CHAPTER 5

SPECIFICATIONS FOR DETECTOR SENSOR UNITS, ELEMENTS AND ISOLATORS

MODEL 222 TWO-CHANNEL LOOP DETECTOR SENSOR UNIT

MODEL 224 FOUR-CHANNEL LOOP DETECTOR SENSOR UNIT

MODEL 231 MAGNETIC DETECTOR SENSING ELEMENT

MODEL 232 TWO-CHANNEL MAGNETIC DETECTOR SENSOR UNIT

MODEL 242 TWO-CHANNEL DC ISOLATOR

MODEL 252 TWO-CHANNEL AC ISOLATOR

TABLE of CONTENTS

5.1 SECTION 1 - GENERAL REQUIREMENTS

5.1.1 The sensor unit and isolator channels shall be operationally independent from each other.

5.1.2 Each sensor unit or AC isolator channel shall draw no more than 100 mA from the +24 VDC cabinet power supply and shall be insensitive to 700 millivolts RMS ripple on the incoming +24 VDC line.

5.1.3 The sensor unit or isolator front panel shall be provided with a hand pull to facilitate insertion and removal from the input file.

5.1.4 All control switches, gain dials and channel indicators shall be mounted on the front panel. Each sensor unit or isolator channel shall have an indicator to provide visual indication of detection or incoming signal.

5.1.5 Each sensor unit or isolated channel output shall be an opto-isolated N Open Collector capable of sinking 50 mA at 30 VDC. The output shall be compatible with the controller unit inputs.

5.1.6 A valid channel input shall cause a channel ground true output to the controller unit of a minimum 100 ms in duration. An onboard jumper shall be provided to bypass the above minimum timing requirement.

5.1.7 The sensor unit or sensing element shall operate and interface successfully with an associate CALTRANS Standard Sensing Unit or Element.

5.1.8 The output transistor shall switch from the OFF state to the ON state in a period equal to or less than 20 us. The transistor shall switch from the ON state to the OFF state in a period equal to or less than 20 us.

5.1.9 The numbered and lettered sides of the PCB connector shall be commonly assigned.

5.2 SECTION 2 - MODEL 222 & 224 LOOP DETECTOR SENSOR UNIT REQUIREMENTS

5.2.1 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 5.2.9.

5.2.2 An open loop shall cause the sensor unit channel to output a signal.

5.2.3 Each sensor unit channel shall be capable of detecting all types of Manitoba licensed motor vehicles when connected to the loop configuration/leadin requirements of 5.2.9.

5.2.4 The sensor unit shall comply with all performance requirements when connected to an inductance (loop plus lead-in) from 50 to 700 micro henries with a Q-parameter as low as 5 at the sensor unit operating frequency.

5.2.5 Loop inputs to each channel shall be transformer isolated.

5.2.6 Each individual channel shall have a minimum of 3 switch selectable operating frequencies.

5.2.7 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.

5.2.8 Mode Selection Requirements

5.2.8.1 Each sensor unit channel shall have Pulse and Presence selectable modes.

5.2.8.1.1 Pulse Mode

5.2.8.1.1.1 In the pulse mode, each new vehicle presence within the detection zone shall initiate a sensor unit channel output pulse of 125 (±25) ms in duration.

5.2.8.1.1.2 Should a vehicle remain in a portion of the detection zone for a period in excess of 2 seconds, the sensor unit channel shall automatically "tune out" the presence of said vehicle. 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.

5.2.8.1.2 Presence Mode

5.2.8.1.2.1 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.

5.2.8.1.2.2 The channel sensitivity settings 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
5.2.8.1.2.2.1 Setting 1	3	0.02% or more
	10	0.06% or more
5.2.8.1.2.2.2 Setting 2 (OCC)	4	1.00% or more

5.2.9 Sensitivity

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

5.2.9.1.1 Each sensor unit channel shall respond to an inductance change of 0.02% while connected to the following California Standard Plan ES-5A & B Loop Configurations. (California Department of Transportation Standard Plans)

5.2.9.1.1.1 Single Type A, B or Q Loop with a 250 foot lead-in cable.

5.2.9.1.1.2 Single Type A, B or Q Loop with a 1000 foot lead-in cable.

5.2.9.1.1.3 Four Type A, B or Q Loops connected in series/parallel with a 250 foot lead-

in cable.

5.2.9.1.1.4 Four Type A, B or Q Loops connected in series with a 1000 foot lead-in cable.

5.2.9.1.1.5 One 50 foot Type C Loop with 250 foot lead-in cable.

5.2.9.2 Each sensor unit channel shall respond while in Setting 2 (OCC) to a 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%.

5.2.9.3 The sensor unit channel shall not detect vehicles, moving or stopped, at distances of 3 feet or more from any loop perimeter, in all configurations listed in paragraph 5.2.9.

5.2.9.4 All sensitivity settings shall not differ ±40% from the nominal value chosen.

5.2.9.5 There shall be a minimum of 7 selectable sensitivity settings including specified sensitivity settings.

5.2.10 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 ground true logic level within 20 ms. When such change is removed, the output shall become an open circuit within 20 ms.

5.2.11 The sensor unit channels shall begin normal operation within 2 seconds after the application of power or after a reset signal of 15 us.

5.2.12 Lightning protection shall be installed within the sensor unit.

5.2.12.1 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.

5.2.12.2 The protection shall enable the sensor unit to withstand the discharge of a 10 microfarad capacitor charged to ±2000 volts directly across either 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.

5.2.13. 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.

5.2.14 Tracking Range

5.2.14.1 The sensor unit shall be capable of normal operation as the input inductance is changed ± 5.0% from the quiescent tuning point regardless of internal circuit drift.

5.2.14.2 The sensor unit shall be capable of normal operation as the input resistance is changed ± 0.5% from the quiescent tuning point regardless of internal circuit drift.

5.2.15 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 degrees C per 3 minutes. The opening or closing of the controller cabinet door with a temperature differential of up to 18 degrees C between the inside and outside air shall not affect the proper operation of the sensor unit.

5.2.16 A switch or switch position shall be provided on the front panel to disable each channel output.

5.3 SECTION 3 - MODEL 231 MAGNETIC SENSING ELEMENT REQUIREMENTS

5.3.1 Each sensing element shall be designed for ease of installation, repositioning, and removal. It shall be no larger than 2.25 inches in diameter and shall have no sharp edges along its length. The overall length shall not exceed 21 inches.

5.3.2 Each sensing element including lead-in shall have a DC resistance of less than 3500 ohms.

5.3.3 The sensing element shall be constructed of nonferrous material and shall be moisture proof. The element shall contain no moving parts or active components. The element shall have a minimum of 50 feet lead-in cable. Leakage resistance shall be a minimum of 10 megohms when tested with 400 VDC between lead wire, including lead wire entrance, and the fluid of a salt water bath after the device has been entirely immersed in the bath for a period of 24 hours at 20 degrees (±3 degrees) C. The salt water bath concentrate shall be one fourth ounce of salt per gallon of water.

5.4 SECTION 4 - MODEL 232 TWO-CHANNEL MAGNETIC DETECTOR SENSOR UNIT REQUIREMENTS

5.4.1 The Model 232 Two-Channel Magnetic Detector Sensor Unit contains 2 channels of detection. When resident in an energized cabinet Input File and each channel connected to its associated Model 231 Magnetic Detector Sensing Element(s), the channel shall produce an output signal to the controller unit when a voltage is induced in the sensing element by a vehicle passing over the sensing element.

5.4.2 Each channel shall detect all Manitoba licensed vehicles passing within 6 feet of the Model 231 Sensing Element with a 1000 foot lead-in cable at all speeds between 3 and 80 miles per hour.

5.4.3 A single control knob for adjusting the sensitivity of each channel shall be readily adjustable without use of tools and shall be mounted on the front panel.

5.4.4 A momentary switch or switch position shall be provided to place a call on each channel on an individual basis.

5.5 SECTION 5 - MODEL 242 TWO-CHANNEL DC ISOLATOR REQUIREMENTS

5.5.1 The Model 242 Two-Channel DC Isolator shall contain 2 isolation channels which provide isolation between electrical contacts external to the module and the controller unit input. The method of isolation shall be based upon a design which shall provide reliable operation.

5.5.2 Each isolation channel shall have front panel-mounted test switch to simulate valid input. The test switch shall be a single pole-double throw, three-position CONTROL test switch: The position assignment shall be UP - constant ON; MIDDLE - OFF; and DOWN - momentary ON.

5.5.3 The isolator shall have an internal power supply which shall supply 20 ±4 VDC to the field input side of the isolation channels. The Isolator shall not draw more than 2.5 watts of AC power. No current shall be drawn from the cabinet power supply.

5.5.4 A channel contact closure input of 5 ms or less shall not cause an out (ground true) to the controller. An input of 25 ms or greater shall cause an output to the controller. An input of duration between 5 and 25 ms may or may not cause an output to the controller. The channel circuitry shall be able to react to a new input closure within 25 ms of an input opening.

5.5.5 Each isolation channel field input shall be turned on (true) when a contact closure causes an input voltage of less than 8 VDC, and shall be turned off (false) when the contact opening causes the input voltage to exceed 12 VDC. Each input shall deliver no less than 15 mA nor more than 40 mA to an electrical contact closure or short from the power supply.

5.5.6 The minimum isolation shall be 1000 megohms and 2,500 VDC measured between the input and output of the same channel.

5.5.7 Lightning protection shall be installed inside the Isolator.

5.5.7.1 The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to ± 1000 volts directly across the input pins with no load present.

5.5.7.2 The protection shall enable the isolator to withstand the discharge of a 10 microfarad capacitor charged to ± 2000 volts directly across either the input pins or from either side of the input pins to equipment ground. The input pins shall have a dummy resistive load attached equal to 5.0 ohms.

5.6 SECTION 6 - MODEL 252 TWO-CHANNEL AC ISOLATOR REQUIREMENTS

5.6.1 The Model 252 Two-Channel AC Isolator shall contain 2 isolation channels which provide isolation between external 120 VAC input circuits and the controller unit input circuits. The method of isolation shall be based upon a design which provides reliable operation.

5.6.2 A channel input voltage (Von) of 80 (± 5) VAC applied for a minimum duration of 100 ms shall cause an output (ground true) to the controller.

5.6.3 A channel input voltage of Von minus 10 VAC applied for a minimum duration of 100 ms shall cause an output (False) to the controller.

5.6.4 Each channel input circuit shall have a input impedance of between 6000 to 15000 Ohms at 60 Hz.

5.6.5 Circuitry switching to invert inputs to read ground false logic (by jumpers) shall be provided.

5.6.6 The transistor shall be capable of sinking 50 mA at 30 VDC.

5.6.7 The minimum isolation shall be 1000 megohms between the input and output terminals at 500 VAC applied voltage.

5.6.8 Each channel input shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to ± 1000 volts, when connected directly to the open input pins. Each channel shall withstand, without damage, the discharge of a 10 microfarad capacitor charged to +/- 2000 volts, when connected between either input pin and equipment ground.