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-CV37 function mapping CVs for F0-F3
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-CV121 Effects configuration registers for outputs 1 and 2

CV NOTES: All CV numbers not listed above may be programmed but not used by the decoder. 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 (and any payment, if required) to:

NCE Warranty Center
82 Main Street
Webster, New York 14580

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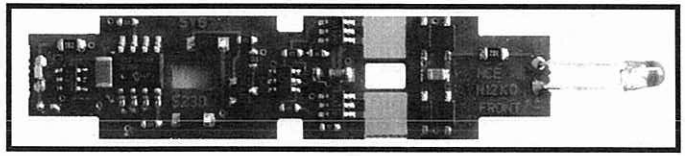
The Power of DCC

N12K0b

Drop in Decoder



$29.95

Decoder version 3.6
Dimensions: 2.65 x 0.370 x .120 inches

Plug and play decoder for Kato N-Scale F3 A&B, F7 A&B and others

This is an EPF (extended packet format) decoder supporting:

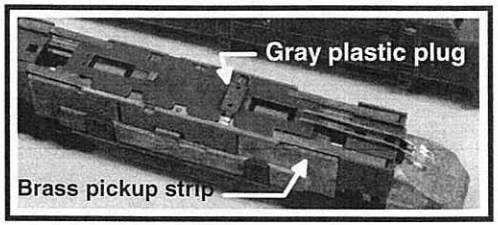
- ✓ Silent Running ™ motor drive
- ✓ Torque Compensation for ultra smooth low speed performance
- ✓ Programmable Start, Mid and Maximum speed works for all speed modes
- ✓ Motor rating 1 Amp continuous, 1.25 Amp peak (stall)
- ✓ Select from 15 different lighting effects (Mars, strobes, beacon, flicker, etc)
- ✓ Uploadable speed table interpolated to 128 speed steps
- ✓ Decoder assisted consisting

05240143

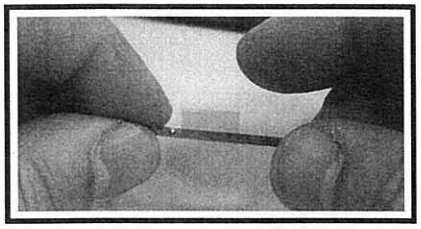
Age 14+

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

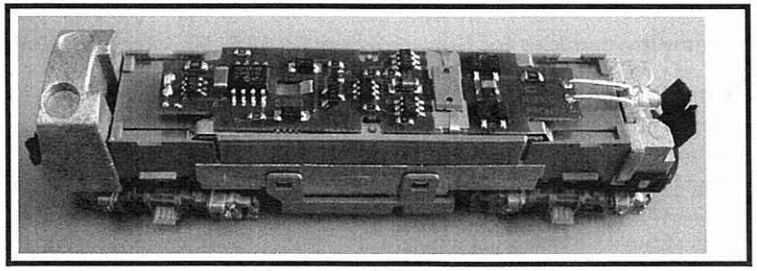
Decoder Installation:



1. Remove the locomotive shell from the frame, and the black plastic cab interior.
2. Carefully remove the gray plastic plug that retains the lighting circuit board in the locomotive and keeps the brass motor contact strips in contact with the circuit board.
3. Bend the motor contacts up and away from the light board.
4. Slide the light board forward a short distance until it releases from the locomotive.



5. Carefully remove one of the brass pick up strips from the locomotive. Do not bend the strip. Use a small piece of the supplied yellow Kapton tape to wrap the strip just ahead of the small "dimple" in the strip (see photo). Make sure to wrap ALL the way around the strip. This is important to isolate the edge of the strip from the brass motor contacts once the decoder is installed.
6. Re-install the pick up strip in the locomotive. Be careful to install the strip over the alignment pin.
7. Isolate the other brass pick up strip with yellow tape in the same manner.
8. Install the decoder between the motor contacts. Press down and slide the decoder rearward until the decoder locks under the plastic frame clip. Check to make sure the brass pick up strips are still aligned and in the proper position under the decoder.
9. Now is a good time to check that the yellow Kapton tape is properly located to keep the motor contacts from shorting to the edge of the pick up strips.
10. Bend the motor contacts down over the corresponding pads on the circuit board. Install the plastic clip (photo below) to hold the motor contacts tightly against the decoder pads. If the plug is loose you can use a piece of tape to help hold it down on the decoder.
11. Bend the LED down at a slight angle to align it to the plastic light bar inside the locomotive body shell.



12. Reinstall the black plastic cab interior over the LED.
13. Test run the locomotive (see below) before replacing the body shell.

Before test running your newly converted locomotive on full power double check your installation to make sure the motor contacts are fully isolated and that there are no misaligned pick up strips.

We recommend that the first "full power" testing be done on regular DC. The decoders should be driven by a good quality smooth DC power unit. Power packs with pulse power systems such as "tracking control", etc. may give unpredictable operation. Analog operation is included in your NCE decoder so you will be able to run on conventional layouts without having to remove the decoder or rewire your locomotive.

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	**35**	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	**6**	06	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	
39	**8**	08	
40	**16**	10	
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

CV	Default value decimal	hex	Description
69	**0**	0	alt spd table step 3
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

Configuration of CV29 settings:
Table of commonly used values for CV29

Value for CV29 decimal	hex	Long/Short Address	Uploadable/Factory Speed table	Analog (DC) operation	Speed mode
0	2	Short	Factory	no	28/128
6	6	Short	Factory	yes	28/128
18	12	Short	Uploadable	no	28/128
22	16	Short	Uploadable	yes	28/128
34	22	Long	Factory	no	28/128
38	26	Long	Factory	yes	28/128
50	32	Long	Uploadable	no	28/128
54	36	Long	Uploadable	yes	28/128

Hex numbers are provided for early Digitrax users

Notes:

- If you want to reverse the direction of travel on DCC increase the value for CV29 by one (this also reverses all directional lighting).
- If you want to reverse the DC direction reverse the track pickup wires.

Effects programming (and function mapping) examples

Mars Light:
What we want to do:
- ➙ Use output 1 for a Mars light.
- ➙ It is to be on in the forward direction only

How to do it:
- ✓ Configure output 1 as a forward only Mars light. Set CV120 to 137. We get the value of 137 by using 8 (Mars Light) plus 1 (output operates only in forward direction) plus 128 because we have an LED lamp.

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 or 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

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 134 is you want F8 to control the dimming instead of F4.

Switcher:
What we want:
- ➙ Headlight that dims in the opposite direction that the locomotive is travelling

How to do it:
- ✓ Output 1 is 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)

Description of EFX configuration CVs

CV120 - Lighting effect configuration for output 1 (Headlight).
CV121 - Lighting effect configuration for output 2 (Read Light).

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 dierectional in real life.

bit weight	128	64	32	16	8	4	2	1
bit name	LED[1]	---	Effect configuration				REV[2]	FWD[3]

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 - Functions are designed to use 12-16 volt 30-40ma incandescent lamps. If you are using a white LED (with a 1K to 3.3K 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

Description of function mapping CVs:

Function mapping can change which outputs are controlled by a function command from your handheld cab. It is possible to have one command control several outputs. In the table below each row corresponds to a function mapping CV and each column indicates an output number. The **bold** number in a column is the factory default. Programming the CV to the value under an output number will change that output to be controlled by that function number. In the table below the factory value of CV34 is 2 which means F0 will control Output #2. If you want F1 to control output 2 program CV35 to 2. If you want F1 to control both outputs 1 and 2 add the two values for those outputs together (1+2=3) and program CV35 with 3.

Note in this decoder CV33 and CV34 operate identically. They are not directional...directionality is provided in the EFX configuration CV for each output.

Factory default function mapping values

	OUTPUT NUMBER	
	2	**1**
CV33 F0 Fwd	2	**1**
CV34 F0 Rev	**2**	1
CV35 F1	2	1
CV36 F2	2	1
CV37 F3	2	1

Recommend dropping resistors if using 1.5 volt bulbs

	Track Voltage								
Bulb Current	**12.5**	**13**	**13.5**	**14**	**14.5**	**15**	**15.5**	**16**	Wattage
15ma	680	680	720	750	820	820	910	910	¼ watt
30ma	330	360	360	390	390	430	430	470	½ watt
40ma	240	270	270	300	300	300	330	330	1 watt
50ma	200	200	220	220	240	240	270	270	1 watt
60ma	160	180	180	200	200	200	220	220	1 watt
80ma	120	130	130	150	150	160	160	160	2 watt

Fine tuning locomotive operation

The factory settings normally provide good performance for most locomotives in HO-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 a 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

Start Voltage - CV2 (Vstart):
This is the amount of voltage sent to the motor when first starting up. We set CV2 so the locomotive is ***almost*** able to maintain movement at speed step 1. We use CV116 and 117 to apply enough torque compensation to keep it turning on speed step 1. Typical values for CV2 are in the range of 0-35.

Torque compensation (dither) kick rate - CV116:
How *frequently* the motor is 'kicked' at slow speed. Typical adjustment is 2 to 4. The smaller the number the more often the motor gets a brief voltage 'kick'. Factory default is 0 (off). A value of 1 applies kicks continuously. The maximum practical value is about 6.

Torque compensation (dither) 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.

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 'customized' 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 CV117 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.