a rate proportional to the strength of the received light signal.

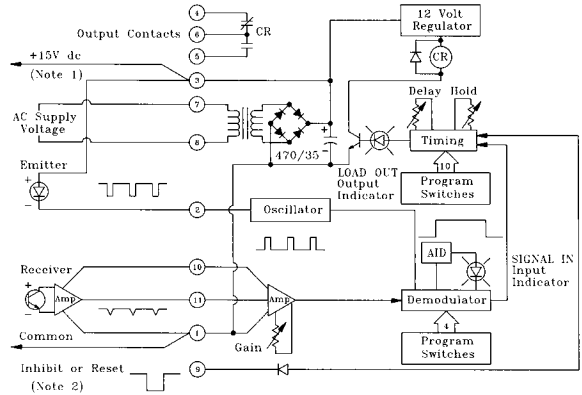
**CONSTRUCTION:** Rugged Noryl® polyphenylene oxide (PPO®) housing, 1.6" x 2.3" x 4". Standard round-pin 11-pole plug base. Noryl® is a registered trademark of General Electric Co.

**Generalized Hookup:  
 models with electromechanical relay output**



**Functional Schematics**

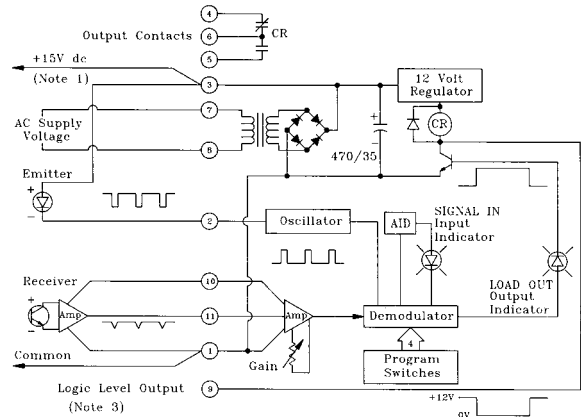
**Models CD5RA, CD5RB**



**NOTE #1:** power is available at pins #3 (+) and #1 (-) for an external 10 to 30V dc device (see hookup example, page 3). Current available is 40 mA at 120V ac (240V ac) line level; 30mA at 105V ac (210V ac) line level. Alternately, the module may be powered by 12 to 28V dc at pins #3 (+) and #1 (-). **Do not connect ac voltage when using external dc power.**

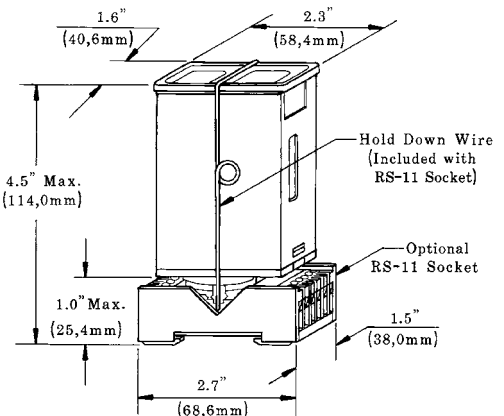
**NOTE #2:** pulling pin #9 low (to common) will inhibit the timing, or reset the latch of CD5 models (see "Description of Logic Functions", page 5).

**NOTE #3:** pin #9 of CD3 models may be connected directly as the input to Banner Models CD3RA, CD3RB



CL Series MAXI-AMPS or to Banner MICRO-AMP™ or Plug Logic modules (see hookup example, page 3).

**Dimension Drawing**



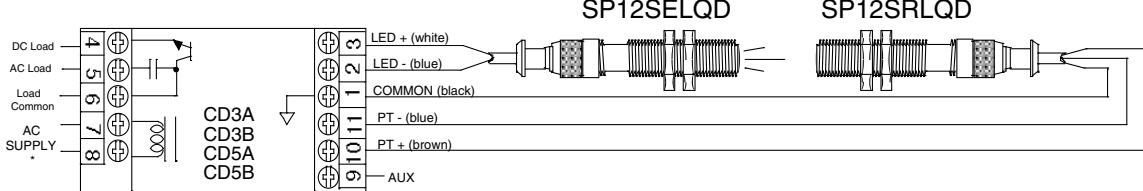
# MAXI-AMP CD Series

## SP12 Sensor Hookup to CD Series MAXI-AMP™ Modules

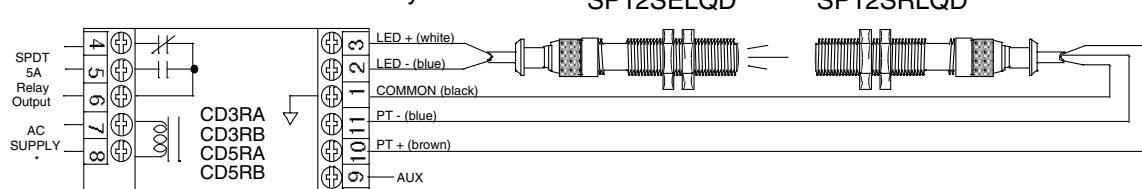
### 1) Hookup of SP12 Series Sensors (all models)

SP12 Series sensors are especially designed for use with CD Series modules. The basic hookup is given here. Each MAXI-AMP™ CD Series module supports use of one pair of SP12 Series sensors. CD5 Series module models also support use of a GATE or INHIBIT sensor at pin #9 (below, this page).

#### Models with isolated solid-state contacts



#### Models with electromechanical relay contacts

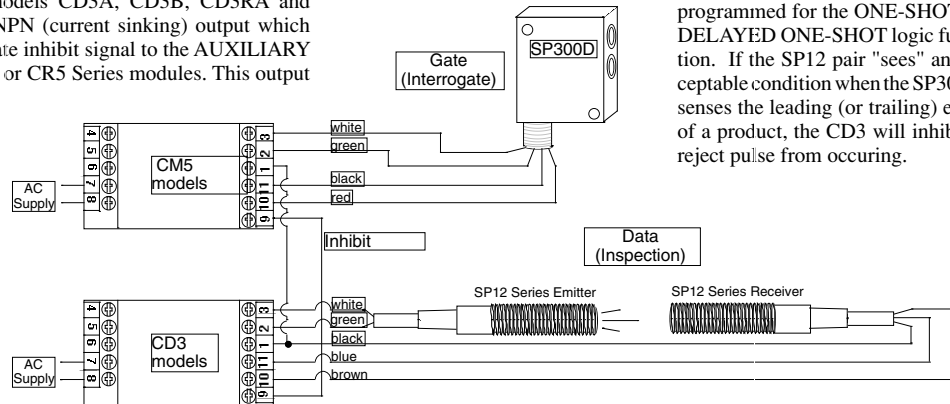


\*105 to 130V ac or 210 to 250V ac, 50/60Hz, depending on model. To power the MAXI-AMP™ module from a dc supply, connect +12 to 28V dc at 70mA to terminal #3 and dc common to terminal #1. Make no connection to terminal #7 or #8.

### 2) Logic Level NPN Output (CD3 models)

The AUXILIARY terminal (#9) of models CD3A, CD3B, CD3RA and CD3RB modules offers a logic-level NPN (current sinking) output which may be used as a fast-response solid-state inhibit signal to the AUXILIARY input of MAXI-AMP CD5, CL5, CM5, or CR5 Series modules. This output may also serve as an input to any MICRO-AMP™, Plug Logic, or CL Series logic module. In addition, this output may interface to other dc devices or circuits like counters, rate meters, or programmable logic controllers. Switching capacity is 20mA at 12V dc.

The example here shows the use of SP12 Series sensors and a CD3 module to provide inspection information, with the SP300D functioning as a product (GATE) sensor.



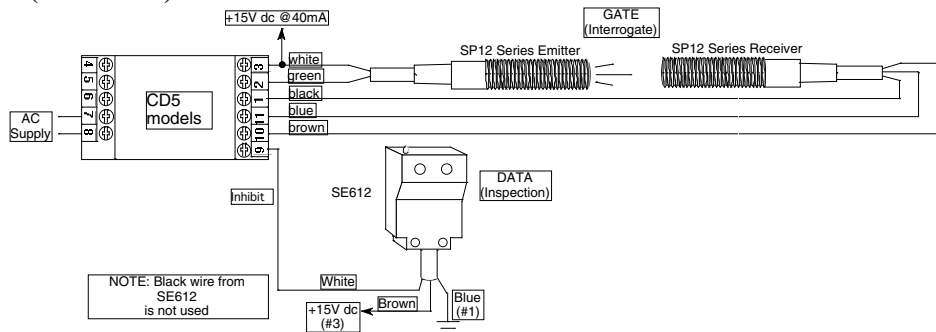
Typically, the CM5 module would be programmed for the ONE-SHOT or DELAYED ONE-SHOT logic function. If the SP12 pair "sees" an acceptable condition when the SP300D senses the leading (or trailing) edge of a product, the CD3 will inhibit a reject pulse from occurring.

See Hookup Diagram #1 (above) for load and power connection information.

### 3) Power for External Devices (all models)

External 10 to 30V dc devices such as self-contained sensors may be connected between terminals #3 (+) and #1 (-) of any CD series MAXI-AMP module. Terminal #3 offers 40mA maximum. This is sufficient to power most Banner self-contained dc sensors.

As the example at the right illustrates, the *current sinking* output of a self-contained sensor powered by the MAXI-AMP may be used as the input to the AUXILIARY terminal of a CD5 module.

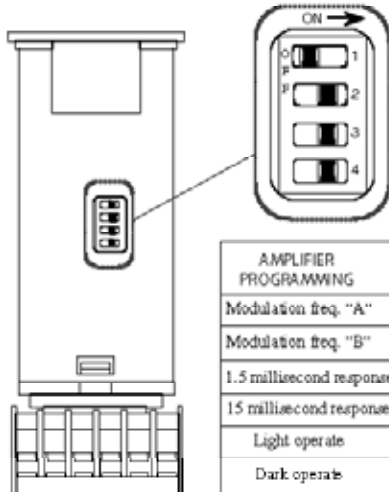


# MAXI-AMP CD Se-

## Amplifier Programming (all CD Series modules)

Amplifier response conditions may be programmed via the group of four switches located on one of the narrow sides of the MAXI-AMP™ module.

**Switch #1** selects the modulation frequency of the amplifier and the emitter light source. When two pairs of SP12 Series sensors are being used in close proximity to each other, the modulation frequency switch of their respective CD Series modules should be set to *different* modulation frequencies. This makes it possible to use the two sensor pairs in close proximity without optical crosstalk. *Both amplifiers must be set for the same response time (either 1.5 or 15 milliseconds) to ensure freedom from crosstalk.*



AMPLIFIER PROGRAMMING	SWITCH #1	SWITCH #2	SWITCH #3	SWITCH #4
Modulation freq. "A"	OFF	—	—	—
Modulation freq. "B"	ON	—	—	—
1.5 millisecond response	—	OFF	OFF	—
15 millisecond response	—	ON	ON	—
Light operate	—	—	—	ON
Dark operate	—	—	—	OFF

**Switches #2 and #3** are used to program the amplifier response time. The 15 millisecond setting allows SP12 Series sensors to operate at their maximum excess gain.

**Switch #4** is used to select LIGHT OPERATE or DARK OPERATE. In the LIGHT OPERATE mode, the output will energize (in ON/OFF or LATCH operation) or the timing function will initiate (in DELAY, ONE-SHOT, or LIMIT operation) when the receiver "sees" sufficient light (excess gain greater than 1X). In DARK OPERATE, the output will energize or timing will begin when the receiver is sufficiently dark (excess gain less than 1X).

The diagram at the left shows the location of switches 1-4, and the table summarizes the settings required for each response condition.

NOTE: An adhesive-backed mylar label is supplied. It may be marked to indicate switch programming and then applied to the MAXI-AMP housing as a switch cover.



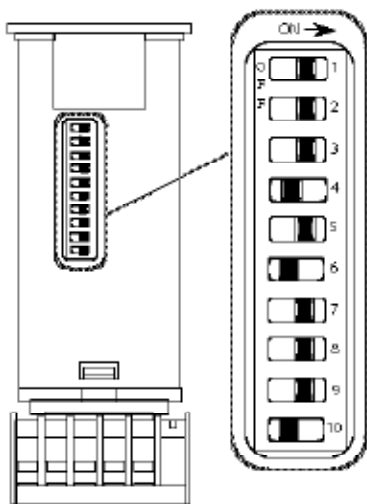
**WARNING** These photoelectric sensing devices do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can result in *either* an energized or a de-energized sensor output condition.

Never use these products as sensing devices for personnel protection. Their use as safety devices may create an unsafe condition which could lead to serious injury or death.

Only MACHINE-GUARD and PERIMETER-GUARD Systems, and other systems so designated, are designed to meet OSHA and ANSI machine safety standards for point-of-operation guarding devices. No other Banner sensors or controls are designed to meet these standards, and they must NOT be used as sensing devices for personnel protection.

## Timing Logic Programming (CD5 models)

Settings illustrated below are factory settings, and are "underlined" in the table.



TIMING LOGIC PROGRAMMING	SWITCH #1	SWITCH #2	SWITCH #3	SWITCH #4	SWITCH #5	SWITCH #6	SWITCH #7	SWITCH #8	SWITCH #9	SWITCH #10
On/Off	ON	ON	ON	OFF	ON	OFF	ON	—	—	—
On Delay	ON	ON	OFF	OFF	ON	OFF	ON	—	—	—
Off Delay	ON	OFF	ON	OFF	ON	OFF	ON	—	—	—
On and Off Delay	ON	OFF	OFF	OFF	ON	OFF	ON	—	—	—
One-shot	OFF	OFF	ON	OFF	ON	OFF	ON	—	—	—
Delayed One-shot	OFF	OFF	OFF	OFF	ON	OFF	OFF	—	—	—
Limit	ON	ON	OFF	OFF	OFF	OFF	ON	—	—	—
Repeat Cycle	ON	OFF	OFF	ON	ON	OFF	ON	—	—	—
AC Latch	OFF	ON	ON	OFF	ON	ON	ON	—	—	—
DC Latch	ON	ON	ON	OFF	ON	ON	ON	—	—	—
Delay and Latch	ON	ON	OFF	OFF	ON	ON	ON	—	—	—
Limit and Latch	ON	ON	OFF	OFF	OFF	ON	ON	—	—	—
N/C Output	—	—	—	—	—	—	—	OFF	—	—
N/O Output	—	—	—	—	—	—	—	ON	—	—
.15 Sec. Max. Time	—	—	—	—	—	—	—	OFF	OFF	—
1.5 Sec. Max. Time	—	—	—	—	—	—	—	ON	OFF	—
15 Sec. Max. Time	—	—	—	—	—	—	—	OFF	ON	—

A group of ten switches, located on the side of the module opposite the amplifier program switches, is used to select the timing logic for the CD5 models.

Switches #1 through #7 are used to select the logic function. Switch #8 programs the output for either NORMALLY OPEN or NORMALLY CLOSED operation. Switches #9 and #10 program the time range(s). There are three ranges: 10 to 150 milliseconds, 0.1 to 1.5 seconds, and 1 to 15 seconds. The programmed range will be the same for *both* functions of a dual timing mode (ON & OFF DELAY, DELAYED ONE-SHOT, and REPEAT CYCLE). However, DELAY and HOLD times are independently adjustable within the selected range.

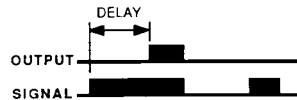
The diagram shows switch locations, and the table summarizes the program switch positions.

# Description of Logic Functions, CD5 models

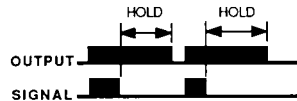
**ON/OFF:** ON/OFF operation does not involve timing. The output simply follows the action of the input signal. Grounding pin #9 (AUXILIARY) turns the output "off", regardless of the state of the input signal. This may be accomplished by closing a switch or relay contact between pins #9 and #1 (common), or by connecting an open collector NPN (current sinking) output of any external dc device directly to pin #9. NOTE: connect the COMMON of any external dc device to pin #1 of the MAXI-AMP to establish a voltage reference between the dc supply for the external device and the internal dc



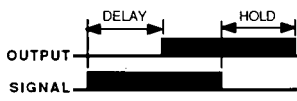
**ON DELAY:** The ON DELAY timer keeps the output "off" until the selected LIGHT or DARK signal has been present for the preset "DELAY" time. If the input signal is interrupted, the timing is reset and starts over with the next signal. Grounding pin #9 immediately cancels an output in progress and resets the delay timer. The delay timer is restarted when the inhibit signal is removed, if an input signal is present.



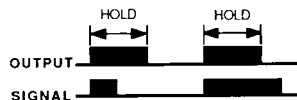
**OFF DELAY:** The output energizes immediately when the input signal occurs, but does not de-energize until the signal has been removed for the preset OFF-DELAY ("HOLD") time. Grounding pin #9 prevents an output from occurring.



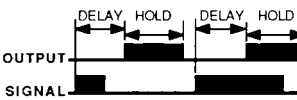
**ON & OFF DELAY:** ON and OFF DELAY logic combines both timing functions into a single mode. The ON-DELAY ("DELAY") time and the OFF-DELAY ("HOLD") time are independently adjustable within the selected time range. Momentary grounding of pin #9 during the ON-DELAY period resets the DELAY timer. An inhibit signal which occurs during an output will allow the output to stay energized for the remainder of the OFF-DELAY time. ON and OFF DELAY logic is often used in jam and void control, high/low level control, and edge-guiding applications.



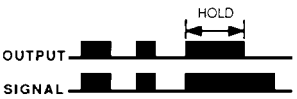
**ONE-SHOT:** The output of a ONE-SHOT function is a pulse of adjustable "HOLD" duration which is independent of the duration of the input signal. With the MAXI-AMP programmed for LIGHT operate, the pulse occurs when the input signal changes from dark to light. In DARK operate, the pulse occurs with a light to dark input transition. Grounding pin #9 prevents the one-shot from triggering, but does not affect a pulse already under way.



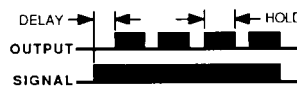
**DELAYED ONE-SHOT:** A DELAYED ONE-SHOT is initiated by either a momentary or maintained input signal. This input starts the adjustable "DELAY" period, after which the output pulses for an adjustable pulse ("HOLD") time. No further action occurs unless the input is removed and reapplied, beginning a new sequence. Grounding pin #9 during the delay period will cancel the sequence, and no output occurs. This feature is often used for inspection/rejection control logic. An inhibit signal will not affect a pulse under way.



**LIMIT:** The output of the LIMIT function follows the action of the input, as it does with the ON/OFF function. However, an input signal which is longer than the adjustable LIMIT ("HOLD") time will turn the output "off". Removing the input signal resets the timer. This function is sometimes called "TIME LIMITED ON/OFF", and is useful for energy conservation. Grounding pin #9 cancels the output. Lifting the inhibit restarts the LIMIT timer, if an input signal is present.



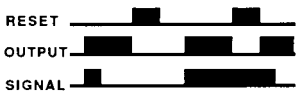
**REPEAT CYCLE:** The REPEAT CYCLE function provides an oscillating output when an input signal is present. Presence of an input signal triggers an adjustable "DELAY" timer. After the delay, the output energizes for an adjustable "HOLD" period. If the input remains, the output continues to cycle "on" and "off" at this rate indefinitely. When the signal is removed, any output in progress completes and then remains "off" until the next signal and DELAY period. Grounding pin #9 cancels the sequence, but will allow the completion of a "HOLD" period in progress. Lifting the inhibit signal begins



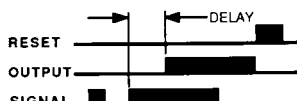
**AC LATCH:** An AC LATCH is the combination of a ONE-SHOT and a LATCH. A momentary or sustained input will latch the output "on". Grounding pin #9 will reset the latch, even if the input signal remains. The output will not re-latch until the input signal is removed and then reapplied.



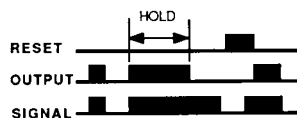
**DC LATCH:** The output will latch "on" whenever the selected LIGHT or DARK input condition occurs. Grounding pin #9 of a dc latch will turn the output "off" regardless of the state of the input signal. If the signal is present when the reset is removed, the output will immediately latch "on" again.



**DELAY AND LATCH:** The DELAY + LATCH is a combination of the ON-DELAY and DC LATCH functions. An input must be present for at least the adjustable "DELAY" time for the output to latch "on". If the input signal is removed during the timing cycle, the timing is reset. Momentary grounding of pin #9 resets the latch and/or the DELAY timing cycle. Sustained grounding of pin #9 inhibits any output.



**LIMIT AND LATCH:** The LIMIT + LATCH operates exactly like the LIMIT function, except that the LIMIT ("HOLD") timer can be reset *only* by the auxiliary input. An output remains latched "off" until reset by momentarily grounding pin #9. In addition to resetting the timer, grounding pin #9 will hold the output "off", regardless of the state of the input signal.



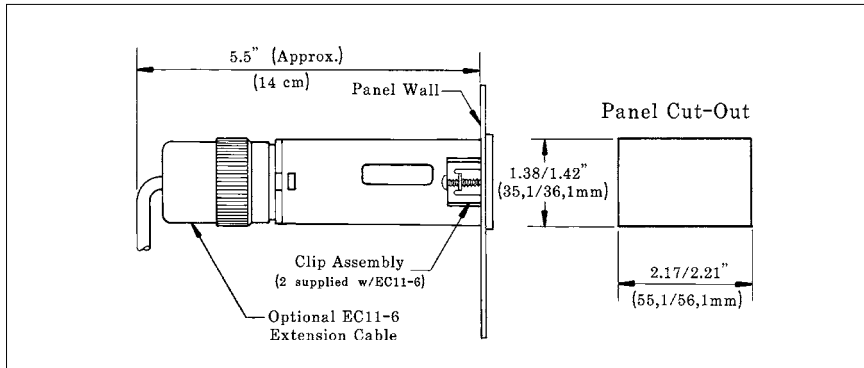
# MAXI-AMP System

## Mounting and Accessories

### Panel Wall Mounting of MAXI-AMP Module

After the panel cutout has been completed and de-burred, slide the MAXI-AMP through the cutout and place one clip assembly into the rectangular depression on each of the two narrow sides of the housing. Orient clips as shown, and alternately tighten the screws for equal pressure against the inside of the panel wall. Do not over-tighten the screws. Attach the optional EC11-6 extension cable (described below) to the MAXI-AMP and route the opposite end of the cable to the RS-11 (or equivalent) socket.

Model EC11-6 extension cable is 6 feet (2m) long. Clips for panel wall mounting of the MAXI-AMP are included with the cable.



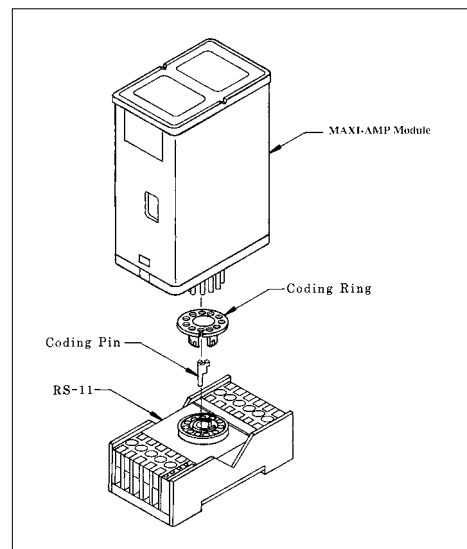
## Accessories for MAXI-AMP Modules

### Model RS-11 Socket

Model RS-11 is an eleven-pole round-pin screw terminal relay socket which is used to make electrical connections to any MAXI-AMP module. The socket provides in-line wire clamp screw terminals which will accept from one #24 AWG up to two #14 wires at each pin. The RS-11 is UL recognized (file #E92191) and CSA approved (file #LR38486). It may be mounted directly to a panel plate or via standard 35mm DIN-rail track (see below). A hold-down wire is supplied with each RS-11 socket (see dimension diagram on page 2).

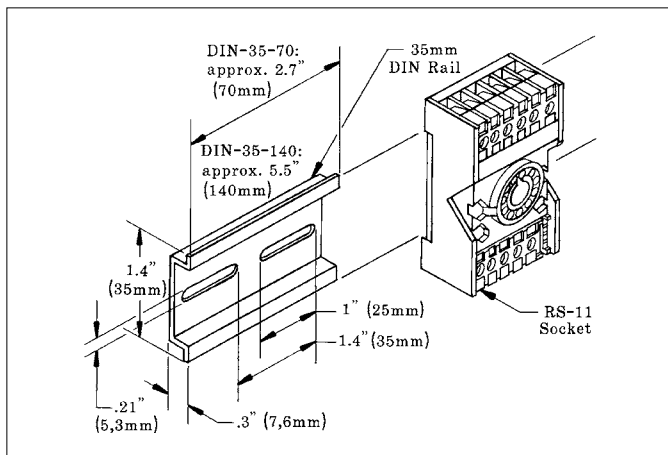


The RS-11 is supplied with a coding ring and pin (see diagram at right). This allows a MAXI-AMP to be keyed to fit only its own 11-pin socket. The pin is installed in one of the eleven slots in the RS-11, and the notch in the ring is aligned to slip over the pin. When the MAXI-AMP is removed from the RS-11, the coding ring stays with the MAXI-AMP base, while the coding pin remains in the socket.



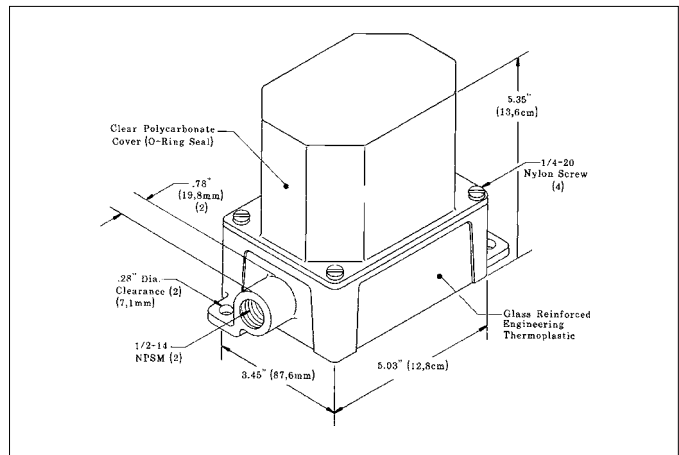
### 35mm DIN Rail Track

Track model DIN-35-70 accommodates one RS-11 socket. Model DIN-35-105 holds two sockets. Model DIN-35-140 holds up to three sockets. The RS-11 socket is designed to snap (or slide) directly into the 35mm DIN track.



### Model BENC-4 Enclosure

Model BENC-4 is a NEMA-4 rated corrosion-resistant enclosure for a MAXI-AMP module or other control device. It is supplied with a DIN-35-70 track for easy mounting of one RS-11 socket. For mounting two sockets, use DIN-35-105.



**WARRANTY:** Banner Engineering Corporation warrants its products to be free from defects for one year. Banner Engineering Corporation will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.