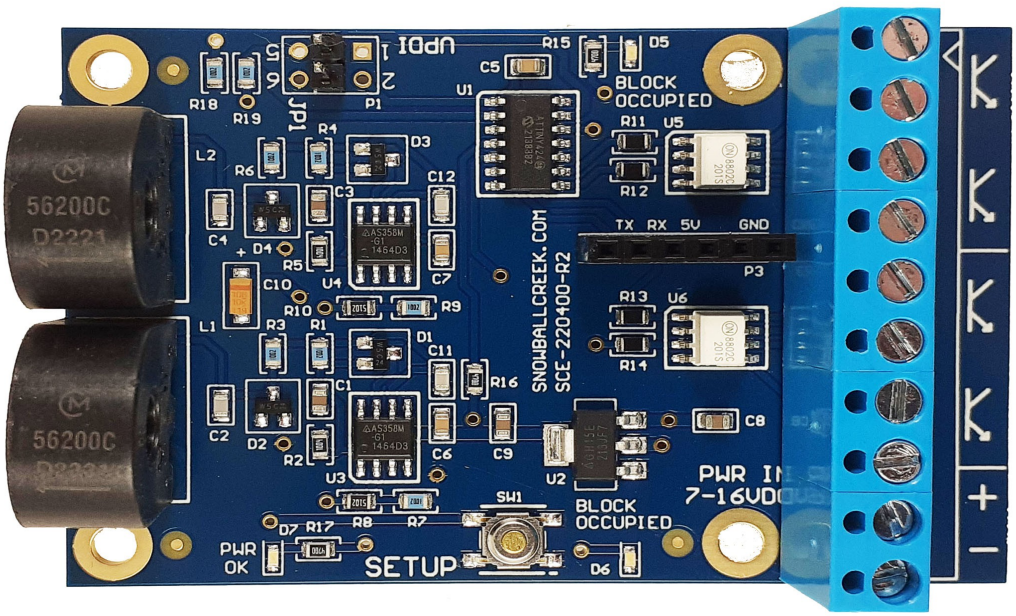
SNOWBALL CREEK
ELECTRONICS

DUAL AUTO-SENSE BLOCK OCCUPANCY DETECTOR

User Guide



The ultimate occupancy detector for rolling stock detection!

Contents

Snowball Creek Electronics

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CANADA

1. Product Description

Thank you for purchasing Snowball Creeks' Dual Auto-Sense Block Occupancy Detector. This block detector is the most sensitive on the market today. (2023)

Any detector can detect a locomotive... but can they detect 39K resistor wheel-sets?

This detector eliminates issues related to sensitivity. Tweaking pots to determine the best performance setting is no longer needed. Each detector measures and stores a baseline value of DCC current for each block. With microprocessor control over the detection process, the hassle of setting up old-style detectors is gone.

This detector is completely isolated from the track DCC voltage. Many old-style detectors rely on a voltage drop across a diode that is in-line with the track power, and thus will not even trigger unless the current exceeds the voltage drop of the diodes. This method has significant loss and as a result may not detect rolling stock with higher value resistors.

Many of the coil design type detectors also suffer from the diode voltage drop issue. They just place the diode on the other side of the coil. Detection of very small signals is lost because the signal is not strong enough to break past the threshold of the diode voltage drop.

Our design uses the proven tuned-coil front end to provide the isolation. But we take it even further by including an amplifier to enhance those tiny micro-volt signals. Then the signal is processed through a precision rectifier circuit, thus eliminating the diode drop problem that other designs have.

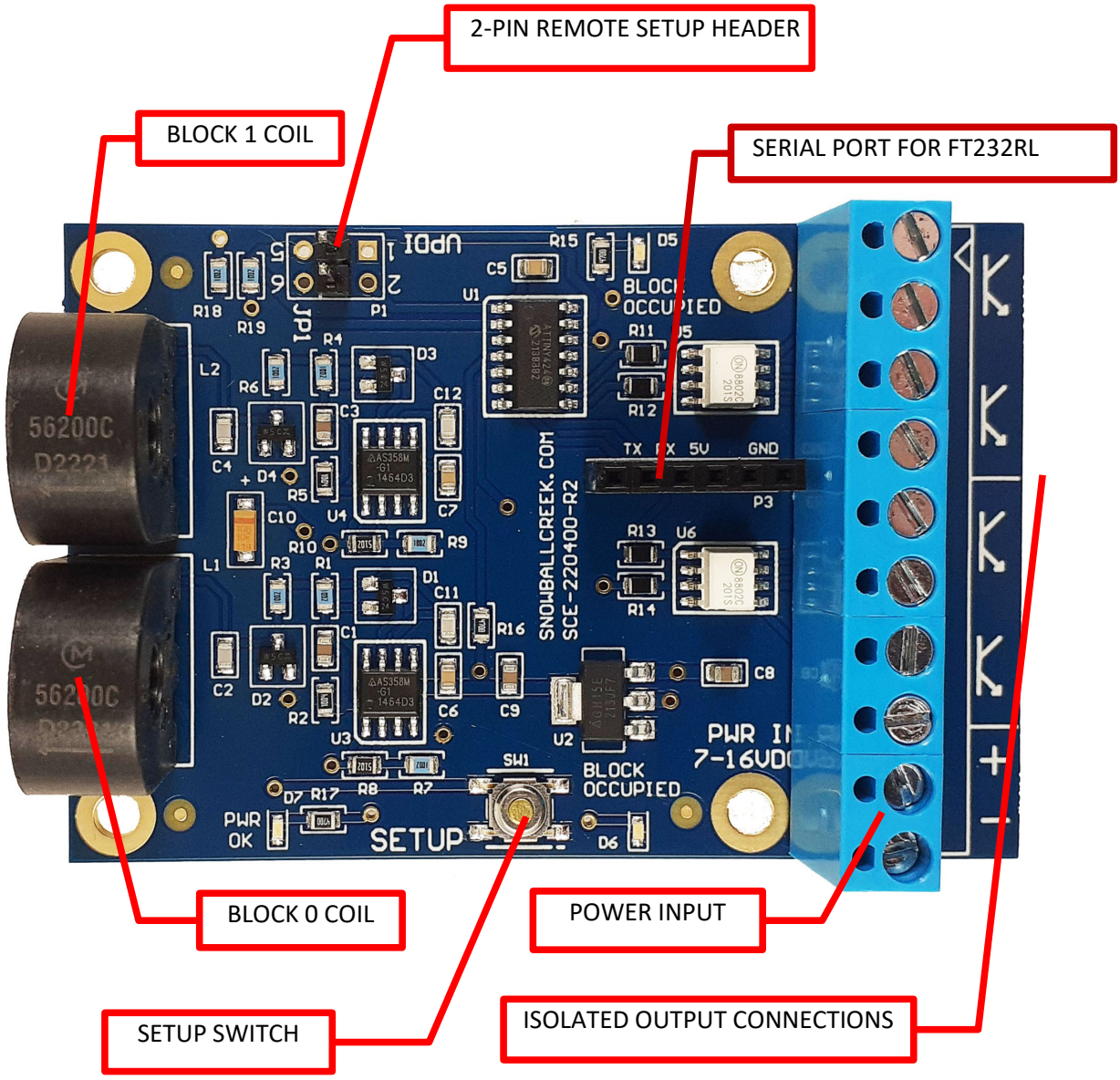
The result? We can detect and make decisions on micro-volt changes in the detection signal, which translates to a reliable detection from changes in DCC current of less than 1 mA.

Our detector also has two isolated outputs per block. This means you can convey occupancy to multiple devices or panel indicators. This isolation means you can connect these detectors to virtually any electronic device or signaling system without issues.

THIS IS A DCC ONLY DEVICE. It has not been tested with DC track power.

2. I/O Identification on the PCB

Key I/O connections are shown in the diagram below.



3. Features & Capabilities

Detects Locomotives and Rolling Stock on Two Blocks

Each detector PCB will monitor two separate DCC blocks.

Ultra Sensitive

Will reliably detect up to 47K Ohm resistors across rails. Specifically designed to detect rolling stock fixed with resistor wheel sets.

Proven Tuned-Coil Front End Design

The current detection coil circuit is tuned to DCC frequencies. It is then amplified with a precision rectifier circuit, then fed into a microprocessor for digital filtering.

Two Isolated Outputs per Block

Each block has two separate outputs. This allows one for input into signaling or LCC devices, and another for panel indicators.

Auto-Sense

No more manual adjustments needed for sensitivity! Simply press the SETUP button for 5 seconds, and the detector will measure the “empty” block to determine a baseline value. It then calculates a threshold value.

Can Manipulate Digital Filter Settings

By using an optional FT232RL serial connection, you can adjust all of the digital filter values ; Measurement group size, Acceptance group size, and Threshold Calculation percentage.

On-Board LEDs

Contains a green “Monitor” LED, plus a blue LED for each block indicating occupancy.

4. Power Requirements

- This device requires a DC power source. It does not take power from your track.

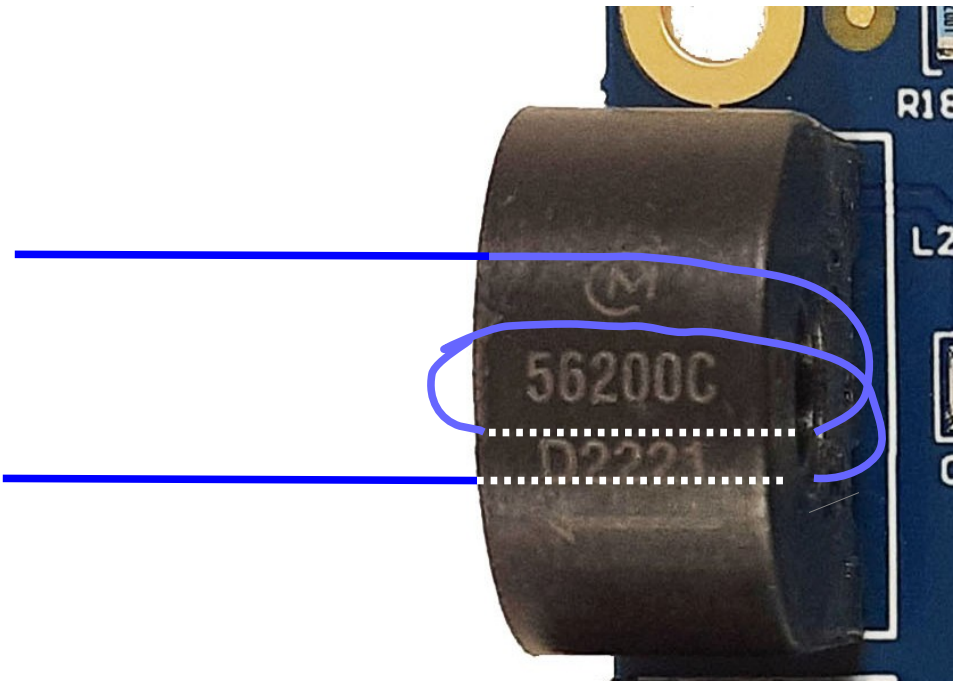
- Any DC voltage between 7 and 16V will work.

- Use Snowball Creeks Accessory Power Tap to get 8V or 12V from virtually any source, including AC, DC, or even DCC.

5. Input Connections

Loop the DCC feeder wire through the hole in the coil. A complete single loop is all that's needed.

That is through the center, around, and through the center one more time.



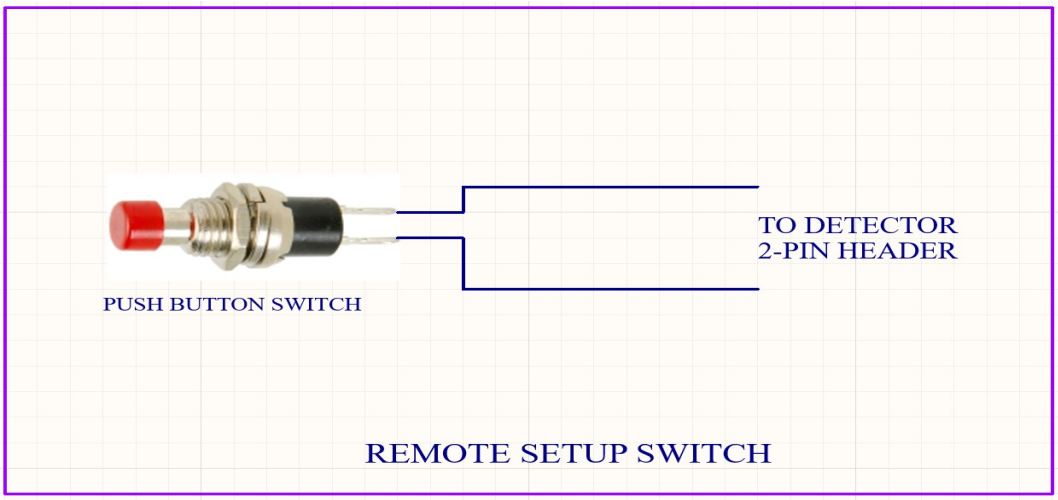
Only use 1 loop of feeder wire through the sensor coil !

5.1 OPTIONAL REMOTE SETUP SWITCH

If the detector is physically located in a difficult or out-of-reach location, It is easy to “move” the setup switch to your front panel, or anywhere you like, where it may be easier to operate.

To add a remote SETUP switch, you will need any type of momentary push button switch, and two wires of the proper length. In a pinch, really, any type of switch would do as long as you operate it in a momentary manner, eg: only ON for a few seconds when needed..

Simply connect the wires to your switch and connect the other end to the 2-pin jumper header on the detector PCB.

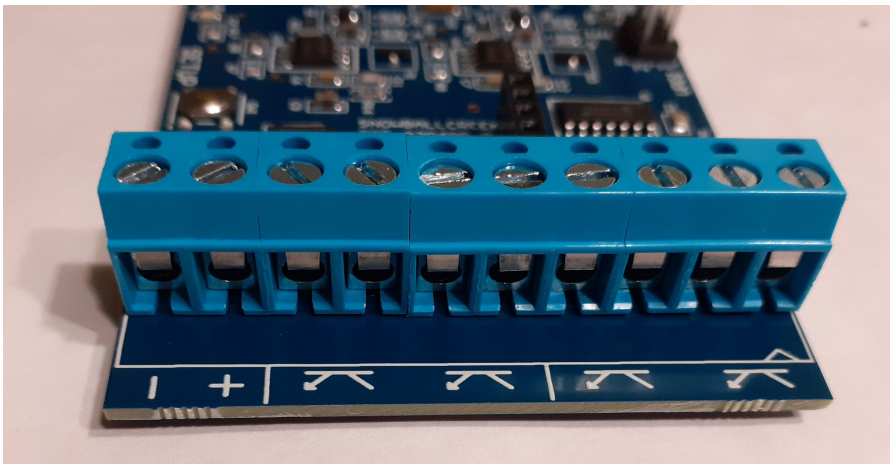


6. Output Connections

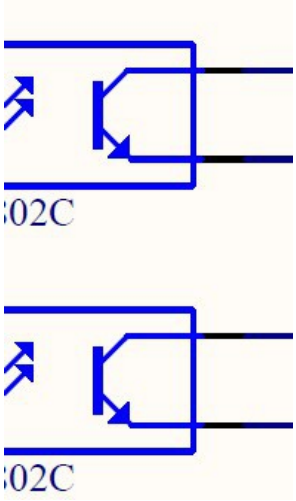
Each Block has two Open Collector transistor outputs. To use these as inputs to other devices, you will need 'pull-up' resistor of 1k to 10k from the output pin to a Positive voltage source. The other pin connects to Ground or negative of the power supply. Each output is identified by the transistor diagram on the PCB. The arrow side will go to ground/negative.

The output is negative logic. When outputs are ON (block occupied), the transistor shorts the output to ground, thus 0V is Occupied, and 5V (or whatever your supply voltage is) is Not Occupied).

When the transistor is OFF (not occupied) the resistor pulls the output pin up to the supply voltage.



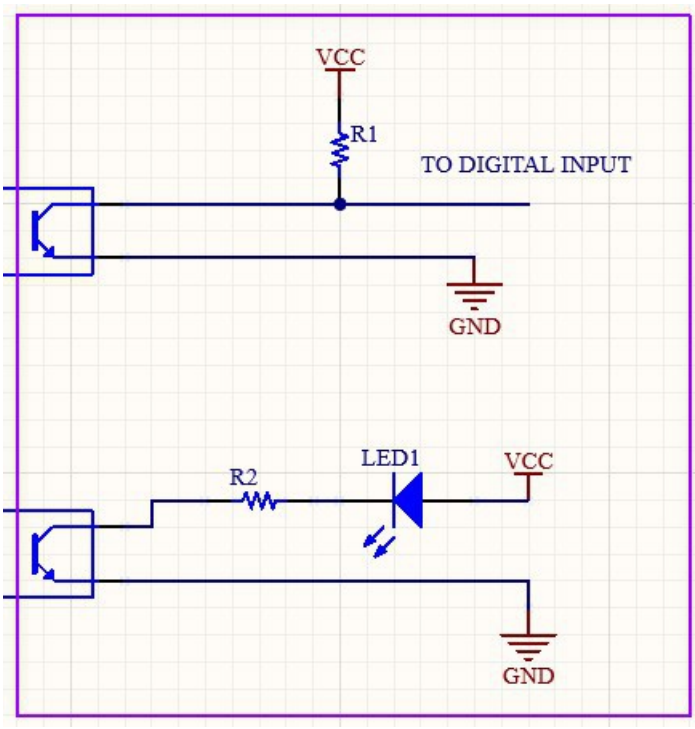
Physical Connections



Electrical Equivalent

7. Output Connection options

Each block has two isolated outputs. You can use them for what-ever purpose you desire, but typically one would go to an input to some digital device and one could be used separately for a panel indication. This scenario is shown below.



Use the top circuit to connect the detector output to any device digital input pin. R1 can be any value from 1K to 10K. VCC and GND shown are the power supply of the device, not the detector.

Use the bottom circuit to connect the detector output to a panel indicator. The diagram shows an LED but this could also be a small lamp. Do not exceed 30mA in your output circuit. VCC in this circuit could be any value up to 80VDC. Typical values are 5V or 12V.

8. Detector Installation

- Mount the detector board to a solid (and convenient) place in or under your layout. You will need to be able to press the SETUP button, and possibly plug in a serial module if you are going to alter the default detector parameters.

- Feed the block feeder wires through the sensor coils. **Only 1 loop is needed**[1]. One loop is defined as through the center-hole, around, and then through the hole again. The wire can then go out to the track. If you have multiple feed points in one block, separate the feeders AFTER going through the sensor coil.

- Because of the high sensitivity of this detector, it is a good idea to have the feeder wire tightly wound on the sensor coil. Use tape if desired, to hold the wires in place. For a permanent installation, even some silicone to hold the wires in place would be a good idea. Loose wiring may cause erratic behavior.

- Connect the outputs to your layout devices or panels. Refer to the section on output wiring for guidance for these connections.

- Connect a DC power source. This can be 7-16 VDC. Once it powers up, it will automatically go into auto-sense mode, but don't worry - you will be able to auto-sense at any time just by pressing the SETUP button.

- Optionally connect a remote push button switch to the 2-PIN header. This will place your REMOTE switch in parallel with the on-board SETUP switch, allowing you to perform the Threshold Reset Procedure by pressing the remote switch instead of the on-board switch. This is helpful if the detector is mounted in a hard-to-reach or remote location.

[1]Adding loops of wire will not improve detector sensitivity!

9. Detector Operation

Powering the Detector for the First Time

The first time unit is powered, the EEPROM contains no data. The MPU will load default values, and immediately execute the “auto-sense” process to determine block baseline and threshold values. Don't worry if you're not ready for this to happen yet, as you can re-learn these values at any time by pressing the SETUP switch.

Normal Power-Up Sequence

When powered on, the unit will read the EEPROM, load the threshold values and the block detection parameters. The green LED will illuminate, indicating the unit is in block monitor mode.

10. Threshold Reset Procedure

BE SURE BOTH BLOCKS HAVE NO LOCOMOTIVES OR ROLLING STOCK,

DCC Power must be ON! ***Blocks must be completely empty.***

If for any reason you wish to reset the thresholds, simply press the SETUP switch (or REMOTE if installed) until all LEDs light up (approximately 5 seconds). Release the switch and the unit will blink all LEDs for another 5 seconds, and then start the auto-sense process.

Each block LED will blink for approximately 5-8 seconds as the unit measures the empty block. It will then store the thresholds in memory and do the same procedure on the 2nd block. Once done, it will re-start and go into monitor mode (green LED on).

*Note: It is best to use a pencil (eraser-end) to press the switch. This ensures constant pressure on the switch. The switch is small and finger pressure may not be enough to keep it pressed for the duration of more than a few seconds. Any switch press of less than 5 seconds will be ignored.

11. How Does it Work?

Normal Operating Mode

When powered ON, the Micro Processor (MPU) reads each block threshold and goes into monitor mode. When the green LED is ON, the unit is monitoring blocks.

The MPU takes groups of DCC current measurements. Each measured value is compared to the threshold value. If a measurement is above the threshold, the “accept counter” is incremented. When the total number of measurements reaches the Group Size (default of 64), the accept counter is compared to the Acceptance Size (default of 5) criteria.

If acceptance count is greater than the Acceptance Size, the block is considered occupied and the outputs are turned ON and the LED is also turned ON.

The MPU then starts another group of measurements. All counters are reset to zero, and the process starts again.

If occupancy is lost, the outputs stay ON for another 1.5 seconds. During this time, the MPU continues to take groups of measurements. If occupancy is reestablished, the outputs stay ON. If the block continues to not be occupied, outputs are turned OFF after the 1.5 second delay. This helps with dirty track as resistor wheels traverse dirty patches of track.

The MPU takes approximately 1000 measurements per second.

Calculating Block Baseline Values

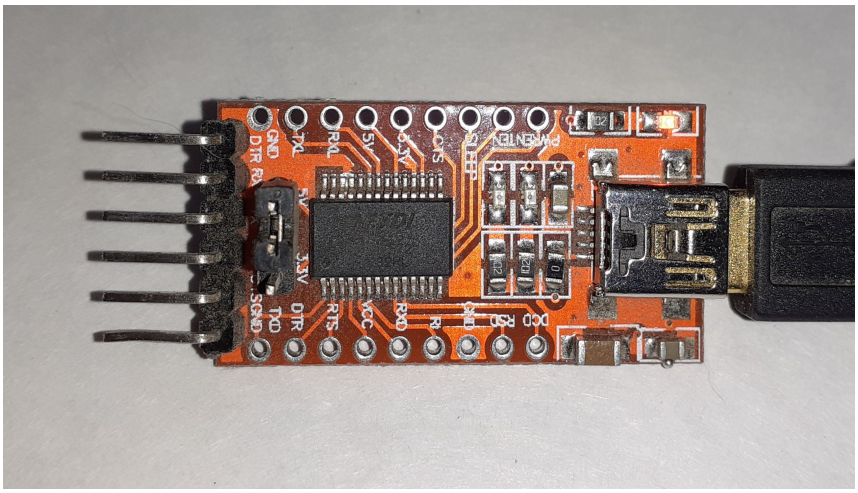
When you press SETUP, the unit auto-senses the baseline DCC track current for each block.

Each block is measured for approximately 8 seconds. *It is critical that the block be completely empty of rolling stock and locomotives.* These measurements are averaged and then multiplied by the Percent Increase value. This is by default 10%. The resulting value then becomes the Threshold Value for that block.

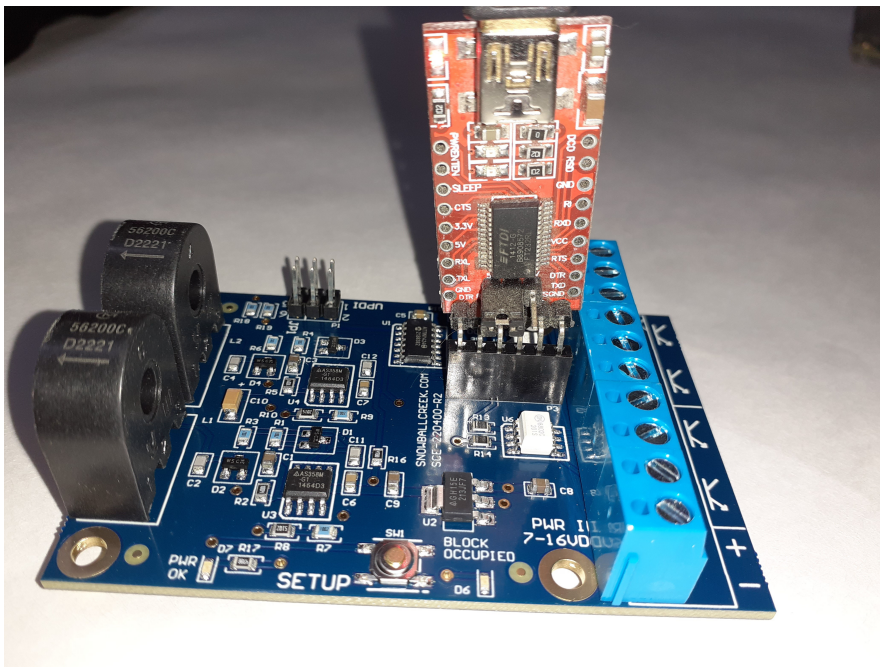
By using an optional FT232RL serial module, you are able to modify the Group Size, Acceptance Size, and Percent Increase values to fine tune the detector. However, the default values should work just fine for all situations.

12. Setup Mode using a FT232RL module

By using an FT232RL USB-Serial adapter, you have the ability to fine tune the detectors monitoring parameters.



FT232RL USB-Serial Adapter



FT232RL plugged into Detector P3. (make sure of correct polarity)

12.1 Entering Detector Utility Mode

Note:

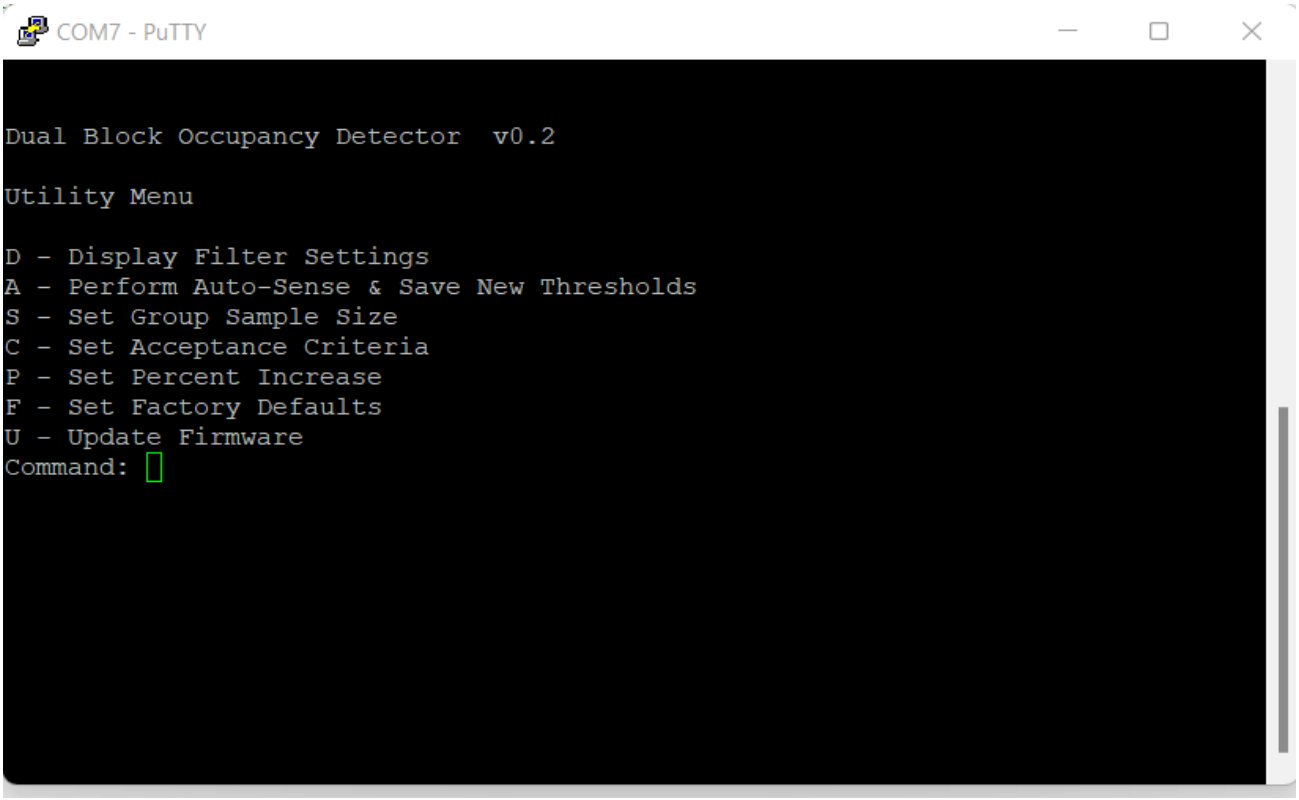
There cannot be an active 'occupied' output state, when plugging in the FT232RL module, or it may not be detected. The Ft232RL module will supply enough power for the detector to operate during this process.

Make sure the jumper on the FT232RL is set to 5V!

Being careful of polarity, plug in the FT232RL module into P3 (as shown in picture above). The detector will detect the module and start sending serial data. You may use any terminal program you like, as long as the settings are 9600 BAUD, 8N1.

If the detector is powered up with the module plugged in, it will immediately go into Utility Mode, and will not monitor blocks.

On your computer screen, terminal window, you will be presented with a simple menu where you can adjust settings and parameters, to fine-tune your detector. You also have the ability to perform a firmware update.



Utility Menu Options

Menu Options:

D Display current EEPROM settings

This will display all the relevant values for each block including, number of measurements in group, number of accepts per group, and the percentage increase from baseline for threshold calculation. It also displays the current values for baseline and threshold.

Note: The Baseline value and calculated threshold value (displayed as mV), have more decimal digits than what is displayed. Thus the baseline and threshold values might appear to be equal (eg. 8mV) when displayed, but internally they are different values.

A Perform Auto-Sense

This will execute the auto-sense process for both blocks and store updated baseline and threshold values into EEPROM.

S Set Group Sample Size

This will set the measurement group size. Each occupied decision is based on a window of measurements. This is the Group Sample Size. Valid values are 5-255.

C Acceptance Criteria

This is the number of measurements that pass the threshold test. Value can be between 5-255, and must be equal or less than the group sample size.

P Percent Increase

This is used in the calculation of thresholds. The detector takes the average baseline value, taken on an empty block, and adds this percentage to determine the threshold.

F Factory Defaults

This will reset all parameters to factory default values, and clears the baseline and threshold values.

Group Sample Size	64
Acceptance Criteria	05
Percent Increase	10 %

U Update Firmware

This will cause the unit to wait for a firmware update. Refer to the Firmware Update procedure for details. *There are currently NO Firmware Updates available!*

13. ELECTRICAL SPECIFICATIONS

Power Requirements	7 to 16 VDC
Current Consumption (Nom)	12mA (Monitor mode)
Current Consumption (Max)	25mA (w/ all outputs ON)
Maximum Input DCC Current	10 Amps
Output Current	30 mA Max / channel
Output Voltage	80 VDC max (Collector to Emitter Volts)
Sensivity*	47K Ohms

*Sensitivity is defined as the highest value resistor that will provide a stable detection state.