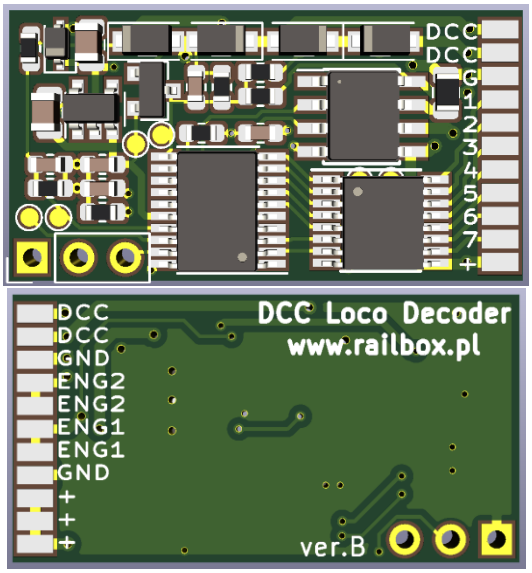
Loco Decoder

Introduction

This Loco Decoder has seven digital outputs and one DC engine output with BackEMF function.

Features:



- Address of short and long locomotives up to 9999
- Control outputs with selectable functions F0 to F28
- **7 outputs** with different independent function effects: 2 different blinking periods with inversing, smooth switching and short pulse.
- **DC engine output** with BackEMF function for smooth and slow speeds

Technical information

- Operating voltage: 5 - 20V.
- Maximum continuous motor current: 1.5A
- Peak motor current: 2A
- Maximum digital output current: 0.5A
- Dimensions: 28x15x2mm

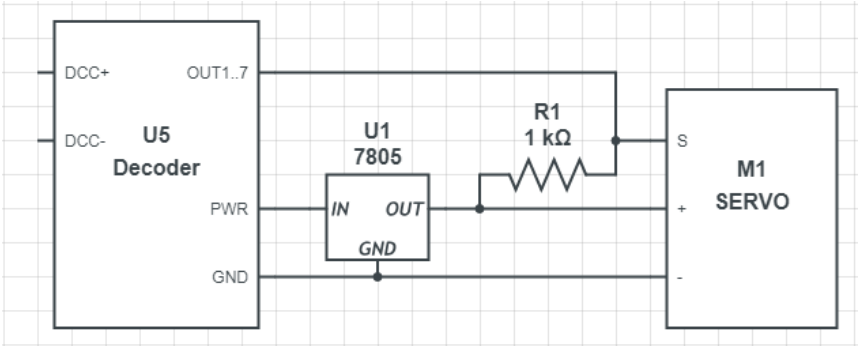
Connection

Output	NEM652	Description
DCC	Black	RailL
DCC	Red	RailR
1	White	Front LED
2	Yellow	Rear LED
3	Pink	Cabin LED(F1)
4		F2(Changeable)
5		F3(Changeable)

Output	NEM652	Description
6		F4(Changeable)
7		F5(Changeable)
ENG1	Black	Motor +
ENG2	Red	Motor -
+	Blue	Common LED anode
G/GND		Ground(Connect Power capacitor between + and G)

Servo connection

To connect servomotor to the decoder the voltage regulator for 5V is required. It can be a simple 7805 micro or DC-DC convector. Also one resistor for 1K Ohm is required per each servo.



Programming

CV can be updated using Paged Mode, Direct Mode or on the main track (PoM).

Programming hints:

The LocoDecoder parameters optimized for the standard model locomotive however depending on the motor you can tweak parameters the main configuration CV is:

1. Acceleration and Deceleration (CV 3 and 4).
2. Maximum speed: There is two configuration for the maximum speed:
    a. CV 5 – This is using together with medium speed (CV 6) and min speed (CV 2) for the creation of the speed curve.
    b. CV 100 is a bit different as this is the voltage at the maximum speed, which BackEMF system will try to maintain at maximum speed. Therefore, if this voltage is less than practical maximum voltage on the motor even the DCC voltage will change the motor will rotate at the constant speed.
3. PID.
    a. The main PID coefficient you can tweak is KP (CV 90) and KP slow speed (CV 91). This is the strength of the response to the motor speed change. On slow speed, we need to have it faster to constantly maintain speed without oscillations.
    b. In all tests, the Integral coefficient (CV 92) does not add any improvements so it is set 0 by default.
    c. Default value of derivative coefficient (CV 93) is good enough for most cases.
    d. KFF_A (CV 94) and KFF_D (CV 95) correspond to the immediate change of the applied motor voltage in case of change of requested speed. Mostly applied only for high acceleration and deceleration (Values near 255).

The main configuration table:

CV	Value	Default value	Description	
1	1..99	3	Decoder Address (Short)	
2	0..255	0	Minimum speed	
3	0..255	40	Acceleration. 255 - acceleration from 0 to maximum speed in 1s 127 – acceleration from 0 to maximum speed in 2s	
4	0.255	40	Deceleration. 255 - deceleration from 0 to maximum speed in 1s 127 – deceleration from 0 to maximum speed in 2s	
5	0..255	255	Maximum speed(See also CV 100)	
6	0.255	127	Medium speed(Could be used for optimizing speed curve)	
7	1	1	Software Revision (Read Only)	
8	13	13	Manufacturer ID: 13 = DIY decoder	
17	192..231	192	Long address (high byte)	
18	0..255	100	Long address (low byte)	
29	Bit		Decoder Configuration:	
			0	1
	0	0	-	-
	1	1	14 speed steps	28/128 speed steps
	2	1	-	-

	3 4 5 6 7	0 0 0 0 0	- - Short Address in CV1 - -	- - Long Address in CV17,CV18 - -
33	0..120	0	Effect Selection, output 1: 0: Incandescent light 1: Blink with blink period 1 (period is CV 54) 2. Blink with blink period 1 (inverse) 3: Blink with blink period 2 (period is CV 55) 4. Blink with blink period 2 (inverse) 5. Short pulse with duration equal to CV 58 6. Custom blinking type 1(See CV 60) 7. Custom blinking type 2(See CV 73) 9. Servo mode (Maximum brightness – max position, minimum brightness – min position. Speed can be set by values below) In modes 0..9 there is a possibility to add 16 or 32 to CV value to enable smooth switching with CV 56 or CV 57 duration Adding 64 to the CV value will disable the continuous mode in custom blinking mode(the sequence will be executed only once)	
34	0..120	0	Effect Selection, output 2	
35	0..120	0	Effect Selection, output 3	
36	0..120	0	Effect Selection, output 4	
37	0..120	0	Effect Selection, output 5	
38	0..120	0	Effect Selection, output 6	
39	0..120	0	Effect Selection, output 7	
40	0..255	0	Minimum brightness output 1	
41	0..255	0	Minimum brightness output 2	
42	0..255	0	Minimum brightness output 3	
43	0..255	0	Minimum brightness output 4	
44	0..255	0	Minimum brightness output 5	
45	0..255	0	Minimum brightness output 6	
46	0..255	0	Minimum brightness output 7	
47	0..255	255	Maximum brightness output 1	
48	0..255	255	Maximum brightness output 2	
49	0..255	255	Maximum brightness output 3	
50	0..255	255	Maximum brightness output 4	
51	0..255	255	Maximum brightness output 5	
52	0..255	255	Maximum brightness output 6	
53	0..255	255	Maximum brightness output 7	
54	0..255	100	Blink 1 period (* 10ms)	
55	0..255	100	Blink 2 period (* 10ms)	
56	0..255	10	Lamp mode switching time 1 (* 10ms)	

57	0..255	10	Lamp mode switching time 2 (* 10ms)
58	0..255	10	Short pulse duration (* 10ms)
59	1..100	1	Custom blinking sequence one step time (* 10ms)
60-72	0..255		Custom blinking sequence 1(one bit is one step of blinking) Default value: 0xB5,0xFD,0x6F,0xF7,0xB5,0xFD,0x6F,0xF7,0xB5,0xFD, 0x6F,0xF7,0xB5
73-85	0..255		Custom blinking sequence 2(one bit is one step of blinking) Default value: 0xC7,0x9F,0xFF,0xFF,0xFF,0xFF,0xFF,0xFF,0xFF,0xFF, 0xFF,0xFF,0xFF

The BackEMF configuration table

CV	Value	Default value	Description
90	0..255	30	PID KP
91	0.255	120	PID KP on slow speed
92	0..10	0	PID KI
93	0..40	25	PID KD
94	0..50	28	PID KFF Acceleration
95	0..50	18	PID KFF Deceleration
97	40..160	80	BackEMF&PID Period
98	6..20	8	BackEMF measure delay
100	30..100	50	BackEMF voltage at maximum speed

The output configuration table:

CV	Description	Default value	Bit							
			7	6 Out7	5 Out6	4 Out5	3 Out4	2 Out3	1 Out2	0 Out1
120	F0 (forward FL)	1	0	0	0	0	0	0	0	1
121	F0 (backward FR)	2	0	0	0	0	0	0	1	0
122	F1 (forward)	4	0	0	0	0	0	1	0	0
123	F1 (backward)	4	0	0	0	0	0	1	0	0
124	F2 (forward)	8	0	0	0	0	1	0	0	0
125	F2 (backward)	8	0	0	0	0	1	0	0	0
126	F3 (forward)	16	0	0	0	1	0	0	0	0
127	F3 (backward)	16	0	0	0	1	0	0	0	0
128	F4 (forward)	32	0	0	1	0	0	0	0	0
129	F4 (backward)	32	0	0	1	0	0	0	0	0
130	F5 (forward)	64	0	1	0	0	0	0	0	0
131	F5 (backward)	64	0	1	0	0	0	0	0	0
132	F6 (forward)	0	0	0	0	0	0	0	0	0
133	F6 (backward)	0	0	0	0	0	0	0	0	0
134	F7 (forward)	0	0	0	0	0	0	0	0	0
135	F7 (backward)	0	0	0	0	0	0	0	0	0
136	F8 (forward)	0	0	0	0	0	0	0	0	0
137	F8 (backward)	0	0	0	0	0	0	0	0	0
138	F9 (forward)	0	0	0	0	0	0	0	0	0
139	F9 (backward)	0	0	0	0	0	0	0	0	0
140	F10 (forward)	0	0	0	0	0	0	0	0	0
141	F10 (backward)	0	0	0	0	0	0	0	0	0

142	F11 (forward)	0	0	0	0	0	0	0	0	0
143	F11 (backward)	0	0	0	0	0	0	0	0	0
144	F12 (forward)	0	0	0	0	0	0	0	0	0
145	F12 (backward)	0	0	0	0	0	0	0	0	0
146	F13 (forward)	0	0	0	0	0	0	0	0	0
147	F13 (backward)	0	0	0	0	0	0	0	0	0
148	F14 (forward)	0	0	0	0	0	0	0	0	0
149	F14 (backward)	0	0	0	0	0	0	0	0	0
150	F15 (forward)	0	0	0	0	0	0	0	0	0
151	F15 (backward)	0	0	0	0	0	0	0	0	0
152	F16 (forward)	0	0	0	0	0	0	0	0	0
153	F16 (backward)	0	0	0	0	0	0	0	0	0
154	F17 (forward)	0	0	0	0	0	0	0	0	0
155	F17 (backward)	0	0	0	0	0	0	0	0	0
156	F18 (forward)	0	0	0	0	0	0	0	0	0
157	F18 (backward)	0	0	0	0	0	0	0	0	0
158	F19 (forward)	0	0	0	0	0	0	0	0	0
159	F19 (backward)	0	0	0	0	0	0	0	0	0
160	F20 (forward)	0	0	0	0	0	0	0	0	0
161	F20 (backward)	0	0	0	0	0	0	0	0	0
162	F21 (forward)	0	0	0	0	0	0	0	0	0
163	F21 (backward)	0	0	0	0	0	0	0	0	0
164	F22 (forward)	0	0	0	0	0	0	0	0	0
165	F22 (backward)	0	0	0	0	0	0	0	0	0
166	F23 (forward)	0	0	0	0	0	0	0	0	0
167	F23 (backward)	0	0	0	0	0	0	0	0	0
168	F24 (forward)	0	0	0	0	0	0	0	0	0
169	F24 (backward)	0	0	0	0	0	0	0	0	0
170	F25 (forward)	0	0	0	0	0	0	0	0	0
171	F25 (backward)	0	0	0	0	0	0	0	0	0
172	F26 (forward)	0	0	0	0	0	0	0	0	0
173	F26 (backward)	0	0	0	0	0	0	0	0	0
174	F27 (forward)	0	0	0	0	0	0	0	0	0
175	F27 (backward)	0	0	0	0	0	0	0	0	0
176	F28 (forward)	0	0	0	0	0	0	0	0	0
177	F28 (backward)	0	0	0	0	0	0	0	0	0
178	Stop (forward)	0	0	0	0	0	0	0	0	0
179	Stop (backward)	0	0	0	0	0	0	0	0	0
180	Moving (forward)	0	0	0	0	0	0	0	0	0
181	Moving (backward)	0	0	0	0	0	0	0	0	0
182	DCC A	0	0	0	0	0	0	0	0	0
183	DCC B	0	0	0	0	0	0	0	0	0