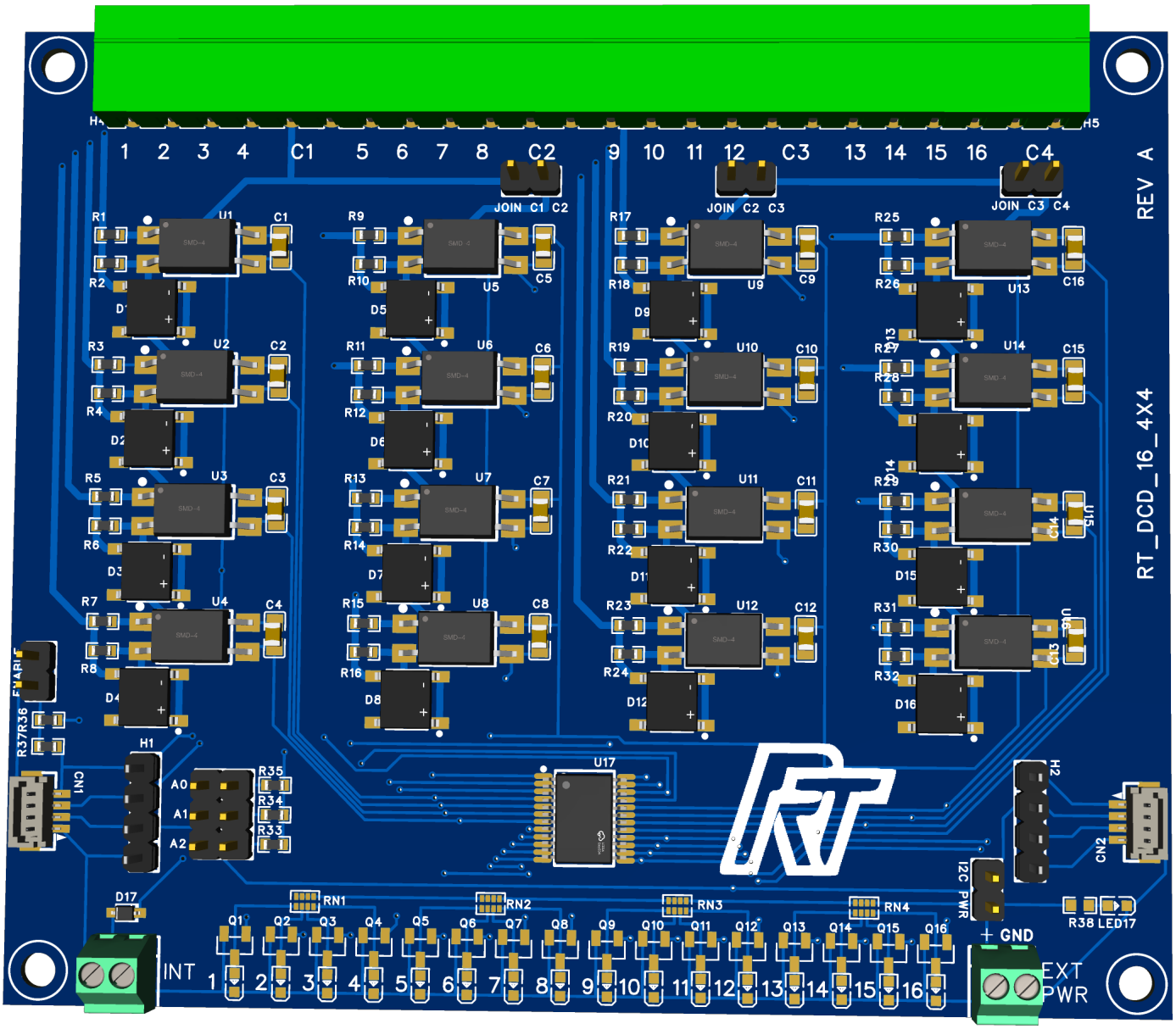
Model Railroad DCC Block Detector.

This is board is a DCC block detection sensor.

This document describes the operation of the board.



In use.

The board can be set up in various configurations.

There are a total of 16 block detection channels.

These can be configured as:

4 4 4 4
4 8 4
4 4 8
8 4 4
4 12
12 4
8 8
16

Depending on your command station type this gives multiple means of detecting trains in blocks.

This manual describes connecting to a DCC-EX CSB1 with or without DCC-EX EX8874 motor driver shield or a Arduino Mega with one or two EX8874 motor shield(s).

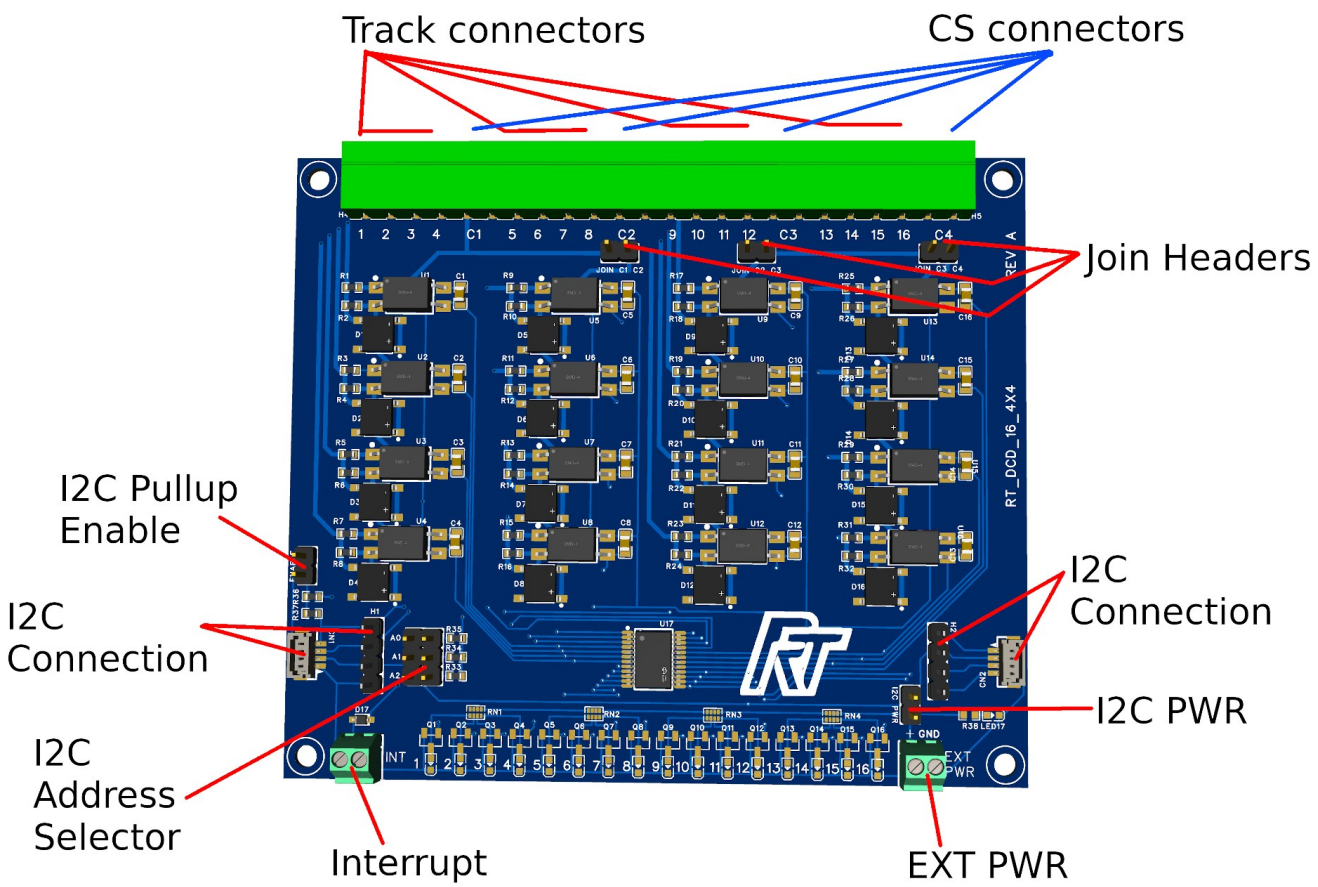
Block detection relies on having isolated sections of track with different feeds to one rail of the track.

This board connects to the CS via I2C. It is recommended that you keep the I2C cabling as short as possible and away from other cabling eg. track feeds.

There are 8 I2C addresses available giving the upto 128 block detection sections. Using I2C multiplexers this can be increased to 1024 blocks.

Each block can have a maximum current of 2A. As it's intended that only one train would be in one block then this is more than sufficient for most operations.

It is also possible to use the board as a point sensor similar to an IR sensor.



Board Layout

Connection to the layout.

How you connect to your layout is really dependent on your setup.

This is a how to connect to a DCC-EX CSB1 command station.

With all power off.

Connect the I2C cable between the CS and RT_DCD_16. The board comes with an appropriate Qwiic cable so plug one end of the cable into the CS socket and the other into the socket on the RT_DCD_16.

The RT_DCD_16 will operate from either 3.3V or 5V DC on the I2C connections.

The simplest connection is to use the RT_DCD_16 as a 16 channel board.

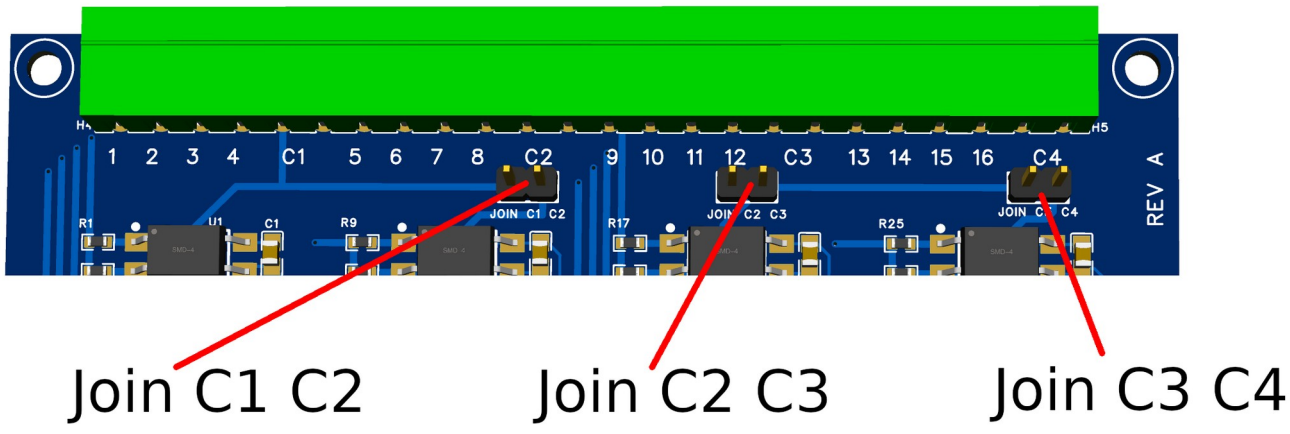
Place the jumpers to close the headers on "Join C1 C2", "Join C2 C3" and "Join C3 C4" if not already in place.

One wire from the command station track output will then go to C1, C2, C3 or C4 whichever is suits your setup best.

The other wire from the command station track output will go to one rail of your track.

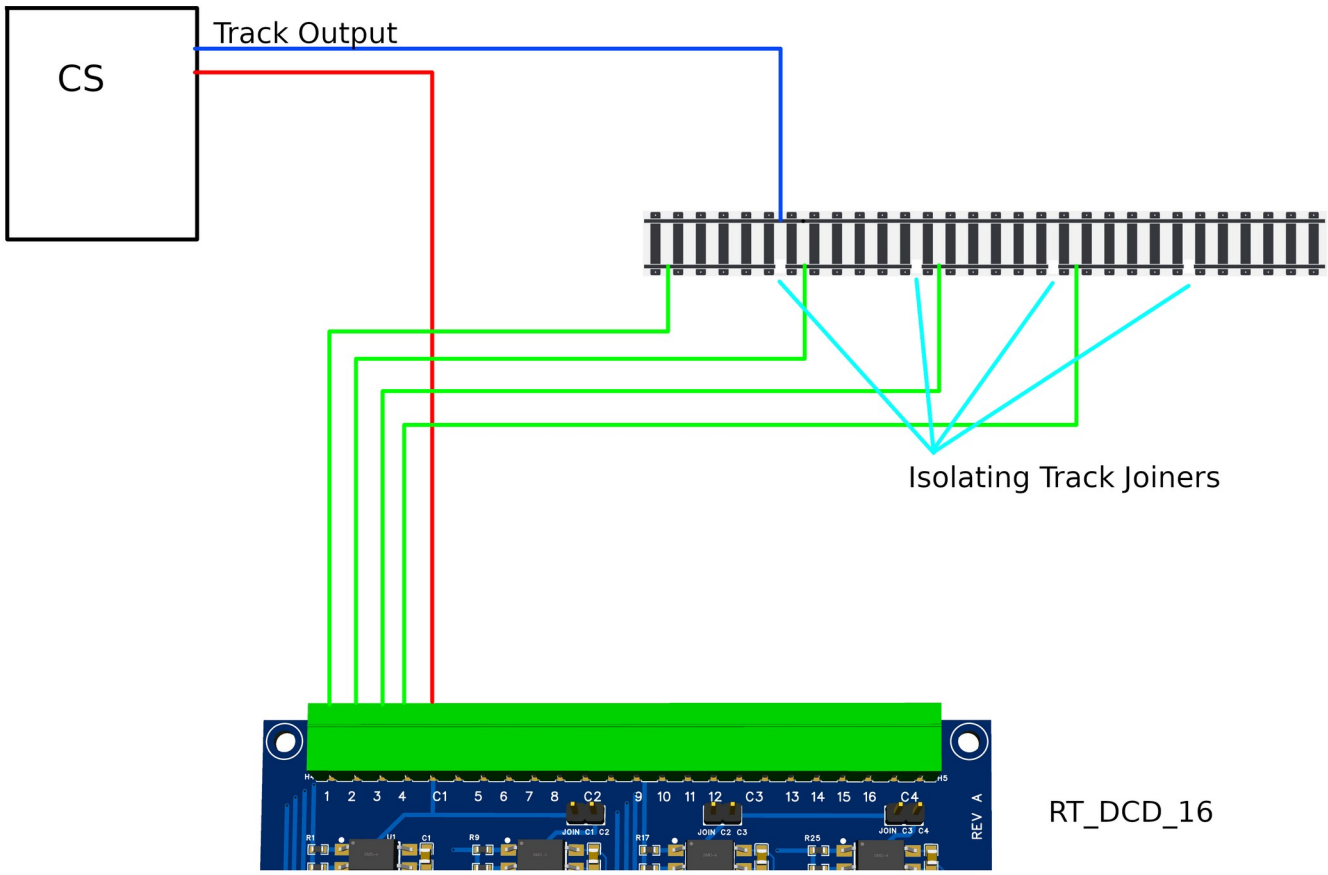
If you are using 2 or more of these boards then you will need to provide external power for the leds.

This can be either a 3.3V or 5V DC supply to the Ext Pwr input or by using an i2c isolator between the command station and the RT_DCD_16 with a separate power supply for the isolated side of the i2c buss.



Then each channel (1 - 16) is wired to an isolated rail section. In the diagram below only 4 channels are show for simplicity.

For reversing sections see page 9.



Different configurations.

Depending on your CS and requirements the RT_DCD_16 can be set for multiple channels and multiple CS track outputs.

Channels	Join C1 C2	Join C2 C3	Join C3 C4
4 4 4 4			
4 4 8			X
4 8 4		X	
8 4 4	X		
4 12		X	X
12 4	X	X	
8 8	X		X
16	X	X	X

X = jumper on.

This table shows the jumper requirements for each configuration.

C1, C2, C3 and C4 are the feed from the track output of you CS.

A command station with four track outputs can be set to any of the configurations in the table above.

A command station with two track outputs can be set to 4 12, 12 4, 8 8 or 16 blocks as above. It can also be used with a 4 4 configuration via any two of C1, C2, C3 and C4.

Default Configuration

The board is delivered configured for 16 channels, I2C pullups enabled and I2C power to leds.

Setup in DCC-EX myAutomation.h

In myAutomation.h add the following line for each RT_DCD_16 board you use:

HAL(PCA9555, 164, 16, 0x20)

If you have a I2C multiplexor then use:

HAL(PCA9555, 164, 16, {I2CMux_0, SubBus_0, 0x20})

you will need to adjust the I2CMux_ and SubBus_ as appropriate. See:

https://dcc-ex.com/reference/hardware/i2c-multiplexers.html#gsc.tab=0

This defines a PCA9555 at vpin 164, with 16 inputs and I2C address of 0x20 (default).

If you have other MCP23017 or PCA9555 devices then you need to adjust the vpin and I2C addresses as required.

If there are no other MCP23017 devices then you may want to include HAL_IGNORE_DEFAULTS as well. This will also remove PCA9685 default devices. See:

https://dcc-ex.com/exrail/exrail-command-reference.html#create-and-manage-hal-device-objects

Once this is in myAutomation.h you can use any of the sensor commands within EX-RAIL. See:

https://dcc-ex.com/exrail/exrail-command-reference.html#sensors-inputs-reading-and-responding

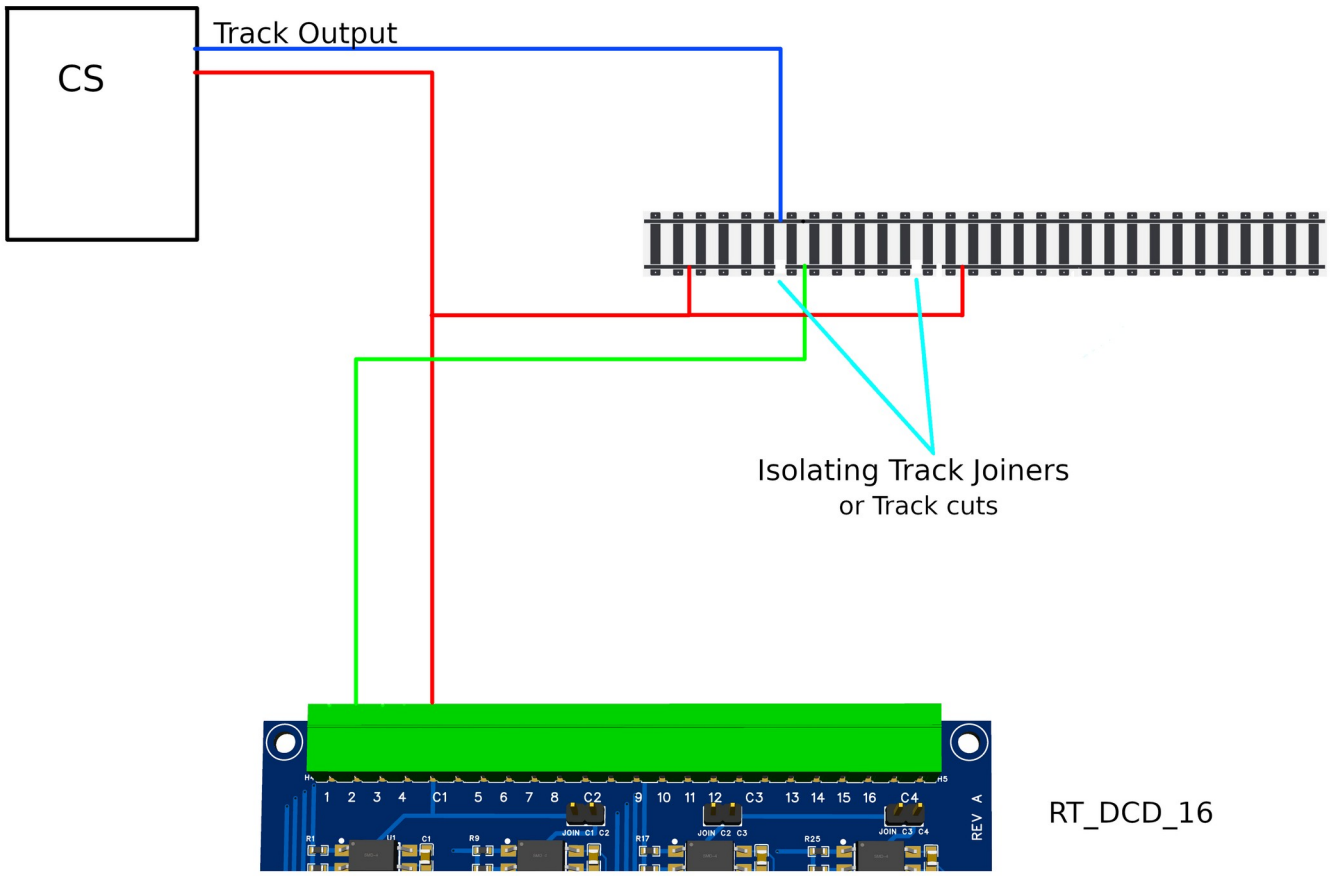
For example to define all 16 channels as JMRI sensors:

```
JMRI_SENSOR(164,16)
```

Using as a point sensor.

This is simply a matter of using a small piece of isolated track.

The isolated track is placed as you would for an IR sensor or similar.

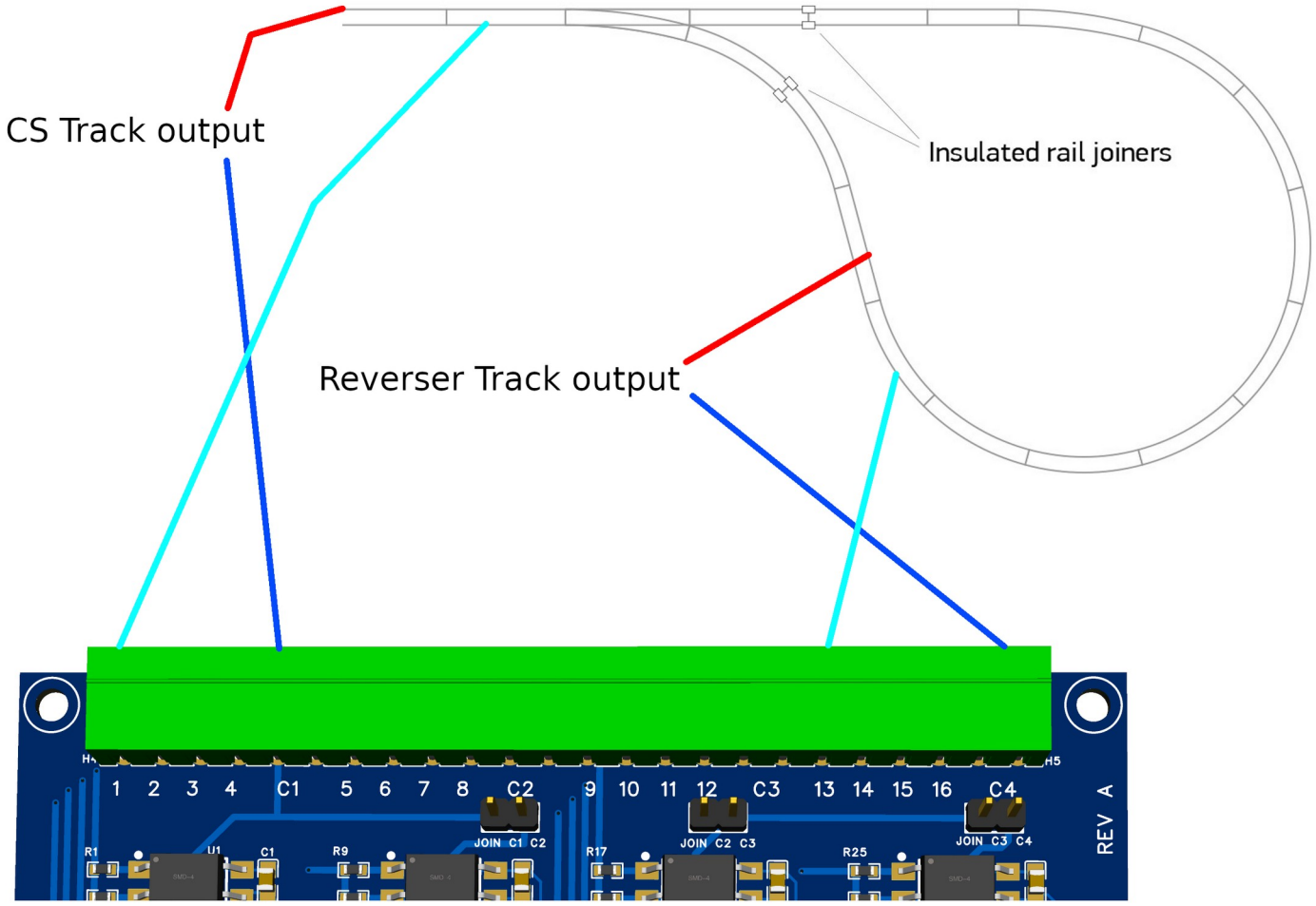


How you make the isolation section will depend on your track type and where you want to place it.

Easiest method is to use a small (1/4, 1/2) straight or curve section of track and use insulated track joiners.

Alternatively the section of rail can be cut to isolate it from the rest of the rail on that side and then a wire soldered to the outside of the rail to connect to the RT_DCD_16.

Reversing sections/loops



Wiring for reversing loops/sections is possible on the one board.

The diagram above shows how to connect using two sections of the RT_DCD_16.

One Cx is connected to the command station track output and then from the RT_DCD_16 to one rail of the main line.

One Cx is connected to the reversing unit track output and then from the RT_DCD_16 to one rail of the reversing section.

The other track outputs from the command station or reversing unit is the connected to the other rail as applicable.

So long as the two commons are not connected together the RT_DCD_16 can be configured as 4-4-4-4, 8-8, 12-4, 4-12 or 8-8.

Connector Reference

A0, **A1**, **A2** - I2C address selector

I2C Addess	A0	A1	A2
0x20			
0x21	X		
0x22		X	
0x23	X	X	
0x24			X
0x25	X		X
0x26		X	X
0x27	X	X	X

X = Jumper on.

CN1, CN2 - Qwiic I2C connection.

H1, H2 - I2C connector with this pinout.

Pin	Function
1	GND
2	VCC
3	SDA
4	SCL

ENABLE - I2C pullup resistors enable. When jumper is on then the pullups are enabled.

INT - interrupt signal to command station. Can be daisy chained to other boards. NOTE this is generally not required.

EXT PWR - External power for the indicator leds, maximum 5VDC. Note the polarity there is no polarity protection. This is needed if you are using two or more boards as most command stations can not provide enough power via i2c for the leds.

I2C PWR - Power for the leds from the I2C connection.

NOTE - Do not connect both EXT PWR and I2C PWR. Use one or the other.

C1, C2, C3, C4 - track output from command station

1, 2, 3, 4 - to isolated track block. Associated with C1

5, 6, 7, 8 - to isolated track block. Associated with C2

9, 10, 11, 12 - to isolated track block. Associated with C3

13, 14, 15, 16 - to isolated track block. Associated with C4

Join C1 C2 - Header to join common C1 and C2
Join C2 C3 - Header to join common C2 and C3
Join C3 C4 - Header to join common C3 and C4

Addendum

References.

DCC-EX EX-RAIL command reference:

https://dcc-ex.com/exrail/exrail-command-reference.html#gsc.tab=0

DCC-EX Discord channel

https://discord.com/channels/713189617066836079/

Gateway NMRA article, fairly old but basics are the same.

https://www.gatewaynmra.org/1997/easy-block-detection-2-color-signals-detection-systems-circuits/