

N3IX ENGINEERING

QuadLN_S Detector Board Manual



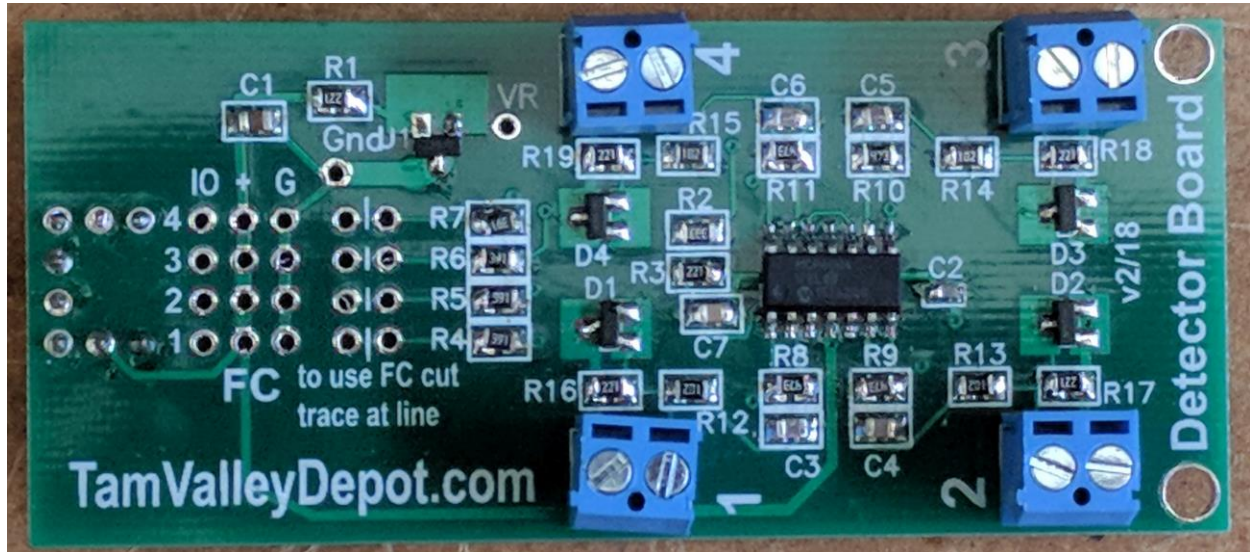
Firmware v2.0

N3IX Engineering
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Basics



2.1 Overview

The **Detector Board** is an add-on to the *QuadLN_S* stationary decoder that provides block detection for up to 4 blocks on DCC systems. Detection is by measuring the block current using Current Transformers. The **Detector Board** uses 4 of the 8 **IO** lines on the *QuadLN_S*.

The *QuadLN_S* / **Detector Board** combo provides:

- Support for up to four 100:1 Current Transformer detectors
- Software detector sensitivity adjustment
- Software selection between two current ranges
- Low current range supports 10K or 15K resistor wheelsets
- No soldering required when using Current Transformers from N3IX Engineering
- Wiring using commonly available CAT5 twisted pair cable
- Can preserve Occupancy information during loss of DCC signal due to short circuit
- Electrically isolated from DCC block current

The Detector Board requires *QuadLN_S* firmware version 2.0 or later. A firmware update is available for *QuadLN_S* boards with older firmware.

2.2 Detection

One rail (or both rails) of the block you want to detect must be isolated at the block boundaries. The track itself may have multiple drops to a block bus, but ultimately there must be a single connection between the block and the DCC bus. The wire for this single connection is passed straight through the

hole in the Current Transformer (CT). The CT sensing mechanism is electromagnetic, not electrical, so the detection system stays totally electrically isolated from the DCC side.

Each CT is connected back to the Detector Board using a single twisted pair from a CAT5 cable. For short distances you can leave the 4 pairs in the cable but it is recommended that you run each pair separately to reduce any potential coupling between detectors. The CT is supplied with a 2 wire screw terminal connector mounted on a small circuit board so that no soldering will be needed.

The *QuadLN_S* analyzes the signal from the detector to determine the block occupancy state. There are delays for occupancy pick-up and drop: when a detector indicates continuous occupancy for 200 milliseconds the *QuadLN_S* will report via a Loconet Sensor message, and subsequently when the detector indicates continuous non-occupancy for 2 seconds the *QuadLN_S* will report again via a Sensor message.

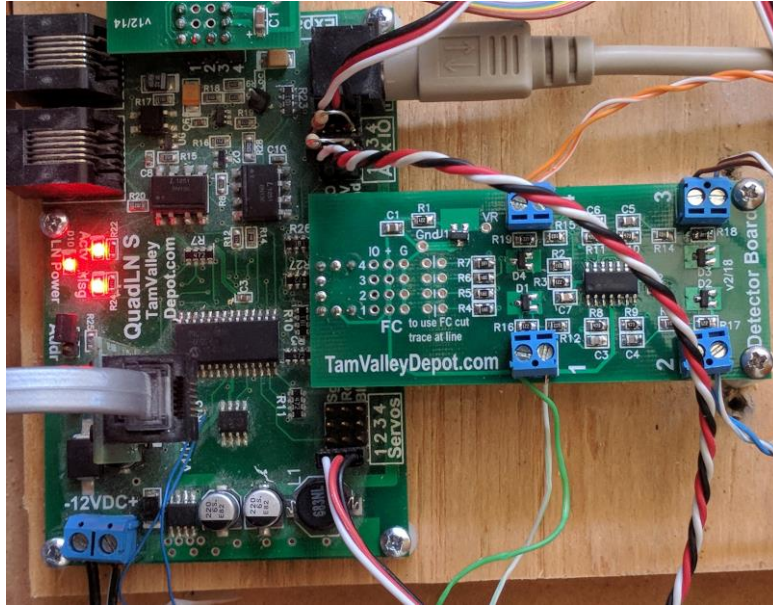
The *QuadLN_S* has a feature to avoid loss of occupancy information when the track bus is short circuited. When you connect the DCC bus that feeds the blocks being monitored by the **Detector Board** (the main DCC bus or a circuit breaker feeding a Power District bus) to the DCC input pins on the *QuadLN_S* and then enable the “Freeze on DCC Loss” option on the detector input, changes in Occupancy state on that input will be ignored unless the DCC signal is alive and solid.

Connections and Wiring

3.1 *QuadLN_S* Connection

The **Detector Board** plugs into the *QuadLN_S* Main IO Port. First remove power from the *QuadLN_S* then carefully align the connector and then press the board into place. Before applying power confirm that all the pins are properly aligned.

ALWAYS TURN *QUADLN_S* POWER OFF BEFORE ATTEMPTING TO INSTALL THE DETECTOR BOARD. VERIFY THAT ALL PINS ON THE DETECTOR BOARD CONNECTOR ARE PROPERLY ALIGNED BEFORE TURNING POWER BACK ON.



3.2 *QuadLN_S* Firmware

The **Detector Board** requires *QuadLN_S* firmware version 2.0.0 or later. If your *QuadLN_S* firmware is older please perform a firmware update before proceeding.

3.3 Mounting

The **Detector Board** has two mounting holes located in the end furthest from the *QuadLN_S*. The standoffs included with the Detector Board must be used when mounting it to ensure the board is adequately supported.

3.4 Wiring Current Transformers to the Detector Board

3.4.1 Signal Cable Type

The recommended cable type for connecting detectors to the **Detector Board** is CAT5 network cable. This cable is commonly available and contains 4 twisted pairs, so one cable can handle 4 detectors. Use one twisted pair for each detector. The individual twisted pairs can be left in the cable or they can be separated as required by your detector locations.

3.4.2 Signal Cable Routing

Following good wiring practice when routing detector cables helps ensure proper operation. Detector cables should be separated from any adjacent DCC bus wiring. When crossing other wiring it is best to do so at right angles to minimize signal coupling.

3.4.3 Signal Cable Connection

A 2-wire screw terminal connector is provided on the **Detector Board** for each detector input. There is no need to observe any input polarity - the wires in a twisted pair can go to either terminal on the connector.

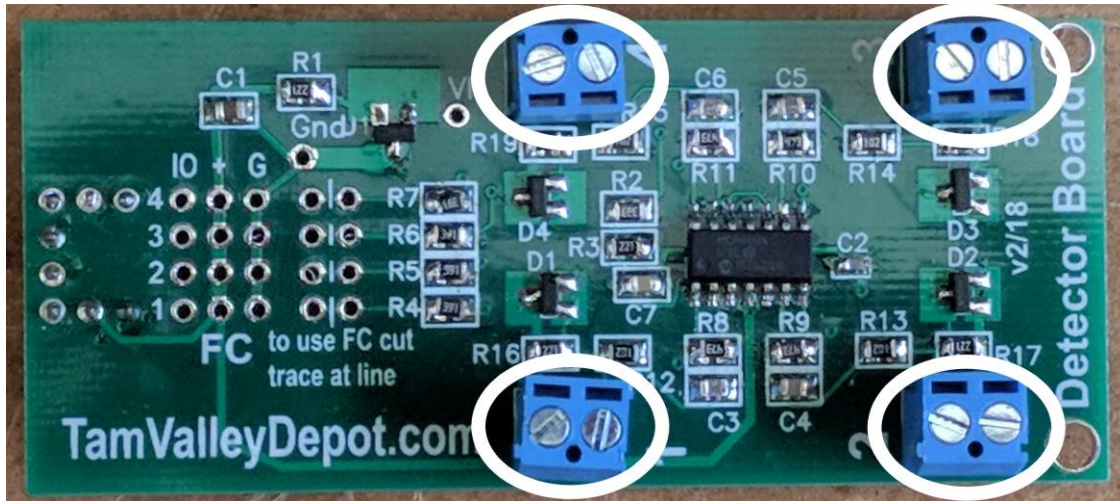
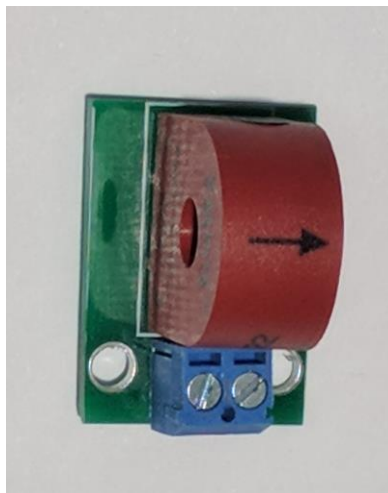


Figure 0-1 Detector Inputs

Current Transformer Installation



4.1 Location

The Current Transformer is located on the block feeder that supplies power to the track block that you wish to monitor.

4.2 Block Feeder

Run the block feeder straight through the center of the Current Transformer. Since the Current Transformer works by magnetic coupling, there is no reason to remove the insulation from the block feeder where it passes through the Current Transformer. Leave the block feeder insulated to avoid any accidental electrical connections.

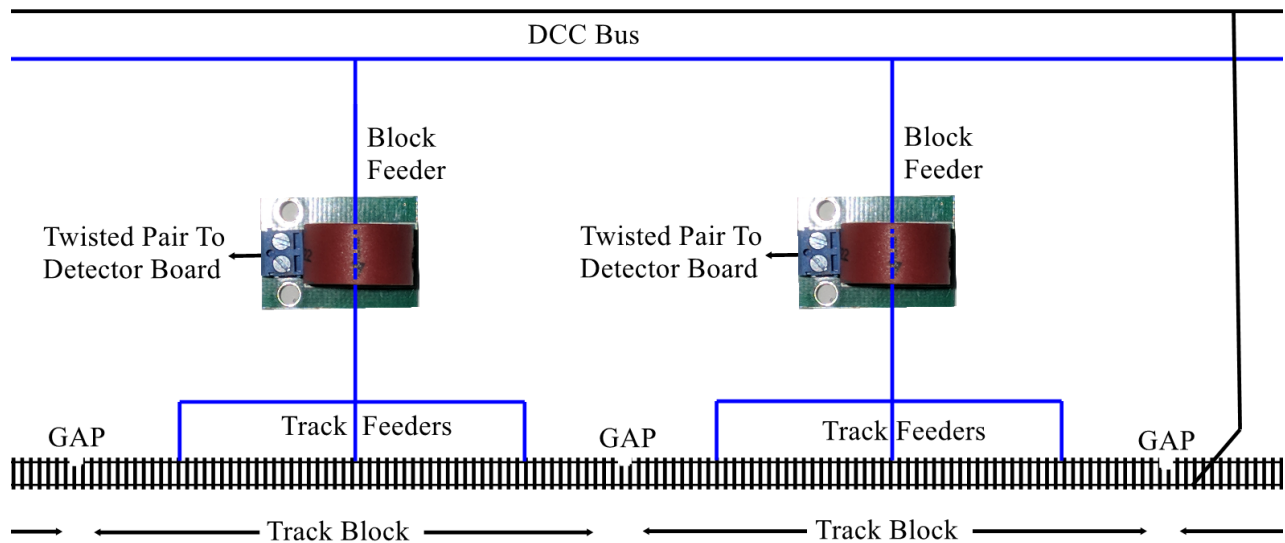
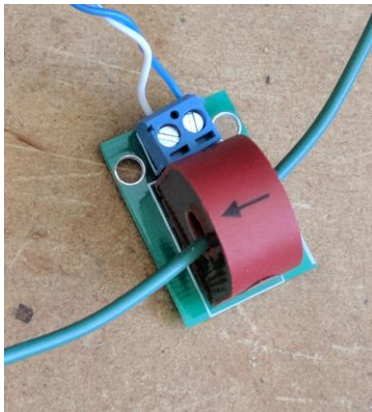


Figure 0-1 Block Feeder Wiring

The **Detector Board** circuitry is very sensitive and can measure currents of under 0.5mA with the block feeder just running straight through the Current Transformer. **DO NOT PASS THE FEEDER THROUGH THE TRANSFORMER MORE THAN ONCE BY LOOPING IT.**



RIGHT!



WRONG!

4.3 Signal Cable Connection

Current Transformers from N3IX Engineering are supplied already mounted on a small circuit board along with a 2-wire screw terminal connector. This eliminates any need to solder connections under the layout. The wires in the twisted pair can go to either terminal on the connector.

General Programming Considerations

5.1 Minimum *QuadLN_S* firmware version

The **Detector Board** requires *QuadLN_S* firmware version 2.0 or later. If your *QuadLN_S* has version 1.x firmware, you must perform a firmware update before proceeding.

5.2 Minimum JMRI Version

Access to the **Detector Board** Range setting requires JMRI version 4.11 or later. If you are running an earlier version, please update before proceeding.

5.3 Roster entry

If you haven't already done so, create a roster entry following the steps in the *QuadLN_S* manual.

Detector Input Programming

To access the following parameters in JMRI always use **Operations Mode / Programming On Main**.

The **Detector Board** uses the four Main IO pins. The detector settings for these pins are configured on four Group tabs. When the *QuadLN_S* is configured for 8 Servos, the Main IO are found on the Group 5/8, Group 6/8, Group 7/8 and Group 8/8 tabs. A sample Group pane is shown in Figure 0-1, with a box drawn around the MAIN IO INPUT section. The settings described below should be adjusted for MAIN IO 1, MAIN IO 2, MAIN IO 3 and MAIN IO 4.

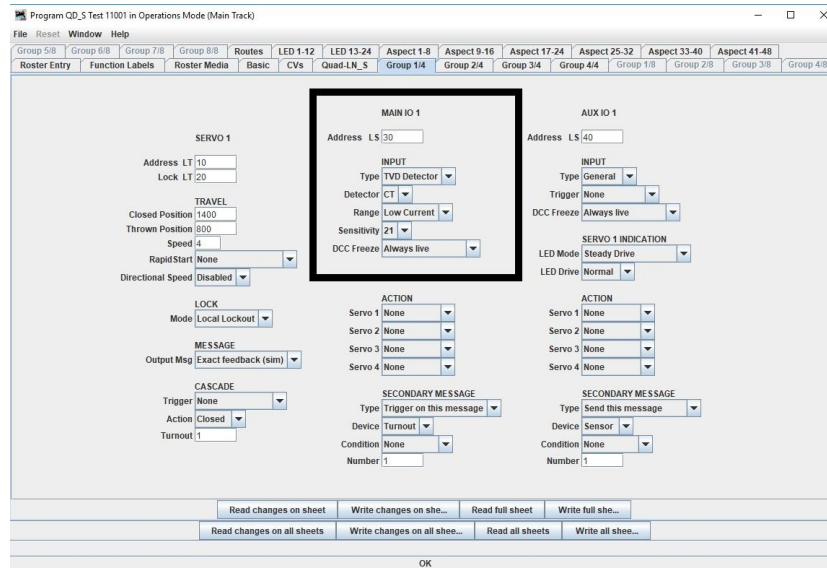


Figure 0-1 Group Pane with Main IO options boxed.

6.1 Type

For each MAIN IO section, the INPUT Type should be set to **TVD Detector**. Once the INPUT Type selection is changed, the other detector settings will appear immediately below the INPUT Type. Figure 0-2 shows a close-up view of the Main IO input settings after the INPUT Type has been set to **TVD Detector**.

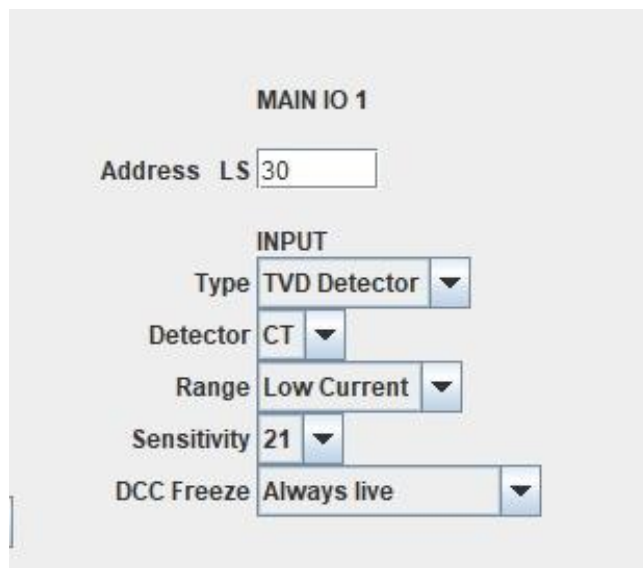


Figure 0-2 Closeup of Main IO settings.

6.2 Detector

The Detector setting should be left at **CT**, which is short for Current Transformer. The **IR** setting is for a future product.

6.2.1 Range

By default the Range is set to **Low Current** which allows the sensitivity to be adjusted between about 0.5 and 5.0 mA. The **Low Current** Range covers most situations where individual cars or axles are being detected. For instance an axle with a 10K resistor will draw about 1.5 mA on a DCC system set for HO. Changing the Range to **High Current** allows the sensitivity to be adjusted between about 4 and 20 mA.

6.2.1.1 Sensitivity

The Sensitivity can be set between 0 (least sensitive) and 31 (most sensitive). On the **Low Current** Range, a setting of 26 is a good starting point for detecting an axle with a 10K resistor.

6.2.1.2 DCC Freeze

The Detector Board cannot determine block occupancy without a DCC signal on the rails. Thus a short circuit in a DCC power district, or turning off DCC power, will cause all detectors in that district to indicate that their blocks are unoccupied. The *QuadLN_S* has the ability to monitor the DCC signal in the power district and to hold the input at its previous value when the DCC signal is lost, preventing false reports from detectors during short circuit conditions. Normal input operation resumes automatically once the DCC signal is restored. To use this capability, connect the DCC input terminals of the *QuadLN_S* to the DCC bus of the power district that is feeding the blocks being monitored by the **Detector Board**.

The available settings are **Always Live** and **Freeze on DCC loss**. Choose **Freeze on DCC lost** to disable detector input action when no DCC signal is present on the DCC input pins. This is generally the best setting when using the Detector Board. If the DCC input pins are not wired to a DCC bus, choose **Always Live** to enable detector input action independent of the DCC state.

Detector Sensitivity Adjustment Using Remote Align Tool

The Sensitivity for each Detector input can be adjusted using the Remote Alignment Board. This allows you to easily match the input sensitivity to each block. Note: Before adjusting the Sensitivity, you must configure the Main IO INPUT Type to **TVD Detector** as described in Section 6.1 above. Here is the adjustment procedure.

Connect the remote alignment board to the *QuadLN_S*. **Remove** the *QuadLN_S* **ADDR** jumper if it is installed.

1. Press and hold the **Down** button until an LED lights on the Remote Align Board (about 1 second) indicating that you are in Detector Input Selection mode. (The initial Detector Input selection will be the same as the last time remote Sensitivity adjustment was performed.) The LED on the Remote Align Board indicates the selected Detector Input using the following method:

Input	Remote Align LED indication
-------	-----------------------------

1	LED 0 steady
2	LED 1 steady
3	LED 2 steady
4	LED 3 steady

If the LED is blinking at this point, it means that the corresponding INPUT Type is not set to TVD Detector. Please refer to Section 6.1 and correct this setting before proceeding.

2. Use the **Up** and **Down** buttons to choose the desired Detector Input, then press the **SEL** button briefly. The LED on the Remote Align Board now indicates the Sensitivity value for the selected Signal Output using the following method:

LED	Sensitivity values
0	0-3
1	4-7
2	8-11
3	12-15
4	16-19
5	20-23
6	24-27
7	28-31

If the LED is blinking it means that signal from the Detector is less than the current Sensitivity setting and the block is considered Unoccupied. If the LED is on steady it means that signal from the Detector is greater than the current Sensitivity setting and the block is considered Occupied.

3. Use the **Up** and **Down** buttons to change the Sensitivity of the Detector Input. The Sensitivity value changes on every press. The LED indication on the Remote Align Board may not change since 4 Sensitivity values are mapped to each LED. If the selected LED does not change, the brightness of the LED will increase slightly with each **Up** press and decrease slightly with each **Down** press to confirm that the Sensitivity has been adjusted.

If you have a car that draws current in the detected block, the LED will change from Steady to Flashing (or Flashing to Steady) when the Sensitivity setting crosses the detection threshold. The suggested procedure is to first put the **minimum** load you wish to detect in the block. This would typically be a car with a resistor axle. Decrease the Sensitivity value so that the LED is Flashing indicating that the block is Unoccupied. Next increase the Sensitivity until the LED just goes Steady indicating that the block is Occupied and then increase the Sensitivity 2 steps further.

4. Press and hold the **SEL** button until the Remote Align Board LED turns off (about 1 second).

Displaying Detector Status

The *QuadLN_S* will send a Loconet Sensor Report message each time a Detector changes state. All *QuadLN_S* boards connected to the Loconet monitor these messages, and a new feature of the *QuadLN_S* firmware allows any *QuadLN_S* **Signal Board** to continuously display the state of any Detector or other Sensor using your own LEDs. See the updated **Signal Board** manual for more information and an example. The Sensor Report messages can also be monitored using PC software and then displayed on computer-generated panels.

Mixing Detectors and Fascia Controller Inputs

If all 4 detector inputs are not required, it is possible to reclaim the spare Main IO inputs for use with Fascia Controllers or other standard input device. To use a spare input requires cutting a trace and soldering a 3-pin header onto the circuit board. Some skill is required so don't attempt this unless you are comfortable performing work on electronic circuit boards.

9.1 Disconnect the Detector Circuit from the Spare Input

There is a cuttable trace on the circuit board between each Detector circuit and the connector to the Main IO pins. Identify which Main IO you wish to reclaim and carefully cut the corresponding trace.



Figure 0-1. Fascia Controller Cuttable Traces

9.2 Add a 3-pin header

Insert a 3-pin header from the top of the board. Solder the pins where they protrude on the bottom of the board, being careful not to create solder bridges between pins.



Figure 0-2. Fascia Controller 3-Pin Headers

9.3 Reconfigure the Input Settings

For the selected MAIN IO, set the INPUT Type to **General** and then adjust the other INPUT settings as required.

Detector CVs

10.1 Detector CV Table

CV #	Description	Range	Default
325-328	Main IO 1-4 Option	Table 0-2	13
329-332	Main IO 1-4 Detector	Table 0-3	160

Table 0-1 Signal CV Table

10.2 Main IO Option CV Format for TVD Detector

CV								
Bit	f	ty	s	l	l	l	tr	tr
Default	0	1	u	u	u	u	u	u

f = DCC Freeze: 0 = Always live, 1 = Freeze on DCC loss

ty = Input Type: 0 = General, 1 = TVD Detector

s = LED Sense: unused when Input Type is set to TVD Detector

l = LED Mode: unused when Input Type is set to TVD Detector

tr = Trigger: unused when Input Type is set to TVD Detector

Table 0-2 IO Option CV Format

10.3 Main IO Detector Option CV Format – Detector Input

CV								
Bit	t	r	g	s	s	s	s	s
Default	0	0	0	1	1	0	1	0

t = Input Type: 0 = CT, 1 = IR

r = Reserved

g = range: 0 = Low, 1 = High

s = Sensitivity: 0-31

Table 0-3 Main IO Option CV Format – Detector Input