

## SECTION 660

### INDUCTIVE LOOP DETECTORS

Delete all sections of ECTCD CRT-660 through Environmental Requirements (Sentence ending in "...coil connected across the loop terminals of each Channel.") and replace as follows:

#### DETECTOR UNIT:

An inductive loop detector unit is an electronic device that energizes sensor loops, monitors the sensor loop's inductance and responds to a predetermined decrease in inductance with an output which indicates the passage of vehicles.

The Model D222 detector unit contains two (2) identical detector Channels, each capable of independent operation. The Model D222 detector unit is a plug-in unit designed for insertion into the "Input File" of the Controller Cabinet. This cabinet is specified under Section 676. The Input File is a controller accessory and is specified under Section 678.

#### GENERAL REQUIREMENTS:

The Model D222 detector unit shall meet all of the electrical, mechanical, environmental, human engineering and design requirements as specified under Section 672-3, 672-4, 672-5 and 672-6. Other requirements are specified herein.

#### SPECIFIC REQUIREMENTS:

- (a) The Model D222 Detector Unit shall contain, in a single module, two (2) detection Channels. Each Channel shall operate independently of the other channel. Each Channel shall conform to the following specifications with or without the other channel being operational.
- (b) The sensor unit channel shall produce an output signal when a vehicle passes over or remains over wire loops embedded in the roadway. The method of detection shall be based upon a design that renders the output signal when a metallic mass (vehicle) enters the detection zone causing a change of 0.02% minimum decrease in inductance of the circuit measured at the input terminals of the sensor unit. The detector zone shall include all configurations listed in paragraph (j) (l), below.
- (c) An open loop shall cause the sensor unit channel to output a signal.
- (d) Each sensor unit channel shall be capable of detecting all types of Florida licensed motor vehicles when connected to the loop configuration/lead-in requirements of paragraph (j)(l).
- (e) The sensor unit shall comply with all performance requirements when connected to an inductance (loop plus lead-in) from 50 to 700 microhenries with a Q-parameter as low as 5 at the sensor unit operating frequency.
- (f) Loop inputs to each channel shall be transformer isolated.

- (g) Each individual channel shall have a minimum of 3 switch selective operating frequencies.
- (h) The sensor unit channel tuning circuits shall be automatic and shall be so designed that drift, caused by environmental changes, or changes in applied power shall not cause an actuation.
- (i) Each sensor unit channel shall have Pulse and Presence selective modes.

(1) Pulse Mode:

- (a) In the pulse mode, each new vehicle presence within the detection zone shall initiate a sensor unit channel output pulse of 125 ( $\pm 25$ ) ms in duration.
- (b) Should a vehicle remain in a portion of the detection zone for a period in excess of 2 seconds, the sensor unit channel shall then be capable of detecting another vehicle entering the same detection zone. The recovery time between the first vehicle pulse and channel capability to detect another vehicle shall be 3 seconds maximum.

(2) Presence Mode:

- (a) In the presence mode, the sensor unit channel shall recover to normal sensitivity within 1 second after termination of vehicle presence in the detection zone regardless of the duration of the presence.
- (b) The channel sensitivity setting shall be provided that detect the presence of a vehicle in the detection zone for a specified time period and inductance change(s). The conditions are as follows:

Minimum Time duration in minutes:	Detector input inductance change:
Setting 1	3 0.02% or more 10 0.60% or more
Setting 2 (OCC)	4 1.00% or more

(j) Sensitivity:

Each sensor unit channel shall be equipped with a front panel selective sensitivity setting(s) in presence and pulse modes to accomplish the following under the operational and environmental requirements of this specifications:

- (1) Each sensor unit channel shall respond to an inductance change of 0.02% while connected to the following Florida Department of Transportation vehicle loop configurations: (Type A and Type B loops are shown in FDOT Roadway and Traffic Design Standards, 1994, Detail #17781.

- (a) Single Type A or B Loop with a 250 foot lead-in cable.

- (b) Single Type A or B Loop with a 1000 foot lead-in cable.
- (c) Four (4) Type A or B Loops connected in series/parallel with a 250 foot lead-in cable.
- (c) Four (4) Type A or B Loops connected in series/parallel with a 1000 foot lead-in cable.
- (2) Each sensor unit channel shall respond while in Setting 2 (OCC) to nominal change in inductance between 0/15% to 0.4% while connected to the above loop configurations. This setting shall not respond to an inductance change of less than 0.1%.
- (3) The sensor unit channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from an loop perimeter, in all configurations listed in paragraph (j)(l), above.
- (4) All sensitivity setting shall not differ +40% from the nominal value chosen.
- (5) There shall be a minimum of 7 selective sensitivity setting including specified sensitivity settings.
- (k) Response time of the sensor unit channel for the OCC setting shall be less than 20 ms. That is, for any decreased inductive change which exceeds its sensitivity threshold, the channel shall output a found true logic level within 20 ms. When such change is removed, the output shall become an open circuit within 20 ms.
- (l) The sensor unit channels shall begin normal operation within 2 seconds after the application of power or after a reset signal of 15 ms.
- (m) Lightning protection shall be installed within the sensor unit:
  - (1) The protection shall enable the sensor unit to withstand the discharge of a 10 microfarad capacitor charged to +1000 volts directly across the sensor unit input pins with no loop load present.
  - (2) The protection shall enable the sensor unit to withstand the discharge of a 10 microfarad capacitor charged to +2000 volts directly across the sensor unit input inductance pins or from either side of the sensor unit input inductance pins to equipment ground. The sensor unit input pins shall have a dummy resistive load attached equal to 5.0 ohms.
  - (3) The Loop Detector shall have an solid state output equal to an elctro-mechanical relay output of a form "C" single pole - double throw type.
- (n) Tracking:
  - (1) Tracking Rate:

The sensor unit shall be capable of compensating or tracking for an environmental change up to 0.001% change in inductance per second.

(2) Tracking Range:

- (a) The sensor unit shall be capable of normal operation as the input inductance is changed  $\pm 5\%$  from the quiescent tuning point regardless of internal circuit drift.
- (b) The sensor unit shall be capable of normal operation as the input resistance is changed  $\pm 0.5\%$  from the quiescent tuning point regardless of internal circuit drift.

(o) Temperature Change:

The operation of the sensor unit shall not be affected by changes in the inductance and/or capacitance of the loop caused by environmental changes with the rate of temperature change not exceeding  $1^{\circ}\text{C}$  per 3 minutes. The opening or closing of the controller cabinet door with a temperature differential of up to  $18^{\circ}\text{C}$  between the inside and outside air shall not affect the proper operation of the sensor unit.

- (p) A switch or switch position shall be provided on the front panel to disable each channel output.

## DESIGN REQUIREMENTS:

### (a) Physical Characteristics:

- (1) Overall dimensions of the Loop Detector shall be as shown in Figure 660-1.
- (2) The Loop Detector shall plug into the socket of the input file specified in Section 678-9.
- (3) The Connector shall be compatible with the specified socket.
- (4) Continuous edge guides shall be provided on the Loop Detector.
- (5) The Loop Detector's control circuitry and switches shall be readily accessible by the use of a screwdriver or wrench. Only one (1) type of screw head end (slotted or Phillips) shall be used throughout.
- (6) Each Loop Detector shall be so constructed that persons inserting or removing the module will not be exposed to any parts having live voltage. A handle shall be attached to the front of each Loop Detector to facilitate the Loop Detector insertion or removal from its mating connector.
- (7) The front panel of the Loop Detector shall be provided with four (4) indicators. The indicators shall be vertically centered on the front panel with top and bottom indicators no more than 1-inch from the panel vertical center.
- (8) One indicator per channel shall indicate the output state of the Loop Detector and the other, the fault state of the detector.
- (9) All printed circuit boards shall be made from NEMA (FA-4) glass epoxy, or equivalent (see NEMA Standards Publications for Industrial Laminated Thermosetting Products, Publication No. L1 1-1971), or latest revision thereof).
- (10) Circuit boards exceeding 2-inches in any dimension shall have a nominal thickness of at least 1/16-inch. Circuit boards not exceeding 2-inches in any dimensions shall have a nominal thickness of at least 1/32-inch.
- (11) The walls of all plated through holes shall have a minimum copper plating thickness of 0.001 inch. All circuit tracks shall have a conductivity equivalent to at least 2 ounces per square foot of copper. All electrical mating surfaces shall be made of non-corrosive material.
- (12) Each component of the Loop Detector shall be identified by a circuit reference symbol. This identification may be affixed to the printed circuit board(s), the cover of the unit, or in the assembly drawing provided with the unit.

### (b) Electrical Characteristics:

- (1) The Loop Detector shall operate from a +24 VDC power source.
- (2) Each channel input shall consist of a signal and an analog ground connection.

(c) Pin Assignment:

Pin assignments for the Model D222 Loop Detector shall be in conformance with the Input File Connector Pin assignments specified in Section 678.