

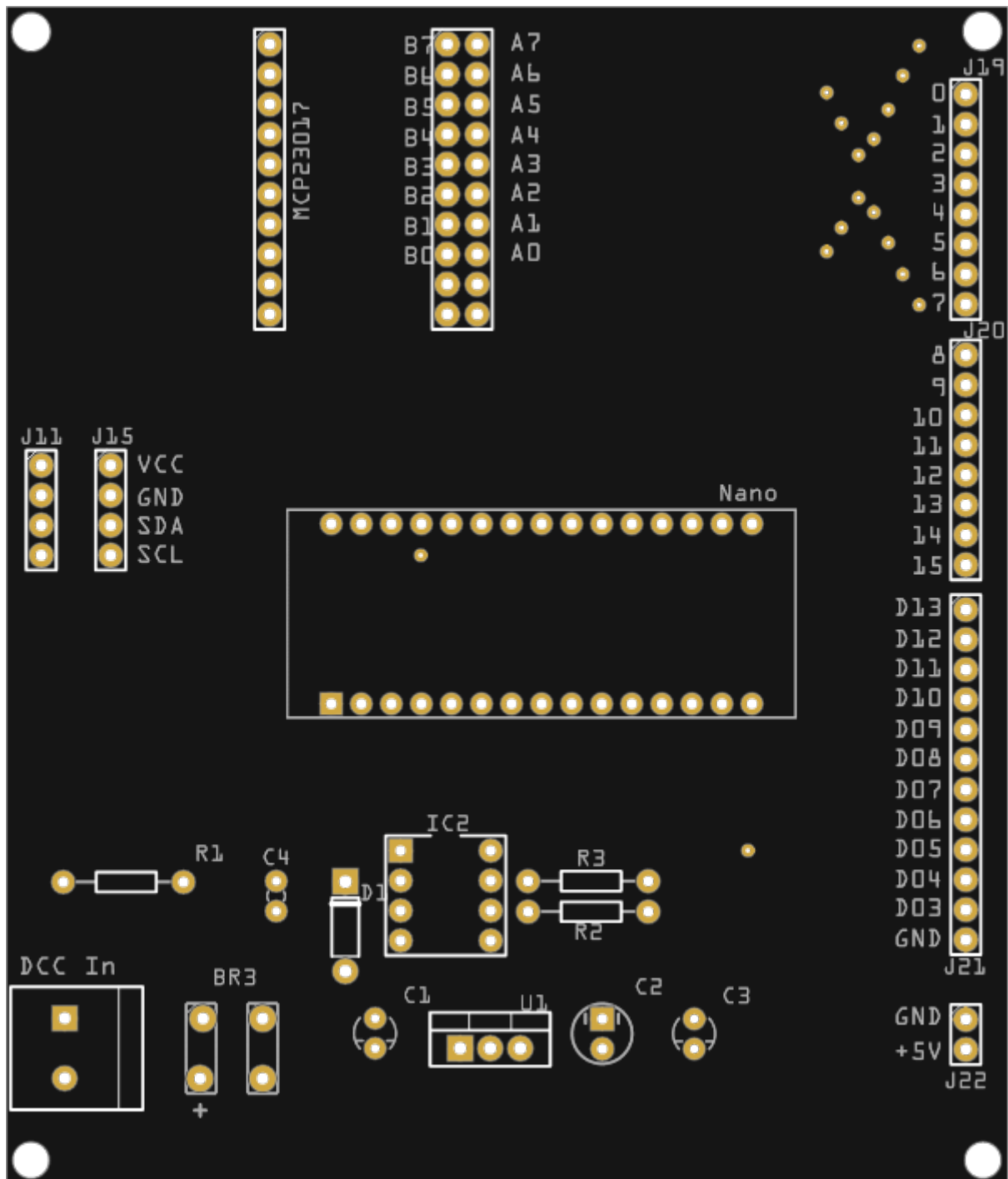
Model Railroad DCC stationary decoder.

Pcb 4x4DCCTD4

This is a DCC stationary decoder for use on model railroads at all scales with any DCC command station.

It is was originally developed to control eight (8) dual solenoid turnouts.

However it can be used to control up to twenty seven (27) items.



Bill of Materials

1	PCB	
	pcbway.com/project/shareproject/DCC_Turnout_Decoder_2288d9b4.html	
1	MCP23017 I2C Serial Interface - 16 bit I/O Expander Module	
	ebay.com.au/itm/265734933121	
1	Arduino Nano	
	store-usa.arduino.cc/products/arduino-nano	
1	2W10 Bridge Rectifier 1000V 2A	
1	7805 Voltage Regulator - 5V TO220	
1	6N137	opto isolator
2	Tantalum Capacitor	voltage 20V; capacitance 1 μ F
1	Electrolytic Capacitor	voltage 20V; capacitance 22 μ F
1	Ceramic Capacitor	voltage 6.3V; capacitance 100nF
1	Rectifier Diode	1N4001
1	1k Ω Resistor	resistance 1k Ω 0.5w
2	10k Ω Resistor	resistance 10k Ω ; 0.25w
1	Screw terminal - 2 pins	0.2in (5.08mm)
1	Generic double row female header - 20 pins	
1	Generic female header - 10 pins	
2	Generic male or female header - 4 pins	**
1	Generic female header 0.1in (2.54mm) - 2 pins	*
2	Generic female header 0.1in (2.54mm) - 8 pins	*
1	Generic female header 0.1in (2.54mm) - 12 pins	*

* these can be screw terminals if preferred.

** male or female depending on whether or not using stacking with driver board (see construction details). Outer could be screw terminal if required.

As with most pcb construction start with soldering in the lowest profile items first, eg resistors, diodes, leds, etc.

The diagram illustrates the hardware setup for a DCC locomotive control system using a Raspberry Pi Zero W. Key components and their connections include:

- DCC In Module:** Provides input to the system.
- BR3 Relay:** Controls the DCC signal path.
- DCC Decoder (IC2):** Receives digital commands from the Nano and outputs analog DCC signals to the locomotive.
- Nano Microcontroller:** The central processing unit, connected to the MCP23017 and the DCC decoder via I2C/SPI.
- MCP23017 I/O Expander:** Extends the GPIO capabilities of the Nano, providing additional digital inputs and outputs.
- Connectors:** J11, J15, J19, J20, J21, and J22 are used for external connections and power distribution.
- Power Management:** Includes a +5V rail and various capacitors (C1-C4) for stable power supply.
- Resistors:** R1, R2, and R3 are used for current limiting and pull-up/pull-down functions.

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Recommended soldering order:

Done

R1 1K Ω
R2 10K Ω
R3 10K Ω

D1 1N4001 Diode

C1 1uF Tantalum capacitor
C2 22uF Electrolytic capacitor
C3 1uF Tantalum capacitor
C4 100nf Ceramic capacitor

BR3 2W10 Bridge rectifier

IC2 6N137 Optoisolator

U1 7805 Voltage regulator

The following will depend on your requirements

J11
J15

J19
J20
J21
J22

Female headers for the MCP23017

Female or male headers for the Arduino Nano depending on mounting above or below the pcb.

Insert the Arduino Nano into the headers. **NOTE** orientation.

Insert the MCP23017 module into the headers. **NOTE** orientation however it really can only go in one way.

Other information.

J11 header can be screw terminal if desired.

J19, J20, J21 and J22 headers can be screw terminals if desired.

Stacking this board with the 4x4CDUP4 board

Then it is recommended to use female headers for J11, J15 and the MCP23017. On the 4x4CDUP4 board then use long pin female headers for the same locations and they are then inserted into the same location on this board.

It is recommended to mount the Ariuno Nano on the underside of this board in this case. Us female headers soldered to the top of the Arduino Nano and male headers soldered to the underside of this board for connection.

In use.

The firmware on github:

<https://github.com/Rosscoetrain/DCC-Turnout-Decoder>

Is a basic turnout decoder for 8 dual solenoid turnouts. It currently needs to be uploaded twice to the Arduino Nano to ensure the eeprom on the board is setup correctly.

Open the firmware in the Arduino IDE.

The first time that it is uploaded the commented line (line 4)

```
3    // uncomment this for first run to initialize eeprom
4    //#define FIRSTRUN
```

needs to be uncommented.

```
4    #define FIRSTRUN
```

This will initialize the eeprom

After this has completed uploading in the Arduino IDE Serial monitor type the command

<>

You will then see a response like this:

```
17:40:32.025 -> CVs are:
17:40:32.025 -> CV1 = 3
17:40:32.025 -> CV7 = 1
17:40:32.025 -> CV8 = 13
```

Comment out the 4th line again:

```
4    //#define FIRSTRUN
```

upload the firmware again to the Arduino Nano and rerun the above command in the serial monitor. The result should be the same.

Serial Commands

Several commands are available via the serial monitor for configuring or displaying information on the decoder.

<?>	Show available commands
<>	Show current Control Variables
<W 1 address>	Change decoder address
<C address subaddress>	Close a turnout
<T address subaddress>	Throw a turnout

The address is the decoder address to use within the DCC command station. The address and address + 1 is how you control your turnouts.

subaddress is the turnout number (0 - 3) within the DCC address.

The default address is 3, you need to change this if using more than one decoder (mobile or stationary) on your layout.

Once the address is set (eg 10), this address and the address + 1 are the addresses you use to control your turnouts.

Some examples using the serial monitor are:

<C 10 0>
<C 11 3>

How you add them to your DCC Command Station will depend on the command station. In most cases you will need to use the address and subaddress within the Command Station.

Other Uses

Future versions of the firmware will provide:

automatic determination if it is first startup and therefore initialization of the eeprom.

ability to set solenoid pulse length or turn it off.

lighting effects.

animation effects.

References.

4x4DCCTD4 pcb on PCBway

https://www.pcbway.com/project/shareproject/DCC_Turnout_Decoder_2288d9b4.html

MCP23017 I2C Serial Interface - 16 bit I/O Expander Module example

<https://ebay.com.au/itm/265734933121>

<https://www.aliexpress.com/item/32865063393.html>