



**BANNER**<sup>®</sup>

the photoelectric specialist

**MINI-ARRAY**<sup>™</sup>

Measuring Light Screen System



# MINI-ARRAY™

## Measuring Light Screen System

### MINI-ARRAY Features



The Banner **MINI-ARRAY** is a programmable measuring light screen system ideally suited for inspection and profiling applications. It excels at on the fly product sizing and profiling, edge-guiding and center-guiding, loop tension control, hole detection, parts counting, die ejection verification, and similar uses. Each system consists of a controller module, an emitter and receiver, and two interconnecting cables.

The **MINI-ARRAY**'s compact controller module may be either factory or user programmed for any one or two of ten measurement modes and any one of four scanning modes. Programming is accomplished via the controller's built-in serial interface using a PC-compatible computer running Windows® 3.1, Windows® 95, or OS/2®.

Advanced **MINI-ARRAY** software† includes on-screen displays for error/diagnostic analysis and sensor alignment.

Emitters and receivers are available in array lengths ranging from 6 inches to 4 feet in 6 inch increments, plus 5 and 6 foot models. All are available with either .375-inch (9.53 mm) or .750-inch (19.05 mm) beam spacing, which translates to either 32 or 16 beams per foot of array length. Sensors with 3/8-inch beam spacing have a sensing range of up to 20 feet (6.1 meters). Sensors with 3/4-inch beam spacing have a sensing range of up to 55 feet (16.8 meters).

System status, including sensor alignment, is displayed via LED indicators on both the controller and the sensors. The controller module offers two discrete outputs (one reed relay and one solid-state dc relay) which can be separately assigned to any of the ten measurement modes.

The **MINI-ARRAY**'s programming versatility also allows the user to "blank" areas of the array to ignore objects that must pass undetected through the light curtain.

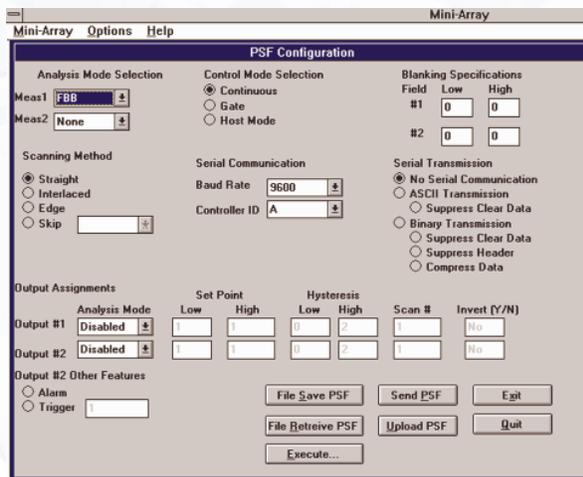
Utilizing the **MINI-ARRAY**'s serial interface, up to 15 **MINI-ARRAY** controllers may be assigned separate IDs and either placed on an RS485 party line or controlled by a host. Scanning can either be set for continuous operation or triggered by a presence-sensing device connected to the optically-isolated "Gate" input. In lieu of a presence sensing device, "Host Mode" may be used, in which scanning is initiated by either a host computer or a program-mable logic controller.



### Compact Emitters and Receivers

A complete **MINI-ARRAY** system includes the following components:

- 1 Model MAC-1 controller module (includes programming software)
- 1 ea. Sensors: emitter and receiver of equal length and beam spacing (see model listing on page 6)
- 2 Sensor cables (see available lengths on page 7)



†Programmable Windows® Software



### MINI-ARRAY Programming Features

#### Measurement Modes

The MAC-1 controller is a highly-versatile microcontroller-based module. It is configured using the supplied Banner software via its built-in RS-232 interface, using a PC-compatible computer running Windows® 3.1 or 95 or OS/2®. The Banner MINI-ARRAY System may be programmed for any one or two of the following Scan Analysis Modes:

##### First Beam Blocked (FBB):

The controller identifies the location of the first blocked beam. Beams are numbered, beginning at the cabled end of the sensor, and continuing in sequence to the opposite end of the sensor.

##### Last Beam Blocked (LBB):

The controller identifies the location of the last blocked beam.

##### Total Beams Blocked (TBB):

The controller totals the number of blocked beams.

##### Contiguous Beams Blocked (CBB):

The controller totals the number of contiguous beams blocked in each group of blocked beams along the length of the sensor.

##### First Beam Made (FBM):

The controller identifies the location of the first unblocked beam.

##### Last Beam Made (LBM):

The controller identifies the location of the last unblocked beam.

##### Total Beams Made (TBM):

The controller totals the number of unblocked beams.

##### Contiguous Beams Made (CBM):

The controller totals the number of contiguous unblocked beams in each group of unblocked beams along the length of the sensor.

##### All Data (ALL):

The controller passes all beam condition data for every scan to the serial interface for analysis by a host computer or controller.

##### Vehicle Separation (VHS):

Controller output #1 is energized whenever six or more inches of curtain length are blocked (i. e. - contiguous beams blocked), and de-energizes when all beams become unblocked.

#### Output Programming

The controller offers two outputs.

**Output #1** is a reed relay contact rated at 125V ac or dc maximum (10VA maximum resistive load).

**Output #2** is a current sinking solid-state switch rated at 30V dc max., 150 mA max. One scan analysis mode may be assigned to Output #1 and a second (different) analysis mode to Output #2. For each scan analysis mode, the following output response criteria may be programmed:

**Set Point (Low and High)** determines where within the array the output(s) will respond. In the case of total or contiguous beams made or blocked, these settings determine the minimum and maximum number of beams required to produce an output.

**Hysteresis (Low and High)** determines how much change must occur at each set point to cause the associated output to change state. Hysteresis avoids unstable output conditions (e. g. - “chattering” of the output) when the scanning condition exactly matches one of the set points.

**Scan #** is the number of consecutive scans of the array that are required before the associated output is updated. The controller may be programmed for from 1 to 9 consecutive scans. The scan data must be identical for all consecutive scans in order for the outputs to be updated.

**Invert (Y/N)** allows the output to be either normally open (“No”) or normally closed (“Yes”).

Output #2, labeled **Alarm** on the controller module, can be programmed to function as the alarm output for the module’s self-diagnostic circuitry whenever it is not assigned to a scan analysis mode. Alternatively, Output #2 may be programmed to serve as a trigger input to initiate the scan sequence of another MINI-ARRAY System.





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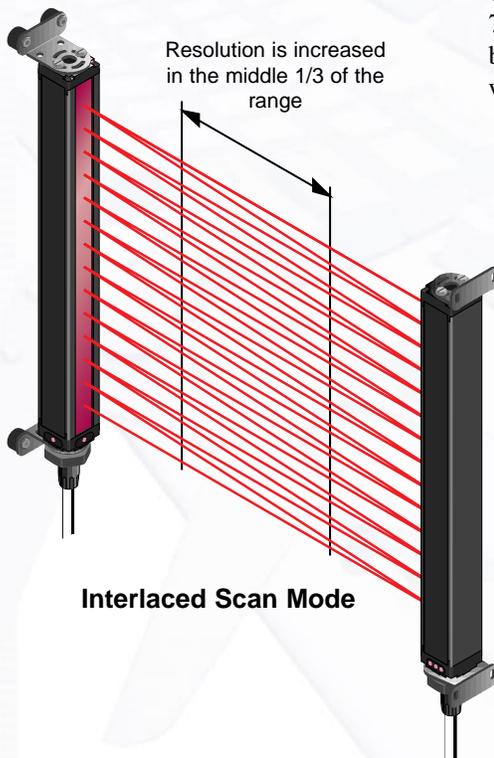
## MINI-ARRAY Scanning

### Scanning Modes

The control module may be configured for any one of four scanning modes:

**Straight Scan** is the default mode. All beams are scanned in sequence from the cable end to the opposite end of the sensors.

**Interlaced Scan** alternates a straight scan with a slanted-beam scan. A slanted-beam scan begins with a beam established between the #2 emitter and the #1 receiver, and next between the #3 emitter and #2 receiver, continuing to between the last emitter and next to last receiver. The last emitter is then reactivated to establish a beam between the last receiver to complete the scan. Alternating slanted-beam scans with straight scans improves optical resolution within the middle one-third of the scanning distance. See the figure, below.



Interlaced Scan Mode

**Edge Scan** activates only the beams located near the top edge of an object which is in the light screen. (NOTE: “top edge” refers to the edge of the object passing nearest to the top end of the sensors, i. e. - the top of the light screen.) Each scan begins six beams prior to the last beam blocked during the previous scan. The scan continues upward from this point and ends at the first unblocked beam. Edge Scan mode is designed to reduce sensing response time when measuring or locating only one edge of an object. Use of the Edge Scan mode limits the scan analysis to LBB (Last Beam Blocked).

**Skip Scan** quickens sensing response time at the expense of decreased sensing resolution. The Skip Scan mode allows from one to seven beams to be skipped during each scan. For example, with one beam skipped, only beams #1, 3, 5, 7, etc. will be interrogated. With two beams skipped, only #1, 4, 7, 10, etc. will be interrogated, and so on.

### Control of Scanning

The controller module may be programmed for either continuous scanning or gated scanning. The module’s optically-isolated GATE input is energized by application of 10 to 30V dc. Gating is typically accomplished using a dc presence sensing device. Alternatively, the MINI-ARRAY System may be programmed for “Host Mode” control, which allows scanning to be initiated by a host computer or a programmable logic controller (PLC).

### Host Control

The MINI-ARRAY System can communicate with either a host computer or a controller via either RS-232 or RS-485 serial protocol. The host can direct the MINI-ARRAY System to scan on demand and/or receive the scan data directly from the MINI-ARRAY System in binary or ASCII form. Selectable communication baud rates are 9600, 19200, and 38400.

### Programming of the Controller Module

Configuration of the MINI-ARRAY control module is done using the Banner-supplied software and an ordinary PC-compatible computer.

Programmed system configurations, called “Parameter Setup Files” (or PSFs), can be stored in the controller module’s non-volatile memory. The supplied software can create and store multiple PSFs in computer files for instant call-up of a particular configuration whenever it is needed.

The Banner software also offers two other useful features. An **Alignment** screen displays the individual status of each beam along the entire length of the array. The same screen also summarizes the total beams blocked and unblocked and indicates the beam numbers of the first beam blocked, the first beam unblocked, the last beam blocked, and the last beam unblocked. This screen is invaluable during setup for monitoring and analyzing exactly what is being seen by the light screen. The second feature, a **Diagnostics** screen, indicates problems with the emitter or the receiver.

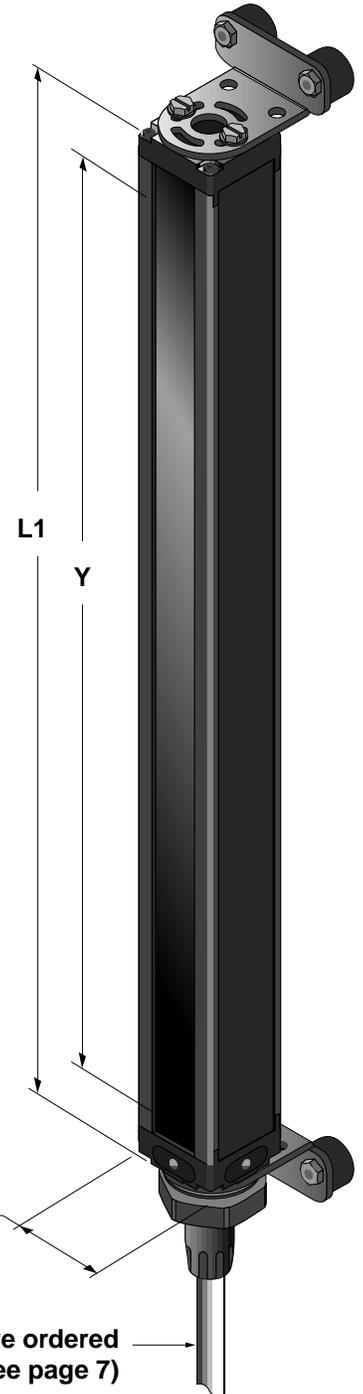


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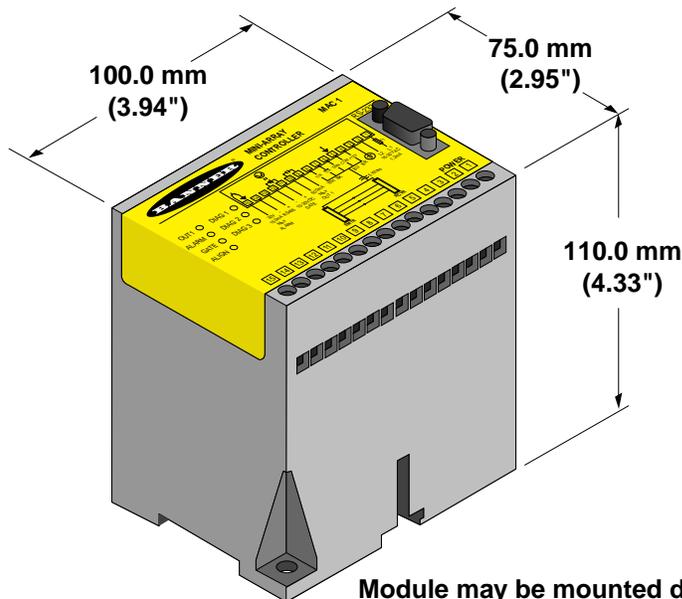
### MINI-ARRAY Dimensions

Sensor Models	Housing Length L1		Array Length Y (16 beams/ft)		Array Length Y (32 beams/ft)	
	(mm)	(inch)	(mm)	(inch)	(mm)	(inch)
BMEL6..A emitter BMRL6..A receiver	201	7.9	143	5.62	133	5.25
BMEL12..A emitter BMRL12..A receiver	356	14.0	295	11.62	286	11.25
BMEL18..A emitter BMRL18..A receiver	505	19.9	448	17.62	438	17.25
BMEL24..A emitter BMRL24..A receiver	659	26.0	600	23.62	591	23.25
BMEL30..A emitter BMRL30..A receiver	810	31.9	752	29.62	743	29.25
BMEL36..A emitter BMRL36..A receiver	963	37.9	905	35.62	895	35.25
BMEL42..A emitter BMRL42..A receiver	1115	43.9	1057	41.62	1048	41.25
BMEL48..A emitter BMRL48..A receiver	1267	49.9	1210	47.62	1200	47.25
BMEL60..A emitter BMRL60..A receiver	1572	61.9	1514	59.62	1505	59.25
BMEL72..A emitter BMRL72..A receiver	1877	73.9	1819	71.62	1810	71.25

Sensors



### MAC-1 Controller Module



Module may be mounted directly to a surface using supplied hardware or onto standard 35 mm DIN rail.



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### MINI-ARRAY Sensor Specifications

Models		Array Length	Total Beams	Models		Array Length	Total Beams		
MINI-ARRAY Sensors - 16 beams/foot models with 0.75" (19.1 mm) beam spacing	BMEL616A	Emitter	143 mm	8	MINI-ARRAY Sensors - 32 beams/foot models with 0.38" (9.7 mm) beam spacing	BMEL632A	Emitter	133 mm	16
	BMRL616A	Receiver	(5.62 in)			BMRL632A	Receiver	(5.25 in)	
	BMEL1216A	Emitter	295 mm	16		BMEL1232A	Emitter	286 mm	32
	BMRL1216A	Receiver	(11.62 in)			BMRL1232A	Receiver	(11.25 in)	
	BMEL1816A	Emitter	448 mm	24		BMEL1832A	Emitter	438 mm	48
	BMRL1816A	Receiver	(17.62 in)			BMRL1832A	Receiver	(17.25 in)	
	BMEL2416A	Emitter	600 mm	32		BMEL2432A	Emitter	591 mm	64
	BMRL2416A	Receiver	(23.62 in)			BMRL2432A	Receiver	(23.25 in)	
	BMEL3016A	Emitter	752 mm	40		BMEL3032A	Emitter	743 mm	80
	BMRL3016A	Receiver	(29.62 in)			BMRL3032A	Receiver	(29.25 in)	
BMEL3616A	Emitter	905 mm	48	BMEL3632A	Emitter	895 mm	96		
BMRL3616A	Receiver	(35.62 in)		BMRL3632A	Receiver	(35.25 in)			
BMEL4216A	Emitter	1057 mm	56	BMEL4232A	Emitter	1048 mm	112		
BMRL4216A	Receiver	(41.62 in)		BMRL4232A	Receiver	(41.25 in)			
BMEL4816A	Emitter	1210 mm	64	BMEL4832A	Emitter	1200 mm	128		
BMRL4816A	Receiver	(47.62 in)		BMRL4832A	Receiver	(47.25 in)			
BMEL6016A	Emitter	1514 mm	80	BMEL6032A	Emitter	1505 mm	160		
BMRL6016A	Receiver	(59.62 in)		BMRL6032A	Receiver	(59.25 in)			
BMEL7216A	Emitter	1819 mm	96	BMEL7232A	Emitter	1810 mm	192		
BMRL7216A	Receiver	(71.62 in)		BMRL7232A	Receiver	(71.25 in)			

**Emitter/receiver range:**

**3/8" Beam Spacing**

0.6 to 6.1 m (2 to 20 ft) for sensors < 4 feet  
0.6 to 4.6 m (2 to 15 ft) for sensors > 4 feet

**3/4" Beam Spacing**

0.9 to 17 m (3 to 55 ft) for sensors < 4 feet  
0.9 to 14 m (3 to 45 ft) for sensors > 4 feet

*Note: Maximum range is specified at the point where 3x excess gain remains*

**Minimum object sensitivity:**

**3/8" Beam Spacing**

19.1 mm (.75 in)  
Interlaced Mode: 12.7 mm (.5 in)\*

**3/4" Beam Spacing**

38.1 mm (1.5 in)  
Interlaced Mode: 25.4 mm (1.0 in)\*

*\*Note: Assumes sensing is in middle one-third of scanning range (see page 4)*

**Sensor Scan time**

55 microseconds per beam, plus 1 millisecond processing time per scan.

**Power Requirements:**

12V dc ±2% supplied by controller

**Emitter**

0.10 amps max. @ 12V dc

**Receiver**

3/8-inch beam spacing - 0.75 amps max. @ 12V dc  
3/4-inch beam spacing - 0.50 amps max. @ 12V dc

*Note: Maximum current is for a 6-foot sensor*

**Connections:**

Sensors connect to controller using two 5-conductor quick disconnect cables (one for emitter and one for receiver), ordered separately. Use only Banner cables, which incorporate a "twisted pair" for noise immunity on RS485 data communication lines. Cables measure .32-inch (8.1 mm) in diameter, and are shielded and PVC-jacketed. Conductors are 20-gauge. Emitter and receiver cables may not exceed 250 feet, each. See bottom of page 7.

**Status indicators:**

**Emitter**

Red LED lights for proper operation

**Receiver**

Green = sensors aligned (> 3x excess gain)  
Yellow = marginal alignment (1x < excess gain < 3x)  
Red = sensors misaligned or beam(s) blocked

**Enclosures:**

Size: see Figure, page 5

**Emitter and receiver:**

Material: Aluminum, with black anodized finish; acrylic lens cover

Rating: NEMA 4, 13 (IP 65)

**Operating Temperature:**

-20 to 70° C (-4 to 158° F); 95% max. rel. humidity (non-condensing)



### MINI-ARRAY Controller Specifications

<b>Power requirements:</b>	16 to 30V dc @ 1.25 amps max. (see current requirements for sensors); controller, alone, (without sensors connected) requires 0.1 amp.
<b>Inputs:</b>	MINI-ARRAY sensor input (5 connections); emitter and receiver wire in parallel to five terminals. GATE input is optically-isolated, requires 10 to 30V dc (7.5K input impedance) for gate signal.
<b>Response Time:</b>	Outputs are inactive for 5 seconds after system power up. Maximum response time for the discrete outputs are two scan cycles. A scan cycle includes a sensor scan plus any serial data transmission. Serial transmission (if activated) follows every sensor scan.
<b>Discrete Outputs:</b>	<p>Output 1 (OUT 1) - Reed relay contact rated 125V ac/dc max., 10 VA max. resistive load (non-inductive).</p> <p>Output 2 (ALARM) - Open collector NPN transistor rated 30V dc max., 150 mA max, short-circuit protected; may be configured as a second data analysis output, a system alarm output, or a scan trigger output for a secondary device (e.g. camera, MINI-ARRAY etc.).</p> <p>OFF-STATE Leakage Current: &lt; 10µA @ 30V dc          ON-STATE Saturation Voltage: &lt; 1V @ 10mA          &lt; 1.5V @ 150mA</p>
<b>Serial Data Outputs:</b>	RS-232, RS-485, ASCII or binary data format, Baud rate: 9600, 19.2K, or 38.4K, 8 data bits, 1 start bit, 1 stop bit, even parity, Clear data may be suppressed, Header string may be suppressed in binary format, Up to 15 controllers may be given unique addresses for RS485 party line.
<b>Controller programming:</b>	Via RS232 to PC-compatible computer running Windows® 3.1 or 95 or OS/2® operating system and using supplied Banner software (see user manual).
<b>Status Indicators:</b>	The following status LEDs are located on the top surface of the module: OUT 1 (red) - Indicates that Output 1 is energized, ALARM (red) - Indicates that Output 2 is energized, GATE (red) - Indicates voltage is applied to GATE input, ALIGN (green) - Indicates sensors aligned (excess gain > 1x), DIAG 1 (green) - Indicates power is applied to the module, DIAG 2 (red) - Indicates receiver failure, DIAG 3 (red) - Indicates emitter failure.
<b>Enclosure:</b>	<i>Size:</i> see Figure, page 5 <i>Material:</i> Polycarbonate <i>Rating:</i> NEMA 12 (IP 52)
<b>Operating Temperature:</b>	-20 to +70°C (-4 to 158°F); 95% relative humidity (non-condensing).

#### Cables (2 required per system)

Model	Length
QDC-515C	4.6 m (15 ft) cable, straight QD connector
QDC-525C	7.6 m (25 ft) cable, straight QD connector
QDC-550C	15.2 m (50 ft) cable, straight QD connector



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When you buy your photoelectric equipment from Banner, you gain the confidence of dealing with the nation's largest, most knowledgeable and experienced photoelectric company. We have the broadest line of products in the photoelectric sensor industry. We can handle any size order, large or small, utilizing the most advanced manufacturing capabilities. We can deliver any of more than 10,000 products in just three days – most can ship within hours.

Just as important, we have the largest photoelectric sales and support network in the industry, a collection of the industry's most knowledgeable distributors and sales engineers, available worldwide. We're close by wherever you're located, and we're ready to help you with your applications, plus give you excellent service support.

When you add it all up, you'll find more value in Banner products.

For more information or applications assistance:

**Call 612-544-3164**



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

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

Only MINI-SCREEN™, MULTI-SCREEN™, 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.

**ISO9002**  
DOCUMENTED QUALITY