Model Electronic Railway Group

TECHNICAL BULLETIN DCC11/13

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MERG DCC Pulsed Output Accessory Decoder (Version 2B)

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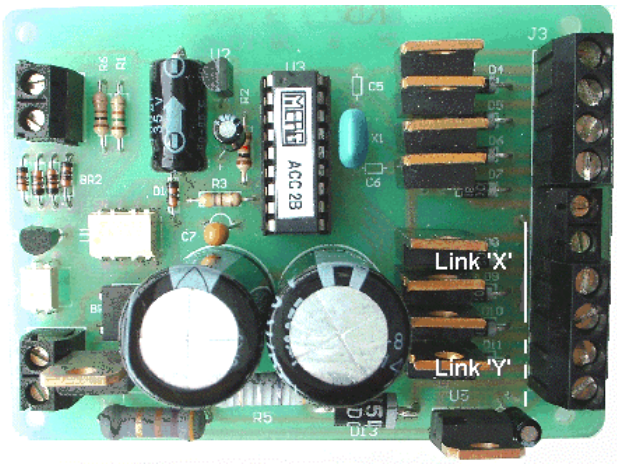
DCC in
Terminal Block [J2]

AC Input
Terminal Block [J1]
15-20V AC



Output Connector [J3]

1N)	Function 1
1R)	Output
Common for	F1 & F2
2N)	Function 2
2R)	Output
3N)	Function 3
3R)	Output
Common or	F3 & F4
4N)	Function 4
4R)	Output

Fig.1 The assembled MERG DCC Pulsed Output Accessory Decoder and its connections

This Technical Bulletin (TB) is based on information provided by Mike Bolton [M786], the designer of the MERG DCC system. Modifications at issue 2 by Edwin Marks [M1876]: more information on use with Lenz systems and various clarifications.

Statements made regarding Lenz command stations are based on experience with a LH100 with software version 30 and LZV100 with version 35 (both purchased April 2005). It is expected that other Lenz equipment such as the LH90 will operate similarly. However, the Lenz Compact is different in a number of ways including how CVs are set, and at least one user has needed a 1K resistor across J2 during programming so the Compact will recognise the decoder.

Introduction

The **Pulsed Output Accessory Decoder** of the MERG DCC Accessory System is designed for driving four twin coil solenoid-type point (turnout) motors that require only a brief pulse of current - but see Output Options overleaf. It has an on-board Capacitor Discharge Unit (CDU) that provides a high-energy output pulse with a programmable pulse duration. Its hardware and software can also be configured to deliver steady currents.

While it is specifically designed for 'stand-alone' operation in conjunction with the MERG DCC Accessory Encoder (see TB DCC11/12), it is also designed to conform to the NMRA DCC specification and so may if desired be operated by a 'conventional' DCC accessory command picked up from a DCC track feed/bus.

However, it does not take its power from the track and needs a separate 15-20V AC, 50/60 Hz supply for both programming and operation.

With the CDU requiring only a brief recharging current, a number of these Decoders can be run off a single low voltage transformer - how many must depend on the demands of both the Decoder outputs (some point motors draw heavier currents than others) and any other modules etc that draw current from the same source.

Technical Description

The circuit diagram of the Decoder is on page 5. (Note: MERG kits are now supplied with 16F628A PICs)

The DCC signal input drives an opto-isolator U1, which electrically isolates both the track and the AC power. The MERG DCC Accessory Encoder provides 12 to 15V for the signal. R1 sets the opto-diode current. It is suitable for any input voltage from around 10 to 25V and as stated above this input may be taken from the track. Isolated acknowledgement (ACK) is provided through U4 and the switched load R6.

A PIC microcontroller decodes the DCC information and drives the 8 MOSFET power switches Q2 to Q9. A low-power regulator U2 provides the 5V DC supply for the PIC. The PIC microcontroller is a 16F627 or 16F628(A) running at 8 MHz, and although supplied pre-programmed, the Source code *ACC4.ASM* may be downloaded from the DCC Resources page of the MERG website.

The CDU circuit is of the conventional rapid recharge type but with current limiting so the transformer is not excessively loaded. The same transformer can power other devices (lighting etc) without the flicker apparent with non-limited CDUs. The storage capacitors C3 and C4 have a high total capacity (4400µF), and with a supply of 15V AC will drive at least two 'PECO' motors simultaneously. Protection (flywheel) diodes for the solenoid coils are included on the PCB.

[Cont. over >>>]

Output Options

A link can be soldered to the PCB (Printed Circuit Board) either as Link 'X' or Link 'Y' (see Fig. 1 and the circuit diagram on page 5).

With Link 'X' in, both the common outputs (terminals 3 and 8 on J4) are connected to the CDU and so all four outputs should be used for solenoid point motors.

With Link 'Y' in, common terminal 3 on J4 is connected to the CDU and common terminal 8 is connected to an on-board fixed 12V DC supply. As the decoder outputs may be programmed to be permanently on, this 12V DC allows functions not requiring the CDU to be run from the same decoder as the points. So for example, output pairs F1 and F2 can drive two solenoid point motors, with F3 and/or F4 pair(s) powering the corresponding signal arms or aspects. [Note that it may be necessary to remove the flywheel diodes on DC outputs connected to lights to prevent the lights flashing when a point is operated.] With Link 'Y' in, it is also possible to have all four outputs as CDU by connecting all four common wires to terminal 3, or to have all four outputs as 12V by connecting all four common wires to terminal 8, thus allowing flexibility when layout changes are made.

Other possibilities will occur to users. For example, a relay could be connected to one or more outputs to expand the available control 'at site'. TB CC1/22, although drafted with reference to ZERO-1 Accessory Decoders, is equally applicable to its worthy successor, the DCC Accessory Decoder. 'Solid state' alternatives may be found in the 'Files' area of the MERG e-group.

Programming the Pulsed Output Accessory Decoder

The decoder is currently supplied with the ACC4 PIC, and therefore does not support the dual address mode implemented in ACC5. If this mode is required in a pulsed decoder, substitute ACC5 and consult DCC11/14 for configuration. A future PIC may include dual address mode in both decoders, but switch it off by default.

Configuration Variables (CVs) can be written (programmed) and read back in 'page' or 'direct' modes. The direct mode has full bit manipulation for both read and write, and this greatly speeds up reading CVs with programmers that use 'bit verify'. The MERG Stand-alone DCC Programmer (see TB DCC11/5) is of course the recommended choice, but any DCC Command Station with programming capability should be suitable (with the decoder connected to the programming track).

Configuration Variable Summary

The MERG Accessory Decoder follows the NMRA Standards & Recommended Practices (RPs) for accessory decoders with CVs starting at 513. However, many commercial DCC systems do not allow the writing of CVs above 255 and so alternate (or 'low range') CVs starting at 1 can also be used. The CVs that are available on the Accessory Decoder are set out in Table 1.

CV	CV	Register	Description	Comments
513	1	1	Low 6 bits of Accessory Decoder address in range 0 – 63	Default as supplied = 1
514	2	-	Output enable: 1 = 'On', 0 = 'Off' for each of the 8 outputs	Default as supplied is 'all enabled' = 255 (11111111 Binary)
515	3	2	'On' time for output pair F1 (0-255)	Default as supplied = 5 (50 milliseconds)
516	4	3	'On' time for output pair F2 (0-255)	Default as supplied = 5 (50 milliseconds)
517	5	4	'On' time for output pair F3 (0-255)	Default as supplied = 5 (50 milliseconds)
518	6	5	'On' time for output pair F4 (0-255)	Default as supplied = 5 (50 milliseconds)
-	-	6	Page register	Must be 0 for register mode
519	7	7	Version number	Fixed (Presently 4 for ACC4)
520	8	8	Manufacturer ID	Fixed at 165 (MERG ID)
521	9	-	High 3 bits of Accessory Decoder address in range 0 – 7	Default as supplied = 0
541	29	-	Configuration	Fixed at 128
545	33	-	Selection of toggle mode	Default as supplied = 15 (00001111 Binary) for ACC4 Toggle mode ON

Table 1. Configuration Variables (CVs) for the MERG Pulsed Output Accessory Decoder

Addressing

The terminology used can be a little confusing. It is important to realise that the range of accessory decoder addresses is separate from the range of loco decoder addresses.

Each Accessory Decoder must have a unique accessory decoder board address, which has 4 consecutive switch addresses for the function cells (see Table 2). The switch address of each cell is used to control the device that is connected to the output pair of the function cell.

When connected directly to the MERG Accessory Encoder, the Accessory Decoder is limited to accessory decoder board addresses 0 to 31 (corresponding to switch positions 1 to 128).

When used with commercial Command Stations, the Decoder may have accessory decoder board addresses in the range 0 to 510 – subject to any limitations of that Command Station. [511 is defined as a broadcast address, which means that all Decoders respond to whatever commands are issued from the Command Station – unlikely to be either useful or advisable!]

For reasons best known to themselves, Lenz use a different addressing sequence. Accessory address 0 cannot be addressed. Accessory address 1 controls switch addresses 1 to 4, and in general accessory address *n* controls switch addresses *(4n - 3)* to *4n*.

Note that the accessory decoder board addresses do not have to be in a continuous numerical sequence – you can leave gaps. You may want to number decoders by geographical locations on the layout, or leave some addresses vacant for future developments.

Each switch address has a pair of outputs. Each output can be individually disabled if necessary by clearing (i.e. setting to 0) a bit in CV514.

Accessory Decoder Address	Switch Address Function 1	Switch Address Function 2	Switch Address Function 3	Switch Address Function 4
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12
3	13	14	15	16
4	17	18	19	20
5	21	22	23	24
6	25	26	27	28
7	29	30	31	32
8	33	34	35	36
9	37	38	39	40
10	41	42	43	44
11	45	46	47	48
12	49	50	51	52
13	53	54	55	56
14	57	58	59	60
15	61	62	63	64
16	65	66	67	68
17	69	70	71	72
18	73	74	75	76
19	77	78	79	80
20	81	82	83	84
21	85	86	87	88
22	89	90	91	92
23	93	94	95	96
24	97	98	99 *	100
25	101	102	103	104
26	105	106	107	108
27	109	110	111	112
28	113	114	115	116
29	117	118	119	120
30	121	122	123	124
31	125	126	127	128 **
	and so on in groups of 4			

* Upper limit of some 'entry level' systems with 2-digit addressing

** Upper limit when used with MERG Accessory Encoder

Table 2. Decoder addresses and associated switch addresses

Note: This table is *not* applicable to Lenz command stations!

Pulse Length

The time for which an output is 'On' can also be programmed. The time unit for the MERG Accessory Decoder is 10ms so the 'On' time ranges from 10ms to 2550ms. The latter could be useful for lineside devices that can complete their operation within the maximum of 2.55 seconds.

Setting the relevant CV to a value of 0 gives a constant 'On' output.

The timing operates on each pair of outputs and it is not possible to set one of a pair to a different time to that of the other.

Using the on-board Capacitor Discharge Unit (CDU), 20ms may be sufficient, although as supplied the timing CV is pre-programmed to 5 (50ms).

Note that an unattached point motor used for testing may operate satisfactorily on a shorter pulse, but require a longer pulse when having to work operating a point tiebar or two solenoids as for a crossover.

Toggle Mode

The default value for CV545 (CV33) on the ACC4 PICs is 15 (1111 Binary) so that a Lenz compatible toggle mode is set on all four output pairs. As a general rule, the toggle mode should be left on for Lenz command stations, and

turned off for the MERG Encoder (by setting CV545 (CV33) to zero). Leaving the toggle mode on with the Encoder appears to work normally, except that a system reset will set the points to the wrong setting.

Programming Example

The following assumes that a MERG DCC Programmer is being used.

Connect the Programmer to J2 and a separate 15-20Vac power supply to J1 (polarity not critical).

Check the existing address:-

Press **Read**: display shows 'CV'.

Key in '513' and press 'Enter'.

The display should show 'CV513 = 1'.
(In this context, the first Decoder is address 1 decimal, or 00000001 in Binary.)

Then program the new address:-

Press **Prog**: display shows 'CV'.

Key in '513' and press 'Enter'.

When the '=' sign appears, key in the required address and then press 'Enter'.
You would normally enter the next address as '2', but you can select any number between 0 and 63 decimal (0 and 31 decimal if used with the MERG DCC Accessory Encoder).

The display should show 'Program OK'.

While you are familiarising yourself with the Accessory system, it is a good idea to re-program two or three more of the CVs if only to become more aware of the options available.

Setting CV514 to all zeros will disable all the outputs - there should be no response to any D-pin contact. Programming CV514 to alternating '1's and '0's will enable or disable all the 'Set' or 'Reset' outputs. This is best achieved by using the data in Binary mode, as follows:-

Press **Prog:** display shows 'CV'.

Key in '514' and press 'Enter'.

When the '=' sign appears, press **Mode**.

'b' (for Binary) appears after the '='.

Key in '01010101' and press 'Enter'.

This will have turned alternate outputs off: check by test-leading the appropriate D-pins. Now re-program with '10101010' and you should find that the opposite outputs are disabled. You may need to manually operate the point motors to check this.

Remember to restore this CV to '11111111' to enable all four pairs of outputs.

Associated documents

TB DCC11/11 is an Overview of the complete MERG Accessory System, and includes details of the functional testing of assembled kits.

TB DCC11/12 describes the MERG DCC Accessory Encoder.

TB DCC11/14 describes the MERG DCC Steady State Output Accessory Decoder.

Any comments or suggestions are welcome, but Mike Bolton has to advise, with regret, that he cannot guarantee to be able to provide custom solutions for individual requirements.