# DCC Decoder

This project implements a full wireless receiver and DCC decoder. It can directly drive a DC motor and up to 7 function outputs. The current version drives 7 outputs from DCC functions, as described in the table below. One input is reserved for an alternative radio frequency to be selected.

One of the outputs can be used as an input for a sensor such as a reed switch or Hall Effect transistor. The sensor allows for 'automatic' operation when magnets are placed in the track to trigger the sensor: a single magnet will stop the locomotive and delay for 20 seconds, while two magnets will stop, delay and reverse direction. The automatic mode is turned on and off with DCC function F5.

The decoder will automatically slow down and stop the locomotive if no wireless input is received for 4 seconds. After 30 seconds all the outputs will be turned off to save power. The decoder will completely shut down if no radio packets are received in 4 minutes, entering a very low power mode with the radio turned off. This mode can also be triggered with DCC Function 6. Packets can’t be received in this state. Toggle the sensor or alt radio input to start up the decoder, or simply power off and on again.

The default mapping of DCC functions to features is shown in the table, but these may be easily changed by modifying the constants at the start of the file. Set the appropriate byte to a value 0-12 to map the corresponding DCC function. The memory layout is as follows:

@1040  
03 00 02 04 00 01 02 FF 05 06 08 09 0C

* 1040 & 1041: loco address, default 3 (03 00)
* 1042: primary radio channel, default 2
* 1043: secondary radio channel, default 4
* 1044: DCC Function to turn on/off forward & reverse lights, default 0
* 1045: DCC Function for bell, default 1
* 1046: DCC Function for horn, default 2
* 1047: DCC Function for extra output, default FF turns off and enables sensor input
* 1048: DCC Function for automatic mode, default 5
* 1049: DCC Function for shutdown, default 6
* 104A: DCC Function for mute sound, default 8
* 104B: DCC Function for heavy load, default 9
* 104C: DCC Function for cab light, default 12 (0C)

A suggested hardware layout is shown on the accompanying png file. This includes an array of 7 Darlington transistors to drive outputs. Note the Darlington chip is mounted underneath the board, to allow room for the connectors on the top side.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DCC** | **Purpose** | **Internal** | **Port** | **MSP Pin** | **Connector** | **Out** | **Out Conn** | **Res.** |
| F0 | Lights on/off (fwd & rev lights) | Y |  |  |  |  |  |  |
| F1 | Bell |  | P2.1 | 9 | J1-9 | 3 | OUT123 |  |
| F2 | Horn/Whistle |  | P2.2 | 10 | J1-10 | 2 | OUT123 |  |
| F3 | \*Extra output (alt. to Sensor) |  | P2.3 | 11 | J2-10 | 1 | SENSOR |  |
| F4 | Unused |  |  |  |  |  |  |  |
| F5 | Automatic mode | Y |  |  |  |  |  |  |
| F6 | Shutdown | Y |  |  |  |  |  |  |
| F7 | Unused |  |  |  |  |  |  |  |
| F8 | Audio Mute on/off |  | P1.2 | 4 | J1-4 | 7 | OUT7 |  |
| F9 | Heavy load on/off | Y |  |  |  |  |  |  |
| F10 | Unused |  |  |  |  |  |  |  |
| F11 | Unused |  |  |  |  |  |  |  |
| F12 | Cab lights on/off |  | P2.0 | 8 | J1-8 | 4 | LED4 | Y |
|  |  |  |  |  |  |  |  |  |
|  | Forward light |  | P1.3 | 5 | J1-5 | 6 | LED6 | Y |
|  | Reverse light |  | P1.4 | 6 | J1-6 | 5 | LED5 | Y |
|  | \*Sensor (alt. to Extra Output) |  | P2.3 | 11 | J2-10 |  | SENSOR |  |
|  |  |  |  |  |  |  |  |  |
|  | Motor A |  | P2.4 | 12 | J2-9 | M1 | MOTOR |  |
|  | Motor B |  | P2.5 | 13 | J2-8 | M2 | MOTOR |  |
|  | Alt radio channel |  | P2.6 | 19 | J2-2 |  | JMPR |  |
|  |  |  |  |  |  |  |  |  |
|  | VCC (3.3V) |  |  | 1 | J1-1 |  |  |  |
|  | Radio: GDO2 (& LED) |  | P1.0 | 2 | J1-2 |  |  |  |
|  | Radio: GDO0 |  | P1.1 | 3 | J1-3 |  |  |  |
|  | Radio: SCLK |  | P1.5 | 7 | J1-7 |  |  |  |
|  | Radio: I2C |  | P1.6 | 14 | J2-7 |  |  |  |
|  | Radio: I2C |  | P1.7 | 15 | J2-6 |  |  |  |
|  | RST |  |  | 16 | J2-5 |  |  |  |
|  | TEST |  |  | 17 | J2-4 |  |  |  |
|  | Radio: CSN |  | P2.7 | 18 | J2-3 |  |  |  |
|  | GND |  |  | 20 | J2-1 |  |  |  |