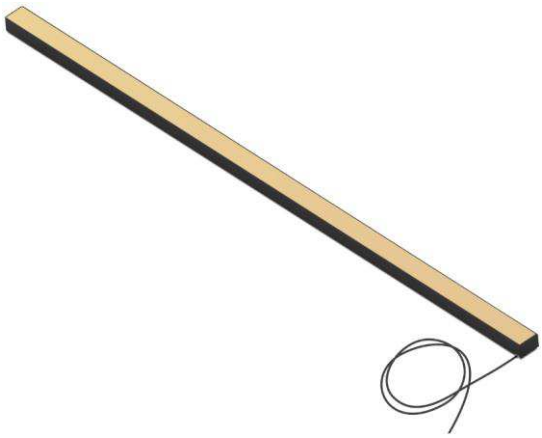

QUARTZ WEIGH-IN-MOTION TRAFFIC SENSOR

Model QL

Quartz Load Sensing Technology

High Sensitivity Charge Output

Uniform Accuracy Over Length

Robust Mechanical Structure

The Quartz Weigh-in-Motion (QL) sensor from TE Connectivity (TE) measures wheel and axle loads which are used to determine the vehicle gross weight under normal traffic conditions.

TE engineers have developed a unique and robust mechanical design for the QL Quartz Weigh-in-Motion sensor which enables easy installation and excellent long-term stability. The design also ensures a uniform sensitivity over the length of the sensor while reducing the effects of temperature changes found in highway environments.

The QL sensor uses piezoelectric quartz sensing elements to measure wheel and axle loads of road vehicles. The sensor provides accurate measurements over a wide range of speeds from 3 mph (5 km/h) to 120 mph (193km/h). In addition, the tire load capability of 0~20 ton (0~178kN) allows the QL sensor to detect all types of vehicles.

The sensor generates a charge output (coulombs) with a magnitude proportional to the force applied by the vehicle tires. An electronic interface is used to convert this charge output signal through integration and algorithms into axle weights and ultimately into gross vehicle weight.

Each sensor includes either 40 or 100 meters of cable that is rugged and will survive exposure to the elements and burial. The cable is terminated with a convenient BNC connector for easy electrical connection to the system.

FEATURES

- Wide speed range capability
- High load range capacity
- Excellent long-term stability
- Low vertical profile

APPLICATIONS

- Weigh-in-Motion (WIM)
- Weight Based Tolling
- Weight limit enforcement
- Weigh station pre Selection
- Bridge and infrastructure protection
- Data Collection for pavement design
- Traffic management
- Vehicle classification
- Traffic density studies

Operating Specifications

(Unless otherwise specified, all parameters are measured at 25°C)

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Operating force range	F_o	0		200	kN	Reference tire footprint of 200mm L x 300mm W
Sensitivity		-1.67	-1.85	-2.04	pC/N	
Linearity error				±1.0	%Span	
Repeatability error			< 1.0	±2.5	%Span	
Temperature coefficient	T_c			±0.02	%/°C	
Sensitivity shift over length			±3.5	±5.0	%	
Vehicle speed range		5		200	km/h	
Cycle life			>40M			ESAL, typical, installation dependent
Long term stability				1	%Span	1 year
Insulation resistance		10			G ohm	@250V

Standard Sensor Length, Cable Length Options, Total Weight, Total Capacitance

(Unless otherwise specified, all parameters are measured at 25°C)

Part Number	Actual Sensor Length (mm)	Cable Length (m)	Sensor + Cable Weight (kg)	Sensor + Cable Capacitance (nf) ±20%[1]
20014750-00	**525**	**40**	**3.3**	**10.6**
20011085-00	**1025**	**40**	**5.1**	**17.3**
20014752-00	**1025**	**100**	**6.8**	**23.3**
20011066-00	**1525**	**40**	**7.1**	**24.0**
20014754-00	**1525**	**100**	**8.8**	**30.0**
20008053-00	**1725**	**40**	**8.1**	**27.4**
20014756-00	**1725**	**100**	**9.8**	**33.3**
20011067-00	**2025**	**40**	**9.0**	**30.7**
20016399-00	**2025**	**100**	**10.7**	**36.6**

[1]If cable is cut or trimmed to a shorter length, capacitance values will be reduced by 0.1nF/m of cable removed

Environmental Specifications

(Unless otherwise specified, all parameters are measured at 25°C @ 5.0V applied)

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Operating temperature range	T_o	-40		80	°C	
Storage temperature	T_s	-40		80	°C	
Ambient humidity		0		95	%RH	Non-condensing
Ingress protection		IP68				
Media compatibility		Sensor exposed materials: Anodized aluminum Polyurethane foam Fiberglass Cable jacket: High density polyethylene (HDPE)				

Absolute Maximum Ratings[1]

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Compressive force	F_{max}			300	kN	Reference tire footprint of 200mm L x 300mm W
Storage temperature	T_S	-40		80	°C	
Output short circuit duration				Indefinite		

[1]Maximum limits the device will withstand without damage

Compliance

ASTM E1318-09 Type III (medium speed pre-selection of overweight vehicles and toll plaza weighing)
COST 323 A (5) (accuracy)
GB/T 21296-2007

Dimensions

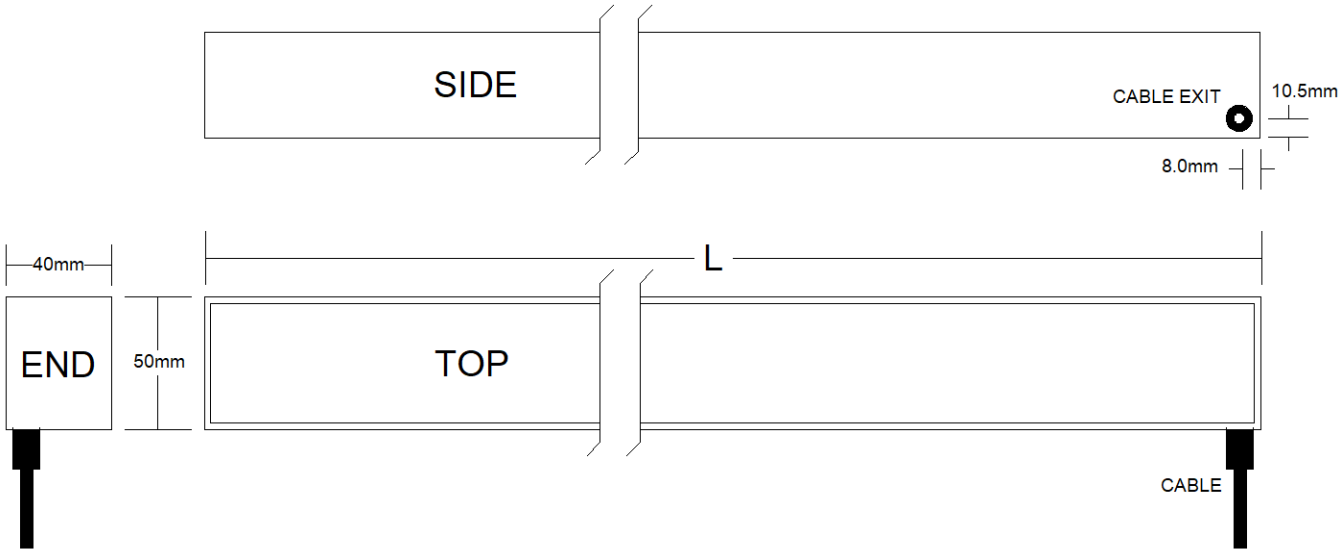

Figure 1. Outline Dimensions

Part Number	L Dimension (mm)
20014750-00	**525**
20011085-00	**1025**
20014752-00	**1025**
20011066-00	**1525**
20014754-00	**1525**
20008053-00	**1725**
20014756-00	**1725**
20011067-00	**2025**
20016399-00	**2025**

Recommended Installation Instructions

1. Ensure that the road meets COST 323/ASTM 1318 or relevant requirements. Make sure that the site plan matches the actual road. This is extremely important before starting so that you can lay it all out and cut at one time. Be sure to look for all joints, cracks, and any previous installations.
2. Have a full and detailed drawing with the layout and the configuration of all the sensors, inductive loops, homerun cables, and conduit routes based on the actual road.
3. Get all materials and tools ready
4. Close the installation traffic lane for safety reasons. Follow local traffic and law enforcement requirements that apply to lane closures.
5. Layout clearly for all cuts for sensors, inductive loops, cables and conduits on the pavement as according to the installation drawings. Configure every sensor and loop to ensure no conflicts, and to make sure that there is enough distance between parallel cuts to maintain the pavement integrity.
6. Mark on the road the location of all cuts.
   a. All sensor cuts are 70 mm wide and 50 mm deep. (2.75” wide and 2 inches deep)
   b. All loops should be as per local practice and conditions, typically 8 mm (1/4” to 3/8”) wide and a minimum of 70 mm deep. (2 ½” to 3”)
   c. All loops and homerun cables should be a minimum of 300 mm (1 ft or 12 inches) from the sensors.
   d. Make sure that the sensors are installed exactly perpendicular to the flow of traffic.
   e. For the sensor slots, make sure to mark both sides of the cut so that it is clear where the actual cut is to be made.
7. Cut all slots. Using a road saw and a 3-4mm wide diamond blade to cut slots. Make sure that every cut meets the dimension as required. Jackhammer out the material in the center.
   a. All sensor cuts are 70 mm wide and 50 mm deep.
   b. Separate slots for cables are needed on parallel sideway, cables of sensors in an array can stack in the common homerun slot that is 10mm wide and a minimum depth of 50mm from the cable, as the illustration 1-1, 1-2 shown. Cut it wider when using the tube or conduit.

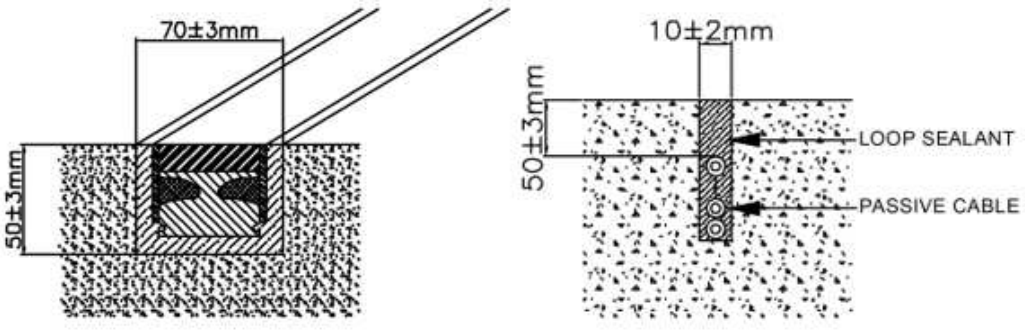

Figure 2. Road Slot Dimensions – Side View

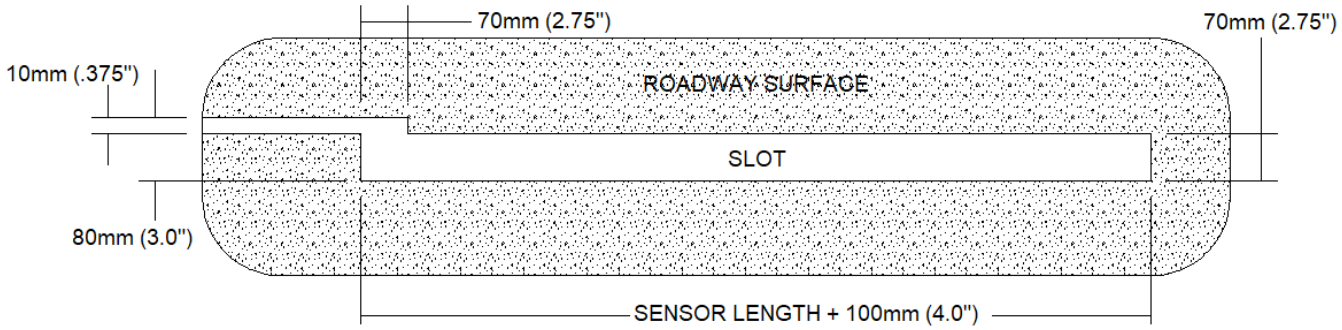

Figure 3. Road Slot Dimensions – Top View

c. If any inductive loops are to be installed, use appropriate recommendations that have been developed for their installation. These loops can help to improve the overall accuracy when combined with the QL WIM system. Typical slots for these loops are 8 mm wide and a minimum of 70 mm deep.

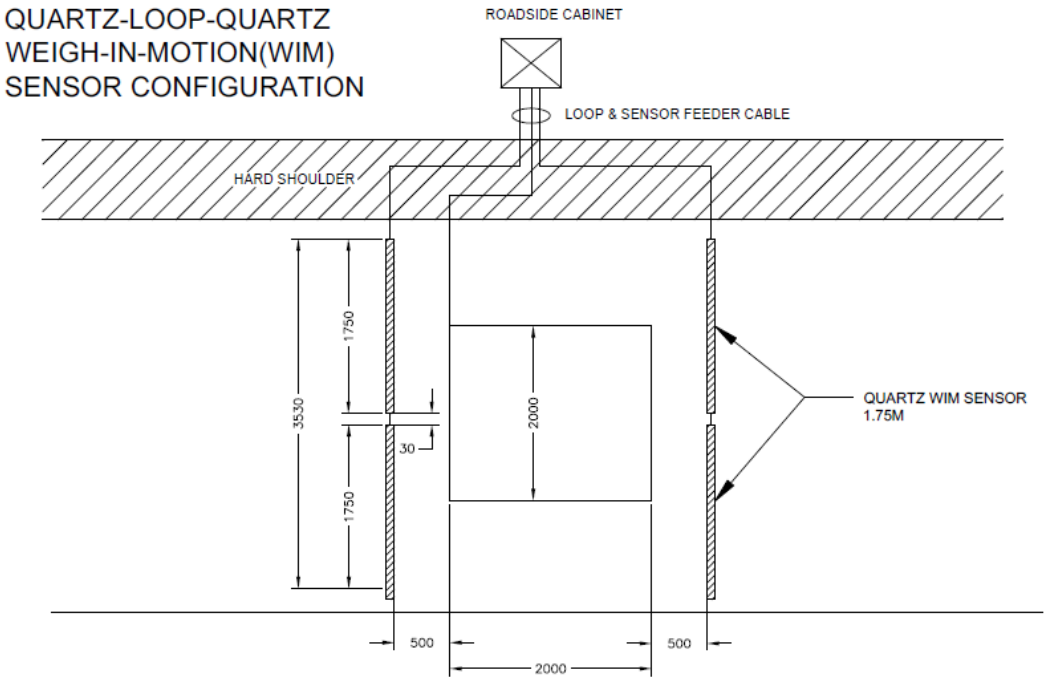

Figure 4. Typical Layout of WIM and Loop Sensors

8. Clean and sweep the entire area. Use a pressure washer and bloom to cleanup all dirt and mud in the slot and on pavement. Use high pressure air to dry the slots and either side. This will ensure good bonding strength with epoxy.
9. Place the 50 mm wide tape on either side of the sensor slot, keep it about 5-10 mm away from the edge of the slot, as shown in Figure 5.This is to keep the road surface clean and assist in leveling the epoxy.

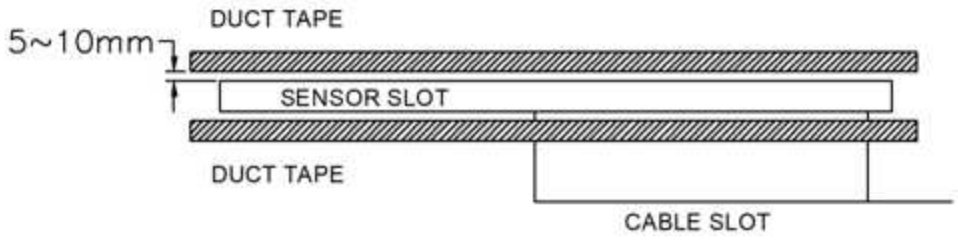

Figure 5. Placement of Tape

10. Lay out the sensors next to the slot. Unspool all wires. Make sure to keep the sensor clean and safe.
11. Test the sensor on capacitance and insulation resistance, and visually check to make sure that there is no visible damage to the sensor.
12. Install the brackets onto the sensor. This is done by placing the block of wood on the top of the sensor and attaching it with the zip-tie. You can use a wedge to tighten it. Do a trial fitting into the slot to ensure that the top of the sensor is flush or slightly proud of the pavement. Take the sensor out from the slot.

Figure 6. Attachment and Use of Mounting Brackets

13. Mix the resin according to manufacturer's instructions. The resin and the hardener need to be fully mixed before slowly adding the sand mixture.
    a. All materials should be between 60F-80F. (can be warmer but it will greatly reduce pot life)
    b. Take out all materials from the 5 gal mixing bucket.
    c. Add the resin (Part A) to the mixing bucket. Make sure that all material is scraped out the tin.
    d. Add the Hardener (Part B). It is in the smaller container.
    e. Mix for 2 minutes using mixing paddle and an electric drill.
    f. Scrape side of 5 gallon to ensure no unmixed material is at the top of the pail
    g. Cut the silica bag and slowly add all the sand while continuing to mix
    h. Mix for 2 minutes more
    i. Pot life/work life will be greatly affected by ambient temperatures. Precautions should be taken so epoxy can be added immediately after mixing.

14. Pour the mixed resin immediately into the slot till at least halfway filled.
15. Use a trowel to create a trough along the full length of the slot in the resin. Smear the resin so that it gets onto both side walls.
16. Place the sensor into the slot. Press it all the way until the top is level with the road or slightly proud. Make sure that it is level. Use additional weights if necessary to hold in place.
17. Trowel the resin to take off any surplus and well as to fill in any low spots. The grout in all places should be slightly higher than the pavement.
18. Wait for the resin to cure. This will be very dependent on the ambient temperature. Two to four hours is very typical to get precured and 24 hours for completely cured at 20°C and above.
19. While waiting, install all loops and other ancillary equipment.
20. Once cured, cut the zip ties and remove the brackets.
21. Route all cables back to junction boxes or cabinets.
22. Once all resins are cured, use an angle grinder or belt sander to level all high spots. For the angle grinder, a diamond wheel works best. It is imperative that there be no high spots or low spots as this will directly affect the accuracy of the WIM measurement.
23. Clean and clear the site. The road should not be opened until the resin has cured completely and the top has been ground flat.
24. Connect all sensors and loops to the WIM electrical device to check signals and functionality. Additional steps are needed for full system calibration. A minimum of 3 days is normally needed between installation and calibration to allow for the epoxy to fully cure.
25. After calibration, set up other relevant equipment to start WIM pre-test with another certain weight truck.
26. Run the pilot detection on the traffic conditions. Analyze the recorded and real time dataset.

Recommended Installation Tools

- QL Sensor. Ensure that the cables are long enough for the full distance to the cabinet
- Zip ties for brackets - included in the box
- Brackets to hold sensor over slot - included in the box
- ALL materials needed for the loops (wire, sealant, splices, tools for twisting wires)
- Appropriate Safety Equipment and Traffic Control.
- Gloves (correct size) for use when working with the epoxy
- Installation Resin. One kit is needed per sensor. Suggest an extra kit per installation site in case of issues
- Mixing buckets. Separate buckets for Resin and Loop sealant if needed
- Road saw with diamond blades. Water cooled preferred. The saw much be powerful enough for the slots being cut
- Jack Hammer for removing the area between the cuts for the Sensor Slot
- Power washer for cleaning slots; if dry cutting, then extra leaf blowers are needed to keep dust under control.
- Air Compressor or other means to dry slots
- Mixing drill. Slow speed ~ 450 rpm recommended
- Mixing paddle (separate ones for resin and the loop sealant)
- Angle grinder with diamond cup wheel and/or belt sander for making all sensors flush with the road.
- Wire Brush
- Cleaning material for the sensor. (Alcohol and cloths and/or paper towels)
- Straight edge (1 meter minimum, 3 meter preferred.)
- Tape (50 mm wide), like duct tape. Will stick to the road.
- Spray pavement paint for marking all cuts
- Rope or cord (5 mm dia) used with paint for marking cut lines
- Chalk line for layout
- Pavement crayons or other marking tools
- Tape measure (8 m/25 ft minimum)
- Large square
- Broom for cleaning road
- Hammer and chisel for fine tuning slot
- If dry cutting, denatured alcohol and be used for cleaning the slots.
- Shovel, broom, other hand tools
- LCR Meter
- BNC connectors and installation tools as needed
- Wire stripper
- Wire cutters
- 50 mm (2” wide trowel) for working grout
- Cable marking material or tape
- Instant read IR non-contact thermometer to verify grout and road temperatures
- Torpedo heaters or other heaters as needed dependent on the road and air temperature.

Ordering Information

Part Number	Sensor Length	Cable Length
20014750-00	**0.5m**	**40m**
20011085-00	**1.0m**	**40m**
20014752-00	**1.0m**	**100m**
20011066-00	**1.5m**	**40m**
20014754-00	**1.5m**	**100m**
20008053-00	**1.75m**	**40m**
20014756-00	**1.75m**	**100m**
20011067-00	**2.0m**	**40m**
20016399-00	**2.0m**	**100m**

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