Configuration Variables used by V3.6 Decoders

CV1 Short decoder address; 1-127 valid
CV2 Start Voltage (useful range 0-100)
CV3 Acceleration rate (each unit = 7mS between speed steps) 255 max.
CV4 Deceleration rate (each unit = 7mS between speed steps) 255 max.
CV5 Vmax, speed at highest speed step. 0=use factory default of 255
CV6 Vmid, speed (on a scale of 1-255) at speed step 7,14,or 63. 0=use default of 127
CV7 Decoder version number. This decoder is 36 which means version 3.6
CV8 Manufactuer ID. NCE = 11 (0B hex)
CV11 Packet timeout value (in ½ second increments) Time the decoder will wait before braking to a stop after running into a section of track with DC power. 0=Don't brake
CV15 Decoder programming lock "KEY". This CV is always programmable even when "locked"
CV16 Decoder programming lock ID. When CV15=CV16, programming is unlocked and the decoder will respond to programming commands. If CV15 is not equal to CV16 then decoder programming is locked and it will not program (except CV15) or read.
CV17 High byte of long (4 digit) address
- bit 6,7 always= 1
- bits 0-5 are upper 6 bits of address

CV18 Low byte of long (4 digit) address
CV19 Consist address. (0 or 128 = no consist active)
- bits 0-6 short consist address (1-127 valid)
- bit 7 0= direction is normal, 1= direction is reversed

CV21 Functions active in consist mode. Bit 0 controls F1,bit 1=F2, bit 2=F3, etc.
- bit 0 - 1=function can be controlled at consist address, 0 = no consist control

CV22 Functions active in consist mode. Bits 0,1 control FLF and FLR respectively each bit 1=function can be controlled at consist address, 0 = no consist control
CV29
- bit 0 1= direction of operation is reversed, 0= direction is normal
- bit 1 1=28 speed mode (always enabled)
- bit 2 1= analog operation mode enabled, 0 = disabled
- bit 4 1= alternate speed table active, 0= use table defined by CV2,5,6
- bit 5 1= use long address in CV17/18, 0= use short address CV1
- bits 3,6,7 are ignored by the decoder

CV30 Set this CV to 2 **on the programming track** and the decoder will reset to factory settings.
CV33-CV40 function mapping CVs for F0-F6
CV67-CV94 Uploadable speed table steps 1-28 (128 speed mode calculates intermediate steps)
CV95 Reverse trim, values 1-127 add to reverse speed, values 129-255 add to forward speed
CV116 Torque kick rate - number of 16ms periods in a row that motor is 'kicked' with voltage pulse
CV117 Torque kick strength - how much voltage is used to kick the motor at slow speeds. Reduces to 0 as speed is increased.
CV118 Ditch light hold time (in ¼ second increments) after F2 goes off.
CV120-CV123 Effects configuration registers for outputs 1- 4

CV NOTES: All CV numbers not listed above are ignored. This decoder supports all DCC programming methods.

Decoder Warranty
This decoder is fully factory tested and warranted against manufacturing defects for a period of 1 year. As the circumstances under which this decoder is installed can not be controlled, failure of the decoder due to installation problems can not be warranted. This includes misuse, miswiring, operation under loads beyond the design range of the decoder or short ciruits in the locomotive manufacturer's factory wiring. If the decoder fails for non-warranted reasons NCE will replace the decoder, no questions asked, for $10 U.S. plus $2 shipping. For warranty or non-warranty replacement send the decoder (an d any payment, if required) to:

NCE Warranty Center
82 Main Street
Webster, New York 14580

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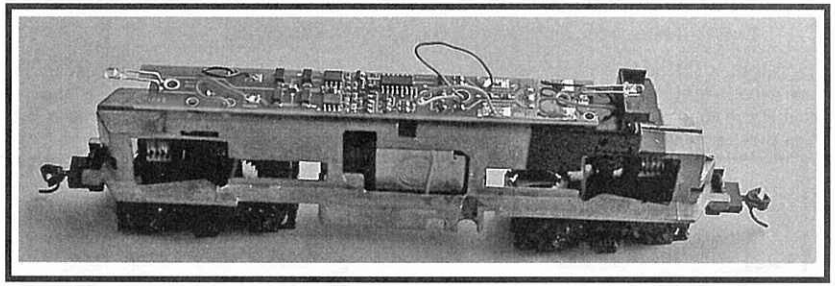
NCE
The Power of DCC

BACH-DSL Decoder



Decoder version 3.6

$19.95

This Silent decoder is designed to replace the decoder in

Bachmann "DCC-EQUIPPED" Diesel Locomotives

Features of this decoder::

- ✓ Silent Running™,torque compensated motor drive
- ✓ Torque Compensation for ultra smooth low speed performance
- ✓ Motor rating 1.3 Amp continuous, 2 Amp peak (stall)
- ✓ All four function outputs have lighting effects generators
- ✓ Select from 15 different lighting effects
- ✓ Full support for LED lighting
- ✓ Decoder programming lock mechanism

Age 14+

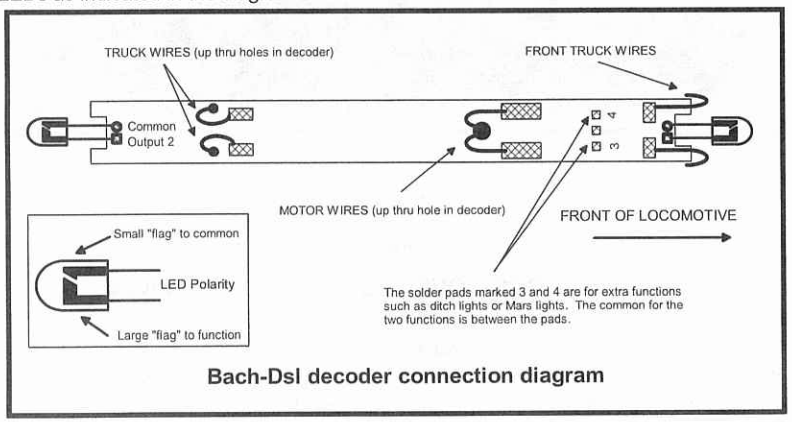
05240139

Warning: This product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.

General Installation Procedure:

- √ Remove the shell from your locomotive
- √ Cut (or unsolder) the wires soldered to the existing locomotive circuit board. Cut as close as possible to the circuit board.
- √ Unscrew the existing circuit board from the locomotive chassis.
- √ Using the original circuit board as a pattern, cut the leads of the supplied LEDs to the original shape and length. Solder to the NCE Bach-Dsl decoder in the same manner as the original, paying special attention to polarity of the LED (see diagram).
- √ See the photos on the right hand page to clip the orange capacitors from the decoder. This is an important step to help the decoder drive the motor properly.
- √ Screw the new decoder (component side up) to the chassis. Use the same mounting holes, screws and washers as the orginal decoder. Duplicate the wire path of motor and truck wires using the corresponding holes on the new decoder.
- √ Flow a small amount of solder on each of the 4 solder pads marked "Track".
- √ Refer to the connection diagram below. Trim the locomotive wires to length as they are soldered to the decoder. Leave about 1/2" slack in the motor leads and wires from the trucks
- √ Strip about 1/8" of the insulation off each wire and tin the end (melt a little solder on the end to keep the individual strands wire together). Just place the tinned wire on its solder pad and touch your soldering iron to the tinned wire and pad at the same time. Watch for shorts!
- √ Solder the supplied LEDs in place using the diagram and text below for reference.
- √ Ensure the decoder is properly seated on the motor bosses.

Lighting: The headlight and rearlight (F Unit locomotives only have headlights) must be soldered to the decoder. Duplicate the length of the LED wires on the old decoder and solder the supplied LEDs in place on the new decoder. Observe the correct polarity of the LEDs as indicated in the diagram below.



Bach-Dsl decoder connection diagram

Now is a good time to test run your newly converted locomotive on a programming track before trying it on full track power. Before running on full power double check your wiring to make sure the motor is fully insulated from the frame and that there are no pinched or broken wires. We see many decoders returned due to wires getting pinched between the body shell and frame causing shorts.

Additional Lighting: The BACH-DSL decoder ships from the factory with two extra usable function outputs, Output 3 and Output 4. Each function has built-in 1K resistors so hooking up LED lights is a snap. Hook your additional LED between the supplied solder pads (marked '3" and "4") and the common pad on the decoder. Observe the correct polarity as above.

Factory default values for decoder Configuration Variables (CVs)

CV	Default value decimal	hex	Description
1	**3**	03	short address
2	**0**	00	start voltage
3	**0**	00	acceleration
4	**0**	00	deceleration
5	**0**	00	maximum speed
6	**0**	00	mid speed
7	**36**	23	decoder version
11	**0**	00	Packet timeout value
15	**0**	00	Programming "key"
16	**0**	00	Programming "lock"
17	**192**	C0	long address high byte
18	**0**	00	long address low byte
19	**0**	00	consist address
21	**255**	FF	consist functions F1-F8
22	**63**	3F	consist function FLF,FLR
23	**0**	00	acceleration adjust
24	**0**	00	deceleration adjust
29	**2**	02	decoder configuration
30	**0**	00	error/reset register
33	**1**	01	Output(s) controlled by F0
34	**2**	02	Output(s) controlled by F0
35	**4**	04	Output(s) controlled by F1
36	**8**	08	Output(s) controlled by F2
37	**16**	10	Output(s) controlled by F3
38	**4**	04	not used
39	**8**	08	not used
40	**16**	10	not used
41	**0**	0	not used
42	**0**	0	not used
67	**0**	0	alt spd table step 1
68	**0**	0	alt spd table step 2
69	**0**	0	alt spd table step 3

CV	Default value decimal	hex	Description
70	**0**	0	alt spd table step 4
71	**0**	0	alt spd table step 5
72	**0**	0	alt spd table step 6
73	**0**	0	alt spd table step 7
74	**0**	0	alt spd table step 8
75	**0**	0	alt spd table step 9
76	**0**	0	alt spd table step 10
77	**0**	0	alt spd table step 11
78	**0**	0	alt spd table step 12
79	**0**	0	alt spd table step 13
80	**0**	0	alt spd table step 14
81	**0**	0	alt spd table step 15
82	**0**	0	alt spd table step 16
83	**0**	0	alt spd table step 17
84	**0**	0	alt spd table step 18
85	**0**	0	alt spd table step 19
86	**0**	0	alt spd table step 20
87	**0**	0	alt spd table step 21
88	**0**	0	alt spd table step 22
89	**0**	0	alt spd table step 23
90	**0**	0	alt spd table step 24
91	**0**	0	alt spd table step 25
92	**0**	0	alt spd table step 26
93	**0**	0	alt spd table step 27
94	**0**	0	alt spd table step 28
95	**0**	0	reverse trim
116	**0**	0	torque kick rate
117	**0**	0	torque kick strength
118	**20**	14	ditch light hold time
120	**1**	01	output 1 EFX generator
121	**2**	02	output 2 EFX generator
122	**0**	00	output 3 EFX generator
123	**0**	00	output 4 EFX generator

Description of EFX configuration CVs

CV120 - Lighting effect configuration for output 1 (Headlight).
CV121 - Lighting effect configuration for output 2 (Rearlight).
CV122 - Lighting effect configuration for output 3 (Solder pad marked 3).
CV123 - Lighting effect configuration for output 4 (Solder pad marked 4).

Each output wire can select from 15 different lighting effects by using its associated EFX configuration CV. Pick the value for the CV from the table below, add 1 or 2 if you want the effect to be directional (footnotes 2 and 3), then add 128 if you are using a white LED for the effect. Ditch lights should not be made directional, they're not directional in real life.

Value for CV	Description of lighting effect	Hex (for Digitrax users)
0	Standard on/off function output	0
4	Firebox flicker (brighter when accelerating)	4
8	Mars light	8
12	Rotary Beacon	0C
16	Gyralight	10
20	Double Strobe	14
24	Strobe A	18
28	Strobe B (alternates with Strobe A)	1C
32	Dim when F0 and F4 on, otherwise bright	20
36	Dim when F0 and F8 on, otherwise bright	24
40	Dim in forward, bright in reverse	28
44	Dim in reverse, bright in forward	2C
48	Type 2 Right Ditch light, effect on if F2 on, output off otherwise	30
52	Type 2 Left Ditch light, effect on if F2 on, output off otherwise	34
56	Type 1 Right Ditch light, effect on if F0 *and* F2 on, bright if F0 on *and* F2 off, off if F0 off	38
60	Type 1 Left Ditch light, effect if F2 *and* F0 on, bright if F0 on *and* F2 off, off if F0 off	3C

1 - Lighting effects assume incandescent lamps. If you are using a white LED (with 1K limiting resistor) add 128 to the CV value.
2 - If you want the function to be active only in the reverse direction add 2 to the CV value
3 - If you want the function to be active only in the forward direction add 1 to the CV value

Configuration of CV29 settings:

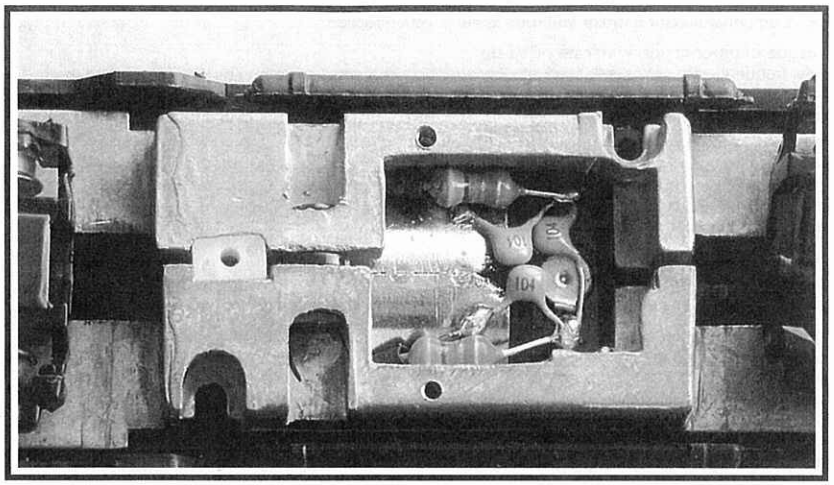
Table of commonly used values for CV29

Value for CV29 decimal	hex	Long/Short Address	Uploadable/Factory Speed table	Analog Conversion	14 or 28 Speed mode
2	2	Short	Factory	no	28
6	6	Short	Factory	yes	28
18	12	Short	Uploadable	no	28
22	16	Short	Uploadable	yes	28
34	22	Long	Factory	no	28
36	24	Long	Factory	yes	14
38	26	Long	Factory	yes	28
48	30	Long	Uploadable	no	14
50	32	Long	Uploadable	no	28
52	32	Long	Uploadable	yes	14
54	36	Long	Uploadable	yes	28

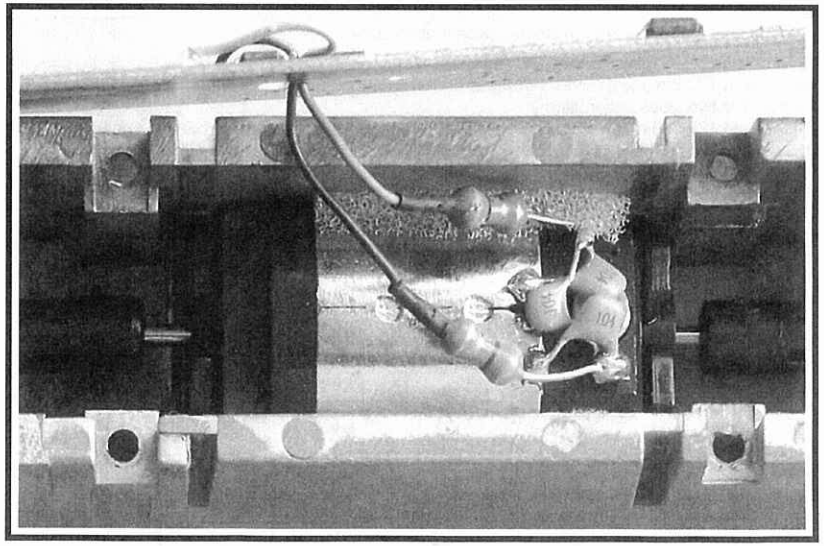
Note: If you want the locomotive to operate in the opposite direction increase the indicated value for CV29 by one. (Hex numbers are provided for Digitrax users)

Cutting the capacitors

Using fine point wire cutters clip each of the three orange "104" capacitors from the locomotive. Do NOT clip the "dogbone" shaped inductors as these are required to connect the motor to the decoder.



The capacitors on the FTA and FTB units are located in the fuel tank



Other diesels have the capacitors mounted on top of the motor, under the decoder.

Fine tuning locomotive operation

The factory settings normally provide good performance for most locomotives in H O-Scale. You may want to improve or fine tune performance by adjust the starting characteristics or top speed .

There are 6 CVs that define:

- → The voltage at which the motor starts
- → How often and how hard the motor gets kicked at slow speeds to keep it turning smoothly.
- → The maximum motor speed
- → The mid speed range response characteristics or 'speed curve'.
- → Compensation for a motor that runs faster in one direction

Torque compensation kick rate - CV116:
How frequently the motor is 'kicked' at slow speed. . The smaller the number the more often the motor gets a brief voltage 'kick'. A value of 1 applies kicks continuously. Most HO locos work well with values of 2-4. Factory default is 0 (off). The maximum practical value is about 8.

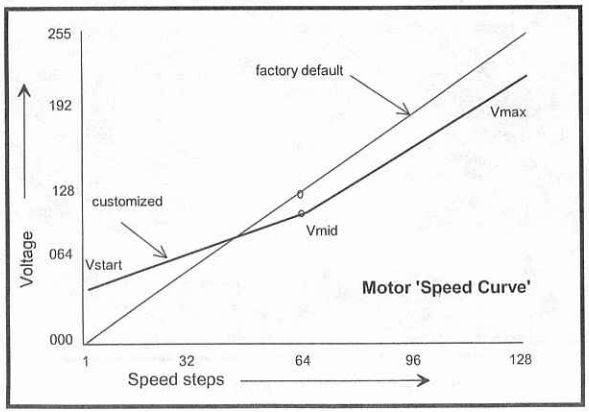
Torque compensation kick strength - CV117:
How hard the motor is 'kicked' at slow speed. Typical adjustment is 4 to 25 The larger the number the more voltage is applied in each 'kick'. The strength of these kicks fade out ratiometrically as speed is increased providing a smooth transition to normal motor operation. Factory default is 0 (off), usable range 0-50.

Start Voltage - CV2 (Vstart): We prefer using Operations Mode Programming (Program on the Main) to set the Torque Compensation (CV116/117) *before setting CV2* so the locomotive is **just able** to maintain movement at speed step 1. CV2 can then be used to "trim" the starting v oltage.

Vmax - CV5: If your locomotive runs too fast you can use CV5 to lower its maximum speed. Setting CV5 to 255 uses the maximum possible voltage to run the motor when full speed is requested. Set CV5 to a smaller value to reduce the top speed. A value of 128 will yield approximately ½ full voltage to the motor at top speed. 192 will provide about ¾ full voltage. All speeds from the middle speed step to the maximum will be proportionally reduced (see diagram). If CV5 is set to 0 the decoder will use 255 for maximum speed. Always make sure CV5 is greater than CV6 to avoid erratic operation.

Vmid - CV6: CV6 determines how the motor responds through its middle speed ranges to advancement of the throttle. If you set CV6 lower than half the maximum speed you'll have smaller increases in motor speed through the lower speed ranges. Then, as you hit the upper speed ranges there will be larger increases between speed steps. In the diagram below you can see this best illustrated by the factory default line. If you set Vstart larger than 0 you'll will most likely want to raise Vmid so a reasonable slope is maintained in the 'speed curve'. If CV6 is set to 0 the decoder will use 127 as the value. If you use high values in CV57 you will want to increase CV6 by a proportional amount to keep a smooth acceleration curve.

Reverse trim (also forward trim) - CV95:
Values from 1-127 make decoder run **faster in reverse** than forward. 1 is one speed step faster in reverse, 2 is two steps faster, etc.
Values from 129-255 make decoder run **faster in forward** than reverse. 129 is one speed step faster in forward, 130 is 2 speed steps faster, etc. 0 and 128 add nothing to either direction .



Function mapping and effects programming examples

Ditch lights:
What we want to do:

- ➡ Use outputs 3 and 4 (marked '3' and '4' on the decoder) for the left and right ditch lights
- ➡ They will be controlled by F2 which is the HORN button on most DCC systems
- ➡ They should continue flashing for 5 seconds after the HORN button is released

How to do it:

- ✓ Program outputs 3 and 4 to both be activated by F2. Set the F2 mapping CV (CV36) to 12. We get the value of 12 by adding the 'values for output 3 and output 4 on the F2 line of the **CV mapping table** on page 6.
- ✓ Program outputs 3 and 4 for ditch light operation. Set CV122 to 184 and CV123 to 188. Using these values the lights will be 'qualified' by the headlight AND function 2. The headlight must be on for the ditch lights to be activated by F2. Type 1 ditch lights are on constantly on when the headlight is on and alternately flash when the horn is blown. Type 2 ditch lights are normally off until the horn is blown.
- ✓ CV118 sets the amount of time the ditch lights stay flashing after the horn (F2) is deactivated. The time is measured in 1/4 second intervals, for a hold time of 5 seconds put a value of 20 in the CV118.
- ✓ One last thing: Set CV35 to 0 so output 3 is not also controlled by F1

Mars Light:
What we want to do:

- → Use output 3 (marked '3' on the decoder) for a Mars light.
- → It is to be on in the forward direction only

How to do it:

- ✓ Output 3 is already activated by F1 (factory default setting of CV35=4).
- ✓ Configure output 3 as a forward only Mars light. Set CV122 to 137 We get the value of 137 by using 8 (Mars Light) plus 1 (output operates only in forward direction) plus 128 (for LED)

Rule 17 lighting:
Rule 17 refers to how the locomotive engineer operates the locomotive headlights during the running of the train. The rule varies from road to road but generally requires the dimming of the headlight(s) when in a siding waiting to meet another train, passing through passenger stations o r moving within yard limits.
What we want to do:

- → Use output 1 for the Headlight
- → The headlight is to be on bright in both directions of locomotive travel
- → We also want to be able dim the headlight
- → Use output 2 for the rear light. It is to come on in reverse, off in forward

How to do it:

- ✓ Output 1 is already activated by F0 (factory default setting of CV33 =1).
- ✓ Configure output 1 as a standard output, on in both directions, yet dimmable when F4 is activated. Set CV120 to 160 (A0 hex). You can optionally set CV120 to 164 is you want F8 to control the dimming instead of F4.
- ✓ Configure the rear light to be on in reverse and off in forward operation: Set CV121 to 2

Switcher:
What we want:

- → Headlights that dim in the opposite direction that the locomotive is travelling
- → Use output 1 as Headlight and output 2 as Rearlight

How to do it:

- ✓ Outputs 1 and 2 are already activated by F0 due to the factory default settings.
- ✓ Configure output 1 as bright in forward dim in reverse . Set CV120 to 172 (AC hex)
- ✓ Configure output 2 as bright in reverse dim in forward . Set CV121 to 168 (A8 hex)