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# USERS GUIDE
# MATRIX2
# DIGITAL INDUCTIVE LOOP SENSORS

## APPLICATION

The MATRIX is a Digital Inductive Loop Detector used for the detection of vehicular traffic. The MATRIX is the ideal solution for parking barrier control, motorized gates and doors, vehicle access control and industrial control systems.
The MATRIX is a high performance single or dual-channel vehicle detector packaged in a compact housing. The connection is made with a standard industrial 11-pin octal (round) socket.

**MATRIX2-S110 CUSTOM**: Single loop detector with 110 to 120 V AC power supply.
**MATRIX2-S12-24 CUSTOM**: Single loop detector with 12-24V AC/DC power supply.

## TECHNICAL SPECIFICATIONS

**Technology** : Inductive loop
**Tuning** : automatic
**Detection mode** : presence
**Presence time** : 1 min to infinity (permanent presence) with 250 steps.
**Pulse time output** : 100 ms or 500 ms
**Inductance range** : 20 µH to 1000 µH
**Frequency range** : 20 kHz to 130 kHz
**Frequency steps** : 4 for single loop
2 for dual loop (for each loop)
**Sensitivity (ΔL/L)** : 0.005% to 0.5% with 250 steps
**Reaction time** : 25ms for single loop
50ms for dual loop(each channel)
**Setup time at power on** : 8 s max by channel
**Setup time after configuration** : 2s max by channel
**Power supply (depending on model)** :
- 12-24 AC/DC ± 10%
- 230VAC ± 10 %
- 115VAC ± 10 %

**Power Frequency** : 48 to 62 Hz
**Power Consumption** : < 2.5 W
**Temperature range** : -22°F to 158°F
[-30°C to +70°C]

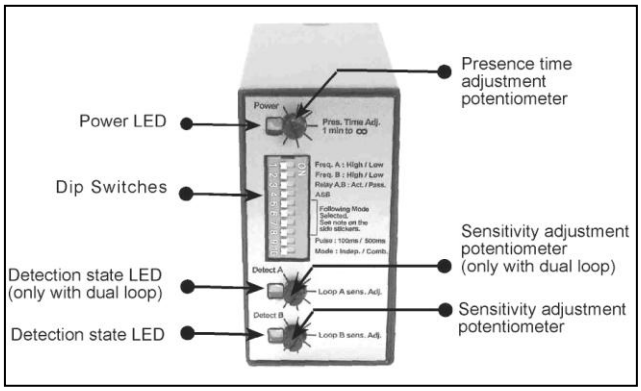
**Degree of protection** : IP40
**2 Output relays (free potential change-over contact)** :
- Max contact voltage : 230 VAC ;
- Max contact current : 5A (resistive).

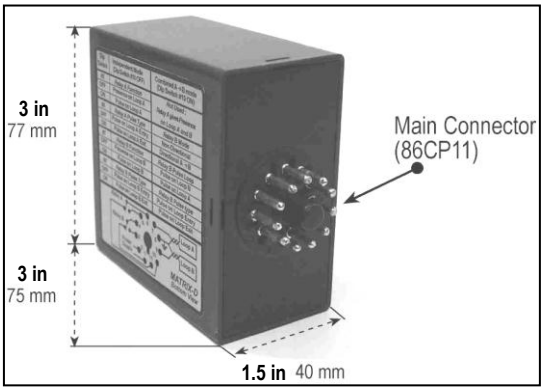
**LED indicators** :
- 1 green LED : power ;
- 1 red LED : Loop status 1 ;
- 1 red LED : Loop status 2.

**Protections** :
- loop insulation transformer ;
- Zener diodes ;
- gas discharge clamping.

**Connection** :
Standard 11-pin round connector 86CP11
**Dimensions** : 3 in (H) x 1.5 in (W) x 3 in (D)
[77mm (H) x 40mm(W) x 75mm(D)]
**Weight** :7 ounces [< 200g]
**Product compliance** :
R&TTE 1999/5/EC
EMC 89/336/EE

## DESCRIPTION OF THE SENSOR




## SAFETY PRECAUTIONS

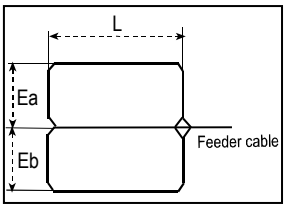
- Shut off all power before attempting any wiring procedures
- Maintain a clean & safe environment.
- Constantly be aware of traffic around the door or gate area.
- Always suspend traffic through the doorway or gate area when performing testing that may result in unexpected reactions by the door or gate.
- Always check placement of all wiring and components before powering up to insure that moving parts will not catch any wires and cause damage to equipment.

## LOOP INSTALLATION TIPS

### A . CABLE SPECIFICATIONS FOR LOOP AND FEEDER

- 16 AWG (1.5mm²) cross section area ;
- Multi-strand cable ;
- Insulation material : PVC or Silicone ;
- For the feeder cable, the wire must be twisted at least 15 times per yard for each cable.
- Feeder for long runs used for foil screened cable is recommended (earth at equipment end only)
- The feeder cable must be firmly fixed to avoid any false detection (max length: 330 feet (100 m)).
- Waterproof cable junction box is required.

### B. LOOP GEOMETRY




- Avoid large loops or long feeder cables [max 330 feet (100 m)]. Longer runs may affect sensitivity of loop.

### C. DETERMINATION OF THE NUMBER OF LOOP TURNS

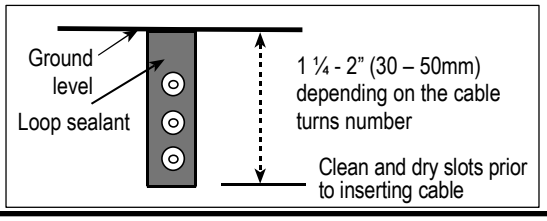
- Measure the length (L) and width (Ea) of one loop. Multiply these numbers together to determine the loop surface area. See above drawing.
- For example, if L=10 ft, Ea= 3 ft, then the area = 30 $ft^2$; 4 loop turns are recommended.
  **or** if L=2m, Ea=1m, then the area = 2 $m^2$ ; 4 loop turns are recommended.

Recommended values for the turns:

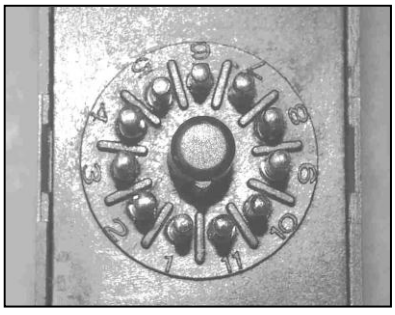
| Area | | Number of turns |
|---|---|---|
| <32 ft² | <3 m² | 4 |
| 32 – 54 ft² | 3 – 5 m² | 3 |
| 65 – 108 ft² | 6 – 10 m² | 2 |

WARNING:
For conformity reasons, in any installation, the loop surface multiplied by the number of turns should not exceed ***215*** (for square feet); ***20*** (for square meters)

### D. SLOT DEPTH




## WIRING



**Pin 1** : Power Supply
**Pin 2** : Power Supply
**Pin 3** : Relay B (NO)
**Pin 4** : Not Required
**Pin 5** : Presence (Relay A - COM)
**Pin 6** : Presence (Relay A – NO)
**Pin 7** : Loop
**Pin 8** : Loop common and **connect to ground** ⏚
**Pin 9** : Relay B (COM)
**Pin 10** : Presence (Relay A - NC)
**Pin 11** : Relay B (NC)

**UL Requirement: Shall be used with suitable UL Recognized SWIV2 Relay Socket.**

WARNING:
Pin #8 must be connected to the loop and to ground

## PROGRAMMING

### CONFIGURATION

| | Single loop Configurations | |
|---|---|---|
| | **OFF** | **ON** |
| **DS#1** | See next table | |
| **DS#2** | Frequency Settings | |
| **DS#3** | Active mode | Passive mode |
| **DS#4** | ASB OFF | ASB ON |
| **DS#5** | Relay A : Presence on loop A | Relay A : Pulse on loop |
| **DS#6** | Relay A : Pulse on loop A entry | Relay A : Pulse on loop A exit |
| **DS#7** | Relay B : Presence on loop A | Relay B : Pulse on loop A |
| **DS#8** | Relay B : Pulse on loop A entry | Relay B : Pulse on loop A exit |
| **DS#9** | 100 ms | 500 ms |
| **DS#10** | Not used | Not used |

### POTENTIOMETERS

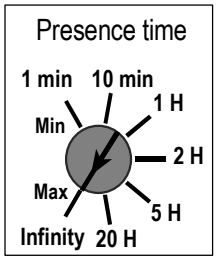


FIG. 1

- A potentiometer for adjustment of the maximum duration of a presence detection : from 1 min to infinity ; (see Fig. 1)
- A potentiometer for adjustment of the linear sensitivity (Δf) for the loop A : from 0.005% to 0.5 % ; (see Fig. 2)
- A potentiometer for adjustment of the linear sensitivity (Δf) for the loop B : from 0.005% to 0.5 %. (see Fig. 2)

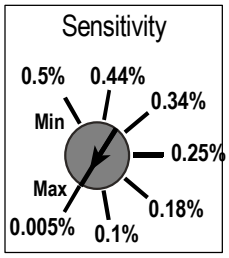


FIG. 2

## DIPSWITCH SETTINGS

A 10 position dip switch is located on the front of the Matrix single detector. Dip switch 3, 5, 6, 7, and 8 configure the relay, while dip switch 9 controls the duration of the pulse when the Matrix is configured for pulse operation, (as opposed to presence). Configurations are as follows:

**Dip Switch 3:**

**OFF= FAIL-SECURE MODE** Relay is NOT energized when power is applied. Relay is energized upon detection only. In this mode, the N.O. circuit is open, and the N.C. circuit is closed. Thus, if a closed circuit is required upon detection, one must use the N.O. and COM terminals since they would close upon detection. When the Matrix is NOT powered, it is in the same state as it would be for non-detection.

**ON = FAIL-SAFE MODE** Relay is energized as soon as power is applied, and de-energizes upon detection or power loss. In this mode, upon powering the detector, the N.O. circuit becomes closed, and the N.C. circuit becomes open. Thus, if a closed circuit is required upon detection, one must use the N.C. and COM terminals, since they would now be OPEN during non-detection, and would close upon detection. When the Matrix is NOT powered, it is in the same state as it would be for detection.

| Detection Status | Fail-Secure Mode (Relay is not energized upon power-on) | Fail-Safe Mode (Relay becomes energized upon power-on) |
|---|---|---|
| **No Detection** | The COM and N.O. terminals are OPEN.<br>COM and N.C. terminals are CLOSED.<br>The relay is de-energized. | The COM and N.O. terminals are CLOSED.<br>COM and N.C. terminals are OPEN.<br>The relay is energized. |
| **Detection** | The COM and N.O. terminals are CLOSED.<br>COM and N.C. terminals are OPEN.<br>The relay is energized. | The COM and N.O. terminals are OPEN.<br>COM and N.C. terminals are CLOSED.<br>The relay is de-energized. |
| **Upon Power Loss** | The COM and N.O. terminals are OPEN.<br>COM and N.C. terminals are CLOSED<br>The relay is de-energized. | The COM and N.O. terminals are OPEN.<br>COM and N.C. terminals are CLOSED.<br>The relay is de-energized. |

Same

Same

## DIPSWITCH SETTINGS (CON'T)

After each dip switch change the sensor launches a learning process. Thus, when changing dipswitch settings, insure that the loop area is all clear. By default, all dipswitches are set to OFF.

| # | OFF | ON | REMARKS |
|---|---|---|---|
| **1** | | | See Frequency Adjustments Chart |
| **2** | | | See Frequency Adjustments Chart |
| **3** | Fail-Secure | Fail-Safe | Output Relay Configuration |
| **4** | ASB OFF | ASB ON | **A**utomatic **S**ensitivity **B**oost (ASB option) [recommended for improved truck detection] :<br>During a detection, the sensitivity increases automatically to 8 times the preset sensitivity given by the sensitivity potentiometer adjustment. It is limited to the maximum sensitivity ($\Delta f$ = 0.005%). It goes back to the preset value after detection stops. |
| **5** | Relay A Presence | Relay A Pulse | In presence mode, Relay A will hold a changed state as long as there is detection at Loop A. A pulse mode will result in a momentary pulse upon entering the loop or exiting the loop, according to dip switch 6. |
| **6** | Pulse On Entry | Pulse On Exit | ON = Relay A will pulse once upon detection at Loop A<br>OFF = Relay A will pulse once upon loss of detection at Loop A |
| **7** | Relay B Presence | Relay B Pulse | In presence mode, Relay B will hold a changed state as long as there is detection at Loop A. A pulse mode will result in a momentary pulse upon entering the loop or exiting the loop, according to dip switch 8. |
| **8** | Pulse On Entry | Pulse On Exit | ON = Relay B will pulse once upon detection at Loop A<br>OFF = Relay B will pulse once upon loss of detection at Loop A |
| **9** | 100ms | 500ms | Pulse Duration: The amount of time the relay will hold a changed state when operating in a pulse mode |
| **10** | Single | Dual | Dual loop mode : independent or combined A→B (not used with single loop) |

## FREQUENCY

| Frequency adjustment for loop A for single loop detector | | |
|---|---|---|
| **Dip Switch #1** | **Dip Switch #2** | **Loop frequency** |
| OFF | OFF | High |
| ON | OFF | Mid High [High –20%] |
| OFF | ON | Mid Low [High – 25%] |
| ON | ON | Low [High – 30%] |

## LED SIGNAL

Green LED shows when the module is powered;
Red LEDs gives:

- the corresponding loop detection state in normal situation;
- the value of the oscillation frequency measurement or an error message on power ON.

In **NORMAL SITUATION** the red LED stays ON as long as the loop detects any object.

On **POWER ON,** the sensor measures the oscillation frequency of each loop. The result of this measurement is displayed using the corresponding red LED. The number of flashes indicates the tens value of the frequency. For example 4 short flashes correspond to a frequency between 40 kHz and 49 kHz. After this message the LED goes back to normal display.
If the loop oscillation frequency falls outside the limits (20 kHz to 130 kHz) the red LED displays an error message and the sensor activates the corresponding relay. The blinking frequency shows the type of error according to the next table. The sensor will stay in error mode until the error is cleared and the frequency goes to the right range.
Remark : The sensor launches automatically a learning process if the oscillation frequency varies more than 10% in comparison with the measurement value.

| Loop Frequency Error | LED Display |
|---|---|
| Oscillation frequency too LOW or loop opened | LED blinking at 1Hz |
| Oscillation frequency too HIGH | LED blinking faster at 2 Hz |
| Loop shorted or no oscillation | LED blinking slower at 0.5 Hz |

## TROUBLE-SHOOTING

| SYMPTOM | PROBABLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| The loop detector will not work. The green LED is off. | There is no power supply to the loop detector. | Check power supply. |
| The loop detector will not work. The red LED is flashing slowly (0.5 Hz). | The corresponding loop is shorted. | Check the loop cable. |
| The loop detector will not work. The red LED blinks at either 1Hz or 2Hz. | The frequency of oscillation falls outside the allowed range. | Adjust frequency with dip switches or change loop turns. |
| The loop LED is detecting properly but the contact is not made. | Bad connection of the relay contacts. | Check relay connections. |
| Dip switches 5 to 8 are not responding properly. | Their function varies according to dip switch #10 setting. | Check the appropriate loop mode required and adjust dip switch #10. |

## COMPANY CONTACT

If after troubleshooting a problem, a satisfactory solution cannot be achieved, please call B.E.A., Inc. for further assistance during **Eastern Standard Time at 1-800-523-2462 from 8am - 5pm.**
For after-hours, call East Coast: 1-866-836-1863 / Mid-West: 1-888-308-8843
West Coast: 1-888-419-2564. **DO NOT leave any problem unresolved**. If you must wait for the following workday to call B.E.A., leave the door inoperable until satisfactory repairs can be made.
**NEVER sacrifice the safe operation of the automatic door or gate for an incomplete solution.**
**Web: www.beasensors.com**