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Inductive Loop Vehicle Detector Applications

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- Heavy Duty Rolling Doors
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- Car Wash Equipment Activation

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Introduction

- Q. What is an inductive loop vehicle detector and how does it work?
- A. The complete detector consists of a loop of wire and an electronic detection unit. The operation is based on the principle of metal detection. As an example, a metal detector has a movable "coil" (or loop) which is waved above a buried metal object, which disrupts the electrical field generated by the loop and causes the metal detector to respond with an output, usually an audible tone. With a vehicle detector, the loop is buried in the roadway and the object to be detected is a vehicle. When the loop detects the vehicle, the detector provides a relay switch closure output.
- Q. What is a loop coil?
- A. The loop consists of one or more turns of wire located in or under the pavement and wound in a square, rectangle or circular form. There are two types of commonly used loops, the "saw cut" loop and the "preformed" loop.
- Q. How is the detection/loop system applied?
- A. When a set pattern of loops are buried on either side of a gate or door and connected to a vehicle detector, the system will detect the presence of a vehicle. This signal can be connected to operate the gate or door trigger. When properly programmed with the operator, the gate or door will open and remain open as long as the loop detects the presence of the vehicle. When the vehicle leaves the loop the gate or door is allowed to automatically close.

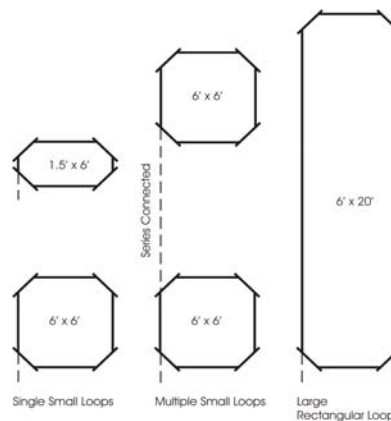


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Design Essentials

- Proper installation of the loops is essential for reliable vehicle detection. Most vehicle detector problems are caused by improper loop installation!
- The geometry (shape and size) of the loop defines the detection zone. See the figures to the right for typical loop geometries used for access or traffic control.
- Loop sizes may differ and will depend on lane width, traffic patterns, and types of vehicles to be detected. The following guidelines are typically used today with most access control applications:
 - Large rectangular loops (4' x 8', 6' x 8', 6' x 12') are used to detect larger vehicles and high bed vehicles (trucks).
 - Small size loops (i.e. 2' x 5', 3' x 6', 6' x 6') are used to detect smaller vehicles, such as motorcycles and automobiles.

Important Note: Typical detection height is about 2/3 of the shortest leg of the loop.



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Design Essentials

- Adjacent loops operating on separate vehicle detectors may interfere (cross-talk) with each other. This interference can be eliminated by changing the operating frequency on one of the detector modules. Note: The Eberle Design LMA *DEFLECTOMETER* Series detectors offer a built-in frequency meter. Upon power up or reset, the detector flashes the frequency on the front panel 7-segment LED (in kilohertz) in order to accurately separate detectors from cross-talking. Typically you want two adjacent detector loops to be separated by at least 5 kilohertz.
- The vehicle detector must operate from a stable power source. If the detector is subjected to excessive line voltage variations, the detector may cause either a false output or may drop an output when a vehicle is over the loop. An example would be a gate operator located some distance from the power distribution panel. If the line power wires are undersized, the voltage at the operator can momentarily drop, due to the inrush current when the operator motor is activated. The detector senses a voltage drop of more than 25% of nominal line voltage as a power failure. When the voltage returns to the proper level, the detector automatically resets. If a vehicle is over the loop, it will be lost when the detector resets. THE GOOD NEWS! All EDI vehicle detectors have a built-in SAFE GUARD for short interruptions of power. If POWER is interrupted for 4 seconds or less the detector will not drop a CALL with a vehicle on the loop.



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Design Essentials

- The correlation between the loop perimeter and the typical number of turns for loop wire in a single loop installation varies. Please review some examples in the diagram at right.
- To receive detailed information on optimizing your loop installation (i.e. inductance of the loop, total inductance of the loop network, height of detection, loop efficiency, and number of turns of wire), please use our LoopCalc Software which can be found at www.EDITraffic.com and click on the following links: SUPPORT / ACCESS / APPLICATION NOTES / LOOPCALC

Loop Perimeter (LP) Side A+B+C+D = LP	Number of Turns
12 Feet (2 x 4 Loop)	5 turns
24 Feet (6 x 6 Loop)	3 turns
32 Feet (6 x 10 Loop)	3 turns
52 Feet (6 x 20 Loop)	2 turns
112 Feet (6 x 50)	1 turn



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Design Essentials

- When connecting more than one loop to a detector, always connect the loops in series. If the loops are close together, the direction of the windings of each loop should be considered. Loops located physically near each other and wound in the same direction electrically (i.e., both clock wise (CW) or both counter clock wise (CCW)) will cause field cancellation effects (a dead zone) between the loops. **This is desirable when two loops are placed on each side of a sliding metal gate or door (see Figure A).** The gate or door can pass between the two loops without creating the effect of a vehicle on the loops.
- If the loops are wound in electrically opposite directions (i.e., CW and the other CCW), field enhancement will occur between the loops (see Figure B). **This is not desirable when two loops are placed on each side of a sliding metal gate or door.** If the loops were connected in this manner and a vehicle had cleared the loop, the controller would trigger the gate to close. The gate or door, moving between the loops, would disturb the fields of the loops and cause the detector to think that another vehicle had entered the loop, causing the gate or door to open. Once the gate or door opened, the detector would sense clear loops and signal a closure. This process would continue to repeat itself until power is removed.

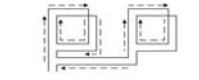


Figure A

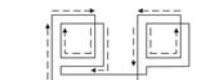
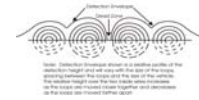
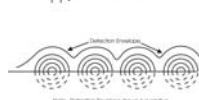


Figure B



Note: Detector threshold point is a relative guide of the detection height and will vary with the size of the loops, spacing between the loops and the size of the vehicle.



Loop Installation Techniques

The following loop installation guidelines are for installing typical roadway loops for traffic and access control applications (i.e. intersections, parking gates, sliding gates, etc.). Always consult with the manufacturer of the equipment that the roadway loop will be connected to. This will confirm that the proper configuration and installation techniques are properly applied for your application.

Useful information about inductive loops:

- a. The typical sensing height is 2/3 of the shortest leg of a loop (in feet). Therefore a 4' x 8' loop typically has a detection height of 2.66 feet.
- b. The inductance of a conventional four-sided loop can be estimated using the formula:

$$L = P \times (T^2 + T) / 4$$

Where L = Loop Inductance in micro Henries
P = Loop Perimeter in feet
T = Number of turns of wires in saw slot

Therefore a 4' x 8' loop with 4 turns would be:

$$L = (4 + 8 + 4 + 8) \times (4^2 + 4) / 4$$

$$L = 24 \times (16 + 4) / 4$$

$$L = 24 \times 20 / 4$$

$$L = 24 \times 5$$

$$L = 120 \text{ micro Henries}$$

Note: Loop feeder cable typically adds 0.22 micro Henries of inductance per foot of cable.

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Loop Installation Techniques

To begin, make sure that the pavement surface in the area that loops are to be installed is dry and free of debris. The outline of the loop(s) should be marked on the pavement in such a way that the lines can be followed easily by the saw operator and not be erased by the water feed from the saw itself. All 90-degree corners should be cut so that the path of the loop wire does not change direction sharply but rather at shallower angles. Core drilling of the corners achieves the same effect but can still lead to failure due to sharp edges remaining in the corner area.

When the outline of the loop and lead-in has been marked, the pavement can be cut. Diamond blade saws are recommended. The saw cut should be approximately 2.0 inches deep and 0.25 inches wide. The saw slot should then be cleaned out and allowed to dry. Compressed air is useful both for ejecting debris and speeding up the drying process. All debris in the vicinity of the saw slot should also be removed so that it is not accidentally pushed back in.

Recommended loop wire is typically 14, 16, 18, or 20 AWG with cross-linked polyethylene insulation. Since moisture can cause significant changes in the dielectric constant of the insulation, which results in excessive loop (frequency) drift, choose an insulation, which is most impervious to moisture. PVC, TFFN, THHN, and THHN-THWN should be avoided since they tend to absorb moisture and crack easily. XLPE (Cross Linked Polyethylene) is very resistant to moisture absorption and provides good abrasion resistance.

If long lead-ins are required, it is suggested that the loop cable be spliced onto shielded, pre-twisted, lead-in wire (IMSA specification 50-2 is suggested) at a convenient pull box location close to the loop. The shield may be connected to earth ground at the cabinet but should then be insulated and isolated from earth ground at the loop end.



Loop Installation Techniques

Start positioning the loop wire from the termination of the lead-in out towards the loop, continue around the loop for the number of turns required (use our FREE *LoopCalc* Software which can be found on our website, www.EDITraffic.com) and finally return to the lead-in termination. Leave the lead-in wire out of the slot so that it may be twisted together before being laid in the slot. Lead-ins should be twisted with a minimum of 4 to 6 twists per foot to prevent any separation of the lead-in wires.

Make sure that the loop wire is pushed fully to the bottom of the saw slot. Small pieces of foam rubber (backer rod) or similar material may be used at various points around the perimeter to prevent the loop wire from rising up while the sealant is poured and curing.

Many different types of loop sealant are now available. Single part types are the easiest to apply since no mixing is required. When applying the sealant, make sure that it is able to sink to the bottom of the slot and completely encase the loop wire. The wire should not be able to move when the sealant has set. Ensure that there is enough sealant to completely fill the slot; if possible the sealant should protrude slightly above the surface of the pavement so that small rocks or other debris cannot collect in the slot.

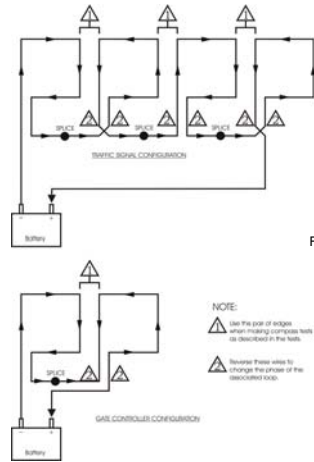
The sealant manufacturer's instructions concerning setting time should be noted - especially when determining the length of time to wait before allowing vehicles to cross the loop area.



Determining Loop Phasing

It was mentioned previously that, when two or more loops are used on the same detector, they should be wired in series and the direction in which each loop is wound electrically is important for proper gate or door operation. It is also very important that the loop connections be accessible for maintenance and repair.

In new installations, where the loops are already installed and covered, we can determine the phasing (the direction in which each loop was wound) and connect them in the desired rotation. The required tools are simple: a 6v lantern battery and a pocket compass. Follow these simple steps to determine loop phasing (See figure C):



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Determining Loop Phasing

1. Identify the wire pairs with the loops in the street.
2. Temporarily connect all loops in series.
3. Connect the free wire from the first loop to one terminal on the battery. Leave it connected until all loops have been checked for proper phasing.
4. Place the compass directly over the wires of the first loop on the side nearest the second loop.
5. Momentarily connect the free wire from the last loop to the other battery terminal and note the movement "DIRECTION" of the compass needle. **WARNING: DO NOT HOLD THE CONNECTION VERY LONG AS THE LOW RESISTANCE OF THE LOOP ACTS AS A SHORT ON THE BATTERY AND CAN OVERHEAT THE LOOP WIRE AND DISCHARGE THE BATTERY!**
6. Place the compass directly over the side of the second loop on the side nearest the first loop and repeat the step above.
7. If the needle pointed in the same direction in steps 4 and 6, the connections are correct for attracting fields (great for traffic control applications, but not sliding gate installations). If the needle pointed in the opposite directions in steps 4 and 6, the connections are correct for opposing fields (great for sliding gates and access control applications, not for traffic control). To reverse the phasing, reverse the connections for the second loop and repeat steps 4 through 6 to verify the desired phasing.
8. Upon completion, disconnect the wires from the battery and make permanent (solder and waterproof) connections on all wires in the loop circuit, including the wires connecting to the lead-in wires to the parking or gate operator.

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Equipment Installation

Refer to Figure D (on next slide) for a typical installation configuration.

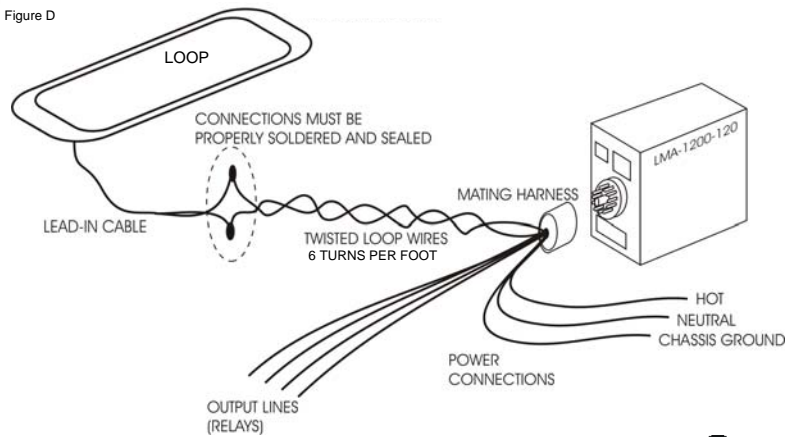
1. Unpack the LMA vehicle detector and LMH4-11 mating harness.
2. Using the wiring pin assignments included with the harness, connect the loop lead-in wires from the buried loop to the appropriate wires of the mating harness.
NOTE: These connection MUST be soldered. All connections exposed to the elements must be properly sealed with a waterproof seal. The loop wires MUST remain twisted.
3. Connect the output relay wires of the mating harness to the external equipment.
NOTE: The relay coil is energized for the "NO CALL" condition. This is known as the Fail Safe mode of the detector.
4. Before going any further, be certain that the power to be used for the detectors is "OFF". Then connect the power lines from the mating harness to the power source lines.
5. Check all connections and verify that the source power matches the LMA detector to be installed (Low Voltage "LV" units for a 12VDC, 24VDC or 24VAC and High Voltage "HV" units for 120VAC or 240VAC).
6. Plug the mating harness into the detector unit.

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Equipment Installation

Figure D



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