MEASUREMENT SPECIALTIES

Piezo Polymer Sensors
Microfused Load Cells
Microfused Pressure Transducers

Dear Traffic Professional,

Thank you for your interest in the Measurement Specialties **Roadtrax7** Piezoelectric Traffic Sensors for *In the Road* and *Over the Road* applications. These sensors are being used for Weigh in Motion (WIM), vehicle classification and counting, speed detection, red light cameras, and parking area control.

Enclosed are the Product Specifications and Installation instructions for the **Roadtrax** BL Sensor. The BL Sensor (named for what it looks like - a Brass Linguini[7]!) is installed directly into a slot in the road. The sensor is only 1/16" thick and 1/4" wide (1.5mm x 6.5mm), but will provide 500 mV for a car. It is installed in a : " wide by 1" deep (19mm-25mm) slot in the road. Available in any length, it can be coiled for easy shipping and handling. These sensors reject road noise 10:1 and reduce ghost axles due to their flat design. This gives your electronics a clean easy to read signal that translates into more accurate classification, speed, and WIM data. The BL Sensor is available in a Class I (Weigh in Motion) configuration. Both the Class I and the Class II sensors are available in a variety of different lengths from 6' to 13', with standard cable lengths of 100' or more (metric lengths of 2 m to 5.5m, with cable lengths standard from 35m to 100m). These sensors are directly compatible with all counters and WIM Systems which have a piezoelectric input. **Roadtrax** sensors are used worldwide. Collectively, they have performed in an exemplary manner, giving unrivaled accuracy and dependability.

We are dedicated to working with you to ensure you have the right product to fully fit your needs. We can assist you in preparing for the installation of the sensors, to ensure it goes smoothly. We are committed to making the **Roadtrax** traffic sensors the best in the world. We appreciate the opportunity to work with you on your traffic data collection needs, and to assist you in making your job easier, safer and at the most cost effective.

An **INSTALLATION VIDEO** outlining the installation of the BL Sensor in the road is available. If you would like a copy of the video, just let us know and we will be happy to send you a copy. It is available in both video formats for use throughout the world.

Please give me a call if you have any questions. I would be happy to provide you with any further information or to quote you for your specific requirements.

Sincerely,

Donald Halvorsen

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Director, Business Development

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The MSI Roadtrax[7] Brass Linguini[7] axle sensor ... and why it's the best sensor for you!!

☞ Great Signal

- ✔ Positive signal as tires pass over the sensor
- ✔ High output - detects small vehicles - motorcycles, even bicycles
- ✔ Good dynamic range - can work with large to small vehicles
- ✔ Reduced Bow Wave
- ✔ Reduced Road Flexing noise
- ✔ High Signal to Noise Ratio for ease of signal processing
- ✔ High capacitance - can drive long cables
- ✔ Works even for slow speeds

☞ Easy to handle

- ✔ Conforms to any road profile
- ✔ Stiff enough not to droop
- ✔ Coils in a 2'x2' (600x600mm) box
- ✔ Rugged so that it does not break in handling

☞ Easy installation

- ✔ Installs in a 3/4" x 1" (19 x 25mm) cut in the road to minimize damage to the road
- ✔ Installs with fast curing epoxy, acrylic, or appropriate poly-urethane
- ✔ No need for heaters
- ✔ Smaller cut means less encapsulation material - a 6' BL sensor uses less than 2 gallon (2m sensor uses less that 1.5 liters)

☞ Quality

- ✔ 100% of sensors tested for capacitance and insulation resistance, and then impacted every 1/4" (6mm) along the length of the sensor to determine the activity and uniformity of the sensor.
- ✔ Computerized process controls the extrusion and polarization of the cable
- ✔ All data electronically archived
- ✔ All sensors Serial Numbered for traceability

☞ Durability

- ✔ Triple sealed coax splice between the sensor and the passive cable
- ✔ The sensor will not be damaged by bending to a radius of > 1' (300mm)
- ✔ Will withstand normal handling without tender loving care
- ✔ Tested to 40 Million Equivalent Single Axle Loadings

☞ Versatility

- ✔ Same sensor for over and in the road applications
- ✔ Surface sensors can be mounted permanently or temporarily
- ✔ Can be used in Portland Cement or Asphalt
- ✔ Several encapsulation techniques can be used - Epoxy, acrylic, or filled poly-urethane

☞ Great Passive cable

- ✔ Super tough High Density Poly Ethylene (HDPE)
- ✔ Rated as Waterproof for direct burial
- ✔ Low capacitance - 27 pF/foot (89 pF/m)
- ✔ Lengths from 100' to 300'(35-100m) standard - longer lengths on a custom basis

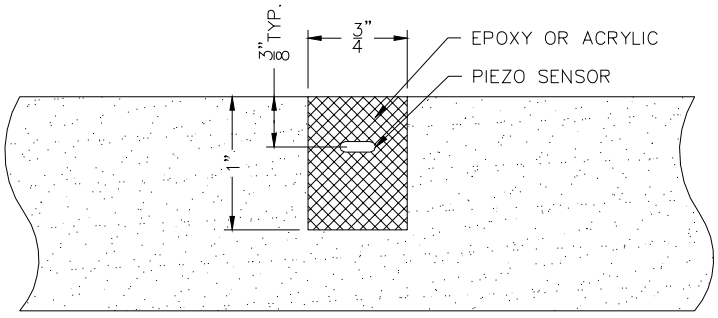
☞ Customer Support

- ✔ Fast delivery - Units in stock
- ✔ Any length - 6', 8', 9',10',11',12',and 13' - with a standard of 100' of passive cable but with the option of any length in multiples of 50'
- ✔ Available in metric lengths - 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 and 5.5 meters, with standard cable lengths of 35, 50, 75 and 100 meters
- ✔ Installation clips included with all sensors
- ✔ Installation instructions available on request
- ✔ Available Internationally
- ✔ On site installation training available

PRODUCT DESCRIPTION

The Roadtrax BL Traffic Sensor is designed for Permanent or Temporary installation into or onto the road surface for the collection of traffic data. The unique construction of the sensor allows it to be installed directly into the road in a flexible format so that it can conform to the profile of the road. The flat construction of the sensor gives an inherent rejection of road noise due to road bending, adjacent lanes, and bow waves of approaching vehicles. The small cut in the road minimizes the damage done to the road, speeds up the installation and reduces the amount of grout used for the installation. The Roadtrax BL sensor is available both as a Class I sensor for the highest level of uniformity needed for Weigh in Motion applications and as a Class II sensor which is more cost effective for Counting, Classifying, High Speed Toll Booths, Speed Detection, and Red Light Cameras.

- Uniform, **high amplitude** piezoelectric output **compatible with existing** counters and classifiers on the market.
- **Excellent Signal to Noise Ratio** which has an inherent **10:1 rejection** of road noise due to road bending, adjacent lanes and bow waves of approaching vehicles.
- **Easy installation** in a 3/4" x 1" (19 x 25mm) slot, which minimizes the disturbance of the road, decreases the depth of the road cut, and minimizes the amount of grout needed.
- **Flexible sensor** - conforms to any road profile while maintaining a uniform distance to the road surface.
- The **final installation is flush** with the road surface - snowplows will not damage the sensor.
- **Durable** enough to withstand normal installation handling and **hundreds of millions ESAL's.**
- All sensors are **100% tested and certified** for performance as a complete sensor prior to shipment.
- Custom Passive Signal Cable with **High Density Poly Ethylene Jacket** which is rated for direct burial and resists nicks and cuts.



Permanent in the Road Installation

Performance Characteristics	
Output Uniformity	< ± 20% for Class II (Classification) < ± 7% for Class I (Weigh in Motion)
Operating Temperature Range	- 40 to 160 °F (-40 to 70°C)
Temperature Sensitivity	0.2%/°F typ, dependent on the grout used
Typical Output Level	A wheel load of 400 pounds will produce a minimum output signal of 250 mV, at 70°F and 55 mph for a proper installation
Passive Signal Cable	RG 58C/U with a High Density Polyethylene Outer jacket that is rated for direct burial; 3/16" (4.75mm) OD
Product Life	40 Million ESAL's; dependent on the installation
Capacitance	See Chart
Weight	See Chart
Insulation Resistance	>500 MΩ
Packaging	All sensors are packages two to the box in a 24"x20"x3"(600x550x75mm) corrugated cardboard box
Installation Brackets	Included. One bracket is used every 6" (150mm)

Specifications[1]

The MSI BL Traffic sensor has the following specifications:

1. Center Core: 16 gauge, flat, braided, silver plated copper wire.
2. Piezoelectric Material: Spiral-wrapped PVDF Piezoelectric film
3. Outer Sheath: 0.016" thick brass, CDA-260, ASTM B587-88
4. Final Dimensions: 0.260" wide x 0.063" thick; 0.005"
5. Insulation resistance between core and shield: > 500 MΩ.
6. Piezoelectric Coefficient: 10 pC/N - nominal.
7. Passive Signal Cable: RG 58 type with a underground/direct burial rated outer jacket. The OD of the cable is 0.187" (4.75mm). The nominal capacitance of the cable is 27 pF/ft (89pF/m).
8. Sensors are packaged 2 per box. The box size is 24"x20"x3" (600x550x75mm).
9. Two sizes of installation brackets are included with the sensors, 3/4" (small) brackets and 1" (large) brackets. There is one small and one large bracket per 6" (150mm)of sensor length.

[1]Although Measurement Specialties Inc. makes every effort to ensure the accuracy of the specifications at the time of publication, specifications for this product are subject to change without notice. Contact MSI for the most current information at +1 610 650 1508.

Sensor Length	Sensor Classification[2]	Capacitance with 100' cable[3]	Weight[4] pounds (kg)	Visible Brass Length	Installed Length[5]	Part Number[6]
6' (1.82m)	Class II	4.00 nF≤C≤10.00 nF	2.75 (1.25)	70" (1.78m)	76" (1.93m)	0-1005333-Y
8' (2.42m)	Class II	5.50 nF≤C≤11.50 nF	2.80 (1.27)	94" (2.38m)	100" (2.54m)	1-1005333-Y
9' (2.73m)	Class II	6.25 nF≤C≤12.25 nF	2.85 (1.30)	106" (2.69m)	112" (2.85m)	2-1005333-Y
10' (3.03m)	Class II	7.00 nF≤C≤13.00 nF	2.90 (1.32)	118" (3.00m)	124" (3.15m)	3-1005333-Y
11' (3.33m)	Class II	7.75 nF≤C≤13.75 nF	2.95 (1.34)	130" (3.30m)	136" (3.45m)	4-1005333-Y
12' (3.64m)	Class II	8.50 nF≤C≤14.50 nF	3.00 (1.36)	139" (3.53m)	145" (3.68m)	5-1005333-Y
13' (3.94m)	Class II	9.25 nF≤C≤15.25 nF	3.05 (1.39)	154" (3.91m)	160" (4.06m)	6-1005333-Y
6' (1.82m)	Class I (WIM)	4.00 nF≤C≤10.00 nF	2.75 (1.25)	70" (1.78m)	76" (1.93m)	1-1005438-Y
8' (2.42m)	Class I (WIM)	5.50 nF≤C≤11.50 nF	2.80 (1.27)	94" (2.38m)	100" (2.54m)	2-1005438-Y
9' (2.73m)	Class I (WIM)	6.25 nF≤C≤12.25 nF	2.85 (1.30)	106" (2.69m)	112" (2.85m)	3-1005438-Y
10' (3.03m)	Class I (WIM)	7.00 nF≤C≤13.00 nF	2.90 (1.32)	118" (3.00m)	124" (3.15m)	4-1005438-Y
11' (3.33m)	Class I (WIM)	7.75 nF≤C≤13.75 nF	2.95 (1.34)	130" (3.30m)	136" (3.45m)	5-1005438-Y
12' (3.64m)	Class I (WIM)	8.50 nF≤C≤14.50 nF	3.00 (1.36)	139" (3.53m)	145" (3.68m)	6-1005438-Y
13' (3.94m)	Class I (WIM)	9.25 nF≤C≤15.25 nF	3.05 (1.39)	154" (3.91m)	160" (4.06m)	7-1005438-Y
2.0m (6'7")	Class II	4.94 nF≤C≤10.94 nF	2.75 (1.25)	1.98 m (78")	2.14 m (84")	1-1005528-Z
2.5m (8'3")	Class II	6.17 nF≤C≤12.17 nF	2.85 (1.30)	2.48 m (98")	2.64 m (104")	2-1005528-Z
3.0m (9'11")	Class II	7.40 nF≤C≤13.40 nF	2.95 (1.35)	2.98 m (117")	3.14 m (123")	3-1005528-Z
3.5m (11'6")	Class II	8.63 nF≤C≤14.63 nF	3.05 (1.40)	3.48 m (137")	3.64 m (143")	4-1005528-Z
4.0m (13'2")	Class II	9.87 nF≤C≤15.87 nF	3.15 (1.45)	3.98 m (157")	4.14 m (163")	5-1005528-Z
4.5m (14'10")	Class II	11.09 nF≤C≤17.09 nF	3.25 (1.50)	4.48 m (177")	4.64 m (183")	6-1005528-Z
5.0m (16'6")	Class II	12.32 nF≤C≤18.32 nF	3.35 (1.55)	4.98 m (196")	5.14 m (202")	7-1005528-Z
5.5m (18'2")	Class II	13.55 nF≤C≤19.55 nF	3.45 (1.60)	5.48 m (216")	5.64 m (222")	8-1005528-Z
3.5m (11'6")	Class I (WIM)	8.63 nF≤C≤14.63 nF	3.05 (1.40)	3.48 m (137")	3.64 m (143")	4-1005527-Z
4.0m (13'2")	Class I (WIM)	9.87 nF≤C≤15.87 nF	3.15 (1.45)	3.98 m (157")	4.14 m (163")	5-1005527-Z
4.5m (14'10")	Class I (WIM)	11.09 nF≤C≤17.09 nF	3.25 (1.50)	4.48 m (177")	4.64 m (183")	6-1005527-Z
5.0m (16'6")	Class I (WIM)	12.32 nF≤C≤18.32 nF	3.35 (1.55)	4.98 m (196")	5.14 m (202")	7-1005527-Z
5.5m (18'2")	Class I (WIM)	13.55 nF≤C≤19.55 nF	3.45 (1.60)	5.48 m (216")	5.64 m (222")	8-1005527-Z

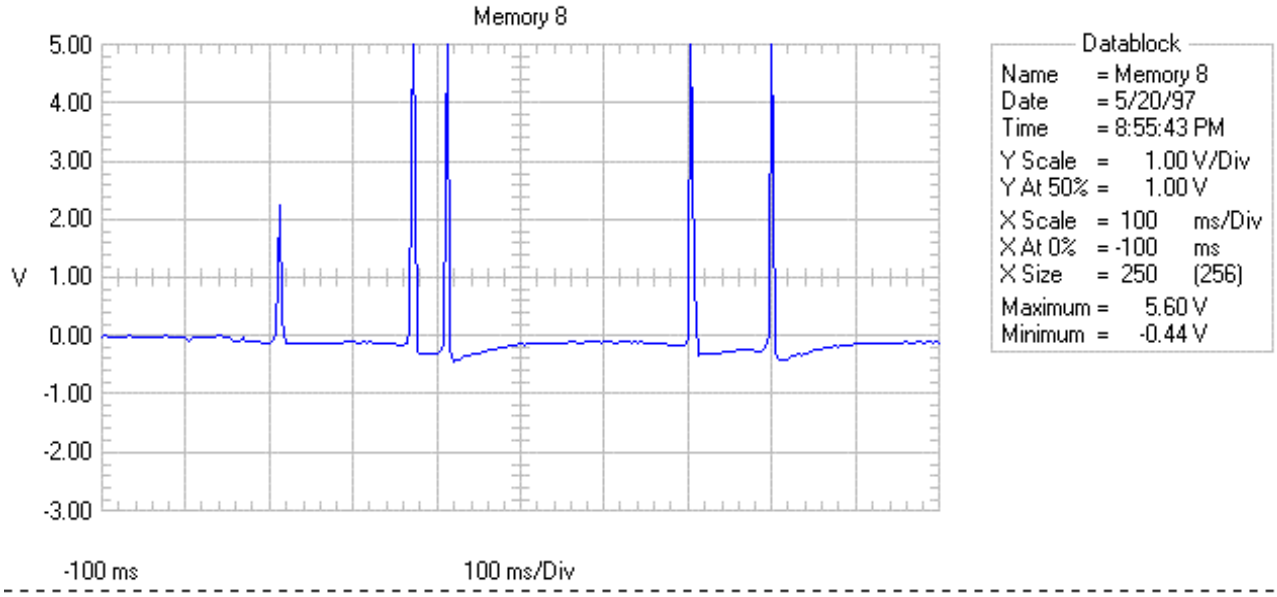
[2]Class II sensors have a uniformity of ≤ ±20% and are typically used for Classification purposes. Class I sensors have a uniformity of ≤ ±7% and are typically used for Weigh in Motion applications.

[3]Additional cable has a capacitance of 27 pF/ft (89 pF/m) or 2.7 nF/100' (2.2 nF/25m). Provided with each sensor is a test certificate with the actual tested value for the sensor. Field tests should be with ± 10% of these values, at room temperature (70F or 23C).

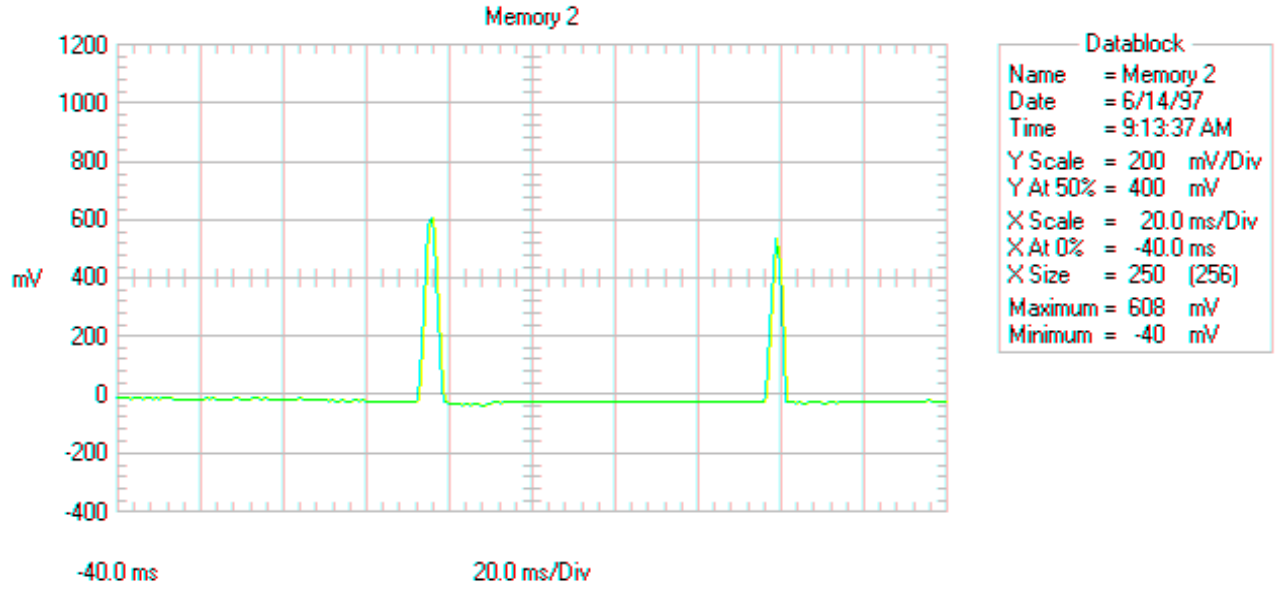
[4]All sensors are packaged 2 per box. The box weighs 1.5 lbs (0.7 kg).

[5]This length refers to the installed length of the sensor. This is the minimum lane width for the installed sensor.

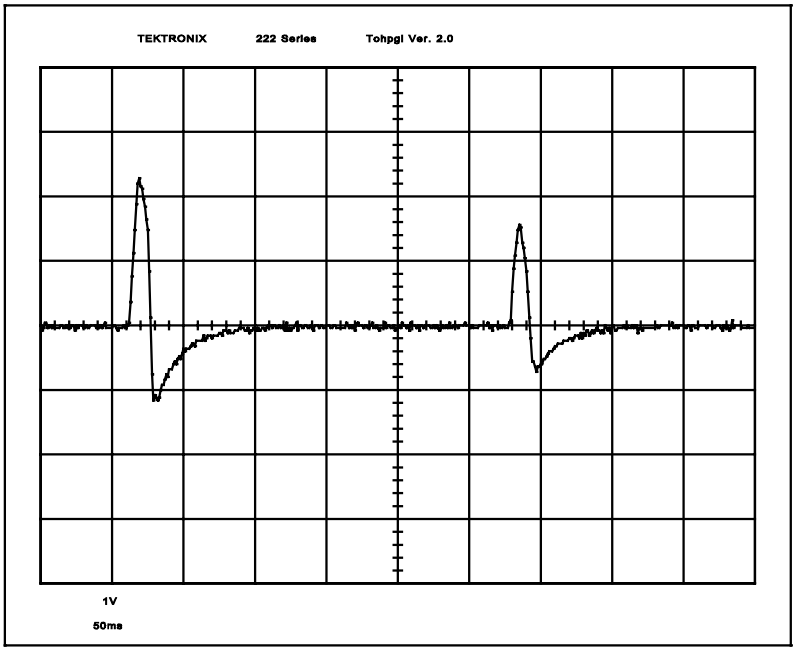
[6]The suffix refers to the cable length. Cable lengths for -Y are as follows: -1 @ 100', -2 @ 150', -3 @ 200', -4 @ 250', -5 @ 300'. Cable lengths for the -Z are as follows: -1@ 35m, -2 @ 50m, -3 @ 75M, and -4 @ 100m.



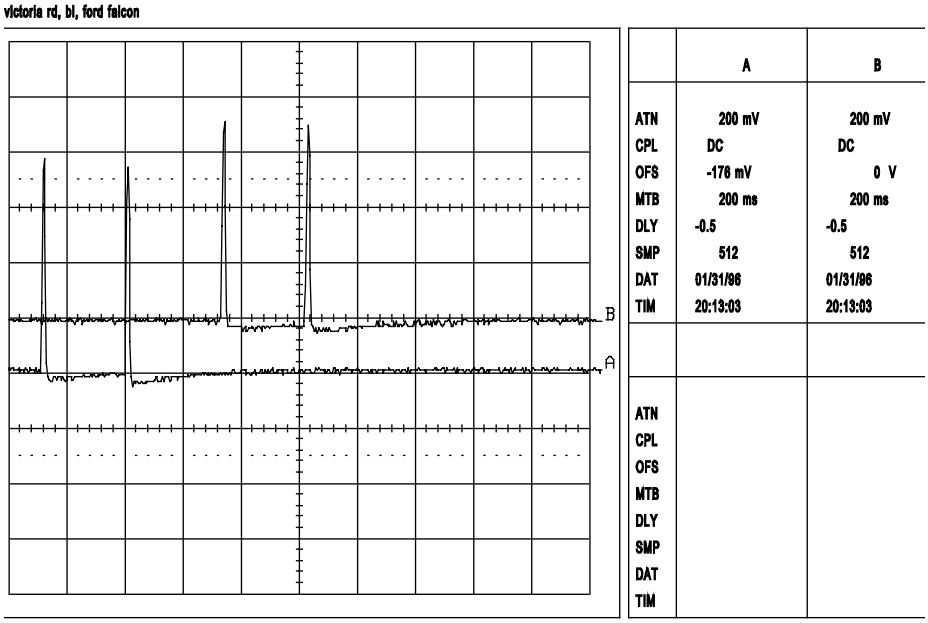
AMP BL, I35n, brick truck, 6n



AMP BL, A74 (England) 12' Sensor, Global 768, Car

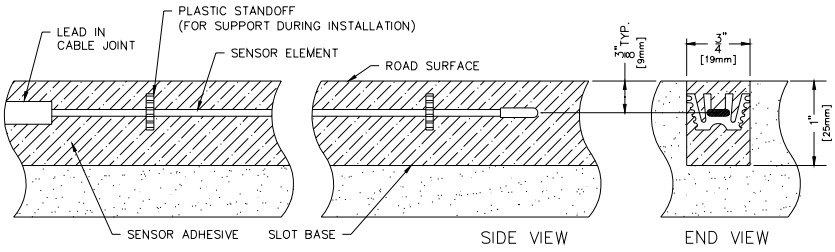


Roadtrax BL Sensor taped to the road. 12' long with 100' passive cable. Chevy Caprice ≈ 25 mph. 4/25/96. 1V/div vertical scale; 50 msec/div horizontal.



	A	B
ATN	200 mV	200 mV
CPL	DC	DC
OFS	-176 mV	0 V
MTB	200 ms	200 ms
DLY	-0.5	-0.5
SMP	512	512
DAT	01/31/96	01/31/96
TIM	20:13:03	20:13:03
ATN		
CPL		
OFS		
MTB		
DLY		
SMP		
DAT		
TIM		

Roadtrax BL Sensor installed in an asphalt road using epoxy. 200mV/div vertical scale, 200 msec/div horizontal scale. 12' sensor with 100' cable. Mid sized car at 35 mph.



Read these instructions completely PRIOR TO INSTALLATION

Approved Installation Epoxies: ECM P5G
Global Resin PU 200, IRD AS475

NOTE: these instructions should be used for THICKER, high viscosity material, such as ECM P5G. If low viscosity material is used, see notes for the PU200/260.

1. Carefully mark the slot to be cut, perpendicular to the flow of traffic. Ensure that the sensors are properly positioned in the lane. Shorter sensors are positioned to one side; longer sensors are typically centered on the lane.

2. Cut a slot 3/4" wide (19mm) and 1" deep (25mm). The slot should be 8" (203 mm) longer than the sensor. The lead out should be centered on the slot.

3. It is strongly recommended that a 3/4" (19mm) wide diamond blade be used for cutting the slot, or that blades be ganged together to get a single 3/4" (19mm) wide cut. The slot should be wet cut to minimize damage to the road and increase the bonding strength of the grout.

4. Use high pressure water, or water and compressed air to clean ALL foreign matter out of the slot and 6" (150 mm) on all sides of the slot. Remove all excess water and debris with a vacuum cleaner and/or sweeping.

5. Carefully dry the slot using torches, torpedo heaters, electric heaters, or natural evaporation. Be very careful not to burn the asphalt if a torch is used.

6. Place a strip of duct tape along the pavement next to the slot, leaving 1/8" gap between edge of slot and tape. Cover out to about 2" (50mm) on either side of the slot for the full length of the slot.

7. Clean the length of the brass element of the sensors with steel wool/emery pad. Bend the end of the sensor down 30º. Bend the lead attachment end down 15º and then back level, forming a lazy Z.

8. Lay the sensor on the tape next to the slot. Ensure that the sensor is straight and flat. Place the clips on the sensor, about every 6" (150mm). DO NOT place the sensor in the slot at this point, as the clips are one way and it will be difficult to remove the sensor prior to putting in the grout.

9. Block off the ends of the slot using plumbers putty or backer rod. Ensure that there are adequate 'dams' at both ends so that the encapsulation material does not flow out. On the passive cable end, the dam should be at least 3" (75mm) past the lead attachment end.

10. Test the sensor for capacitance, dissipation factor and resistance, according to the directions enclosed. Record the test results and the sensor serial number. This information should be stored in the counter cabinet or returned to a data storage file.

11. Mix the grout according to the manufactures instructions. Be sure to pre-mix the resin before combining the two parts since the aggregate material has a tendency to settle. Fill the slot full of the encapsulation material. Using a trowel, distribute the encapsulation material along the sensor, and smooth it out.

12. Ensure that you are wearing protective plastic or rubber gloves. Place the sensor in the slot, with the brass element about 3/8" (9mm) below the road surface, and the top of the brackets about 1/8" (3mm) below the road surface. Ensure the ends of the sensors are pushed down sufficiently. Smooth out the grout on top of the sensor, ensuring there is not a trough on top.

13. Remove the tape on the sides of the sensor as soon as the grout starts to cure.

14. Carefully remove the plumber's putty or backer rod used to form the dam at the sensor's end.

15. Route the lead in cable through the home run slot, and cover with loop sealant or grout. DO NOT USE HOT TAR.

16. When the encapsulation material is fully cured, grind the top of the encapsulation material flush with the road using an angle grinder or belt sander. The profile should be flat or with a slight 'mound' (1/16"), provided that there is no concave portion to the curve.

17. Clean up the site. When the encapsulation material is fully cured, it may be opened to traffic. Failure to wait for the encapsulation material to fully cure may ruin the installation and cause it to fail prematurely.

Important Notes and Hints:

- The quality of the road will affect the quality of the data. The roads should conform to ASTM specifications for Weigh in Motion applications.
- Diamond blades should be used on the road saw. The tolerance for the cut is 11/16" to 13/16". A 3/4" diamond blade is recommended for cutting the slot. Do not try to do two independent cuts as it is very difficult to achieve this level of accuracy.
- Wet cutting is preferred to dry cutting. The dry cutting forces particles into the sidewalls of the slot which are very difficult to thoroughly clean. This residue will diminish the adhesion of the adhesive to the road, potentially causing the premature failure of the sensor.
- The passive cable length should not exceed 300' without consulting the manufacture. It is STRONGLY recommended that the sensors be ordered with sufficient cable to avoid splices. If splices are needed, only similar grade of RG-58 cable should be used, the splices must be soldered, and an approved splice kit used to waterproof the splice. MSI Sensors is not responsible for any problems arising from spicing the cable.
- Disposable gloves must be worn when working with the clean sensor and encapsulation material. Appropriate precautions should be taken, according to the encapsulation material manufacturer's instructions. Ensure you read and follow all safety instructions.
- Adequate traffic control is essential. Do not put any of your workers at risk.
- Ensure that the sensor is placed in the correct location on the road. Six foot sensors should be positioned in a wheel path, NOT in the center of the lane.
- Care should be taken when mixing the encapsulation material to minimize the amount of trapped air in the material. Do not lift the mixing paddle out of the encapsulation material while the mixing head is spinning. Stop the blade and then use a stirring paddle to scrape the edges of the can.
- If heaters are needed to speed the curing process for the grout, extreme care should be taken to ensure that the sensors are not destroyed. The maximum temperature that the sensors can withstand is 170ºF! An A-Frame should be constructed out of metal or plywood, and placed over the sensor. Warm air from a torpedo heater should be blown in horizontally into the A-Frame, but NEVER aimed directly at the sensor. The air temperature at the sensor location should not be higher than what can be tolerated by your hand for 20-30 seconds. If it is hotter than this, the sensor will loose its piezo activity and will not function.
- Once the sensor is installed and the grout is cured, it is recommended that any excessive grout be ground off, using an angle grinder or belt sander. The best installation has the grout flush with the road surface to minimize any chance of the tires bridging over the sensor.
- Thin walled plastic tubing may be used to contain the home run cable. In the unlikely event that the sensor needs to be replaced, the passive cable can then be pulled through the tubing, thereby eliminating the need for recutting the home run slot.
- Read all of the directions carefully and completely prior to the installation. Ensure that you have all of the required equipment available. If there are any questions on the installation, call MSI and we will be happy to 'walk' you through the procedures.

Required/recommended tools and materials

- MSI BL Sensors with installation brackets. Sensors should be ordered with sufficient passive cable to reach the control cabinet.
- Installation instruction. Read these instructions prior to the installation. There may need to be some adaptation of these instructions based on local conditions.
- Sensor support brackets. These are shipped in the box with the sensors.
- Installation encapsulation. See Recommended materials under frequently asked questions. Approximately 2 to 1 gallon (1.5 to 3 liters) of material is needed per sensor. The slot must be carefully cut in order to ensure that it is not too deep; otherwise excessive material is used. Read, understand and follow the directions supplied by the manufacturer of the installation encapsulation. Adhere to the temperature limits imposed on the material to ensure adequate drying time is available. Follow all recommended safety precautions.
- Loop sealant material, to cover the home run cables. Amount used will depend on the length and width of the homerun cuts. DO NOT USE HOT TAR..
- ★ Thin wall tubing for homerun cables. Minimum 3/8" (9mm) ID, flexible tubing. Materials for this tubing are typically flexible PVC or polyethylene. Sufficient quantity for all homeruns from the end of the sensors to the cabinet.
- ★ PVC pipe, 2-3" (50-75mm) dia. For use as conduit for any underground runs from junction boxes to cabinets.
- ★ PVC solvent and joints - as needed for any splices in the pipes.
- Wet cutting pavement saw. A self-propelled saw of at least 35 hp, fitted with a 14" (350mm) or larger blade. This saw must be capable of cutting a 3/4" wide x 1" deep (19mm wide x 19-25mm deep) cut in a single pass.
- Diamond Blades for the saw. Appropriate type for the pavement being cut. The Piezo sensor needs a cut 11/16" to 13/16" (19mm ± 1mm) wide, 1" (25mm) deep slot cut in the road in a single pass. If a single blade is not available, multiple blades can be put together to form a dado blade . A 3/8" (9mm) and a 1/4" (6mm) blade, with a 1/16" (2mm) spacer between them performs very well. Additional blade widths are necessary for cutting the slots for the tubing for the home run cables.
- Large capacity air compressor (at least 150 CFM) with hose and nozzle - for blowing out the slot and drying the area after the cut.
- Trenching equipment as required for burying the conduit to the control cabinet.
- Power washer or high pressure water hose - for washing out the slot.
- Water - for saw and for washing out the slot
- Broom - Street broom type with stiff bristles for general cleanup.
- Slow speed electric drill with mixing paddle
- Additional mixing blade if a 2 part loop sealant is used. There should not be cross contamination of the grout used for the piezo and the loop sealant material.
- Wire Brush and/or bristle brush - for cleaning out the slot after cutting and during washing.
- 3" or 4" (75-100mm) putty knife for use with the grout
- Small pointed trowel for putting the grout into the slot.
- Wire Strippers. Knife type blade strippers, such as Ideal Tools Stripmasters should be used due to the toughness of the HDPE jacket on the sensor homerun cable.
- Cleaning Materials for hands and equipment. The citrus hand cleaner works well. Include lots of paper towels.
- Angle Grinder with appropriate grinding wheel or belt sander for smoothing out the grout after the installation.
- Hammer and masonry chisels. May be required for chipping corners, etc.
- Disposable gloves (rubber dishwashing gloves work much better than the latex or plastic gloves)
- 2" (50mm) duct tape. Enough for twice the length of all the sensors. Used to keep excessive grout off the road next to the slot during the installation.
- Plumbers putty or duct seal to form dams at the end of the grout
- Straight edge
- Tape measure - at least 20' (6m) long
- Pavement crayons
- Chalk line
- Pavement paint
- 1/8" (3mm) diameter cord or rope for use in laying out the lines
- ★ Hammer drill and 2" (12mm) concrete bit
- LCR Meter, such as a BK 875A, to check and measure Capacitance and Resistance of the sensors before and after installation.
- ★ Oscilloscope. Although not essential, it is the only instrument that will give a complete verification that the sensors are fully functioning when the installation is complete. If reliable power is not available on the site, a battery operated oscilloscope should be used, such as the Fluke Scopemeter.
- Generator if electrical power is not available on site. Verify the electrical load of the tools being used compared to the capacity of the generator.
- Appropriate traffic control, as required by local regulations and appropriate safety guidelines
- Safety equipment required for workers. Safety helmets, safety glasses, reflective vests, etc, as required.
- ★ Not included in this list are materials required for inductive loops (if used), control cabinets, junction boxes, and other off the road work.

! Required Equipment
★ Recommended Equipment

Sensor Testing:

The piezoelectric sensors should be tested prior to and after installation. Because of the high costs of installation compared to the cost of the sensor, it is imperative that the sensors be checked out prior to putting them into the road to determine if any damage has been done to the sensor during shipping and handling. The following tests should be done prior to installation:

Equipment needed: LCR meter, such as a BK Instruments 875A or 875B.

1. **Capacitance:** Measure the capacitance of the sensor with the attached lead in cable. This should be 20% of the sensor's data sheet included in the box. The meter should typically be set on a 20nF range. The red probe should be connected to the center electrode of the cable and the Black probe to the outer braid. Make sure that you hands are not holding across the two connections.

2. **Dissipation Factor:** With the capacitance set on the scale indicated above, switch the meter over to Dissipation Factor. The reading should be less than 0.04.

3. **Resistance:** Measure the resistance across the sensor. The meter should be set on the 20MΩ setting. The meter should read in excess of 20MΩ, which is typically displayed with a '1'.

Testing after installation:

Once the sensor is installed and the grout has cured, retest the sensor according to the instructions above. In addition, it is recommended that an oscilloscope be connected to the sensor and typical waveforms be collected for a truck and a car. These should then be printed out and saved for permanent records. The output of the sensor will depend on the type of the installation, sensor length , cable length and epoxies used for the installation. Typical settings for the scope would be 200 mV/div for a voltage setting and 50 msec/div for a time setting. The trigger should be set at about 50 mV for a positive going signal.

Sensor Maintenance:

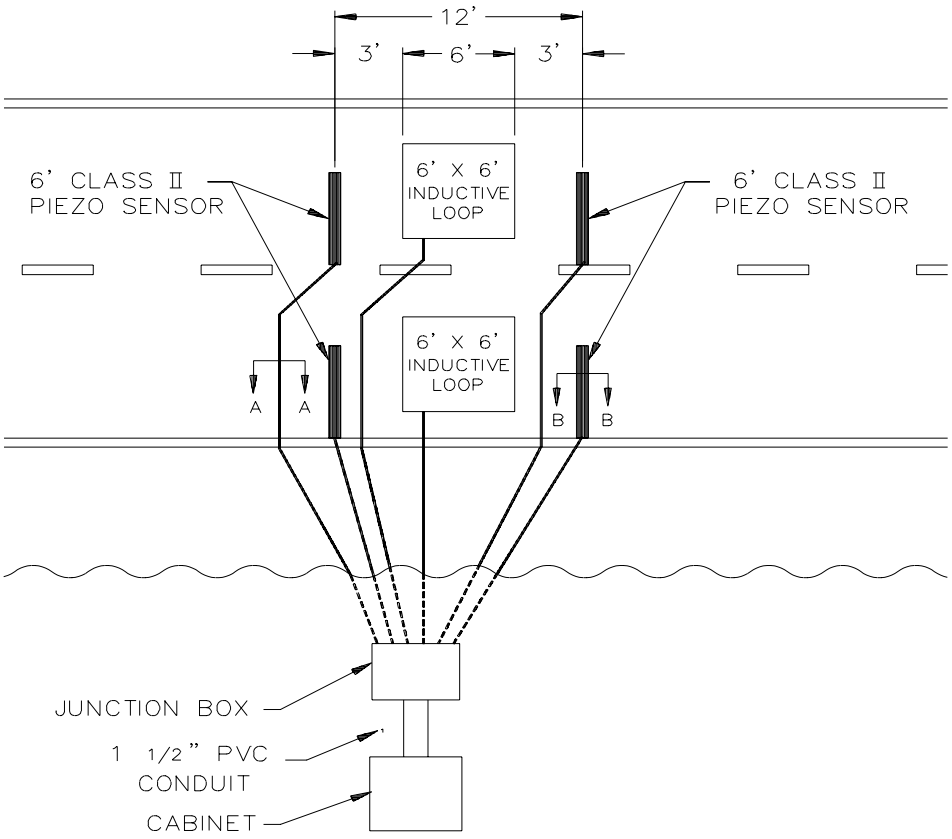
Like any piece of equipment, regular maintenance should be done to the piezoelectric sensors in order to maintain them for a long service life. The sensors should be inspected on a bi-annual basis, and any cracks in the road or in the sensor encapsulation should be filled. A low viscosity loop sealant such as Bondo 606 or a low viscosity epoxy such as Global PX768 should be poured into any cracks, and then squeegeed smooth. Any loose asphaltic material should be wire brushed away prior to pouring the sealant material in the cracks. Be carful not to raise the profile of the sensor. The sensor should be tested for capacitance and resistance, and the results logged in on the data sheet for the sensors.

Quantity of Grout to be Used:

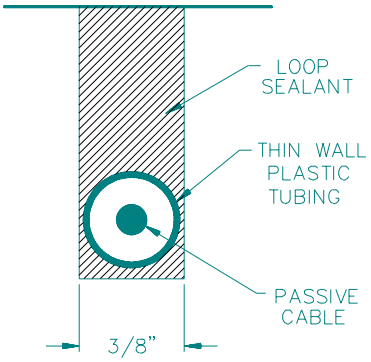
The BL sensor is to be installed in 3/4"x1" (19 x 25mm) slot. However, this is difficult to accurately cut, especially in depth. The formula for the purposes of calculating the amount of encapsulation material to be used is as follows:

(Length of Sensor {in inches} + 12") *(3/4"1")*2 or (Length of Sensor {in millimeters} + 300mm) *(19mm*25mm)*2

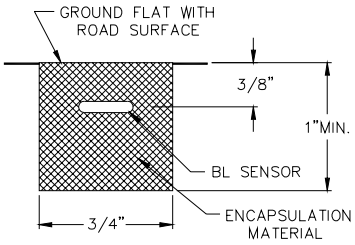
This gives a 100% safety factor, in case the slot is slightly deep or long and so that the bottom of the bucket is not being scraped. For planning purposes, 6' (2m) sensors use approximately 2 gallon (1.5 liters)of encapsulation material and 12' (3.5m) sensors use a gallon (3 liters) of material. There are 230 cubic inches in a US gallon. Check with the manufacturer of the encapsulation material for the closest package size. If the resin is sold by weight, divide the weight by the specific gravity (density) to get the volume.



Typical installation layout for a Piezo-Loop-Piezo installation for 6' Class II sensors



A-A: The passive cable can be put in a thin wall plastic tube for additional protection.



B-B: Typical cross section of a BL Sensor installation.

Frequently Asked Questions:

Approved Grout for installation

Polyurethane

PU 260 or PU260 (Winter and Summer versions are available) There is an updated product called PU260.

Global Resins Limited
Unit 7
Park Lane Industrial Estate
Corsham, Wilts SN13 9LG
England
Tel: +44 1249 715566
Fax: +44 1249 715533

Available in the USA through:
International Traffic Corporation
2402 Spring Ridge Dr, Suite E
Spring Grove, IL 60081
Tel: 815 675 1430
Fax: 815 675 1530

Epoxy

None

Acrylic

ECM P5G
Electronic Control Measurement Inc
PO Box 888
Manor, TX 78653
Tel: 512 272 4346
Fax: 512 272 4966

AS475
International Road Dynamics
702 43rd Street East
Saskatoon, Saskatchewan
Canada S7K 3T9
Tel: 306 653 6600
Fax: 306 242 5599

Diamond Saw Blades

Texas Diamond Tools
805 Hilbig Rd
Conroe, TX 77301
Tel: 800 346 0646
Tel: 409 756 0646
Fax: 409 756 0687
14x.750x.250x1", PN# 07147507

Bituthane Pocket Tape for Temporary installations

Mar Mac Manufacturing Co, Inc
PO Box 278, US Highway One North
McBee, SC 29101
Tel: 843 335 8211
Toll Free: 800 845 6962
Fax: 843 335 5909
Tape ST0005604 (4" wide with a 2" pocket)

BNC Connectors

AMP Incorporated
PO Box 3608
Harrisburg, PA 17111
Tel: 1-800 52AMP52
Also available through Newark Electric and other Distributors
Part Number 227079-5 (BNC with Gold center contact)
Part Number 227079-1 (BNC with Tin-lead center contact)
Hand Crimper - PRO-CRIMPER Hand Tool 58433-1
Stripping Tool 603995-6
Installation Instructions 408-2798
RF Connector Catalog 82074

Installation hints for the MSI BL sensor when using Global Resin PU 200/PU260 Resin, IRD AS475 and other low viscosity installation materials.

- Layout and mark the location of the sensors on the road. The sensors should be exactly perpendicular to the flow of traffic. Position the sensor in the left side of the wheelpath, with the lead attachment of the sensor toward the cabinet. The end of the sensor should be all the way to the edge of the lane.
- Cut a slot for the sensor 3/4" wide (± 1/16") and 1" deep (±1/4"). The slot should be 8" longer than the sensor. Wet cut the slot with a diamond blade.
- Cut the lead in cable slot centered on the sensor slot. The lead in cable slot should be a minimum of 2" deep and 1/4" wide. If conduit or tubing is used for the lead in cable, the slot should be 1/8" wider than the conduit.
- Sweep and powerwash with fresh water to clean the slots. Dry them compressed air, natural evaporation or heaters, depending on weather conditions.
- Place a stip of duct tape along the edge of the slot. The duct tape should not overlap into the slot; it can be up to 1/8" away from the slot.
- Remove the sensor from the box. Do not set the sensor on the road. Check to see that the sensor is straight and flat, with no twists or curls. Straighten the sensor if necessary.
- Use an LCR Meter, measure the capacitance, resistance and dissipation factor of the sensor. Use the 20nF setting for capacitance and dissipation tests and the 20MΩ setting for the resistance test. Record all results. All capacitance reading should be within 20% of the readings on the data sheet provided with each sensor.
- Clean the length of the brass element of the sensor with steel wool or an emory pad. Place the installation brackets on the sensor every 6" (±1"). Make sure all of the brackets are facing the same direction.
- Slightly bend down the end of the sensor at a 30° angle. Slightly bend down the sensor at the lead attachment at a 15° angle. Then bend it back level, forming a lazy Z.
- Position the sensor in the slot. Start at the end of the sensor and set the clips into the slot. The end of the sensor should be 3" from the center line/edge of the road.
- Press down on the top of the brackets so that they are just below the road surface.
- Using a locally made jig or a combination square, press down on the top of the sensor near the installation bracket so that the top of the sensor is exactly 3/8" below the road surface and the top of the brackets are 1/8” below the surface of the road.
- Use two pieces of backer rod, 2" diameter and about 6" long to seal the home run slot beyond the location of the lead attachment. The backer rod should be positioned on both sides of the passive cable, 3" past the end of the lead attachment. Place the passive cable into the slot, ensuring that it goes all the way to the bottom of the slot. The cable itself should be positioned in the midpoint of the slot.
- If tubing or conduit is used for enclosing the home run cable, it should stop on the far side of the backer rod.
- Visually check the positioning of the sensor. It should be at the same depth along the entire

length. The lead attachment area should be below the road surface at all points, and centered in the slot. The backer rod should be 3" beyond the lead attachment. The sensor should not cross any expansion joints or cracks in the pavement.

- Premix the resin for about 2 minutes or until smooth. Use a drywall plaster (mud) mixing paddle (for example, Grainger part number 4R539, or Home Depot part number 81-001) in a 500 - 600 rpm drill. Make sure the resin is homogeneous prior to adding in the hardener.
- Immediately, pour the resin into the slot. Start at the end and pour a small bead in the direction of the lead attachment. Go back to the end, and pour another pass, continuing in this process until the slot is filled completely.
- Lightly trowel the resin smooth. Be very careful to ensure that it is not over worked.
- As soon as the resin starts to cure, remove the tape.
- Allow the resin to fully cure.
- Remove the backer rod used at the lead attachment area.
- Grind off any excess resin off the top of the sensor, using a masonry cup wheel on an angle grinder or a belt sander. Use the grinder flat - not at an angle where it will make the top of the grout concave. Do not overgrind.
- Complete the installation by filling the homerun slot with loop sealant material.
- Using a LCR meter, perform the final tests on the sensor, including capacitance, resistance and dissipation factor. Record all results. All capacitance reading should be within 20% of the readings on the data sheet provided with each sensor.
- When the cable is routed all the way into the cabinet, cut the cables to the final length. Again check capacitance, resistance and dissipation factor and RECORD RESULTS. The resistance and dissipation factor should be the same; the capacitance will go down at a rate of 2.7 nF/100' of cable cut off.
- When the lane is opened to traffic, perform a functional test on the sensor using an oscilloscope. Record results.