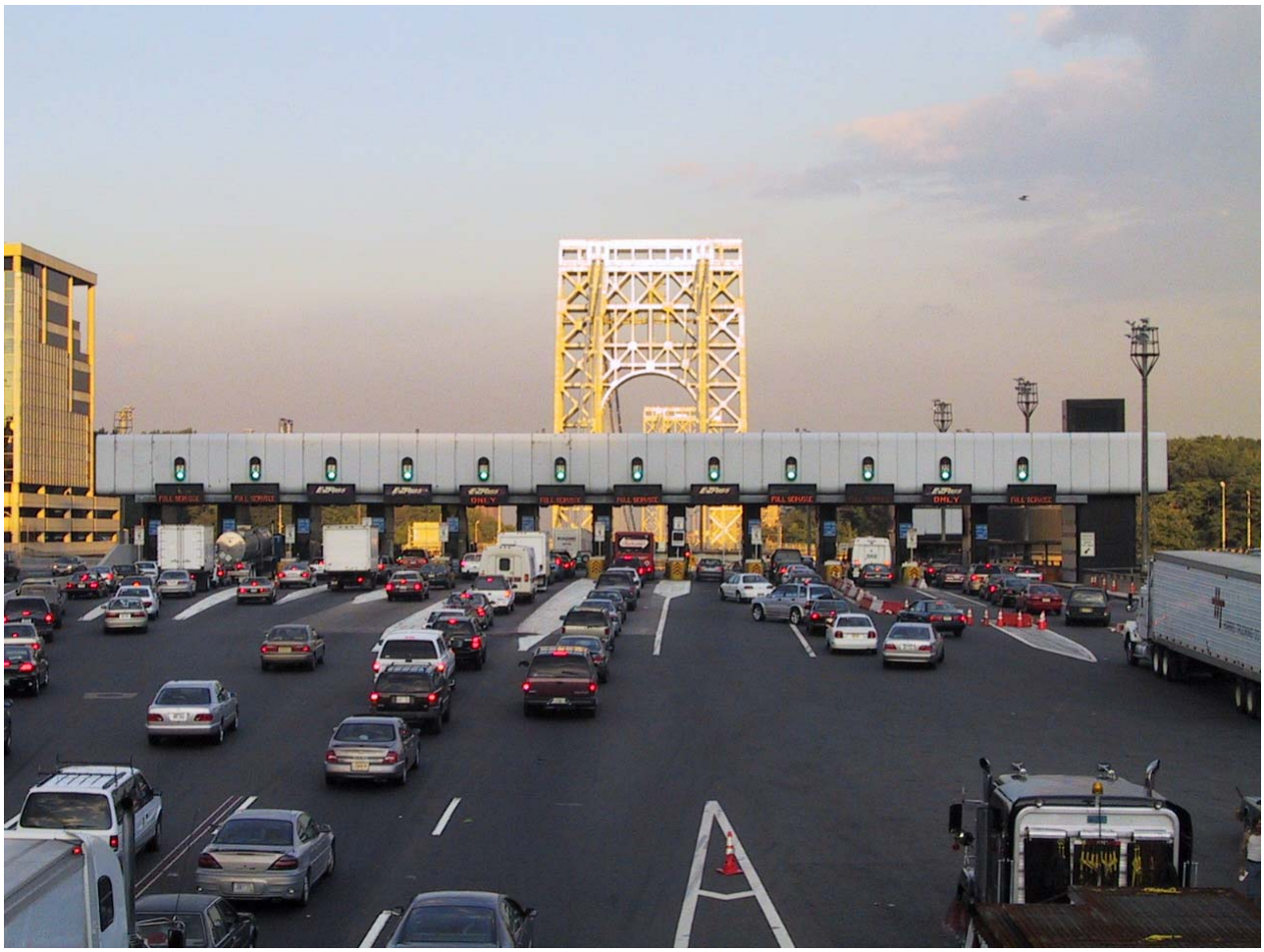
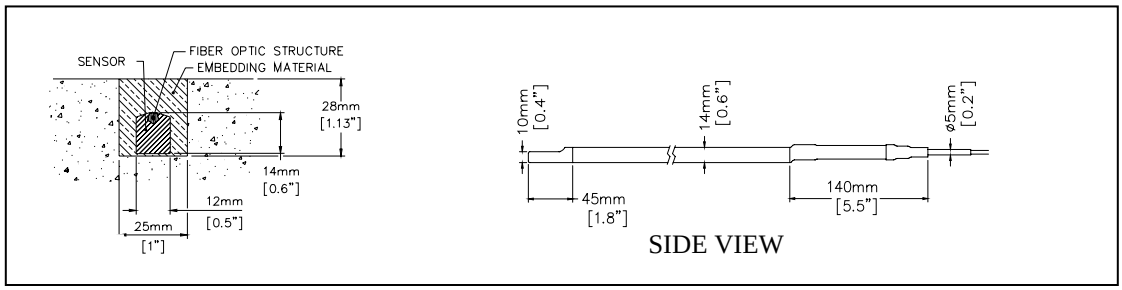
Fiber Optic Traffic Sensors SPZ



Measurement Specialties, Inc.
1000 Lucas Way
Hampton, VA 23666
Tel: 757.766.4474
Email: piezo@meas-spec.com
www.meas-spec.com

Sensor Line - Gesellschaft für
optoelektronische Sensoren mbH
Carl-Poellath-Str. 19
D-86259 Schrobenhausen
- Germany -
Tel.: +49 (0) 8252 / 8943-0
Fax.:+49 (0) 8252 / 8943-11
Email: sensorline@sensorline.de
www.sensorline.de

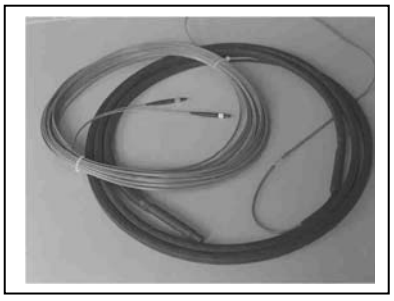
SPZ Fiber Optic Traffic Sensor Product Description

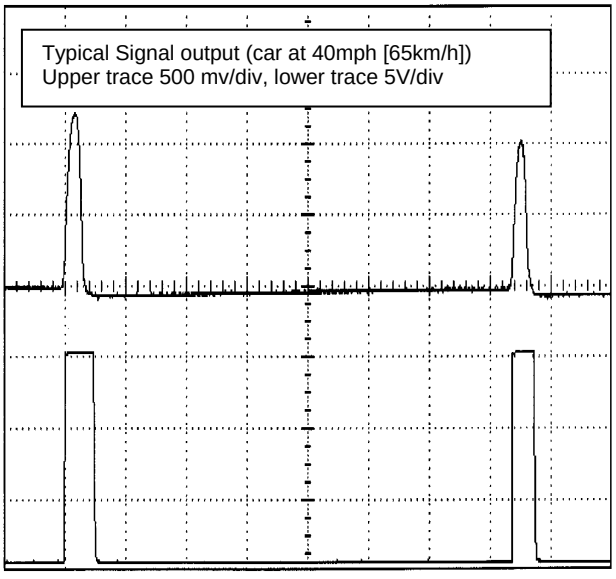


Sensor Line SPZ traffic sensor is a fiber optic load sensor designed for permanent in the road installation. When a load is applied to the sensor, it experiences a decrease of optical transmittance. An opto-electronic interface detects these changes and transforms them into signals for traffic data processing.

Characteristics

- The fiber optic structure is fitted into a base that makes the SPZ sensor sensitive to vertical pressure only.
- The sensor is immune against EMI, corrosion, and lightning because it has no metal parts.
- The SPZ traffic sensor is composed of the SPZ sensor element itself and a fiber optic feeder cable with SMA fiber optic connectors.
- The sensor is embedded into a small saw cut slot with Sensor Line SL-Cast 90 embedding material.
- The SPZ sensor is connected to a Sensor Line MA-110 Optical Transmittance Analyzer.
- Applications include toll treadles, axle counts, speed measurement, vehicle classification and speed and red light cameras.





SPZ Fiber Optic Traffic Sensor

Technical Data

Dimensions			
Sensor Element (including splice protections)			
Length (Standard)		2.0/2.5/2.75/3.0/3.5	m
		6.6/8.2/9.0/9.8/11.5	ft
Insensitive End Zones		45/95 (1.75/3.75)	mm (in)
Width		12 (0.5)	mm (in)
Height		14 (0.6)	mm (in)
Weight		180	g/m
Duplex Fiber Optic Feeder Cable			
Type Blue			
Outer Diameter		2.2x4.6 (0.09x0.18)	mm (in)
Lengths (Standard) *		1/25//35/50/75/100	m
		3.2/82/115/164/246/328	ft
Weight		12.3	g/m
Minimum Short Term	Pull Tension	205(46)	N(lbs.)
Fiber Connectors			
Type	Crimp and Cleave	SMA-905	
Length		64 (2.5)	mm (in)
Max. Diameter		8 (0.3)	mm (in)

Optical Data		
Sensor Waveguide		
Core Diameter	200	µm
Buffer Diameter	500	µm
Numerical Aperture	0.3	
Sensor Attenuation	typ. 7-9	dB
Feeder Waveguide		
Core Diameter	200	µm
Buffer Diameter	500	µm
Numerical Aperture	0.3	
Feeder Attenuation @ 850 nm	6	dB/km

Performance		
Storage Temperature Range	-55…+85 (-67…185)	°C (°F)
Operating Temperature Range	-40...+80 (-40…176)	°C (°F)
Maximum Stretching	3	%
Minimum Bend Radius Sensor Element	100 (4)	mm (in)
Minimum Bend Radius Feeder Cable	15 (0.6)	mm (in)
Minimum Calculated MTBF	10	years
Maximum Number of Load cycles	unlimited	
Sensitivity	Typical light change caused by a midsize passenger car 10 %	

* custom lengths up to 250 meter available on request

SPZ Fiber Optic Traffic Sensor

Part List

Sensor Length	Connectors Included and Attached	Sensor Nomenclature[1]	Active Sensor Length[2]	Installed Length[3]	Part Number[4]
2.5m (8.2')	No	SPZ-250-0-XX	2.36m (7.74')	2.6m (8.6')	2-1005798-Y
2.75m (9.0')	No	SPZ-275-0-XX	2.61m (8.56')	2.8m (9.2')	5-1005798-Y
3.0m (9.8')	No	SPZ-300-0-XX	2.86m (9.38')	3.1m (10.2')	3-1005798-Y
3.5m (11.5')	No	SPZ-350-0-XX	3.36m (11.02')	3.6m (11.8')	4-1005798-Y
2.5m (8.2')	Yes	SPZ-250-0-XX	2.36m (7.74')	2.6m (8.6")	2-1005799-Y
2.75m (9.0')	Yes	SPZ-275-0-XX	2.61m (8.56')	2.8m (9.2")	5-1005799-Y
3.0m (9.8')	Yes	SPZ-300-0-XX	2.86m (9.38')	3.1m (10.2")	3-1005799-Y
3.5m (11.5')	Yes	SPZ-350-0-XX	3.36m (11.02')	3.6m (11.8')	4-1005799-Y

[1]This suffix refers to the passive cable length. Avaliable in 1m, 25m, 35m, 50m, 75m and 100m for the SPZ sensor.

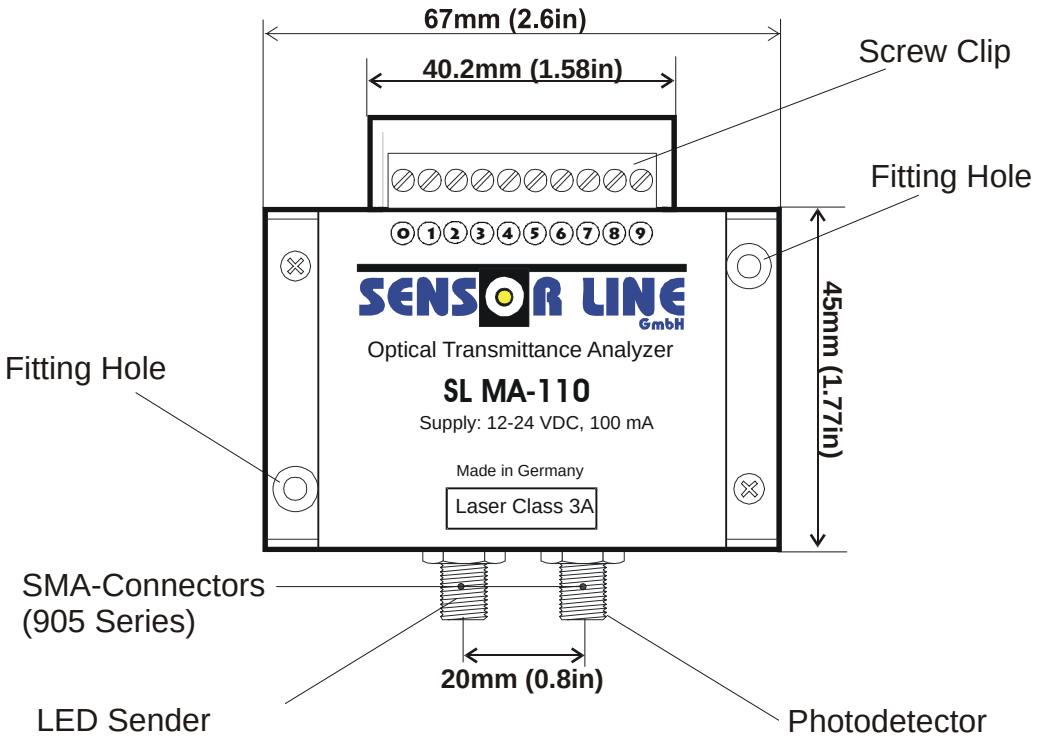
[2]This length is the actual active area of the sensor minus the loop at the end and the dead space required for the splice connection.

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

[4]The suffix refers to the cable length. Cable lengths for -Y are as follows: -1 @ 1m, -2 @ 25m, -3 @ 35m', -4 @ 50m, -5 @ 75m, -6 @ 100m.

Part Name	Part Number	Remarks
SL Cast 90-3	0-1005896-3	3kg Kit, 1kg of grout per 1m of sensor (1 kit per 3m sensor)
SPZ Wedge Kit	0-1005797-5	Wedges are included with each sensor, order if extras needed
4430-C Plastic	0-1005858-2	Pack of 20, Plastic end connectors to terminate passive cable – not reusable
4430-C Metal	0-1005858-1	Each, Metal end connectors to terminate passive cable – removable and reuseable
SL MA-110	0-1005796-1	1 required per sensor, 3-23dB of dynamic range

SL MA-110 Optical Transmittance Analyzer (OTA)
Product Description



The SL MA-110 OTA interface operates a Sensor Line SPZ fiber optic traffic sensor. It responds to changes in optical transmittance and provides respective electrical output signals that traffic data processing devices can use. The unit is comprised of a LED transmitter, a PIN diode photodetector, and an optical transmission analysis electronics.

Features

- Dynamic analog output signal for automatic long term signal adaptation
- Static analog monitor output for normalizing of the analog signal
- Optocoupler digital outputs enable free definition of any logical polarity and level
- Trigger threshold does not require any adjustment
- Sensor failure indication
- Reverse power protection
- Outputs short circuit protection

Utilization

The SL MA-110 OTA interface is typically located in a roadside cabinet. A Sensor Line SPZ traffic sensor is connected to the MA-110 by way of the SMA connector plugs on the ends of the fiber optic feeder cable. The screw clip connector bar is used provide power and retrieve the output signals.

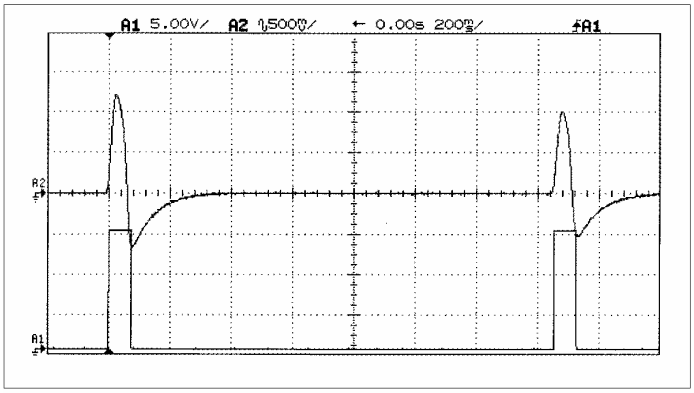
Technical Data

Housing:	Plastic
Size:	67 x 58 x 25 mm (2.6 x 2.3 x 1”)
Protection Class:	IP 30 (NEMA 2)
Connection:	Screw clip, 10 pins
Optical Interface:	SMA 905
LED Type	GaAlAs
LED Peak Output Wavelength	850 nm
Relative Humidity:	80% at 25°C (77°F)
Temperature Range:	-40°C to 85°C (-40°F to 185°F)
Supply Current:	< 100 mA
Supply Voltage:	+12 to +24 VDC
Analog Output:	0-10 V
Trigger Threshold:	1% change of light transmittance
Optocoupler Output max.:	60V/25mA
Velocity Range:	1 to 250 km/h (0.6 to 155 mph)
Feeder Length:	up to 250 meters (820ft)
Comparative Laser Class:	3A (sensor disconnected)
EMV/EMI:	Fulfills CE-requirements

Connections

Pinning	Sign	Description
0	Vsupply	Supply Voltage
1	GND	Ground (shorted)
2	GND	
3	Vref	Reference Voltage Output
4	Vmon	Transmittance Monitor Signal Output
5	Vanalog	Analog Load Signal Output
6	–ERROR	Error Optocoupler Output (Low Resistance on Sensor Failure)
7	+ERROR	
8	–TRIGGER	Trigger Optocoupler Output (Low Resistance on Load Response)
9	+TRIGGER	

Output Signals



The upper trace shows the analog signal waveform with respect to Vref caused by a two-axle vehicle at a speed of 7 km/h (one wheel). The amplitudes are proportional to the axle/wheel load.

The lower trace shows the signal then occurring at –TRIGGER with +TRIGGER connected to +15V and a 10k pull down resistor from –TRIGGER to GND.

Installation Manual for Fiber Optic Traffic Sensors SPZ

Site / Environmental Requirments

The installation site should be in the following condition:

1. The road surface in the area must be an undamaged flat plane.
2. Existing track deformations (ruts) should not be deeper than ½“ (15mm) over the whole sensor length.
3. The slope of the road surface can have a height of 3/8“ (10mm).
4. Slots must not cross over separate road surface sections.

The environmental conditons should be as follows:

1. NEVER INSTALL SENSORS IN THE RAIN.
2. The ideal ground temperature is between 50° to 90°F (10°C and 35°C). Installation is possible outside this temperatures range, but the curing time of the grout will be much slower or faster.
3. If the installation is done at freezing temperatures, be extremely careful to avoid ice particles between the embedding material and the sides or bottom of the slots.

Required Tools and Equipment

- Safety Equipment (as per local regulation)
- Sensorline Fiber Optic Axle Sensor(s)
- MA-110 Optical Transmitter Analyzer
- SL Cast 90 Encapsulation Material (1kg of grout per 1m of sensor)*
- Loop sealant (NO hot tar)
- PVC or Polyethylene Tubing (home run cables)
- Straight edge (8’ [2.5m] minimum)
- 20’ (6m) tape measure
- Pavement Crayons and Pavement Paint
- 1/8” (3mm) diameter cord
- 35hp Wet-Cutting Pavement Saw (self-propelled)
- Diamond Blade ¾” (20mm) wide (or equivalent)
- 3/8” (9mm) or ¼” (6mm) blade (home run)
- Hammer & Masonry Chisels
- Power Washer
- Water (at least 250 gal)
- Large Capacity Air Compressor (at least 150 CFM)
- Street Broom
- LED Source or light power source with light power meter with SMA adapters
- Volt Meter
- 2” Duct Tape
- Foam Backer Rod
- Latex Gloves
- Electrical Power or Generator
- Low Speed Mixing Drill (400-600RPM)
- 2 each Mixing Paddles
- Large Putty Knife or Small Trowel
- Angle Grinder with Masonry Wheel or Belt Sander
- 20 or 22 gauge wire (enough to connect MA-110 to power supply and interface board)
- Wire strippers
- Oscilloscope (recommended)

** Up to 30 % more material is required at temperatures below 10°C (50° F) due to increased viscosity.*

Marking and Cutting the Slots

1. Ensure the road is safely closed, as per local regulations.

2. Using the pavement crayons, paint, tape measure and cord, carefully mark the layout of the sensor installation. Ensure sensors are emplaced exactly perpendicular to the flow of traffic and that all lines are straight. The sensors should not be placed any closer than 4"-6" (100-150mm) apart in order to ensure integrity of the road surface.

3. Using the ¾" (20mm) Diamond Blade, wet cut the slot for the sensors The slot demensions are as follows:

length = sensor + 2" (50 mm)
width = ¾"-1" (19mm-25mm)
depth = 1 1/8" –1 ¼" (28mm –31mm)

4. Cut the home run slots. The home run slots should be centered on the sensor slots. The minimum width of the home run slot is ¼" (6mm) and the minimum depth is ½" (12mm). More than one passive cable may be run in a home run slot, but the slot should be cut wider, approx.½" (12mm) wide, in this case

5. Power wash and sweep all slots. All slots must be very clean.

6. Dry all slots with compressed air. **All slots and the pavement 1' (300mm) on either side of the slot must be completely dry.**

Preparing Slot and Sensor for Installation

7. Place duct tape along the length of both sides of the sensor slot. Tape should be 1/16"-1/8" (1.5mm-3mm) away from the edge of the slot. Repeat for all slots.

8. Remove the Fiber Optic Sensor from the box. Visually check the sensor for damage. The sensor should not be broken or bent, and outer black coating should not be ripped, cut or torn. Check the lead attachment for breaks. Ensure that the passive cable is straight without any kinks, tears or breaks. Lightly tug at end connectors to ensure they are not loose or broken.

9. Connect light power source to one end connector and the light power meter to the other. Using the 650nm or 780nm setting, measure the amount of light attentuation. The reading should be below 30dBm. If the reading is above 30dBm consult with MSI before installing sensors. If you do not have a light power source and meter use an LED or other light source (sunlight or overhead lights). Connect the LED to one connector or hold the connector up the the light source and look for light coming out the other connector. DO NOT LOOK DIRECTLY INTO THE CONNECTOR WHILE AN LED IS ON. If you cannot see any light coming from the other connector, the sensor is broken. Consult MSI for replacement/repair.

10. Place the sensor on the tape next to the slot. Unwind the passive cable and place it in the home run slot. If the passive cable must be pulled through a conduit, pull the passive cable all the way through to the lane conroller/traffic box where the MA-110 is to be emplaced. Pull cable slowly and steadily through the conduit. DO NOT JERK CABLE THROUGH CONDUIT AND DO NOT PULL HARD ENOUGH TO STRETCH THE PASSIVE CABLE. DO NOT PULL THE PASSIVE CABLE BY THE END CONNECTORS. ATTACH SNAKE OR ROPE TO PASSIVE CABLE AT LEAST 3" FROM END CONNECTORS. Be extremely careful when pulling the cable through and around 90° bends or turns. Minimum bend radius for the conduit is 5/8" (15mm).

11. Once the passive cable is pulled to the lane controller/traffic box repeat step #9. If the sensor now fails, it was damaged while being pulled through conduit/home run slot. Replace end connectors and repeat (see instruction sheet for replacing end connectors). If it still fails, do not install sensor.
12. Place sensor in slot to ensure length and fit is correct. The sensor should have space at least 1/8" (3mm) between it and the slot wall on both sides.

13. Remove sensor from slot and place on tape. Remove cork wedges from bag and place next to sensor at 6“-8“ (150mm-200mm) intervals.

Installing and Encapsulating the Sensor

14. Place passive cable inside home run slot and seal slot with foam backer rod to keep SL Cast 90 from seeping out of the sensor slot into the home run slot.

15. Using a low speed mixing drill (400-600rpm) with a mixing paddle, premix component 1 (black) of the SL Cast 90 for two minutes. Be sure to keep air bubbles out of component while mixing.

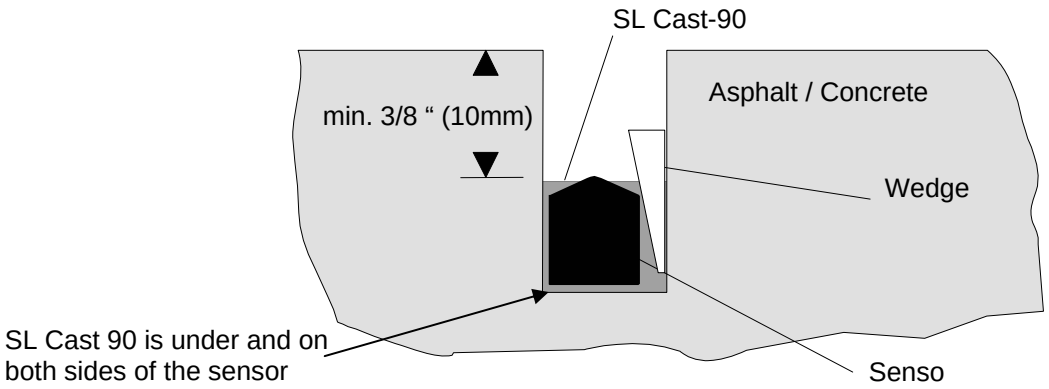
16. Add all of component 2 (clear hardner) into can of component 1. Mix for at least 1 minute with low speed drill (400-600rpm) with a mixing paddle.

17. Mix only enough material to fill the bottom of the slot. Pour SL Cast 90 into the slot, making sure bottom of the slot is complely covered and level. The top of the SL Cast 90 layer should be 1“ (25mm) from the surface of the road and level along its length. SL Cast 90 will remain fluid for approxiametly 10-15 minutes at 68°F (20°C). One 3kg kit of SL Cast 90 will fill the bottom of three 10’ (3m) slots.

18. There are two methods for emplacing the sensor in the slot. Method two can be used if you have enough slots to fill to completly use one pail of SL Cast 90 or have ordered extra grout (one 3kg pail can be used to fill the bottom of 3 slots for 10’ (3m) sensors without wasting any SL Cast 90). Otherwise use Method 1.

Method 1:

Immediatly after filling bottom of the slot, place the sensor in SL Cast 90, starting with the lead attachment end. NEVER USE SHARP TOOLS TO PRESS SENSOR INTO GROUT. Make sure SL Cast 90 material is pressed up between slot and both sides of the sensor. Postion the sensor against one wall of the slot with the SL Wedge Kit (cork wedges). The wedges are pressed every 6“-8“ (150mm-200mm) between the sensor and the slot edge. REMEMBER 10-15MIN AFTER MIXING, THE REMAINING SL CAST 90 IN THE CAN WILL BE TOO VISCOUS TO POUR.

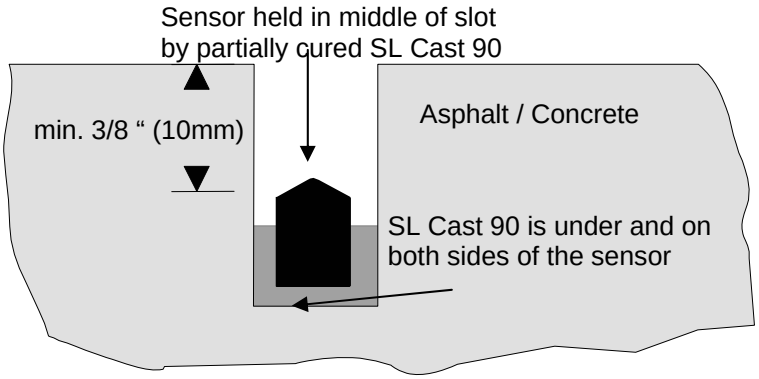


Slot with Sensor and Wedge (Method 1)

-OR-

Method 2:

After filling bottom of the slot wait 10-20 minutes for SL Cast 90 to cure. Then place sensor in SL Cast 90, starting with lead attachment end. Push sensor down into SL Cast 90 with hands. NEVER USE SHARP TOOLS FOR THIS. The SL Cast 90 should be tacky and firm enough to hold the sensor in place. Be careful not to trap any air under the sensor.



Slot with Sensor (Method 2)

19. Repeat step 18, method 1 or 2, for all sensors.

20. Fill the remainder of the sensor slots with SL Cast 90 unil slightly above or level with tape. Mix SL Cast 90 according to Steps 15&16. Do not create any air pockets or flat holes while filling the slot.

23. Use Putty Knife or Trowel to smooth the surface of embedding material until it is level with tape.

24. Once the pour is complete, imediately remove the tape on either side of the slot.

25. Repeat for all sensors.

26. Once grout has set, 20-30 minutes, remove backer rod and fill home run slots.

27. If needed, use an angle grinder or a belt sander to grind/sand the grout flush with the road.

28. Await the allotted time for the loop seleant and SL Cast 90 to cure enough to open the road. The SL Cast 90 will be cured enough in 60-90 minutes, depending on temperature. The grout will cure to final hardness after one week.

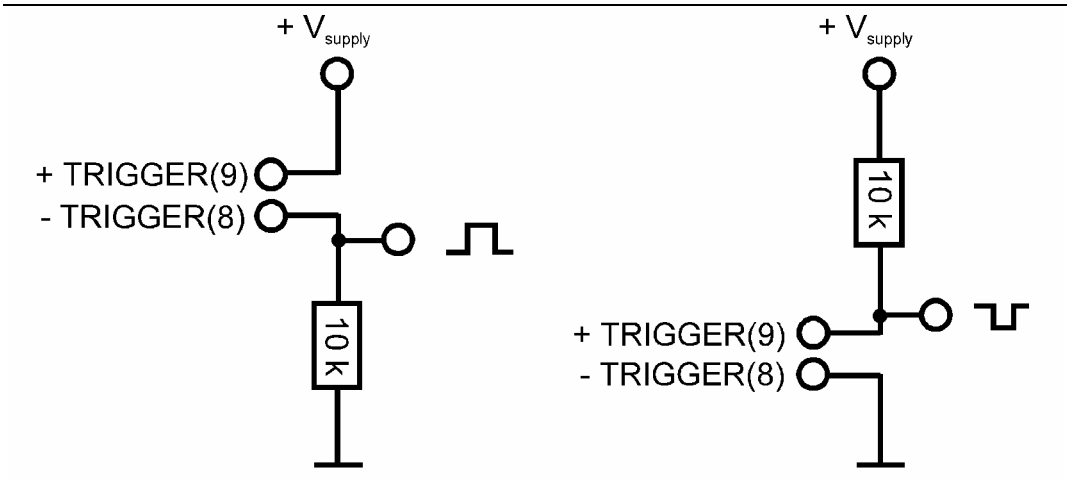
29. Repeat step #9 to ensure sensor were not damaged durning the filling of the slots.

Installing MA-110 and Testing System

30. Emplace MA-110 in cabinet using screws, glue or velcro. Screw sensor connectors into MA-110.

31. Using 20 or 22 gauge wire connect terminal 0 to power and terminal 1 to ground. Power the MA-110 with 12-24VDC.

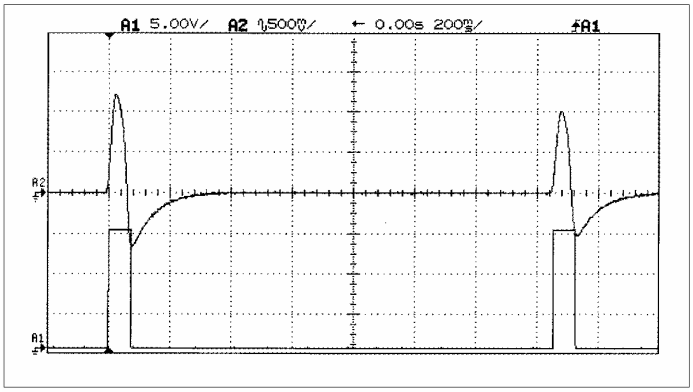
32. Connect MA-110 to lane controller/interface board input using 20 or 22 gauge wire according to one of the two circuits (or equivalent) below.



33. Use Voltage Meter to check voltage between teriminals 0 and 1 and terminals 8 and 9. Voltage should equal voltage supplied to terminals 1 and 9. Also check monitor voltage by using the Voltage Meter to check the voltage between terminals 3 and 4. This DC voltage should be greater than 250mV. A voltage less than 250mV means that the light attentuation of the transmission path exceeds the limit needed for proper operation of the triggering cirucit. In this case, consult MSI.

34. Hook up the occilisocope to terminals 8 and 9 (for digital pulses) or terminals 2 and 5 (for analog signals) and view waveforms as the vehicles pass. The waveforms should be clear of any noise.

EXAMPLE WAVEFORMS



Repairing Damaged Sites

Damaged installations, low SL Cast 90 level and surface cracks, can be repaired by adding SL Cast 90. Use an angle grinder or a belt sander to rough up the top of the area where the SL Cast 90 is to be added. This will ensure a good chemical bond between the two surfaces.