SENSORS

# 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

ACCESSORIES page 353

### Emitters/Receivers


ONLINE
AUTOCAD, STEP, IGES & PDF

| MINI-ARRAY Sensors | |
|---|---|
| W = 38.1 mm | D = 38.1 mm |

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

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

More on next page

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

* "E" and "R" in model numbers denotes "Emitter" and "Receiver" respectively. Sold separately.

## A-GAGE® MINI-ARRAY® Emitters/Receivers–19.1 mm Beam Spacing (cont'd)

| Housing Length (L) | Array Length | Total Beams | Connection | Minimum Object Size | Range | Models* |
|---|---|---|---|---|---|---|
| 659 mm | 591 mm | 32 | 5-pin Mini QD | 38.1 mm<br>Interlaced Mode: 25.4 mm | 0.9 - 17 m | BMEL2416A<br>BMRL2416A |
| 810 mm | 743 mm | 40 | | | | BMEL3016A<br>BMRL3016A |
| 963 mm | 895 mm | 48 | | | | BMEL3616A<br>BMRL3616A |
| 1115 mm | 1048 mm | 56 | | | | BMEL4216A<br>BMRL4216A |
| 1267 mm | 1200 mm | 64 | 5-pin Mini QD | 38.1 mm<br>Interlaced Mode: 25.4 mm | 0.9 - 14 m | BMEL4816A<br>BMRL4816A |
| 1572 mm | 1505 mm | 80 | | | | BMEL6016A<br>BMRL6016A |
| 1877 mm | 1810 mm | 96 | | | | BMEL7216A<br>BMRL7216A |

ACCESSORIES page 353

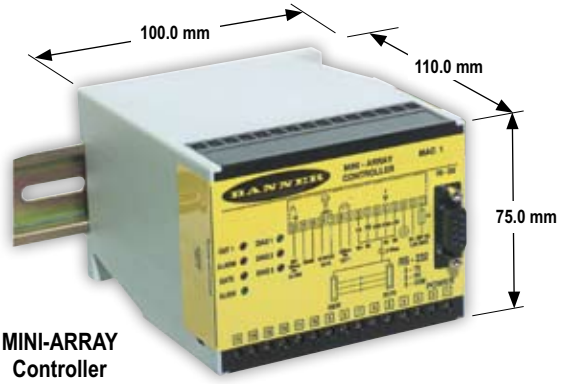
## A-GAGE® MINI-ARRAY® Emitters/Receivers–9.5 mm Beam Spacing

| Housing Length (L) | Total Beams | Array Length | Connection | Minimum Object Size | Range | Models* |
|---|---|---|---|---|---|---|
| 201 mm | 16 | 143 mm | 5-pin Mini QD | 19.1 mm<br>Interlaced Mode: 12.7 mm | 0.6 - 6.1 m | BMEL632A<br>BMRL632A |
| 356 mm | 32 | 295 mm | | | | BMEL1232A<br>BMRL1232A |
| 505 mm | 48 | 448 mm | | | | BMEL1832A<br>BMRL1832A |
| 659 mm | 64 | 600 mm | | | | BMEL2432A<br>BMRL2432A |
| 810 mm | 80 | 752 mm | | | | BMEL3032A<br>BMRL3032A |
| 963 mm | 96 | 905 mm | | | | BMEL3632A<br>BMRL3632A |
| 1115 mm | 112 | 1057 mm | | | | BMEL4232A<br>BMRL4232A |
| 1267 mm | 128 | 1210 mm | | | 0.6 - 4.6 m | BMEL4832A<br>BMRL4832A |
| 1572 mm | 160 | 1514 mm | | | | BMEL6032A<br>BMRL6032A |
| 1877 mm | 192 | 1819 mm | | | | BMEL7232A<br>BMRL7232A |

**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.

## Contollers




MINI-ARRAY Controller

ONLINE
AUTOCAD, STEP, IGES & PDF

## A-GAGE® MINI-ARRAY® Controllers†, 16-30V dc

| Inputs | Solid-State Discrete Outputs | Analog Outputs | Serial Output | Controller Models |
|---|---|---|---|---|
| 1 Sensor pair & Trigger (Gate) | 1 Reed & 1 NPN | – | RS-232 & RS-485 | **MAC-1** |
| | 2 NPN | – | | **MACN-1** |
| | 2 PNP | – | | **MACP-1** |
| | 1 NPN | (2) 0-10V Sourcing | RS-232 | **MACV-1** |
| | 1 NPN | (2) 4-20 mA Sinking | | **MACI-1** |
| 1 Sensor pair & Trigger (Gate) | 16 NPN | – | RS-232 | **MAC16N-1** |
| | 16 PNP | – | | **MAC16P-1** |
| 1 Sensor pair & Trigger (Gate) | 2 NPN | – | – | **MACNXDN-1*** |
| | 2 PNP | – | – | **MACPXDN-1*** |

ACCESSORIES page 353

* 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

| | | |
|---|---|---|
| **Emitter/Receiver Range**<br>Max range is specified at the point where 3x excess gain remains. | **9.5 mm beam spacing**<br>**Array Length 143 to 1057 mm:** 0.6 to 6.1 m<br>**Array Length 1210 to 1819 mm:** 0.6 to 4.6 m | **19.1 mm beam spacing**<br>**Array Length 133 to 1057 mm:** 0.9 to 17 m<br>**Array Length 1200 to 1810 mm:** 0.9 to 14 m |
| **Minimum Object Sensitivity** | **9.5 mm Beam Spacing**<br>**Straight, Edge Modes:** 19.1 mm<br>**Interlaced Mode:** 12.7 mm*<br>**With DeviceNet Controller:**<br>**Straight, Edge Modes:** 19.1 mm<br>**Skip Mode:** Multiply the above by the number of skipped beams, plus 1<br>**Interlaced Mode:** 12.7 mm*<br><br>*Assumes sensing is in the middle 1/3 of sensing range. | **19.1 mm Beam Spacing**<br>**Straight, Edge Modes:** 38.1 mm<br>**Interlaced Mode:** 25.4 mm*<br>**With DeviceNet Controller:**<br>**Straight, Edge Modes:** 38.1 mm<br>**Skip Mode:** Multiply the above by the number of skipped beams, plus 1<br>**Interlaced Mode:** 25.4 mm* |
| **Sensor Scan Time** | 55 microseconds per beam, plus 1 millisecond post process time per scan.<br>**DeviceNet:** Post process time will vary, based on the number of channels interrogated during each scan. | |
| **Power Requirements**<br>†Maximum current is for a 6' sensor. | **9.5 mm beam spacing**<br>12V dc ±2%, supplied by controller<br>**Emitter:** 0.10 A @ 12V dc<br>**Receiver:** 0.75 A @ 12V dc† | **19.1 mm beam spacing**<br>12V dc ±2%, supplied by controller<br>**Emitter:** 0.10 A @ 12V dc<br>**Receiver:** 0.50 A @ 12V dc† |

More on next page

## 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.<br>See page 353. |
| **Status Indicators** | **Emitter:** Red LED lights to indicate proper emitter operation<br>**Receiver:** Green indicates sensors aligned (> 3x excess gain)<br>Yellow indicates marginal alignment of one or more beams (1x -3x excess gain)<br>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 |
| **Certification** | CE |
| **Operating Conditions** | **Temperature:** -20° to +70° C **Relative humidity:** 95% at 50° C (non-condensing) |

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

| | |
|---|---|
| **DeviceNet Configurations** | **Vendor code:** 12 (Banner Corp.)<br>**Device type:** 110<br>**Product code:** 1 (MACNXDN-1)<br>2 (MACPXDN-1)<br>**Connection types supported:** Explicit Message, Poll, COS<br>**Network address:** 0-63 (network configured), default = 63<br>**Baud rate supported:** 125K, 250K, 500K (network configured), default = 125K |
| **Output Configurations** | **MACPXDN-1:** Two PNP discrete (switched)<br>**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.<br>**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.<br>**PNP outputs:** Open collector PNP transistor rated at 30V dc max., 150 mA max.<br>**All discrete outputs:** **OFF-state leakage current:** less than 10 µA @ 30V dc<br>**ON-state saturation voltage:** less than 1V @ 10 mA; less than 1.5V @ 150 mA |
| **System Programming** | Via DeviceNet interface and supplied EDS files. |
| **System Status Indicators** | **Output (steady red):** Output #1 energized.<br>**Alarm (flashing red):** Output #2 energized.<br>**Gate (steady red):** Trigger (Gate) input status.<br>**Alignment (steady green):** Proper emitter/receiver alignment and a clear, unblocked light screen (ON) when green or green/yellow receiver LEDs are ON.<br>**Diag 1 (Green), Diag 2 (Red), Diag 3 (Red):** Used in combination to display System status |
| **Network Status Indicator** | **Bicolored (Red/Green) LED visible on the control module front panel indicates network status:**<br>**Steady Green:** On-line, connected to master<br>**Flashing Green:** On-line, address and baud rate OK<br>**Steady Red:** Critical network fault or duplicate node address detected<br>**Flashing Red:** Connection timeout<br>**OFF:** No network power or off-line |
| **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 |
| **Hookup Diagrams** | MI30 (p. 765) |

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<br>**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).<br>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<br>**OFF-state leakage current:** less than 10 µA @ 30V dc<br>**ON-state saturation voltage:** less than 1V @ 10 mA; less than 1.5V @ 150 mA<br><br>**MACN-1:** (2) Open collector NPN transistor outputs<br>**MACP-1:** (2) Open collector PNP transistor outputs;<br>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<br>**OFF-state leakage current:** less than 10 µA @ 30V dc<br>**ON-state saturation voltage:** less than 1V @ 10 mA; less than 1.5 V @ 150 mA<br><br>**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<br>**OFF-state leakage current:** less than 10 µA @ 30V dc<br>**ON-state saturation voltage:** less than 1V @ 10 mA; less than 1.5 V @ 150 mA<br><br>**MAC16P-1:** Sixteen open collector PNP transistor outputs<br>**MAC16N-1:** Sixteen open collector NPN transistor outputs<br>30V dc max, 150 mA max., short circuit protected<br>**OFF-state leakage current:** less than 10 µA<br>**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<br>**Baud Rate:** 9600, 19.2K, or 38.4K, 8 data bits, 1 start bit, 1 stop bit, even parity<br>Clear data may be suppressed Header string may be suppressed in binary format<br>**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)<br>**MACI-1:** 4-20 mA current sinking adjustable Null and Span (16 to 30V input)<br>**Resolution:** Span/(Number of sensor channels) **Linearity:** 0.1% of Full Scale<br>**Temperature variation:** 0.01% 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.<br>The processing time is dependent on the scan analysis and the number of active outputs.<br>This timing assumes a straight scan, continuous, and TBB mode<br>**MAC-1, MACN-1 & MACP-1:** 1 millisecond processing time<br>**MACV-1 & MACI-1:** 1.5 milliseconds processing time<br>**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.<br>A scan cycle includes a sensor scan plus any serial data transmission.<br>Serial transmission (if activated) follows every sensor scan. |
| **Status Indicators** | The following status LEDs are located on the top surface of the module:<br>**MACV-1 & MACI-1:** V OUT (Red) - (also called I OUT) Indicates that the analog outputs are active<br>**MAC-1, MACN-1 & MACP-1:** OUT 1 (Red) - Indicates that output 1 is energized<br>**MAC16N-1 & MAC16P-1:** OUT (Red) - Indicates that at least one output is active<br>ALARM (Red) - Indicates that Output 2 is active/MAC16N-1 & MAC16P-1: Indicates output 16 is active<br>GATE (Red) - Indicates voltage is applied to Trigger (Gate) input<br>ALIGN (Green) - Indicates sensor aligned (excess gain > 1x)<br>DIAG1 (Green) - Indicates power is applied to the module*<br>DIAG2 (Red) - Indicates receiver failure<br>DIAG3 (Red) - Indicates emitter failure |

| Condition | DIAG1 (Green) | DIAG2 (Red) | DIAG3 (Red) |
|---|---|---|---|
| Normal condition | on | off | off |
| Receiver error | on | on | off |
| Emitter error | on | off | on |

More on next page

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

| | | |
|---|---|---|
| **Construction** | Polycarbonate | |
| **Environmental Rating** | NEMA 1; IP20 | |
| **Operating Conditions** | **Temperature:** -20° to +70° C | **Relative humidity:** 95% (non-condensing) |
| **Certifications** | CE UL LISTED | |
| **Hookup Diagram** | **MAC-1:** MI27 (p. 764)<br>**MACV-1/MACI-1:** MI29 (p. 765) | **MACN-1/MACP-1:** MI28 (p. 765)<br>**MAC16N-1/MAC16P-1**: MI31 (p. 765) |

## Cordsets

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

See page 702

| Length | Threaded 5-Pin Straight |
|---|---|
| 4.57 m | QDC-515C |
| 7.62 m | QDC-525C |
| 15.2 m | QDC-550C |
| 22.9 m | MAQDC-575C |
| 30.5 m | MAQDC-5100C |
| 38.1 m | MAQDC-5125C |
| 45.7 m | MAQDC-5150C |

**DB9 Communication**

See page 704

| Length | 9-Pin Straight |
|---|---|
| 2.00 m | MASC |

Additional cordset information available. See page 679.

## Brackets

**MINI-ARRAY®**

pg. 628 — DIN-35-..

pg. 633 — MSMB-3

Additional bracket information available. See page 620.

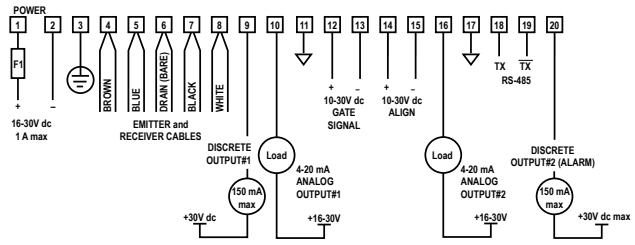
ENCLOSURES PAGE 728

STANDS PAGE 722

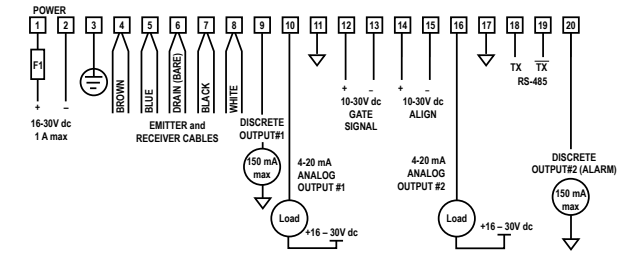
LENS SHIELDS PAGE 732

# Measurement and Inspection Hookups

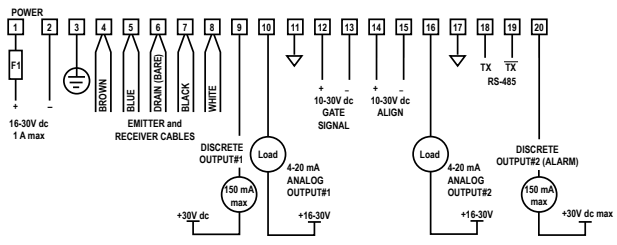
## MI25 High-Resolution MINI-ARRAY Discrete (NPN) and Analog (0-10V) MAHCVN-1



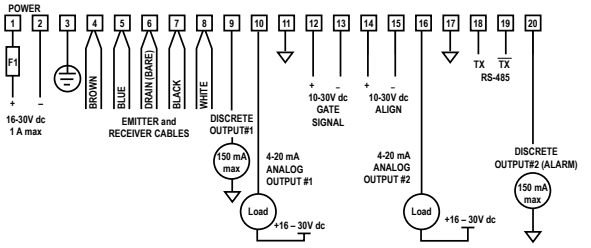

## High-Resolution MINI-ARRAY Discrete (PNP) and Analog (0-10V) MAHCVP-1



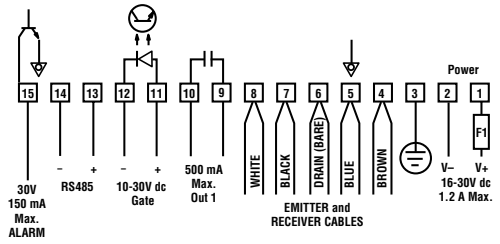

## MI26 High-Resolution MINI-ARRAY Discrete (NPN) and Analog (4-20 mA) MAHCIN-1



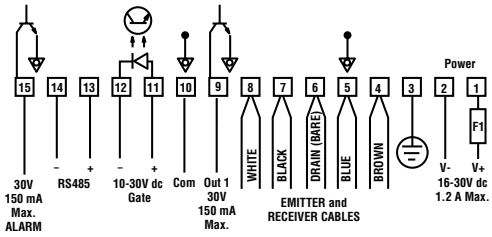

## High-Resolution MINI-ARRAY Discrete (PNP) and Analog (4-20 mA) MAHCIP-1



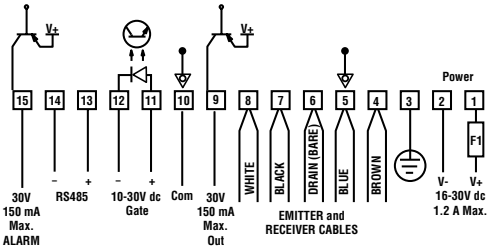

## MI27 MINI-ARRAY Discrete Sinking (1-NPN) MAC-1




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



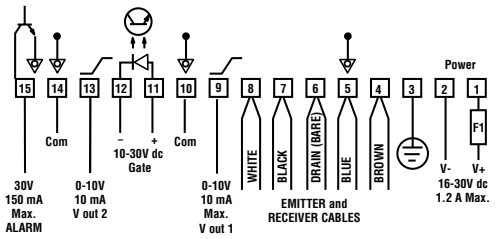

## MINI-ARRAY Discrete Sourcing (2-PNP) MACP-1



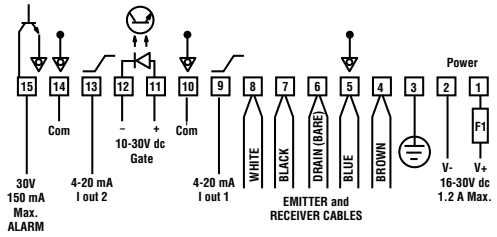

More on next page

# Measurement and Inspection Hookups

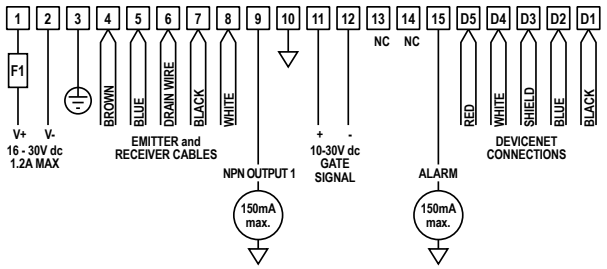
## MI29 MINI-ARRAY Discrete Sinking (1-NPN) and Analog (0-10V) MACV-1



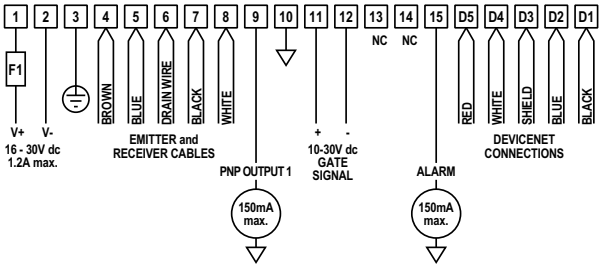

## MINI-ARRAY Discrete Sinking (1-NPN) and Analog (4-20 mA) MACI-1



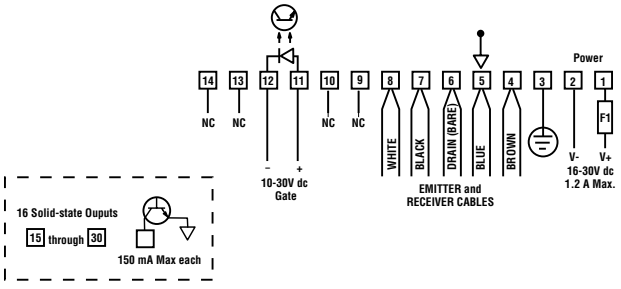

## MI30 MINI-ARRAY with DeviceNet™ Sinking (NPN) MACNXDN-1



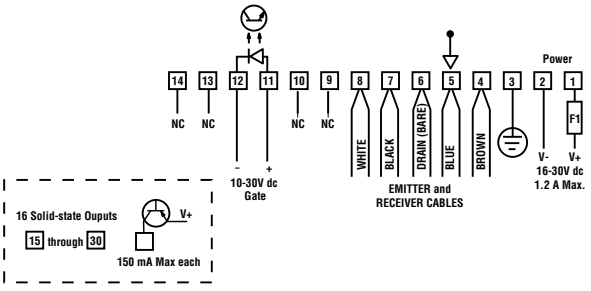

## MINI-ARRAY with DeviceNet™ Sourcing (PNP) MACPXDN-1




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




## MINI-ARRAY Discrete Sourcing (16-PNP) MAC16P-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