A-GAGE® MINI-ARRAY®
Inspection and Profiling Light Screens

- Features low-profile, programmable measuring light screen systems for inspections and profiling
- Requires a controller, emitter/receiver pair and interconnecting cordsets for a complete system
- Offers programmable controller with a selection of measurement modes, scan modes and output configurations
- Offers emitters/receivers for detecting objects as small as 12.7 mm
- Available with 9.5 or 19 mm beam spacing
- Features ranges to 17 m, depending on length and beam spacing
- Includes advanced software for system configuration using a PC
- Available in models for central monitoring and control over a DeviceNet™ control network
- Features optional heated enclosures for outdoor applications
- Makes status monitoring easy with indicators visible from three sides of emitter/receiver

Emitters/Receivers

A-GAGE® MINI-ARRAY® Emitters/Receivers—19.1 mm Beam Spacing

<table>
<thead>
<tr>
<th>Housing Length (L)</th>
<th>Array Length</th>
<th>Total Beams</th>
<th>Connection</th>
<th>Minimum Object Size</th>
<th>Range</th>
<th>Models*</th>
</tr>
</thead>
<tbody>
<tr>
<td>201 mm</td>
<td>133 mm</td>
<td>8</td>
<td>5-pin Mini QD</td>
<td>38.1 mm</td>
<td>0.9 - 17 m</td>
<td>BMEL616A</td>
</tr>
<tr>
<td>356 mm</td>
<td>286 mm</td>
<td>16</td>
<td></td>
<td>Interlaced Mode: 25.4 mm</td>
<td></td>
<td>BMRL616A</td>
</tr>
<tr>
<td>505 mm</td>
<td>438 mm</td>
<td>24</td>
<td></td>
<td></td>
<td>356 mm 286 mm 16</td>
<td>BMEL1216A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>505 mm 438 mm 24</td>
<td>BMRL1216A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BMEL1816A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BMRL1816A</td>
</tr>
</tbody>
</table>

QD models: A model with a QD requires a mating cordset (see page 353).

* “E” and “R” in model numbers denote “Emitter” and “Receiver” respectively. Sold separately.

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### A-GAGE® MINI-ARRAY® Emitters/Receivers–9.5 mm Beam Spacing (cont’d)

<table>
<thead>
<tr>
<th>Housing Length (L)</th>
<th>Total Beams</th>
<th>Array Length</th>
<th>Connection</th>
<th>Minimum Object Size</th>
<th>Range</th>
<th>Models*</th>
</tr>
</thead>
<tbody>
<tr>
<td>659 mm</td>
<td>16</td>
<td>143 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMEL632A</td>
</tr>
<tr>
<td>356 mm</td>
<td>32</td>
<td>295 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMRL632A</td>
</tr>
<tr>
<td>505 mm</td>
<td>48</td>
<td>448 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMEL1232A</td>
</tr>
<tr>
<td>659 mm</td>
<td>64</td>
<td>600 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMRL1232A</td>
</tr>
<tr>
<td>810 mm</td>
<td>80</td>
<td>752 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMEL1832A</td>
</tr>
<tr>
<td>963 mm</td>
<td>96</td>
<td>905 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMRL1832A</td>
</tr>
<tr>
<td>1115 mm</td>
<td>112</td>
<td>1057 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMEL2432A</td>
</tr>
<tr>
<td>1267 mm</td>
<td>128</td>
<td>1210 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMRL2432A</td>
</tr>
<tr>
<td>1572 mm</td>
<td>160</td>
<td>1514 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMEL432A</td>
</tr>
<tr>
<td>1877 mm</td>
<td>192</td>
<td>1819 mm</td>
<td>5-pin Mini QD</td>
<td>19.1 mm Interlaced Mode: 12.7 mm</td>
<td>0.6 - 4.6 m</td>
<td>BMRL432A</td>
</tr>
</tbody>
</table>

**QD models:** A model with a QD requires a mating cordset (see page 353).  
* "E" and "R" in models numbers denotes “Emitter” and “Receiver” respectively. Sold separately.
### A-GAGE® MINI-ARRAY® Controllers†, 16-30V dc

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Solid-State Discrete Outputs</th>
<th>Analog Outputs</th>
<th>Serial Output</th>
<th>Controller Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sensor pair &amp; Trigger (Gate)</td>
<td>1 Reed &amp; 1 NPN</td>
<td>–</td>
<td>RS-232 &amp; RS-485</td>
<td>MAC-1</td>
</tr>
<tr>
<td></td>
<td>2 NPN</td>
<td>–</td>
<td></td>
<td>MACN-1</td>
</tr>
<tr>
<td></td>
<td>2 PNP</td>
<td>–</td>
<td></td>
<td>MACP-1</td>
</tr>
<tr>
<td></td>
<td>1 NPN (2) 0-10V Sourcing</td>
<td></td>
<td>RS-232</td>
<td>MACV-1</td>
</tr>
<tr>
<td></td>
<td>1 NPN (2) 4-20 mA Sinking</td>
<td></td>
<td></td>
<td>MACI-1</td>
</tr>
<tr>
<td>1 Sensor pair &amp; Trigger (Gate)</td>
<td>16 NPN</td>
<td>–</td>
<td>RS-232</td>
<td>MAC16N-1</td>
</tr>
<tr>
<td></td>
<td>16 PNP</td>
<td>–</td>
<td></td>
<td>MAC16P-1</td>
</tr>
<tr>
<td>1 Sensor pair &amp; Trigger (Gate)</td>
<td>2 NPN</td>
<td>–</td>
<td></td>
<td>MACNXDN-1*</td>
</tr>
<tr>
<td></td>
<td>2 PNP</td>
<td>–</td>
<td></td>
<td>MACPXDN-1*</td>
</tr>
</tbody>
</table>

* DeviceNet™ models
† One controller and an emitter/receiver pair (of matching length and resolution) required per system.
DeviceNet™ is a trademark of the Open DeviceNet Vendor Association, Inc.

### A-GAGE® MINI-ARRAY® Emitter/Receiver Specifications

<table>
<thead>
<tr>
<th>Emitter/Receiver Range</th>
<th>9.5 mm beam spacing</th>
<th>19.1 mm beam spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array Length 143 to 1057 mm:</td>
<td>0.6 to 6.1 m</td>
<td>Array Length 133 to 1057 mm:</td>
</tr>
<tr>
<td>Array Length 1210 to 1819 mm:</td>
<td>0.6 to 4.6 m</td>
<td>Array Length 1200 to 1810 mm:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Object Sensitivity</th>
<th>9.5 mm Beam Spacing</th>
<th>19.1 mm Beam Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight, Edge Modes:</td>
<td>19.1 mm</td>
<td>Straight, Edge Modes:</td>
</tr>
<tr>
<td>Interlaced Mode:</td>
<td>12.7 mm*</td>
<td>Interlaced Mode:</td>
</tr>
<tr>
<td>With DeviceNet Controller:</td>
<td></td>
<td>With DeviceNet Controller:</td>
</tr>
<tr>
<td>Straight, Edge Modes:</td>
<td>19.1 mm</td>
<td>Straight, Edge Modes:</td>
</tr>
<tr>
<td>Skip Mode: Multiply the above by the number of skipped beams, plus 1</td>
<td></td>
<td>Skip Mode: Multiply the above by the number of skipped beams, plus 1</td>
</tr>
<tr>
<td>Interlaced Mode:</td>
<td>12.7 mm*</td>
<td>Interlaced Mode:</td>
</tr>
</tbody>
</table>

* Assumes sensing is in the middle 1/3 of sensing range.

<table>
<thead>
<tr>
<th>Sensor Scan Time</th>
<th>55 microseconds per beam, plus 1 millisecond post process time per scan.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeviceNet:</td>
<td>Post process time will vary, based on the number of channels interrogated during each scan.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Requirements</th>
<th>9.5 mm beam spacing</th>
<th>19.1 mm beam spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum current is for a 6’ sensor.</td>
<td>12V dc ±2%, supplied by controller</td>
<td>12V dc ±2%, supplied by controller</td>
</tr>
<tr>
<td>Emitter:</td>
<td>0.10 A @ 12V dc</td>
<td>Emitter:</td>
</tr>
<tr>
<td>Receiver:</td>
<td>0.75 A @ 12V dc</td>
<td>Receiver:</td>
</tr>
</tbody>
</table>

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
## A-GAGE® MINI-ARRAY® Emitter/Receiver Specifications  (cont’d)

### Connections

Sensors connect to controller using 5-conductor Mini-style quick-disconnect cordsets (one each for emitter and receiver), ordered separately. Use only Banner cordsets, which incorporate a “twisted pair” for noise immunity. Cordsets measure 8.1 mm dia. and are shielded and PVC-jacketed. Conductors are 20 gauge. Emitter and receiver cordsets may not exceed 75 m long, each. See page 353.

### Status Indicators

- **Emitter:** Red LED lights to indicate proper emitter operation
- **Receiver:** Green indicates sensors aligned (> 3x excess gain)  
  Yellow indicates marginal alignment of one or more beams (1x - 3x excess gain)  
  Red indicates sensors misaligned or one or more beam(s) blocked

### Construction

Aluminum, with black anodized finish; acrylic lens cover

### Environmental Rating

NEMA 4, 13; IP65

### System Programming

Via DeviceNet interface and supplied EDS files.

### Network Status Indicator

Bicolored (Red/Green) LED visible on the control module front panel indicates network status:

- **Steady Green:** On-line, connected to master
- **Flashing Green:** On-line, address and baud rate OK
- **Steady Red:** Critical network fault or duplicate node address detected
- **Flashing Red:** Connection timeout
- **OFF:** No network power or off-line

### Hookup Diagrams

MI30 (p. 765)

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## A-GAGE® MINI-ARRAY® Controller with DeviceNet™ Specifications

### DeviceNet Configurations

- **Vendor code:** 12 (Banner Corp.)
- **Device type:** 110
- **Product code:** 1 (MACNXDN-1) 2 (MACPXDN-1)
  - **Connection types supported:** Explicit Message, Poll, COS
  - **Network address:** 0-63 (network configured), default = 63
  - **Baud rate supported:** 125K, 250K, 500K (network configured), default = 125K

### Output Configurations

- **MACPXDN-1:** Two PNP discrete (switched)
- **MACNXDN-1:** Two NPN discrete (switched)

### Power Requirements*

- **Controller, emitter and receiver:** 16 to 30V dc @ 1.2 A max. (typical: 0.5 A @ 16V dc)

### DeviceNet Power*

11 to 25V dc - supplied by DeviceNet BUS Network

### Inputs

- **Sensor input:** Emitter and receiver wire in parallel to five terminals.  
  **Trigger (Gate) input:** Optically isolated, requires 10 to 30V dc (7.5 kΩ impedance) for gate signal

### Discrete Outputs

- **NPN outputs:** Open collector NPN transistor rated at 30V dc max., 150 mA max.
- **PNP outputs:** Open collector PNP transistor rated at 30V dc max., 150 mA max.
- **All discrete outputs:**  
  - **OFF-state leakage current:** less than 10 µA @ 30V dc  
  - **ON-state saturation voltage:** less than 1V @ 10 mA; less than 1.5V @ 150 mA

### System Status Indicators

- **Output (steady red):** Output #1 energized.
- **Alarm (flashing red):** Output #2 energized.
- **Gate (steady red):** Trigger (Gate) input status.
- **Alignment (steady green):** Proper emitter/receiver alignment and a clear, unblocked light screen  
  (ON) when green or green/yellow receiver LEDs are ON.
- **Dia 1 (Green), Dia 2 (Red), Dia 3 (Red):** Used in combination to display System status

### Construction

Polycarbonate housing; mounts to flat surface or directly onto 35-mm DIN rail

### Environmental Rating

NEMA 1; IP20

### Operating Conditions

- **Temperature:** -20° to +70° C  
  **Relative humidity:** 95% @ 50° C (non-condensing)

### *Application Note

The controller must be powered up before the DeviceNet connection in every power-up situation for proper operation

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*DeviceNet™ is a trademark of the Open DeviceNet Vendor Association, Inc.*
A-GAGE® MINI-ARRAY® Controller Specifications

**Power Requirements**
16 to 30V dc @ 1.25 amps max. (see current requirements for sensors); controller alone, (without sensors connected) requires 0.1 amp.

**Inputs**
- Sensor input (5 connections): Emitter and receiver wire in parallel to five terminals
- Trigger (Gate) input: Optically isolated, requires 10 to 30V dc (7.5K input impedance) for gate signal

**Discrete Outputs**
- **MAC-1**: Output 1 (OUT 1) - Reed relay contact rated 125V ac/dc max., 10 VA max. resistive load (non-inductive).
  - 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 parallel array
  - OFF-state leakage current: less than 10 µA @ 30V dc
  - ON-state saturation voltage: less than 1V @ 10 mA; less than 1.5V @ 150 mA

- **MACN-1**: (2) Open collector NPN transistor outputs
- **MACP-1**: (2) Open collector PNP transistor outputs;
  - 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 parallel array
  - OFF-state leakage current: less than 10 µA @ 30V dc
  - ON-state saturation voltage: less than 1V @ 10 mA; less than 1.5 V @ 150 mA

- **MACV-1/MACI-1**: Alarm - Open collector NPN transistor rated 30V dc max. 150 mA max. short circuit protected; may be configured as a data analysis output, a system alarm output, or a scan trigger output for a parallel array
  - OFF-state leakage current: less than 10 µA @ 30V dc
  - ON-state saturation voltage: less than 1V @ 10 mA; less than 1.5 V @ 150 mA

- **MAC16P-1**: Sixteen open collector PNP transistor outputs
- **MAC16N-1**: Sixteen open collector NPN transistor outputs
  - 30V dc max, 150 mA max., short circuit protected
  - OFF-state leakage current: less than 10 µA
  - ON-state saturation voltage: less than 1V @ 10 mA; less than 1.9V @ 150 mA

**Serial Data Outputs**
- RS-232, 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
  - **MAC-1**: Up to 15 controllers may be given unique address for RS-485 party line

**Analog Outputs**
- **MACV-1**: 0-10 Volts sourcing adjustable Null and Span (20 mA current limit)
- **MACI-1**: 4-20 mA current sinking adjustable Null and Span (16 to 30V input)
- **Resolution**: Span/(Number of sensor channels)
- **Linearity**: 0.1% of Full Scale
- **Temperature variation**: 0.001% of Full Scale/° C

**Controller Programming**
- **All models**: Via RS-232 PC-compatible computer running Windows® 95, 98, NT, ME, XP or 2000 operating system and using Banner supplied software

**Sensor Scan Time**
- All models: 55 microseconds per beam plus processing time.
- The processing time is dependent on the scan analysis and the number of active outputs.
- This timing assumes a straight scan, continuous, and TBB mode
- **MAC-1, MACN-1 & MACP-1**: 1 millisecond processing time
- **MACV-1 & MACI-1**: 1.5 milliseconds processing time
- **MAC16N-1 & MAC16P-1**: 2.3 to 7 milliseconds processing time

**System Response Time**
- Outputs are not active for 5 seconds after system power up. Maximum response time for the system is two sensor scan cycles.
- A scan cycle includes a sensor scan plus any serial data transmission.
- Serial transmission (if activated) follows every sensor scan.

**Status Indicators**
- The following status LEDs are located on the top surface of the module:
  - **MACV-1 & MACI-1**: V OUT (Red) - (also called I OUT) Indicates that the analog outputs are active
  - **MAC-1, MACN-1 & MACP-1**: OUT 1 (Red) - Indicates that output 1 is energized
  - **MAC16N-1 & MAC16P-1**: OUT (Red) - Indicates that at least one output is active
  - ALARM (Red) - Indicates that Output 2 is active/MAC16N-1 & MAC16P-1: Indicates output 16 is active
  - GATE (Red) - Indicates voltage is applied to Trigger (Gate) input
  - ALIGN (Green) - Indicates sensor aligned (excess gain > 1x)
  - DIA1 (Green) - Indicates power is applied to the module*
  - DIA2 (Red) - Indicates receiver failure
  - DIA3 (Red) - Indicates emitter failure

<table>
<thead>
<tr>
<th>Condition</th>
<th>DIA1 (Green)</th>
<th>DIA2 (Red)</th>
<th>DIA3 (Red)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal condition</td>
<td>on</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Receiver error</td>
<td>on</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Emitter error</td>
<td>on</td>
<td>off</td>
<td>on</td>
</tr>
</tbody>
</table>

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A-GAGE® MINI-ARRAY® Controller Specifications  (cont’d)

<table>
<thead>
<tr>
<th>Construction</th>
<th>Polycarbonate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Rating</td>
<td>NEMA 1; IP20</td>
</tr>
<tr>
<td>Operating Conditions</td>
<td>Temperature: -20° to +70° C, Relative humidity: 95% (non-condensing)</td>
</tr>
<tr>
<td>Certifications</td>
<td>UL, CE</td>
</tr>
<tr>
<td>Hookup Diagram</td>
<td>MAC-1: MI27 (p. 764), MACN-1/MACP-1: MI28 (p. 765), MAC16N-1/MAC16P-1: MI31 (p. 765)</td>
</tr>
</tbody>
</table>

Cordsets

**Mini QD (Shielded with Twisted Pair)**

<table>
<thead>
<tr>
<th>Length</th>
<th>Mini QD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.57 m</td>
<td>QDC-515C</td>
</tr>
<tr>
<td>7.62 m</td>
<td>QDC-525C</td>
</tr>
<tr>
<td>15.2 m</td>
<td>QDC-550C</td>
</tr>
<tr>
<td>22.9 m</td>
<td>MAQQDC-575C</td>
</tr>
<tr>
<td>30.5 m</td>
<td>MAQQDC-5100C</td>
</tr>
<tr>
<td>38.1 m</td>
<td>MAQQDC-5125C</td>
</tr>
<tr>
<td>45.7 m</td>
<td>MAQQDC-5150C</td>
</tr>
</tbody>
</table>

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**DB9 Communication**

<table>
<thead>
<tr>
<th>Length</th>
<th>DB9 Communication</th>
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</thead>
<tbody>
<tr>
<td>2.00 m</td>
<td>MASC</td>
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</tbody>
</table>

See page 704

Brackets

**MINI-ARRAY®**

<table>
<thead>
<tr>
<th>Length</th>
<th>MINI-ARRAY®</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.57 m</td>
<td>DIN-35-...</td>
</tr>
<tr>
<td>7.62 m</td>
<td>MSMB-3</td>
</tr>
</tbody>
</table>

See page 679

Additional bracket information available. See page 620.
Measurement and Inspection Hookups

**MI25**
High-Resolution MINI-ARRAY Discrete (NPN) and Analog (0-10V) MAHCVP-1

**MI26**
High-Resolution MINI-ARRAY Discrete (NPN) and Analog (4-20 mA) MAHCVN-1

**MI27**
MINI-ARRAY Discrete Sinking (1-NPN) MAC-1

**MI28**
MINI-ARRAY Discrete Sinking (2-NPN) MACN-1

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More information online at bannerengineering.com
Measurement and Inspection Hookups

**MI29** MINI-ARRAY Discrete Sinking (1-NPN) and Analog (0-10V) MACV-1

**MI30** MINI-ARRAY with DeviceNet™ Sinking (NPN) MACNXDN-1

**MI31** MINI-ARRAY Discrete Sinking (16-NPN) MAC16N-1

**Key**

- Output 1 = Pin 16
- Output 2 = Pin 17
- Output 3 = Pin 18
- Output 4 = Pin 19
- Output 5 = Pin 20
- Output 6 = Pin 21
- Output 7 = Pin 22
- Output 8 = Pin 23
- Output 9 = Pin 24
- Output 10 = Pin 25
- Output 11 = Pin 26
- Output 12 = Pin 27
- Output 13 = Pin 28
- Output 14 = Pin 29
- Output 15 = Pin 30
- Output 16 = Pin 15

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- 10 Solid-state Outputs
- 150 mA Max each