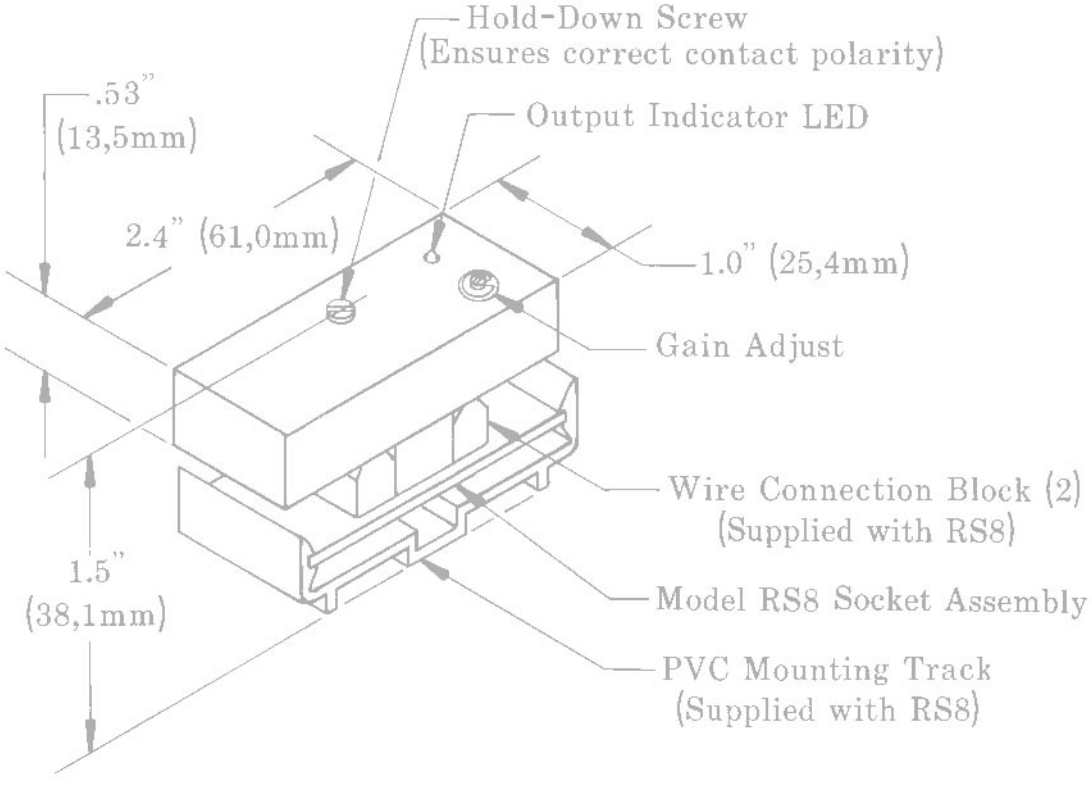
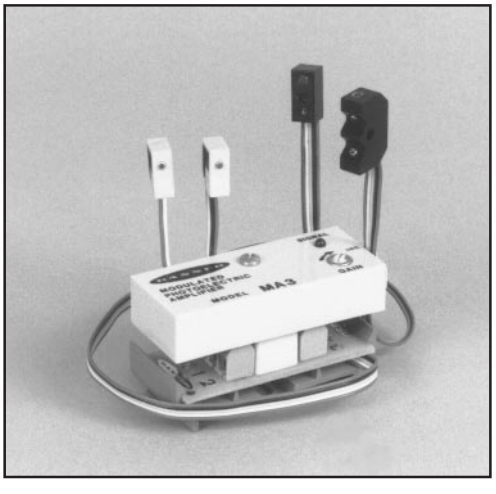
Product Line Specifications

the photoelectric specialist

MICRO-AMP® System

Remote sensors, modulated amplifiers, and logic modules



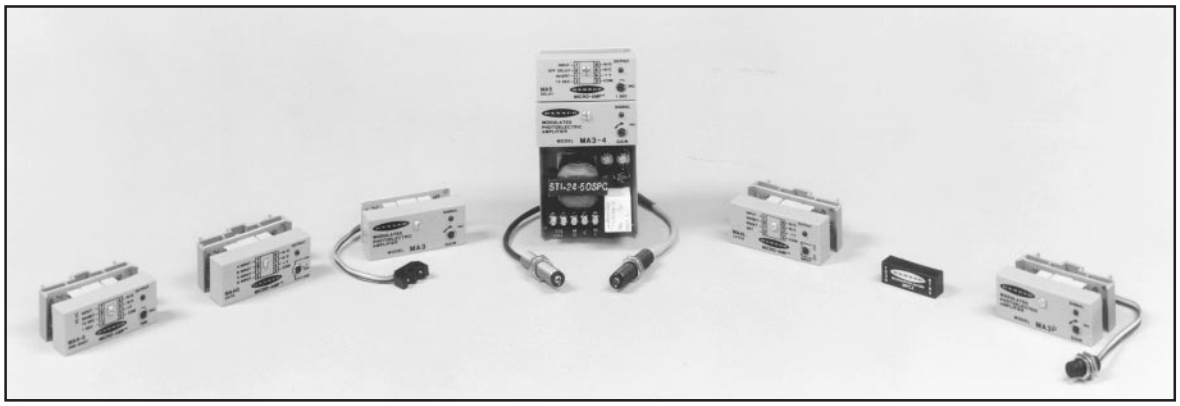


- **A versatile system of compact, high-performance remote sensors modulated amplifiers, and logic modules**
- **Remote sensors for opposed, retro, diffuse, convergent, and fixed-field sensing modes, in a variety of sizes, shapes, and housing styles to suit nearly any remote sensing application**
- **Rugged, epoxy-encapsulated amplifier modules; also logic modules for one-shot, 4-input gate (AND, NOR, XNOR), latch, and delay functions**
- **Plug-in amplifier and logic modules are track mountable for ease of installation and replacement (helpful in large systems)**
- **All modules have an output indicator for system monitoring; amplifier modules include Banner's exclusive AID™ indicator system**

Printed in USA *P/N 32885*

ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

MICRO-AMP® System



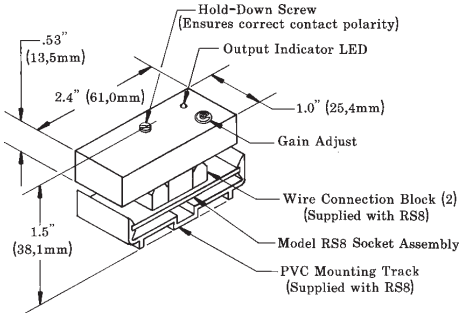
The Banner MICRO-AMP® System is a family of miniature dc modulated photoelectric amplifiers and logic modules which offer the same sensing performance as larger, conventional modules. They are the smallest photoelectric control modules ever built, and can fit easily into tight areas of machines or control panels. Built around the concept of an I/O module, they are the perfect photoelectric control device for use with computers or programmable logic controllers (PLCs). Multiple modules stack neatly on 1-inch (25mm) centers in PVC mounting track, taking only a fraction of the control panel space required by standard photoelectric modules.

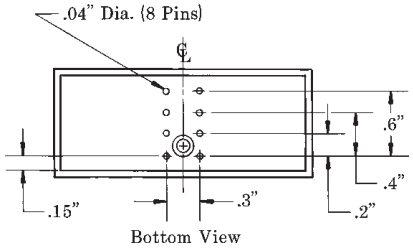
Model MA3 is a complete dc-powered modulated amplifier designed for use with Banner's SP100 Series of miniature remote sensors. Model MA3-4 is a higher-gain amplifier which is used with Banner's complement of high-performance modulated remote sensors. Building-block style control logic may be added to a system with a selection of MICRO-AMP logic modules.

Model MPC3 is similar to amplifier model MA3, except that it is specifically designed for PC board mounting in OEM sensing applications.

MICRO-AMP modules may be mounted and wired using the optional model RS8 socket (shown in the drawing at right) or they may be mounted directly to a printed circuit board (see Accessories, p. 20).

Dimension Drawing, MICRO-AMP Modules (except MPC3) with RS8 Wiring Socket





MICRO-AMP module pin configuration

Module Model	Modulated Amplifier	Logic Functions	Used with (Input)	Full Description
MA3	YES	NONE (ON/OFF)	Banner SP100 Series miniature modulated remote sensors	See pages 3-4
MA3A	YES	NONE (ON/OFF)	Banner SP100FF modulated fixed-field sensor	See page 18
MA3-4	YES	NONE (ON/OFF)	Banner high-performance remote sensors	See pages 5-10
MA4-2	MICRO-AMP logic modules are designed to accept the output signal from a MICRO-AMP amplifier and process that signal for a required logic function. MICRO-AMP logic modules themselves contain no amplifier.	ONE-SHOT	Switches, contacts, or NPN (current sinking) output of dc sensors or amplifiers, including: Banner MULTI-BEAM, MAXI-BEAM, VALU-BEAM, MINI-BEAM, and ECONO-BEAM sensors; plus MAXI-AMP and MICRO-AMP modules.	See page 11
MA4G		4-input logic gate: AND, NOR, X-NOR		See page 12
MA4L		Latch or alternate-action flip-flop		See page 13
MA5		ON-delay or OFF-delay		See page 14
MPC3 (for printed circuit board mounting)	YES	NONE (ON/OFF)	Banner SP100 Series miniature modulated remote sensors	See pages 15-16, 18

MICRO-AMP® System
MA3 and MA3P Modulated Amplifiers



Banner MICRO-AMP® modules **MA3** and **MA3P** are **modulated amplifiers designed for use with SP100 Series miniature remote sensors**. Miniature photoelectric sensors have traditionally been used as *non-modulated* devices with very limited response. MICRO-AMP amplifiers have a specially-engineered *modulated* design which brings about a dramatic improvement in the optical performance of miniature remote sensors.

MICRO-AMP modules are powered by 10 to 30 volts dc, and feature the patented Banner Alignment Indicator Device (AID™) signal strength LED. Sensor sensitivity is adjustable via a top-mounted GAIN potentiometer. Model MA3 has complementary current sinking (NPN) outputs; model MA3P has complementary current sourcing (PNP) outputs. Circuitry is epoxy-encapsulated and enclosed in a tough molded VALOX® housing. Connections may be made to the MICRO-AMP via the optional RS8 socket/wiring base, or the module may be mounted directly to a printed circuit board (page 20).

The small size and the slim ribbon-style connecting cable of SP100 Series sensors make it possible to use photoelectrics in many situations previously thought to be impractical or even impossible.

MICRO-AMP® Model MA3 Specifications

SUPPLY VOLTAGE: 10 to 30V dc at less than 20 milliamps (exclusive of load); 10% maximum ripple.

OUTPUT CONFIGURATION: two open-collector NPN (current sinking) transistor (solid-state) switches; one normally open (light operate) and one normally closed (dark operate); 150 milliamps maximum, each output. Saturation voltage less than 0.5V dc at 10 milliamp load. Off-state leakage current less than 1 microamp.

RESPONSE SPEED: 1 millisecond ON and OFF.

REPEATABILITY: 0.3 millisecond.

SENSOR LEAD LENGTH: 15 feet (4,5 m) maximum.

ADJUSTMENT: GAIN adjustment (single-turn potentiometer; adjust with small flat-blade screwdriver).

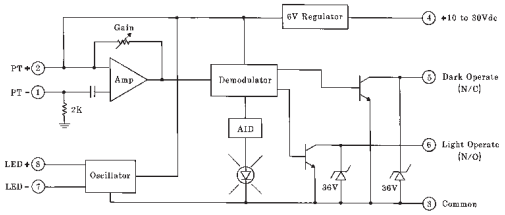
INDICATOR: exclusive Banner Alignment Indicator Device (AID™) system lights a red LED indicator whenever the sensor "sees" its own modulated light source, and pulses at a rate proportional to the strength of the received light signal.

CONSTRUCTION*: totally encapsulated plug-in package with molded VALOX® housing. Gold-flashed connection pins.

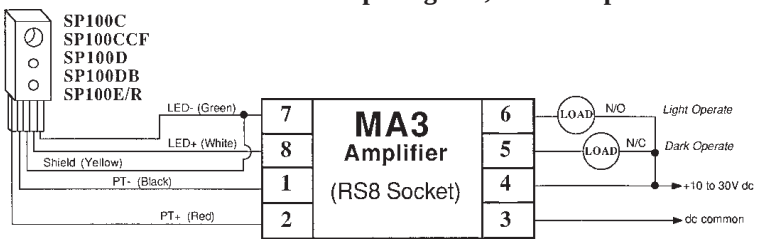
OPERATING TEMPERATURE:
0 to +70 degrees C (32 to +158 degrees F).

***A Dimension Drawing appears on page 2.**

Functional Schematic, MA3 Amplifier



Hookup Diagram, MA3 Amplifier

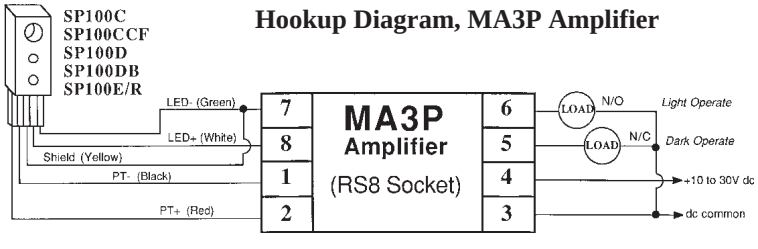


Model MA3P: PNP (current sourcing) output

Model MA3P has the same specifications and performance as the MA3 amplifier, except that the MA3P has complementary PNP outputs in place of the MA3's NPN configuration.

OUTPUT: two PNP transistors, complementary outputs; one normally open (light operate) and one normally closed (dark operate). 150 milliamps maximum, each output. *Saturation voltage* is less than 1V dc at 10 milliamps. *Off-state leakage current* is less than 1 microamp.

Hookup Diagram, MA3P Amplifier

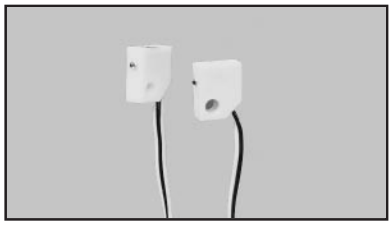




Sensors for use with MA3 and MA3P Modulated Amplifiers

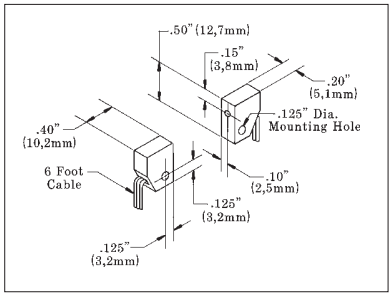
Temperature range for all miniature modulated remote sensors is 0 to 70 degrees C (+32 to 158 degrees F).
Sensors are epoxy-encapsulated and optics are hermetically sealed.

Models/Dimensions *Excess Gain* *Beam Pattern*



SP100E & SP100R

Range: 8 inches (20cm)
Beam: infrared, 880nm
Effective beam: .05 inch (1,3mm diameter)



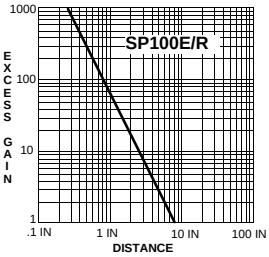
Cable (all 6-foot lengths): SP100E: 2-wire ribbon cable (white, green).

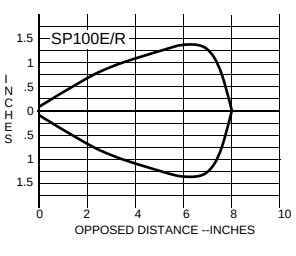
SP100R: 3-wire ribbon cable (red, black, yellow).

SP100D, DB, C, CCF: 5-wire ribbon cable (white, green, red, black, yellow). See hookup drawing.

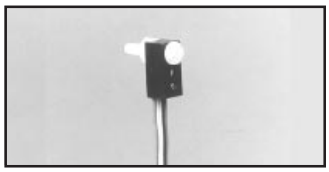
OPPOSED Mode Sensors

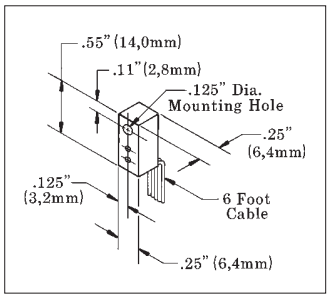
SP100E and SP100R miniature opposed sensors have a slim right-angle design which allows them to be mounted in very tight locations. The thin, flexible ribbon cable which exits from one corner may be run in any direction away from the sensing point. The SP100E and R have a wide beam angle for forgiving line-of-sight alignment. Alignment is easily made exact (and monitored) using the AID™ LED on the MICRO-AMP module.



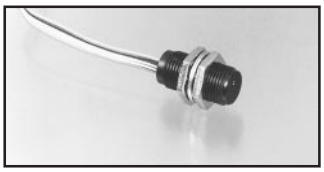


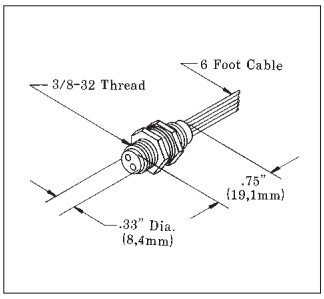
SP100D





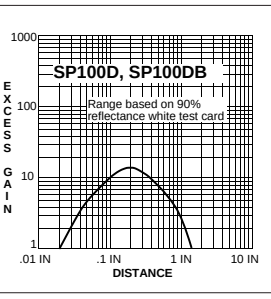
SP100DB

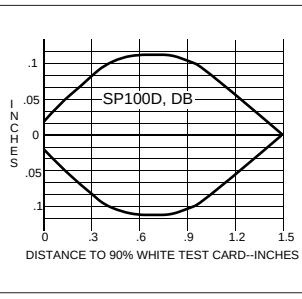




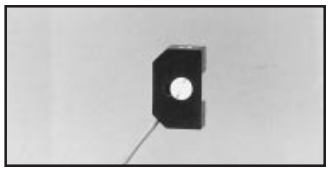
DIFFUSE Mode Sensors

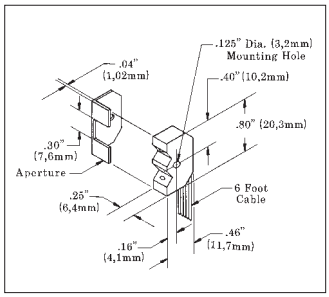
Models SP100D and SP100DB are general-purpose miniature diffuse sensors which detect the reflection of their own light from the surface of an object. The SP100D is a right-angle design which is generally held in place using a #4 (3mm) screw. The SP100DB ("B" = Barrel) is an in-line threaded barrel which typically mounts through a 3/8" (10mm) diameter hole using the lock nuts which are supplied. The optical response characteristics of these two sensors are identical.



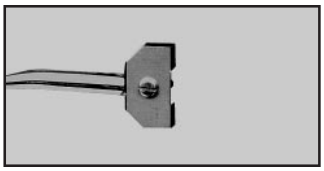


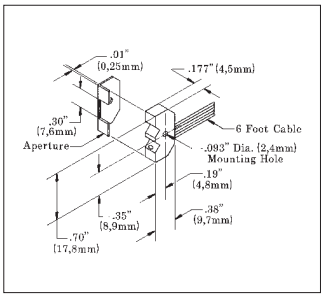
SP100C





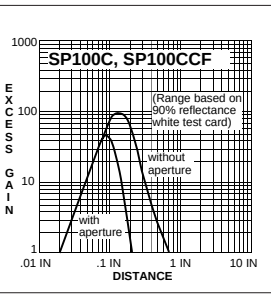
SP100CCF

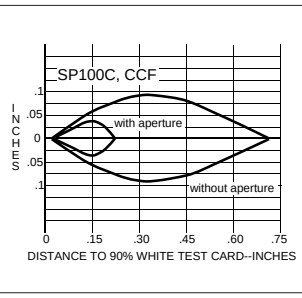




CONVERGENT Mode Sensors

Models SP100C and CCF are ideally suited to applications where depth of field is critical. The emitter and receiver are both directed at a point 0.1 inch (2,5mm) ahead of the front surface. An aperture is included which, when attached, narrows the depth of field (see curves, below). This is particularly useful when it is necessary to detect an object while ignoring another object or a surface just a fraction of an inch farther away. The high excess gain at the focus allows detection of objects of low reflectivity. The SP100C and CCF differ only in housing style. Model SP100C is for general application. Model SP100CCF is used where a narrow profile is important for mounting.





MICRO-AMP® System
MA3-4 and MA3-4P Modulated Amplifiers

Banner MICRO-AMP® module **models MA3-4** and MA3-4P are modulated amplifiers designed for use with the popular family of Banner high-performance remote sensors. When these modulated remote sensors are used with the MA3-4 or MA3-4P, their optical response is the same as when they are used with the larger MAXI-AMP™ CM Series modules.



These modules are powered by 10 to 30 volts dc. They feature the patented Banner Alignment Indicator Device (AID™) signal strength LED. Sensor sensitivity is adjustable via a top-mounted GAIN potentiometer. Circuitry is epoxy-encapsulated and protected by a tough molded VALOX® housing. Connections may be made to these modules via the optional RS8 socket/wiring base, or the module may be mounted directly to a printed circuit board.

The sensors which are used with these modules are totally encapsulated for durability and infinite life. Wide beam angles eliminate alignment problems, and high optical gain permits reliable sensing under severe conditions.

MICRO-AMP MA3-4 Specifications

SUPPLY VOLTAGE: 10 to 30V dc at less than 20 milliamps (exclusive of load); 10% maximum ripple.

OUTPUT CONFIGURATION: two open-collector NPN (current sinking) transistor (solid-state) switches; one normally-open (light operate) and one normally closed (dark operate). 150 milliamps maximum, each output. Saturation voltage less than 0.5V dc at 10 milliamp load. Off-state leakage current less than 1 microamp.

RESPONSE SPEED: 1 millisecond ON and OFF.

REPEATABILITY: 0.3 millisecond.

SENSOR LEAD LENGTH: 30 feet (9m) maximum.

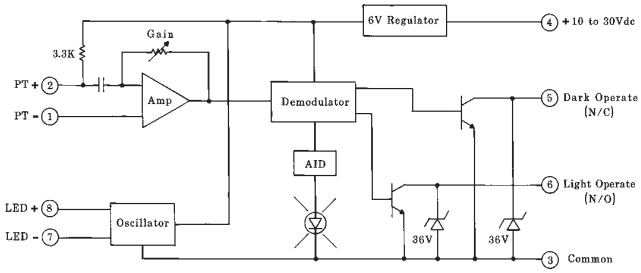
ADJUSTMENT: GAIN adjustment (single-turn potentiometer; adjust with small flat-blade screwdriver).

INDICATOR: exclusive Banner Alignment Indicator Device (AID™) system lights a red LED indicator whenever the sensor "sees" its own modulated light source, and pulses at a rate proportional to the strength of the received light signal.

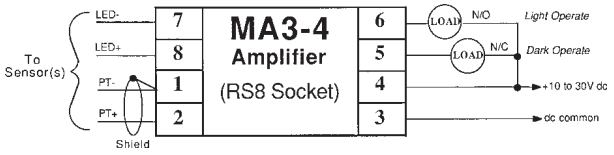
CONSTRUCTION: totally encapsulated plug-in package with molded VALOX® housing. Gold-flashed connection pins.

OPERATING TEMPERATURE:
-40 to +70 degrees C (-40 to +158 degrees F).

Functional Schematic, MA3-4



Hookup Diagram, MA3-4

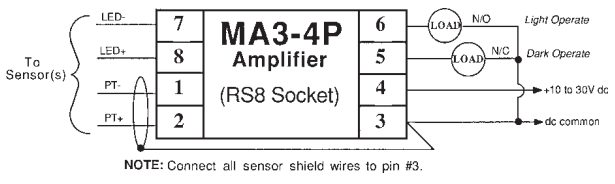


Model MA3-4P: PNP (current sourcing) output

Model MA3-4P has the same specifications and performance as the MA3-4 amplifier, except that the MA3-4P has complementary PNP outputs in place of the MA3-4's NPN configuration.

OUTPUT: two PNP transistors, complementary outputs; one normally open (light operate) and one normally closed (dark operate). 150 milliamps maximum, each output. Saturation voltage less than 1V dc at 10 milliamps. Off-state leakage current less than 1 microamp.

Hookup Diagram, MA3-4P





Sensors for use with MA3-4 and MA3-4P Modulated Amplifiers

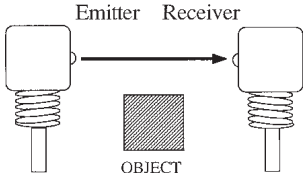
Sensors are epoxy-encapsulated and optics are hermetically sealed. Cables are 6 -1/2 feet (2m) long. 30-foot (9m) cables available by special order.

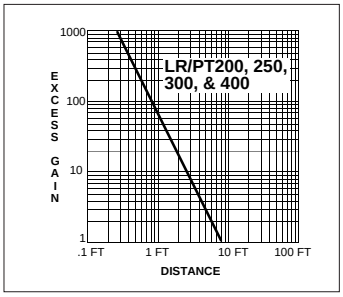
Models/Dimensions *Excess Gain* *Beam Pattern*

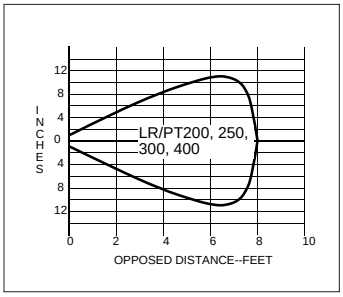
OPPOSED Mode

ALL MODELS
Range: 8 feet (2,4m)
Beam: infrared, 880nm
Effective Beam:
0.14 inch (3,6mm) dia.

PT models are receivers
LR models are emitters

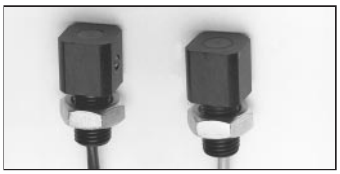


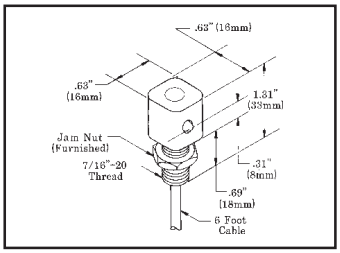




LR200 & PT200

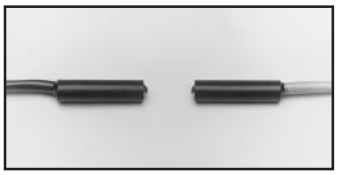
Temp. range: -40 to +100°C
Housing material: black Delrin®

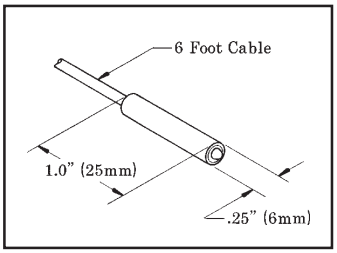




LR250 & PT250

Temp. range: -40 to +100°C
Housing material: black Delrin®

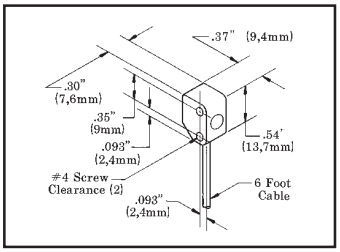




LR300 & PT300

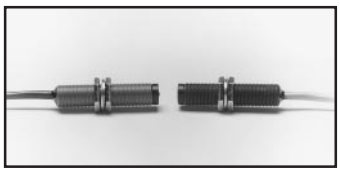
Temp. range: -40 to +80°C
Housing material: black VALOX®

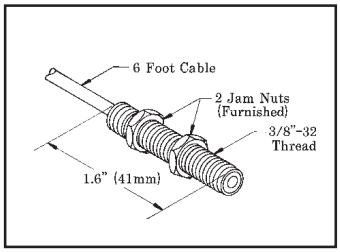




LR400 & PT400

Temp. range: -40 to +100°C
Housing material: anod. aluminum





LR/PT200, 250, 300, and 400 opposed mode remote sensors are identical electronically and optically, and differ only in their housings. All are totally epoxy-encapsulated and use hermetically sealed glass lenses to eliminate condensation inside the optical chamber. These sensors may be washed down without damage. Operating temperature is determined by the type of cable used (see specifications above). All models have a wide beam angle for forgiving line-of-sight alignment. At the same time, the effective beam of each pair is only 1/8 inch, allowing small-profile resolution and reliable response to fast-moving objects. *LR models are emitters, and PT models are receivers.*

LR200 & PT200: this is a right-angle design which mounts through a 7/16 inch (12mm) diameter hole, using the steel jam nut which is included. This pair is used most commonly on small conveyors when it is desireable to run the cable directly down to a wireway.

LR250 & PT250: these sensors feature a 1/4 inch (6,4mm) diameter smooth barrel design, and are usually held in place in a clearance hole with a small set-screw. Optional mounting blocks (shown below) are available. Model SMB250 holds the sensor in place with two set-screws. The block is then mounted to a bracket (such as model SMB300), or directly to a machine frame with two #6 screws. Block model SMB250C holds an LR & PT250 together to converge at approximately 1/2 inch ahead of the block.

LR & PT300: this is a miniature right-angle design which is mounted in place using two #4 screws. This pair uses a very flexible, low-profile 2-wire cable. Despite their small size, the optical performance of the LR/PT300 is equal to the other remote sensor pairs.

LR400 & PT400: the 3/8 inch (9,5mm) diameter threaded barrel design makes the LR/PT400 the most versatile and most popular remote opposed sensor pair. They are easily mounted through clearance holes using the jam nuts which are supplied. They may be used with optional L4 or L16 lenses for extended range and/or higher excess gain. The addition of an L4 lens on both the LR and PT400 will increase their range from 8 feet to 40 feet and increase the excess gain at any distance by a factor of 25X. A pair of L16 lenses will increase available excess gain by a factor of 250X.

L4 lens



L16 lens



The LR/PT400 pair is often used at close range with optional AP400 aperture assemblies to create a very small and well-defined effective beam for resolving small profiles, increasing sensing repeatability, or easing response time requirements.

SMB250



SMB250C



AP400 apertures



Aperture model	Aperture size
AP400-010	.010" dia.
AP400-015	.015" dia.
AP400-040	.040" dia.
AP400-030R	.030" x .125"

Sensors for use with MA3-4 and MA3-4P Modulated Amplifiers

Sensors are epoxy-encapsulated. Cables are 6-1/2 feet (2m) long. 30-foot (9m) cables available by special order.

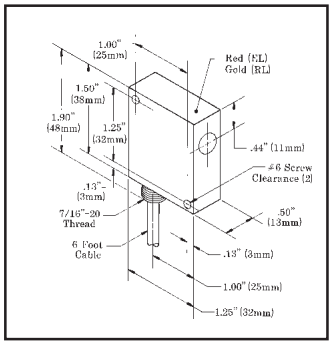
Models/Dimensions ***Excess Gain*** ***Beam Pattern***

SP300EL & SP300RL

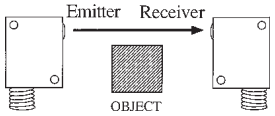
Range: 50 feet (15m)
Effective Beam: .5 inch (13mm) dia.

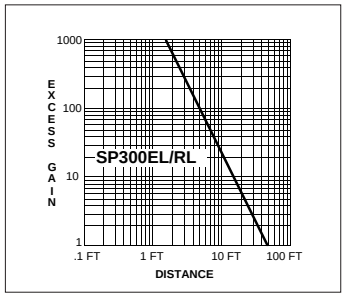
Temp. range: -40 to +100°C
Housing material: anodized aluminum

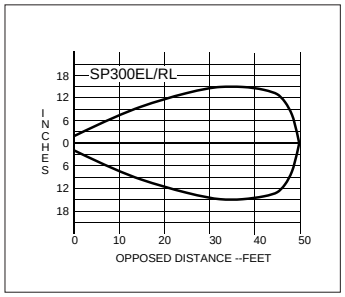




Long Range OPPOSED Mode







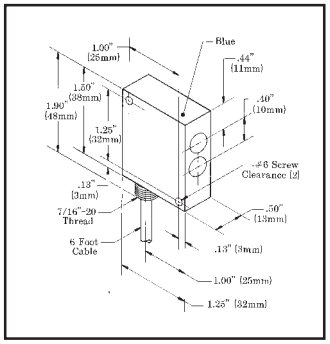
Emitter-receiver pair **SP300EL/RL** are extremely rugged and are totally encapsulated in anodized aluminum housings. The threaded hub at the cable exit allows for the use of flexible armored cable or protective PVC tubing with the addition of compression gland model CF7-16. This pair uses collimating lenses to increase range. These sensors should also be used at short ranges for their high excess gain or to avoid optical "crosstalk" in situations which require several pairs to be mounted adjacent to one another.

SP300L

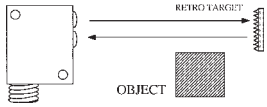
Range: 15 feet (4,5m) with BRT-3 retroreflector
Temp. range: -40 to +80°C

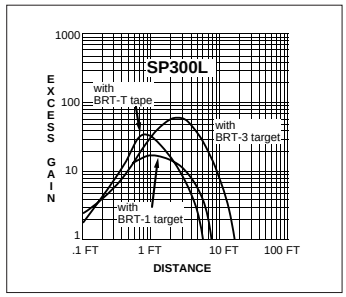
Housing material: blue anodized aluminum

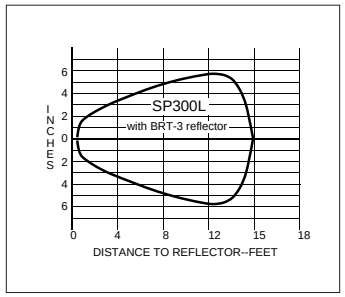




RETROREFLECTIVE Mode





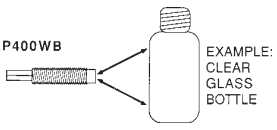


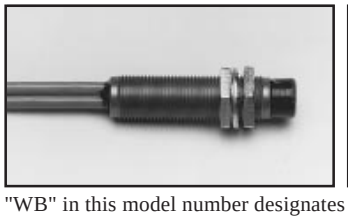
Model **SP300L** is a remote retroreflective sensor with the same rugged design as the SP300EL/RL, described above. Its useable range is from 6 inches to 15 feet (0,2 to 4,5m) using the model BRT-3 retroreflector.

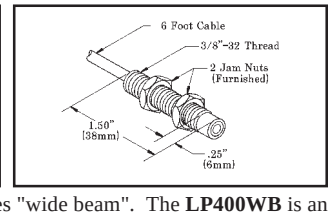
If the object that is to break the beam has a shiny surface, then the SP300L and its retroreflector should be mounted so that the beam is at an angle of 10 degrees or more to that surface in order to eliminate false signals which are caused by proxing.

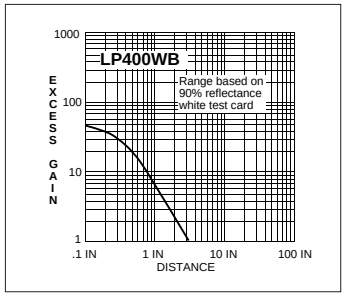
LP400WB DIVERGENT Mode

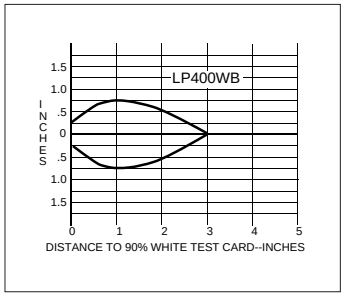
Range: 3 inches (76mm)
Temp. range: -40 to +80°C
Housing material: blue anodized aluminum











"WB" in this model number designates "wide beam". The **LP400WB** is an infrared divergent mode (wide angle diffuse mode) sensor which is particularly forgiving for reflectively sensing transparent or translucent materials or for sensing objects with irregular surfaces (e.g.- webs with "flutter"). The optics are such that even small threads or wires .005" (0,1mm) or greater in diameter may be detected when they pass within .25" (6mm) of the sensor's plastic lens. Due to its wide response pattern, the LP400WB should not be used for precise positioning control, nor should it be mounted with its lens recessed into a hole.

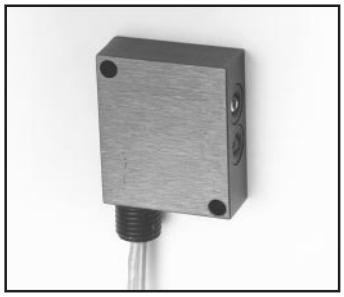
Sensors for use with MA3-4 and MA3-4P Modulated Amplifiers

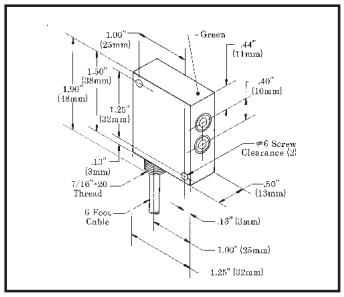
Sensors are epoxy-encapsulated. Cables are 6-1/2 feet (2m) long. 30-foot (9m) cables available by special order.

Models/Dimensions *Excess Gain* *Beam Pattern*

SP300D

Range: 12 inches (30cm) both models
Housing material (SP300D):
green anodized aluminum

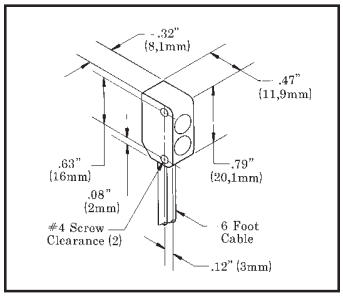




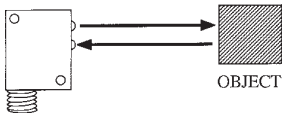
SP320D

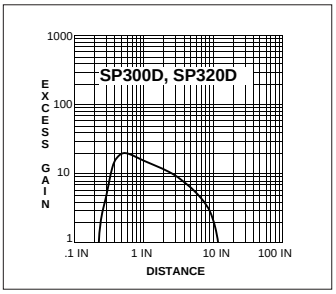
Temp. range: -40 to +80°C both models
Housing material (SP320D):
black VALOX®

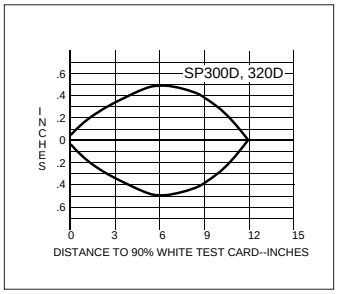




DIFFUSE Mode





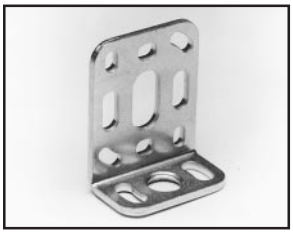


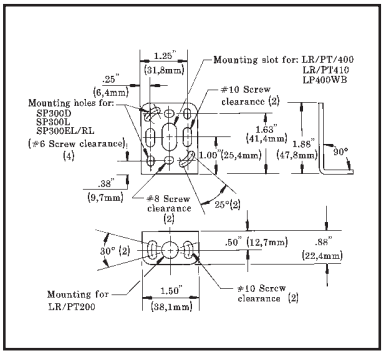
SP300D: the SP300D is the diffuse mode version of the SP300L with the same rugged aluminum housing and totally encapsulated construction. The glass lenses are hermetically sealed, which eliminates any possibility of condensation inside the lenses and allows operation in adverse environments like steam washdown and high vibration. The SP300D may be mounted by its through-holes or with the SMB300 bracket, as shown below.

SP320D: model SP320D is identical to the SP300D, except for its housing. The 320 is a miniature plastic package, designed to fit into very tight locations. It mounts using two #4 (3mm) screws. The SP320D and the SP300D are excellent for nearly any presence sensing application.

SMB300

Universal Mounting Bracket for SP300 Sensors



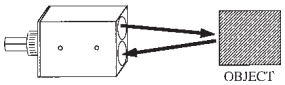


Accessory bracket model SMB300 is designed for 2-axis universal mounting of sensor models SP300EL, SP300RL, SP300L, and SP300D. These sensors are affixed to the SMB300 with two #6 (3,5mm) screws. The bracket, in turn, mounts with two #10 (5mm) screws.

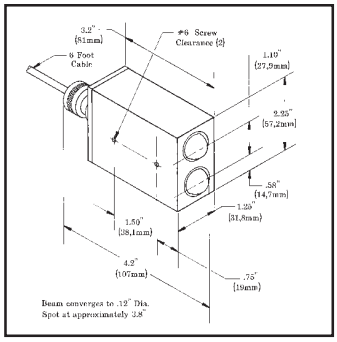
In addition, as indicated by the dimension drawing, the SMB300 has a clearance slot for mounting LR400, PT400, and LP400WB barrel sensors. LR & PT200 sensors may be mounted with the SMB300, using its 7/16-20 threaded hole and steel jam nut, which is supplied with the sensors. LR250 and PT250 sensors may be used with the SMB300 when the SMB250 block is used. Also, two SMB250 blocks may be attached to the SMB300 bracket and angled to mechanically converge an LR & PT250 sensor pair.

SP1000V CONVERGENT Mode

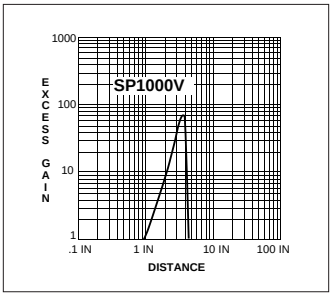
Range: focus at 3.8 inches (96mm)
Temp. range: -40 to +80 degrees C
Housing material: black anodized aluminum

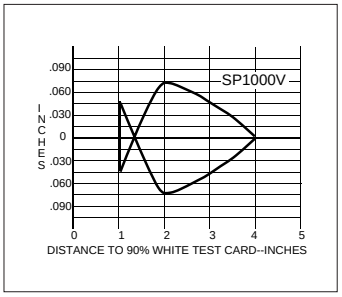






The **SP1000V** is a convergent mode sensor that produces a very small 0.1 inch (2,5mm) diameter sensing image at a point exactly 3.8 inches (96mm) from its glass lenses. As the excess gain curve illustrates, the SP1000V has a very sharp drop-off of gain beyond the focus point. This feature makes it an excellent choice for detecting a small part which is only a fraction of an inch in front of another surface, such as parts on a conveyor (viewed from above). It is also ideal for fill level detection and for precise positioning control, in lieu of opposed sensing.





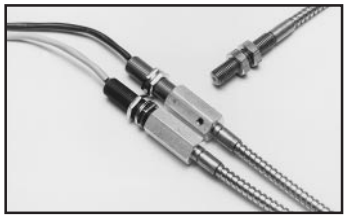
Sensors for use with MA3-4 and MA3-4P Modulated Amplifiers

Sensors are epoxy-encapsulated and optics are hermetically sealed. Cables are 6-1/2 feet (2m) long. 30-foot (9m) cables available by special order.

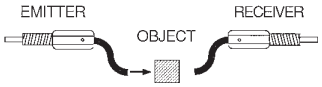
Models/Dimensions ***Excess Gain*** ***Beam Pattern***

FIBER OPTIC Mode

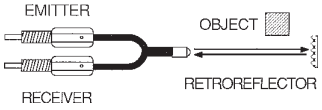
glass fiber optics



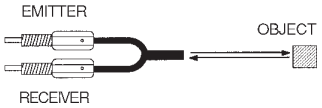
OPPOSED MODE



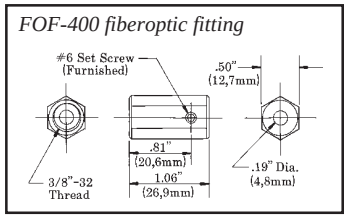
RETROREFLECTIVE MODE



DIFFUSE MODE



FOF-400 fiberoptic fitting



LR400 & PT400

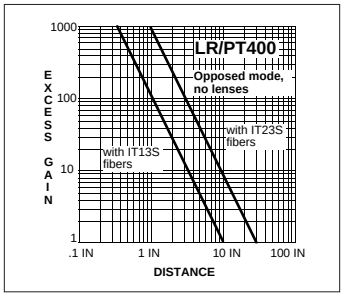
with FOF-400 fittings and fiber optics

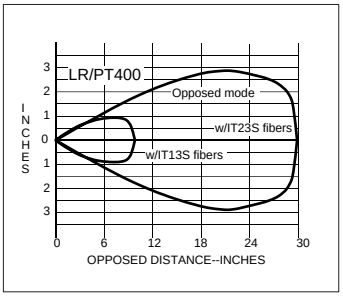
Range: see excess gain curves
Temp. range: -40 to +100°C

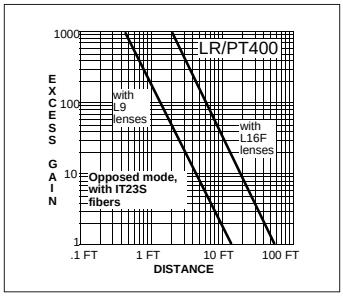
The threaded barrel design of the **LR400 and PT400** permit the connection of any Banner glass fiber optic assembly by using two model FOF-400 fittings. The sensors are typically mounted through a 3/8 inch (10mm) diameter clearance hole, with the FOF-400 fittings threaded onto them after mounting. Setscrews in the fittings lock the fibers in place, but allow rapid replacement without disturbing any electrical wiring.

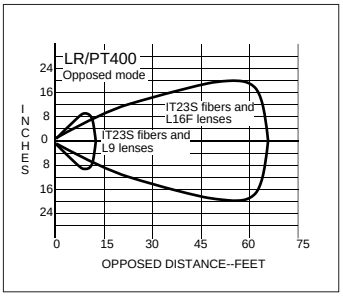
As the excess gain curves show, the LR/PT400 combination produces a high-performance fiber optic sensing system. With the amplifier's 1 millisecond response time, this system can be used for almost any fiber optic requirement.

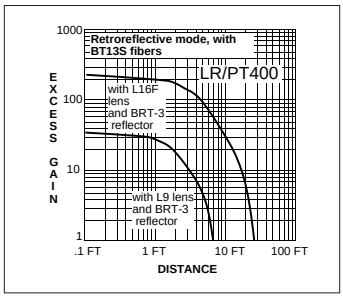
Fiber optic information:
IT13S: individual assembly .06 in. (1,5mm) dia. bundle
IT23S: individual assembly .12 in. (3mm) dia. bundle
BT13S:bifurcated assembly .06 in. (1,5mm) dia. bundle
BT23S:bifurcated assembly .12 in. (3mm) dia. bundle
L9: .5 in. (12mm) dia. lens
L16F: 1.0 in. (25mm) dia. lens

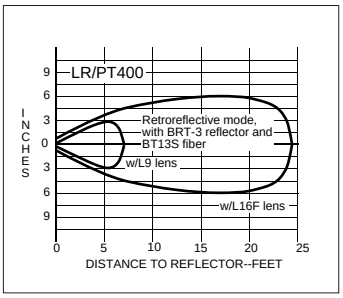


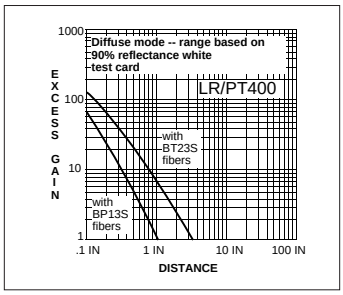


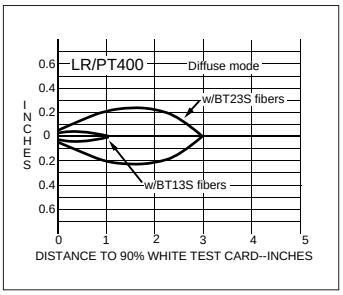










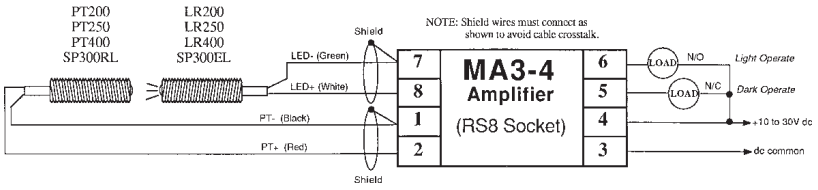


Sensor Hookup Diagrams for MA3-4 MICRO-AMP Modules (continued on page 10)

The following hookup diagrams include all of the remote sensors for use with the model MA3-4 modulated amplifier module. It is important to note how the shield wire of a remote sensor is wired. The shield wire is the uninsulated wire in each sensor cable. Failure to connect the shield as shown may result in false operation of the amplifier. When wiring emitters, it is good practice to connect the positive wire first. LEDs are sensitive to application of the wrong voltage, and can easily be destroyed.

NOTE: only one sensor may be connected to each MA3-4 amplifier.

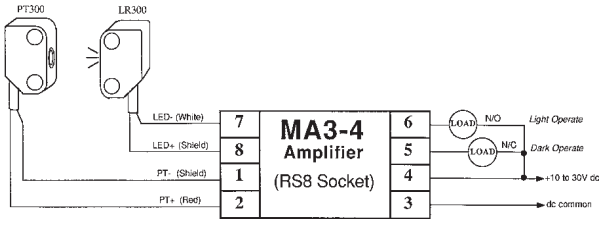
Hookup of LR/PT200, 250, 300, and 400



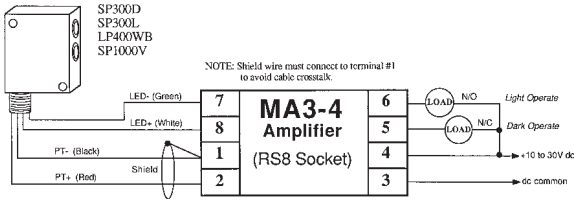
NOTE: Shield wires must be connected as shown to avoid cable crosstalk.

Sensor Hookup Diagrams for MA3-4 MICRO-AMP Modules (continued)

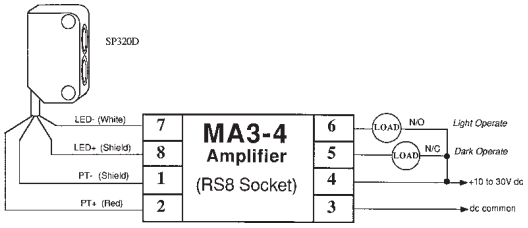
Hookup of LR300 and PT300



Hookup of SP300D, SP300L, LP400WB, SP1000V



Hookup of SP320D



IMPORTANT : Cable Splicing Information

Remote sensor cables may be run up to 30 feet (9m) away from the MA3-4 amplifier. All sensor models are available from the factory with 30 feet of cable, installed as an option.

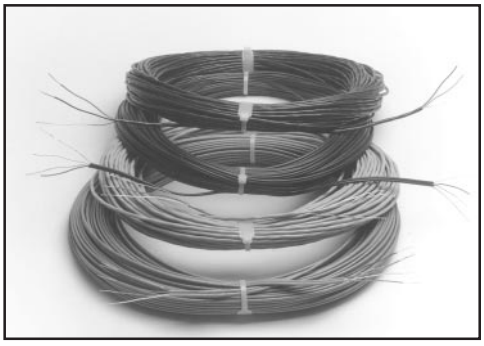
When splicing additional cable to the standard 6-1/2 foot length, it is important to use a separate shielded cable for emitter and receiver wires. Combining emitter and receiver wires together in the same cable (even if the cable is shielded) will result in direct coupling of the emitter signal to the receiver leads.

This is called "cable crosstalk" and will not allow full amplifier sensitivity setting without an amplifier "lock on" situation, which appears as a continuous LIGHT condition. Banner offers 100 foot (30m) lengths of sensor extension cable (see below) which, if used for cable splicing, will minimize the chances for cable crosstalk.

Accessories for High Performance Modulated Remote Sensors

Extension Cable

Modulated remote sensors require specially designed cable for efficient sensor performance. Extension cable is available in 100 foot (30m) lengths.



Extension Cable Model	Used on Sensor Models	# of Wires	Wire Colors
ESC-100	LR200, LR250, LR400, SP300EL	3	White, Green, Shield
RSC-100	PT200, PT250, PT400, SP300RL	3	Red, Black, Shield
SSC-100	SP300D, SP300L, LP400WB, SP1000V	5	White, Green, Red, Black, Shield
EC300E-100	LR300	2	White, Shield
EC300R-100	PT300	2	Red, Shield
EC320-100	SP320D	4	White, Shield, Red, Shield

Cable Protection

AC-6 6 feet (1,8m)
AC-30 30 feet (9m)
This is mild-steel flexible tubing used with the compression fittings, at right, to achieve maximum protection to sensor cables.
I.D. = 5/16"; O.D. = 7/16".

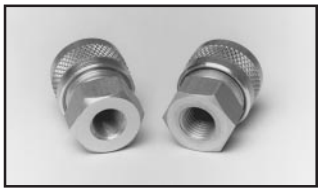


PVC-6 6 feet (1,8m)
PVC-30 30 feet (9m)
Heavy duty PVC tubing used to protect sensor cable in applications involving moisture and/or corrosive materials. I.D. = 1/4"; O.D. = 3/8".



Compression Fittings used to Attach Protective Tubing to Remote Sensors

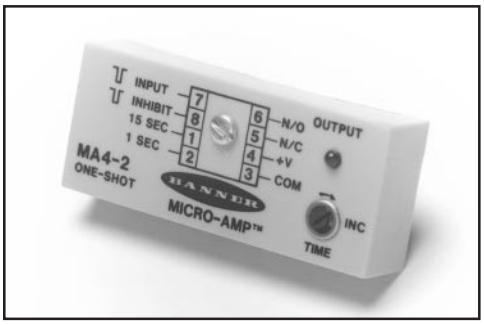
CF3-8 3/8"-32 thread
CF7-16 7/16"-20 thread



Compression Fitting Model	Used to Attach Tubing to these Models
CF3-8	LR400, PT400, LP400WB
CF7-16	SP300EL, SP300RL, SP300D, SP300L, LR200, PT200

MICRO-AMP® System
MA4-2 One-Shot Logic Module

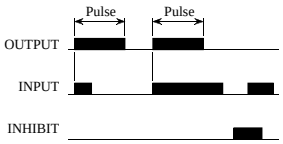
MICRO-AMP® module MA4-2 is a plug-in one-shot logic module with adjustable pulse length. It is designed as a way to easily add one-shot timing to a MICRO-AMP system which uses an MA3 or MA3-4 amplifier. It may also be used to add a one-shot timer to any current sinking DC device or to a system which offers a contact closure output.



A low-going logic INPUT signal at pin #7 of the module activates a one-shot output at both pins #5 and #6, unless a low-going logic INHIBIT signal is present at pin #8 *when the input occurs.* Both NORMALLY OPEN (pin #6) and NORMALLY CLOSED (pin #5) outputs are available. Both are NPN open-collector (current sinking) transistors, each capable of switching up to 150 milliamps.

Three pulse duration time ranges are selectable. The .001 to .1 second range is standard, and .01 to 1 second and 1 to 15 second ranges are selected by connecting the appropriate module pin to pin #3 (dc common). The MA4-2 is a retriggerable-type one-shot, but may easily be programmed to the non-retriggerable mode by connecting pin #6 (N/O output) to pin #8 (INHIBIT input).

One-shot logic, MA4-2:



MICRO-AMP MA4-2 Specifications

SUPPLY VOLTAGE: 10 to 30V dc at less than 20 milliamps (exclusive of load); 10% maximum ripple.

INPUTS: INPUT and INHIBIT both respond to a logic "low" signal (less than 2V dc). A logic "high" is at least 6V dc or an open circuit. Inputs must be capable of sinking at least 4 milliamps. Inputs may be derived from limit switches or from dc sensors with NPN (current sinking) output transistors.

RESPONSE SPEED: INPUT and INHIBIT will respond to a low signal or high signal of 1 millisecond duration or longer.

OUTPUT CONFIGURATION: two open-collector NPN transistors with complementary outputs (one normally open, one normally closed). Maximum sinking current 150 milliamps, each output. Saturation voltage less than 0.5V dc at 10 milliamps. Off-state leakage current less than 1 microamp.

PULSE DURATION: standard range is .001 to .1 second. Programmable ranges are .01 to 1 second and 1 to 15 seconds. Select the .01 to 1 second range by connecting pin #2 to pin #3. Select the 1 to 15 second range by connecting #1 to #3.

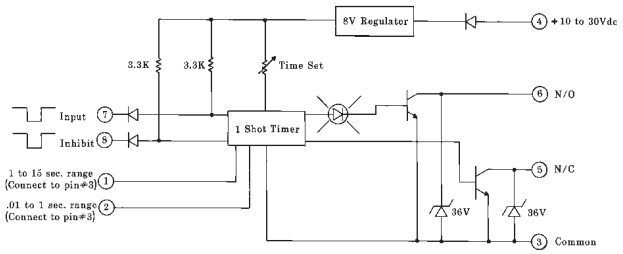
TIMING ADJUSTMENT: single-turn timing potentiometer allows adjustment of pulse duration within the selected range (use small flat-bladed screwdriver).

INDICATOR: red LED indicator on the top of the module lights whenever the N/O output is conducting (i.e. when the N/O output is closed and the N/C output is open).

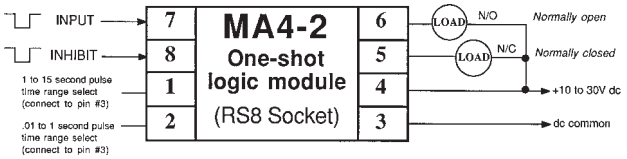
CONSTRUCTION: totally encapsulated plug-in package with molded VALOX® housing. Gold-flashed connection pins.

OPERATING TEMPERATURE: 0 to 70 degrees C (32 to 158 degrees F).

Functional Schematic, MA4-2 ONE-SHOT Module

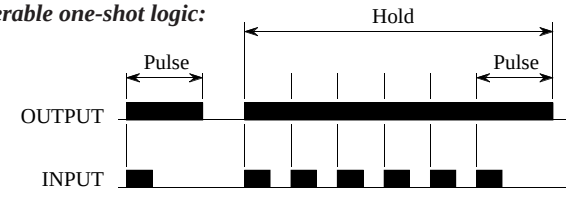


Hookup Diagram, MA4-2 ONE-SHOT Module



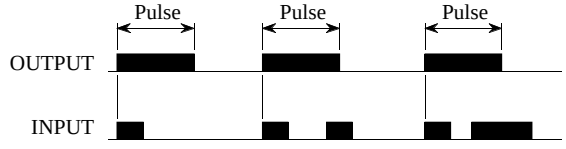
There are two types of basic "one-shots": RETRIGGERABLE and NON-RETRIGGERABLE. The output pulse timing of a retriggerable one-shot is re-started with the reoccurance of every input. The output will remain "on" as long as the time between consecutive inputs is shorter than the one-shot pulse time (see timing diagram, below).

Retriggerable one-shot logic:



A non-retriggerable one-shot timer must complete a pulse before it will accept any new input signals. Non-retriggerable one-shots sometimes offer an advantage in indexing or registration control applications where multiple input signals are possible during advance of the product. The MA4-2 may be programmed for the non-retriggerable mode by connecting pin #6 to pin #8.

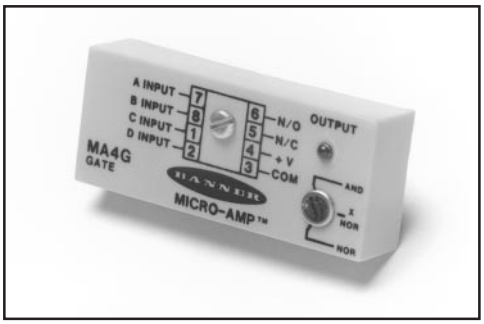
Non-retriggerable one-shot logic:



MICRO-AMP® System
MA4G 4-input Gate Logic Module

MICRO-AMP® module MA4G is a 10 to 30V dc, plug-in, 4-input logic gate module. It offers three selectable logic modes: "AND", "NOR", and "X-NOR" (exclusive "NOR"). In the AND gate mode, the output(s) will change state when all four inputs are low simultaneously. The NOR logic mode requires that all four inputs be high at the same time for the output(s) to change state. The output(s) will change state in the X-NOR mode when all four inputs are simultaneously *either* high *or* low. The MA4G may be used as a 2, 3 or 4-input gate. Unused inputs are simply tied low (to pin #3) or left unconnected (high), depending upon the logic mode in use.

The MA4G directly accepts the outputs of other MICRO-AMP modules plus the NPN (current sinking) output of self-contained dc sensors.



MICRO-AMP MA4G Specifications

SUPPLY VOLTAGE: 10 to 30V dc at less than 20 milliamps (exclusive of load); 10% maximum ripple.

INPUTS: INPUT and INHIBIT both respond to a logic "low" signal (less than 2V dc). A logic "high" is at least 6V dc or an open circuit. Inputs must be capable of sinking at least 4 milliamps. Inputs may be derived from limit switches or from dc sensors with NPN (current sinking) output transistors.

RESPONSE SPEED: all INPUTS will respond to a low signal or high signal of 1 millisecond duration or longer.

OUTPUT CONFIGURATION: two open-collector NPN transistors with complementary outputs (one normally open, one normally closed). Maximum sinking current 150 milliamps, each output. Saturation voltage less than 0.5V dc at 10 milliamps. Off-state leakage current less than 1 microamp.

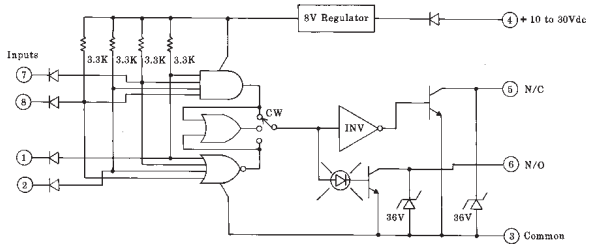
SELECTOR SWITCH: single-turn potentiometer selects logic mode. Fully clockwise = NOR mode; fully counterclockwise = AND mode; midpoint = X-NOR mode.

INDICATOR: red LED indicator on the top of the module lights whenever the N/O output is conducting.

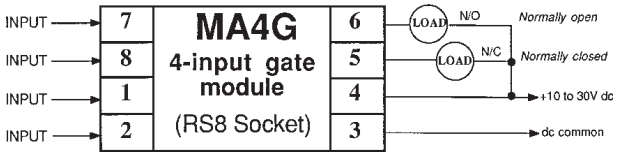
CONSTRUCTION: totally encapsulated plug-in package with molded VALOX® housing. Gold-flashed connection pins.

OPERATING TEMPERATURE:
0 to 70 degrees C (32 to 158 degrees F).

Functional Schematic, MA4G LOGIC Module



Hookup Diagram, MA4G LOGIC Module



Truth Table

This table lists the various input states and their corresponding outputs available in each logic mode. The key to reading the table is given below. Logic statements in the table read down the columns. For example, in the first column, if the selector control is at "AND" and all four inputs are logic low, the MA4G's N/O output is low, the N/C output is high, and the LED indicator is "on".

Truth Table Key
H = logic HIGH
L = logic LOW
X = either HIGH or LOW (does not matter)

"AND": all inputs low energizes N/O output.
Any input(s) high energizes N/C output.

"NOR": all inputs high energizes N/O output.
Any input(s) low energizes N/C output.

"X-NOR" ("exclusive NOR"):
All inputs the same energizes N/O output.
All inputs not the same energizes N/C output.

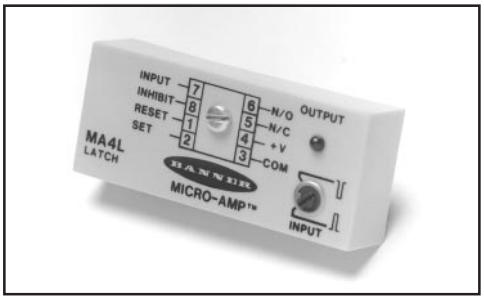
MA4G LOGIC TRUTH TABLE

SELECTOR	AND	AND	NOR	NOR	X-NOR	X-NOR	X-NOR
INPUT	L	H	H	L	L	H	H
INPUT	L	X	H	X	L	H	L
INPUT	L	X	H	X	L	H	X
INPUT	L	X	H	X	L	H	X
N/O OUTPUT	L	H	L	H	L	L	H
N/C OUTPUT	H	L	H	L	H	H	L
Indicator LED	ON	OFF	ON	OFF	ON	ON	OFF

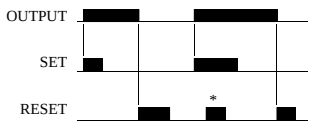
MICRO-AMP® System
MA4L Latch Logic Module

MICRO-AMP® model MA4L offers two latching logic modes. It can be latched and unlatched with low-going signals to its SET and RESET inputs. It also will function as an edge-triggered "D" flip-flop latch when signals are presented to its INPUT pin. The edge-triggered latch may be interrogated with a second signal at the INHIBIT or the RESET pin. In this mode, the MA4L is very useful in inspection/rejection applications. The MA4L may also be wired for alternate-action divide-by-two logic (see logic diagram, below).

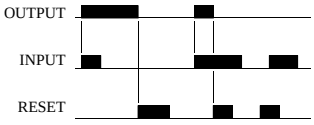
The MA4L directly accepts the outputs of other Banner MICRO-AMP modules plus the NPN (current sinking) output of self-contained dc sensors.



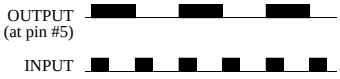
Set/reset latch mode, MA4L:



Edge-triggered latch mode, MA4L:



Flip-flop (÷2) logic, MA4L:



NOTE: Jumper pin #8 (INHIBIT) to pin #6 (N/O Output)

MICRO-AMP MA4L Specifications

SUPPLY VOLTAGE: 10 to 30V dc at less than 20 milliamps (exclusive of load); 10% maximum ripple.

INPUTS: INPUT, INHIBIT, RESET, and SET signals are buffered for 1-millisecond response. A logic "low" must be less than 2V dc. A logic "high" is at least 6V dc or an open circuit. Inputs must be capable of sinking at least 4 milliamps. Inputs may be derived from limit switches or from dc sensors with NPN (current sinking) output transistors. INPUT signal polarity is selectable for either high-going or low-going transition.

OUTPUT CONFIGURATION: two open-collector NPN transistors with complementary outputs (one normally open, one normally closed). Maximum sinking current 150 milliamps, each output. Saturation voltage less than 0.5V dc at 10 milliamps. Off-state leakage current less than 1 microamp.

RESPONSE SPEED: all inputs will respond to a low signal or a high signal of 1 millisecond duration or longer.

CIRCUIT PROTECTION: reverse voltage polarity protected. Latch comes up reset after power-up.

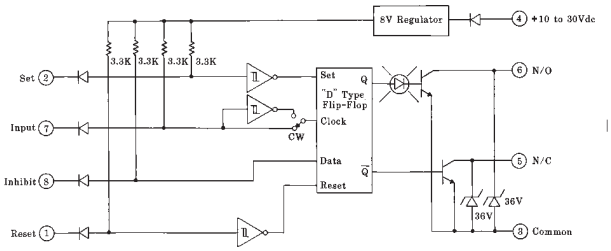
SELECTOR SWITCH: single-turn potentiometer selects response polarity of INPUT. Fully clockwise = high-going transition; fully counterclockwise = low-going transition.

INDICATOR: red LED indicator on the top of the module lights whenever the N/O output is conducting.

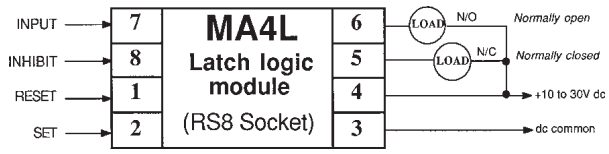
CONSTRUCTION: totally encapsulated plug-in package with molded VALOX® housing. Gold-flashed connection pins.

OPERATING TEMPERATURE:
0 to 70 degrees C (32 to 158 degrees F).

Functional Schematic MA4L LATCH Module



Hookup Diagram, MA4L LATCH Module



Logic Truth Tables

TRUTH TABLE KEY

H = logic HIGH
L = logic LOW
X = either HIGH or LOW (does not matter)

↘ = HIGH to LOW transition

↗ = LOW to HIGH transition

NC = no change of state

**NOTE: both outputs conduct in this condition (*).*

SET-RESET LATCH MODE (no connections to INPUT or INHIBIT)			
SET (pin #2)	H	L	L
RESET (pin #1)	L	H	L
N/O OUTPUT (pin #6)	H	L	L*
N/C OUTPUT (pin #5)	L	H	L*
Indicator LED	Off	On	On

EDGE-TRIGGERED LATCH MODE (no connections to SET)						
Input Polarity:	⊓			⊔		
INPUT (pin #7)	↘	↘	↗	↗	↗	↘
INHIBIT (pin #8) or RESET (pin #1)	H	L	X	H	L	X
N/O OUTPUT (pin #6)	L	H	NC	L	H	NC
N/C OUTPUT (pin #5)	H	L	NC	H	L	NC
Indicator LED	On	Off	NC	On	Off	NC

MICRO-AMP® System
MA5 Delay Logic Module

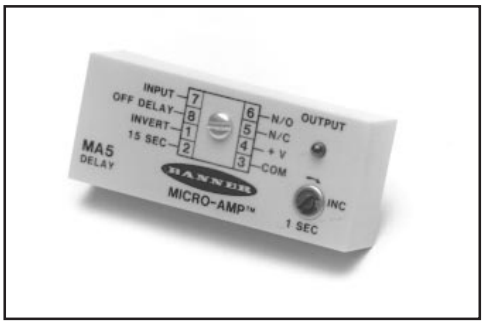
MICRO-AMP® model MA5 is a plug-in delay logic module with adjustable delay timing. It is designed as a way to easily add an ON DELAY or an OFF DELAY timer to a MICRO-AMP system which uses an MA3 or MA3-4 amplifier. It may also be used to add a delay timer to any current sinking dc device or to a system which offers a contact closure output.

A low-going logic INPUT signal at pin #7 of the module activates an ON DELAY timer. If the signal remains longer than the set ON DELAY time, the output at both pins #5 and #6 will change state. If pin #8 is connected to pin #3, the MA5 is converted to an OFF DELAY timer. In the OFF DELAY mode, an output will occur immediately when an input signal appears at pin #7, and the output will remain "on" after the input is removed for the OFF DELAY time period.

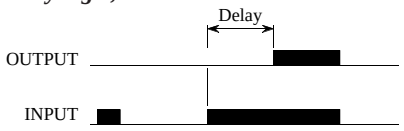
The MA5 may be programmed to respond to a high-going input signal by connecting pin #1 to pin #3. Both NORMALLY OPEN (pin #6) and NORMALLY CLOSED (pin #5) outputs are available (simultaneously). Both outputs are NPN open-collector (current sinking) transistors, each capable of switching up to 150 milliamps.

Two delay time ranges are selectable. The .01 to 1 second range is standard, and a 1 to 15 second range may be programmed by connecting pin #2 to pin #3. A potentiometer allows fine adjustment within each time range.

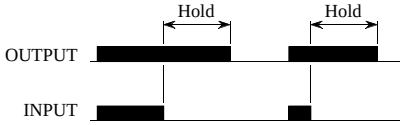
The MA5 may be mounted and wired using the optional RS8 socket, or it may be wired into a printed circuit board either directly or by using the model RS8K PC board socket.



On-delay logic, MA5:



Off-delay logic, MA5:



MICRO-AMP MA5 Specifications

SUPPLY VOLTAGE: 10 to 30V dc at less than 20 milliamps (exclusive of load); 10% maximum ripple.

INPUTS: A logic "low" must be less than 2V dc) A logic "high" is at least 6V dc or an open circuit. Connecting pin #1 to pin #3 (dc common) causes the MA5 to respond to "high-going" signals. Inputs must be capable of sinking at least 4 milliamps. Inputs may be derived from limit switches or from dc sensors with NPN (current sinking) output transistors.

RESPONSE SPEED: INPUT will respond to a low or high signal of 1 millisecond or longer duration.

OUTPUT CONFIGURATION: two open-collector NPN transistors with complementary outputs (one normally open, one normally closed). Maximum sinking current 150 milliamps, each output. Saturation voltage less than 0.5V dc at 10 milliamps. Off-state leakage current less than 1 microamp.

DELAY SELECTION: connect pin #8 to pin #3 (dc common) for OFF DELAY operation. For ON DELAY operation, leave pin #8 unconnected.

DELAY DURATION: standard range is .01 to 1 second. Select the 1 to 15 second range by connecting pin #2 to pin #3.

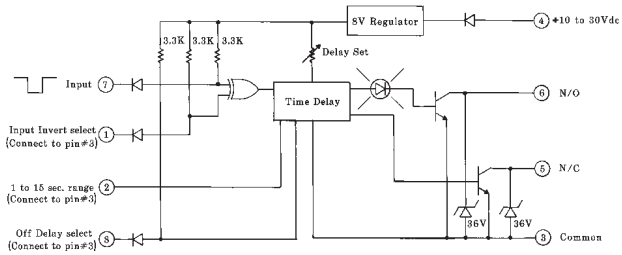
TIMING ADJUSTMENT: single-turn timing potentiometer allows adjustment of delay time within the selected range (use small flat-bladed screwdriver for adjustment).

INDICATOR: red LED indicator on the top of the module lights whenever the N/O output is conducting.

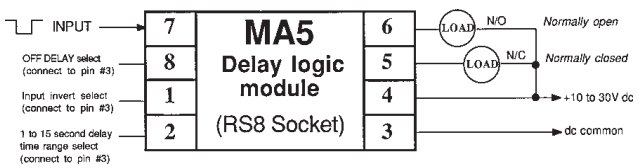
CONSTRUCTION: totally encapsulated plug-in package with molded VALOX® housing. Gold-flashed connection pins.

OPERATING TEMPERATURE:
0 to 70 degrees C (31 to 158 degrees F).

Functional Schematic, MA5 DELAY Module

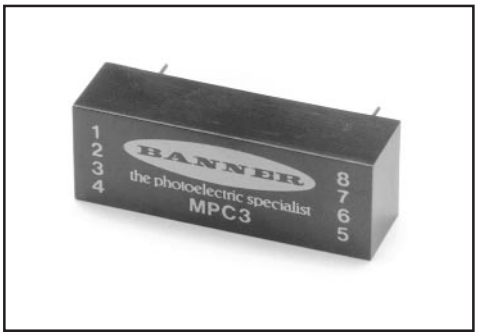


Hookup Diagram, MA5 DELAY Module



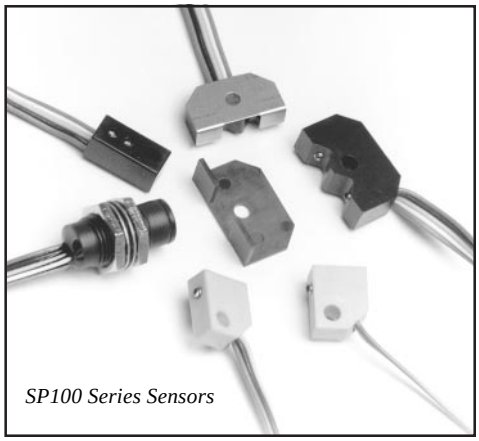
MICRO-AMP® System
MPC3 Miniature Modulated Amplifier for direct PC-board mounting

Model MPC3 is a modulated LED photoelectric amplifier which utilizes custom CMOS integrated circuitry. It contains all the circuitry necessary to modulate nearly any Light-Emitting Diode (LED) and to amplify and demodulate the light received by a phototransistor. The outputs are conventional buffered complementary CMOS gates.



The MPC3 is designed to work with the Banner SP100 series miniature modulated remote sensors. However, it may be used with nearly any LED and phototransistor pair, as supplied by most major semiconductor manufacturers. The small size and low cost of the MPC3 permit its use in OEM equipment where conventional photoelectric controls are not justified, or where non-modulated sensors are now being used. Typical OEM applications include duplicating machines, semiconductor processing equipment, label sensors, vending machines, vibratory feeder controls, robotic sensors, and automatic testing equipment.

The MPC3 also contains the patented Banner "AID™" (Alignment Indicator Device) circuitry, which shows the strength of the received signal in addition to indicating the state of the outputs. This feature permits easy setup and alignment of the sensors, and also provides a means for the ultimate user of the equipment to monitor its performance without test instruments. An LED indicator is added (externally) to utilize the AID circuitry. Amplifier sensitivity is adjusted with an external potentiometer or fixed resistor. Amplifier response speed is set at 10 milliseconds. An optional frequency control resistor (R_f) may be used for faster amplifier response.



SP100 Series Sensors

The circuitry of the MPC3 is totally encapsulated in a high-impact molded polystyrene housing. It is designed for mounting directly to a printed circuit board. A set of eight closed-back pin jacks is supplied to allow the MPC3 to plug into the PC board. A battery-powered demonstration board, model MPC3-DB, is available for evaluation of the MPC3.

MICRO-AMP® MPC3 Specifications

SUPPLY VOLTAGE: 5V dc ±10% at less than 20 milliamps; 100 millivolts maximum ripple. Voltage must not exceed 6V dc, or be connected in reverse polarity. Install a 0.1 microfarad capacitor as close as possible to the supply pins of the MPC3 (across pins #1 and #3) if voltage transients are anticipated.

OUTPUT CONFIGURATION: the outputs at pins #7 and #8 are conventional CMOS buffered gates. The output at pin #7 is high in the DARK condition and low in the LIGHT condition. The output at pin #8 is low in the DARK condition and high in the LIGHT condition. Each output will source or sink several milliamps.

CIRCUIT PROTECTION: outputs are short-circuit protected. They may be shorted to either the positive or negative supply line without damage. The emitter output at pin #5 is internally current-limited, and may be grounded indefinitely. The "AID" output at pin #6 is internally current-limited, and may be connected to the positive supply indefinitely.

SENSITIVITY ADJUSTMENT: the value of the sensitivity adjustment potentiometer, or of the fixed resistor if sensitivity adjustment is not anticipated, is 2,000 ohms (2kΩ). This is the optimum value for Banner sensors and for most phototransistors of other manufacturers. In situations where very high gain photodarlingtons or very low gain phototransistors or photodiodes are being used, Banner can help determine the best value.

FREQUENCY ADJUSTMENT: the response time of the circuit is 10 milliseconds or 4 oscillator pulses. Since the demodulator is digital, faster response times are possible by simply increasing the frequency of the emitter oscillator. This is done by installing a resistor ("Rf" in the hookup diagram) from pin #2 to the positive supply (pin #1). The value of the resistor is best determined empirically, by observing the signal at pin #5 (with respect to ground) on an oscilloscope. The response time of the MPC3 is equal to the time required for four pulses, and the repeatability of the response time is the time for one pulse. The approximate value of Rf is 390kΩ for 5 millisecond response, and 39kΩ for 1 millisecond response.

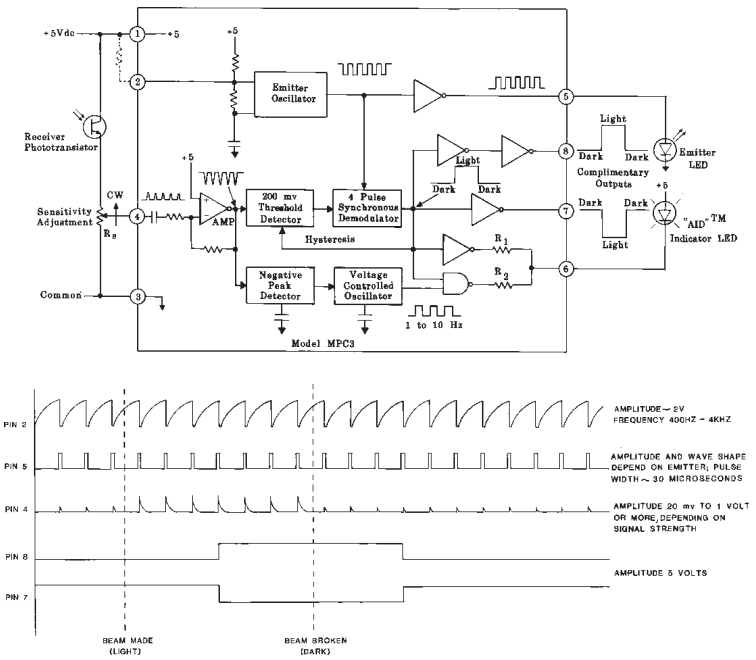
An internal emitter oscillator generates 30 microsecond pulses at a rate of about 400Hz. When the frequency of the emitter oscillator is increased, the automatic emitter power control reduces the magnitude of the pulse current to the emitter so that it will not be damaged by the increased duty cycle. As a result, the excess gain (and the range) of the sensors will automatically be reduced. For this reason, the MPC3 should be operated at the slowest frequency (response time) that is consistent with the application requirements.

INDICATOR: a constant current output is provided at pin #6 for a customer-supplied indicator LED. This current is held to only a few milliamps in order to minimize power supply requirements. If the LED that is selected does not appear bright enough, Banner can suggest or supply high-brightness indicators.

CONSTRUCTION: totally encapsulated circuitry in molded high-impact polystyrene housing. Closed-end jacks for PC plug-in mounting are included.

OPERATING TEMPERATURE:
-40 to 70 degrees C (-40 to 158 degrees F).

Functional Schematic, MICRO-AMP MPC3



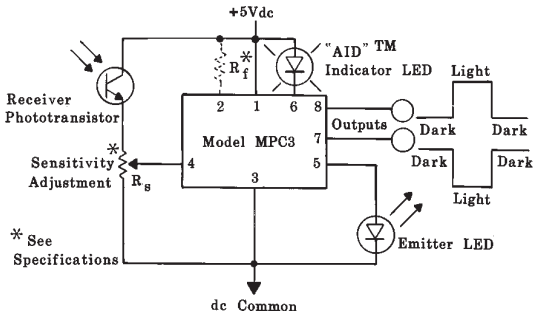
* U.S. Patent #4598198 **U.S. Patent #4356393

Circuit Description

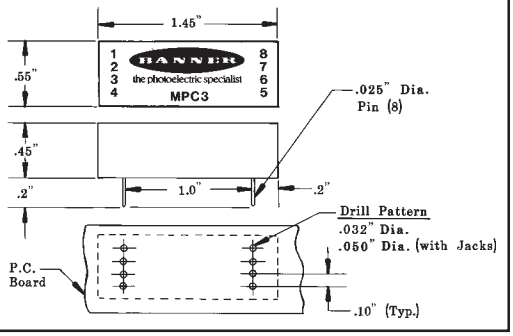
The functional schematic shows the MPC3 powered by 5V dc at pins #1 and #3. An internal emitter oscillator generates 30 microsecond pulses at a rate of approximately 400Hz, which are fed to the emitter at pin #5. These emitter current pulses are controlled automatically by a patented* power-limiting circuit that adjusts to the emitter and to the frequency in use.

The phototransistor receives the light pulses from the LED, either directly or by reflection from an object, and sends them to the input (pin #4) via the sensitivity adjustment resistor (or potentiometer). These low-level signals are amplified, separated from the emitted light, and then detected by the threshold detector. The resultant logic-level pulses are then gated synchronously with the oscillator output (to eliminate noise and interference) and demodulated. The demodulated output is then buffered and inverted, and brought to the output pins #7 and #8. In addition, a small amount of hysteresis is fed back to the threshold detector to assure clean, bounce free output switching. The amplified signal is also fed through a negative peak detector and to a voltage-controlled oscillator whose output frequency is directly proportional to signal strength. This is the patented** Banner "AID™" feature which flashes the LED indicator at a rate which is proportional to the strength of the received light signal (excess gain).

Hookup Diagram, MICRO-AMP MPC3



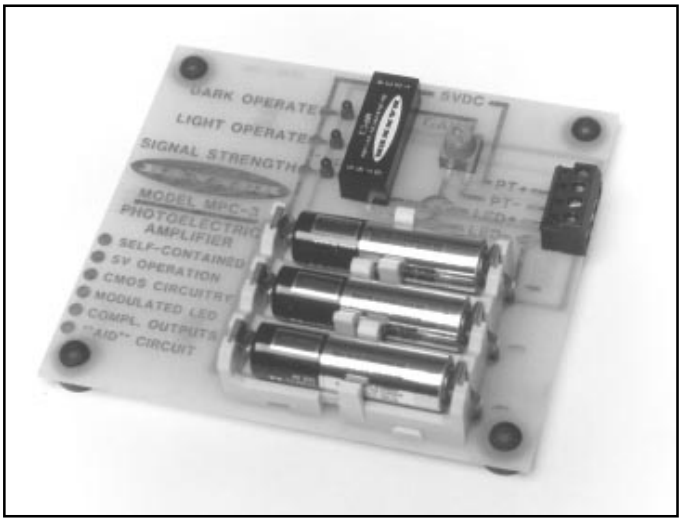
Dimensions, MPC3



Model MPC3-DB Demo Board

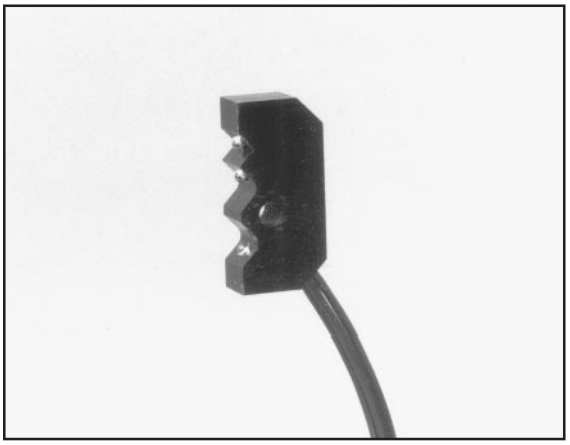
The MPC3-DB is a battery-powered demonstration/testing board which is available to help in evaluating the MPC3 and its sensor(s). The demo board includes a plug-in MPC3 and indicator LEDs for both outputs, plus the "AID™" indicator, a sensitivity potentiometer, and a 4-pin terminal strip to which the LED and receiver phototransistor may be connected.

The MPC3-DB is powered by 3 "AA" penlight batteries. (Yes, batteries *are* included!!!) This is a very simple and inexpensive way to become familiar with the characteristics of the MPC3, and to evaluate the sensors to be used with the MPC3.



MICRO-AMP® System SP100FF Fixed-field Sensor

- **Optical design ensures an exact range limit, regardless of the surface reflectivity of the objects to be sensed**
- **Powerful infrared light source and modulated amplification provide reliable sensing of objects with low surface reflectivity**
- **Sensor response to background objects is completely suppressed**
- **Miniature size fits easily into tight areas of machines**
- **Works with special versions of Banner's MICRO-AMP® series of modulated amplifiers**



Model SP100FF is a fixed-field convergent mode sensor that detects objects directly by reflection of light from the object's surface. The light is sensed at two receive points and compared to define a precise limit to the maximum sensing range. Objects in the background are ignored, regardless of their surface reflectivity.

This sensing response feature makes the SP100FF an ideal choice for detecting a part or a surface that is only a small fraction of an inch in front of another surface. The SP100FF is highly reliable for semiconductor wafer sensing. Wafers of all reflectivities are sensed without mechanical or system sensitivity adjustment. Other applications include cut-to-length control, double-thickness detection, and precision edgeguiding. The SP100FF is an excellent choice for precise position control (e.g. as a robotic end effector).

The SP100FF works in conjunction with Banner MICRO-AMP modulated amplifier model MA3A or MPC3A. Model MA3A is powered by +10 to 30V dc and uses a model RS8 socket. Model MPC3A is powered by +5V dc and is designed for mounting directly onto PC boards.

With a typical excess gain of 100X at the peak signal point (referenced to a 90% reflectance white test card), the SP100FF has enough optical energy to reliably sense material of very low reflectivity such as nitride-coated semiconductor wafers. The typical peak signal point is 0.12 inch from the sensor face. Excess gain falls off sharply beyond the peak signal point (see excess gain curve, below).

Theory of Operation

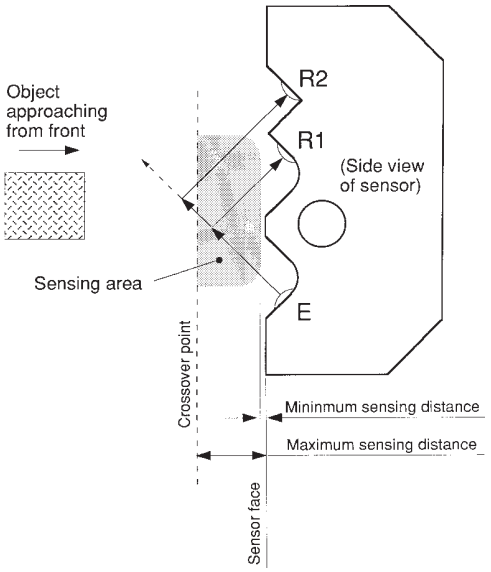
The SP100FF uses two photoelements that operate with the modulated amplifier in a differential mode. The photoelements are mechanically convergent with the LED light source at two different distances from the sensor face. The inner photoelement (R1) produces a positive-going pulse which turns the output of the amplifier "on". The outer photoelement (R2) produces a negative-going pulse that works to turn the amplifier "off".

A target is sensed whenever the amount of light reaching receiver R1 is equal to or greater than the amount of light "seen" by R2. The output of the amplifier is cut off as soon as the amount of light at R2 becomes greater than at R1. The location of this "crossover point" is dictated by the geometry of the optoelement configuration, and remains the same regardless of the target's reflectivity.

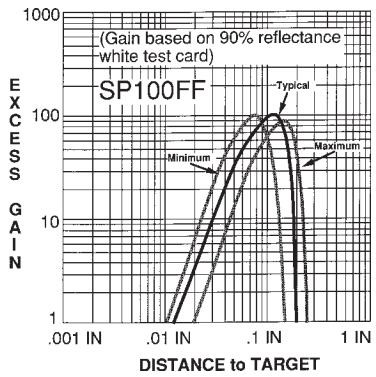
Reflections even from highly-polished mirror-like surfaces are ignored if the reflections originate from beyond the crossover point. Modulated LED design offers very high excess gain at the convergent point of R1 (see excess gain curve). As a result, even objects of very low reflectivity may be sensed.

The rapid fall-off in signal strength over a very short distance (as seen in the excess gain curve) accounts for the highly repeatable distance-sensing accuracy of the SP100FF, independent of target surface reflectivity.

Conceptual Drawing



Excess Gain Curve



Specifications, model SP100FF

Crossover Point: .15 to .25 inch (3,8 to 6,4mm), .20 inch (5,1mm) nominal referenced from sensor face

Peak Signal Point: .08 to .16 inch (2 to 4mm), .12 inch (3mm) nominal referenced from sensor face

Response Speed: a function of the amplifier (see below)

Emitter characteristics: infrared LED, 880nm

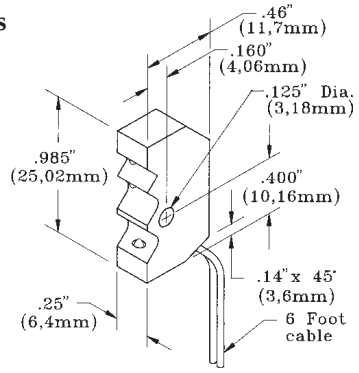
Construction: totally encapsulated, glass lenses. Black Delrin® housing; NEMA 1, 3, 4, 12, and 13.

Operating Temperature: 0 to 70°C (+32 to 158°F)

Cable: supplied with 6 feet of 4-conductor PVC-covered cable.

Delrin® is a registered trademark of DuPont Co.

Dimensions



SP100FF Hookup to MICRO-AMP® MA3A Amplifier

MICRO-AMP modulated amplifier model MA3A is designed for use with the SP100FF sensor. Model MA3A has the same specifications as standard MICRO-AMP model MA3 (page 3), with the exceptions of response speed and sensor hookup.

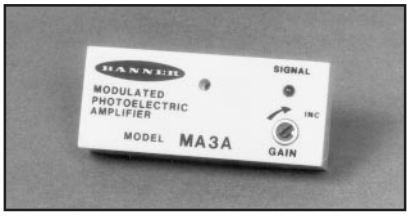
Model MA3A offers complementary *current sinking* outputs. Each output has sufficient capacity to switch small electromechanical devices, such as relays, and will directly interface logic inputs.

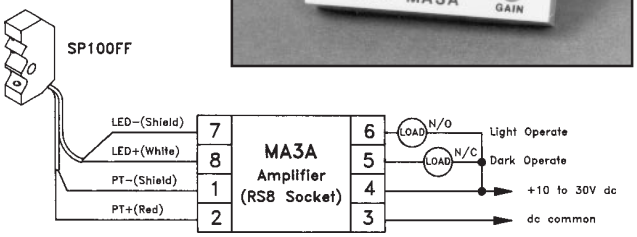
Connections are made using the optional RS8 socket and wiring base, or the MA3A may be mounted directly to a PC board. The sensing system is powered by +10 to 30V dc. Power supply model MPS-15 is available, and includes its own board-mounted socket for the MA3A and a built-in SPDT output relay (see page 19).

Model MA3A features the patented Banner Alignment Indicator Device (AID™) signal strength LED. The SP100FF's sensitivity is adjustable via a gain potentiometer on top of the amplifier module. Circuitry is epoxy-encapsulated and protected by a tough molded VALOX® housing.

Additional information for model MA3A may be obtained from the description of standard amplifier model MA3 on page 3 of this catalog.

VALOX® is a registered trademark of General Electric Company





Specifications, MICRO-AMP MA3A Amplifier

Power Supply Requirements: +10 to 30V dc at less than 20mA; 10% maximum ripple. Power may be obtained from Banner power supply model MPS-15 (page 19), CP12C, CP12RC, or PS120-15.

Output Configuration: two open-collector NPN (current sinking) transistor solid-state switches, one normally open, one normally closed. 150mA maximum, each output.

Response speed: 2 milliseconds (typical)

Maximum Sensor Lead Length: 15 feet (4,5m)

Operating Temperature: 0 to 70°C (+32 to 158°F)

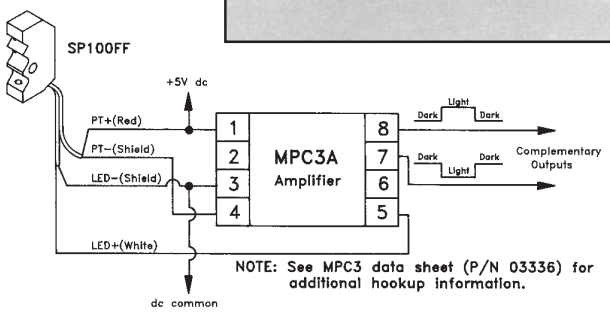
SP100FF Hookup to MICRO-AMP® MPC3A Amplifier

Amplifier model MPC3A is a modified version of standard model MPC3 (pages 15-16). The MPC3A is configured for use with sensor model SP100FF.

Model MPC3A is a miniature "component" amplifier that is designed for mounting directly to a PC board. The MPC3A is powered by +5V dc, and outputs are conventional buffered (complementary) CMOS gates.

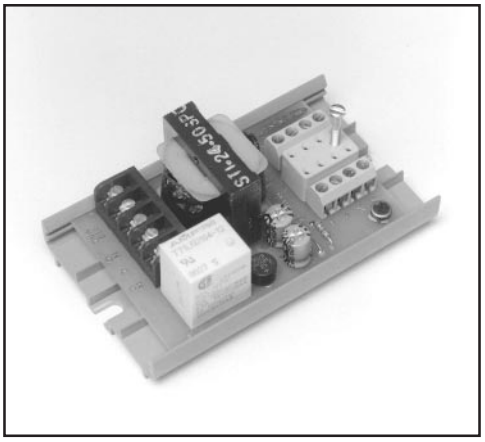
Specifications for model MPC3A (except for response time and hookup information) are identical to standard model MPC3. MPC3A response time is less than 1.5 milliseconds, and may be adjusted for faster response. See page 15 for complete information.





MICRO-AMP® System
MPS-15 and MPS-15-230 Power Supplies

MPS-15 Series power supplies are designed specifically to supply power for the Banner MICRO-AMP series amplifiers and logic modules. They are constructed on small PC boards that are track-mountable for compatibility with other track-mounted MICRO-AMP components. The MPS-15 includes a socket for a MICRO-AMP amplifier or logic module. The combination of an MPS-15 series power supply and a MICRO-AMP module makes a complete and compact sensing and/or control system.



A built-in 5-amp rated SPDT output relay is supplied for easy interfacing to an external load or circuit. Its action is controlled by the outputs of a MICRO-AMP module which is plugged into the on-board module socket. A switch on the PC board selects which module output (normally open or normally closed) will activate the relay.

Two models are available. Model MPS-15 is for 120V ac operation. Model MPS-15-230 is for 220/240V ac power. Up to three MICRO-AMP modules may be powered by one MPS-15 power supply. A 4-inch (100mm) long mounting track is supplied with each MPS-15. Optional 6-inch (150mm) track model TR100-6 neatly accomodates the MPS-15 Series PC board plus the PC boards of two additional RS8 sockets to form a complete three-module MICRO-AMP sensing/logic system.

Specifications

SUPPLY VOLTAGE: model MPS-15 is for 105 to 130V ac (50/60Hz); model MPS-15-230 is for 210 to 250V ac (50/60Hz).

OUTPUT CONFIGURATION: SPDT electromechanical relay. Contact rating: 250V ac max., 30V dc max., 5 amps max. (resistive load). Install MOV (metal oxide varistor) transient suppressor of appropriate voltage across contacts used to switch inductive loads.
*Contact response: 20 milliseconds open and close.
Mechanical life: 10,000,000 operations.

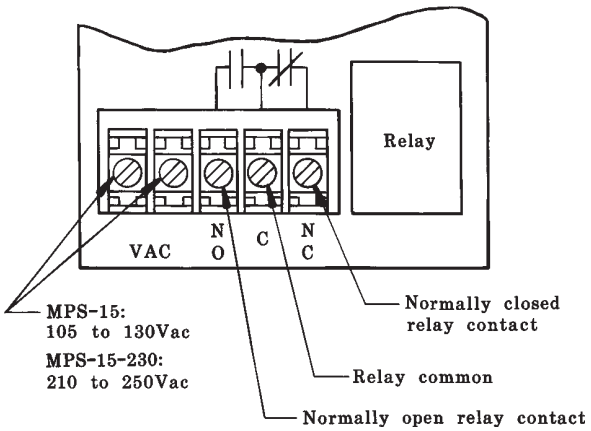
*NOTE: dc loads may be easily connected directly to the output(s) of the MICRO-AMP module used with the chassis in order to bypass the relay and therefore take advantage of the 1 millisecond response time of the module (see MICRO-AMP module specifications and hookup).

COMPATIBLE MODULES: models MA3, MA3A, MA3-4, MA4-2, MA4G, MA4L, MA5. *Do not plug modules with current-sourcing PNP outputs (MA3P, MA3-4P, etc.) into the socket on the MPS-15.*

POWER FOR EXTERNAL DEVICES: 40 milliamps is available to power external 10 to 30V dc devices (e.g.- two additional MICRO-AMP modules or two MINI-BEAM sensors, etc.).

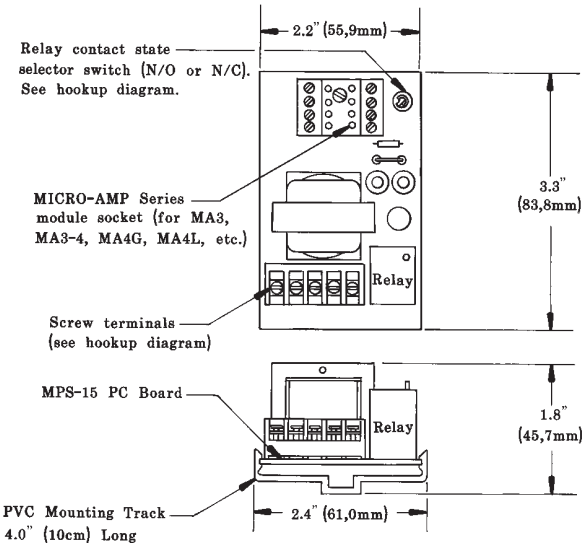
OPERATING TEMPERATURE:
-40 to 70 degrees C (-40 to 158 degrees F).

Hookup Diagram, MPS-15 & MPS-15-230



NOTE: for hookup of sensors or inputs to the module socket, see the hookup diagram for the module used.

Dimension Drawing, MPS-15 & MPS-15-230



MICRO-AMP® Accessories

Sockets

RS8

The RS8 socket is the most frequently used means of mounting and wiring a MICRO-AMP module. It consists of a socket with two four-terminal connection strips, all wired together onto a PC board. The PC board assembly slides into a 1 inch (25mm) long PVC track which is used to mount the entire assembly. A hold-down screw keys the correct polarity of the module.

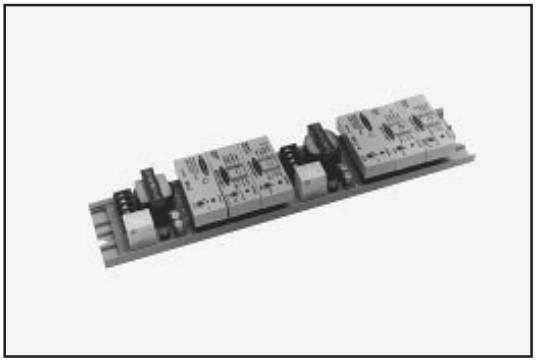


RS8K

The RS8K is a kit of parts which comprise the socket portion of the RS8 assembly. It is used to provide a socket for MICRO-AMP modules that are installed onto printed circuit boards. The RS8K consists of a molded socket block and 8 individual socket pins. A nylon screw is included to affix the socket block to the PC board. The drill size for the pins is #50 (.070"; 1,8mm). Drill pattern dimensions are included with the RS8K.



Mounting Track



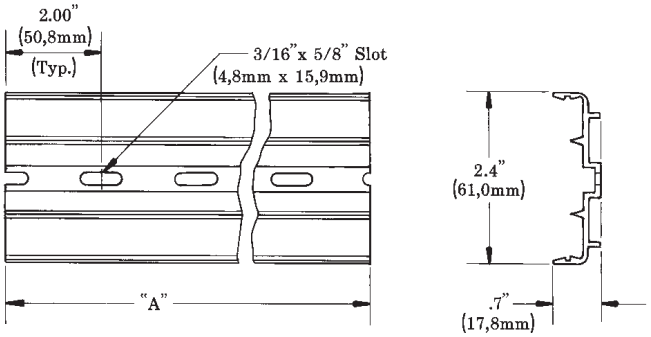
TR100-1 1 inch (25mm) long (supplied with RS8 socket)
TR100-4 4 inch (100mm) long (supplied with MPS-15 series power supply)
TR100-6 6 inch (150mm) long
TR100-12 12 inch (300mm) long

PVC mounting track for MICRO-AMP components is available in 6 and 12 inch lengths for systems which use multiple components. For example, a 6-inch length will accomodate one MPS-15 power supply plus two additional RS8 sockets with modules.

Longer lengths of mounting track may be supplied on a quote basis.

Track Model	"A" Dimension	Minimum number of slots
TR100-1	1" (25mm)	1
TR100-4	4" (100mm)	2
TR100-6	6" (150mm)	3
TR100-12	12" (300mm)	8

Dimensions, TR-100 Mounting Track



WARNING MICRO-AMP sensors, amplifiers, and logic modules 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 output condition.

Never use MICRO-AMP 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.

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.

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