

## Configuration Variables used by v3.5 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 35 which means version 3.5  
CV8 Manufacturer ID. NCE = 11 (0B hex)  
CV11 Packet timeout value (in 1/2 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 1/4 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.

### Formula for computing the long address if using a Lenz SET01 or SET02:

If using a Lenz SET01, SET02, SET90, SET100 or other entry level system, use paged programming mode and see below for programming long addresses.

CV17 = 192 + (the whole number portion of the long address divided by 256)

CV18 = the remainder after the long address is divided by 256

CV29 = 34 if analog mode disabled, 38 if analog mode enabled

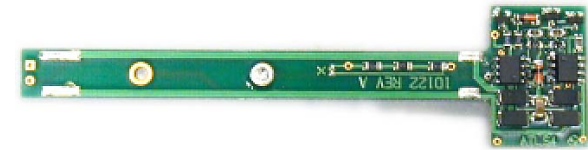
### Decoder Warranty

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 circuits 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, 899 Ridge Road, Webster, New York 14580

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# TTE AtlasS1234

H0 Decoder



## TECHNICAL REFERENCE

Decoder version 3.5

Decoder for easy installation in Atlas Alco S1, S2, S3 and S4 locomotives. This is an EPF (extended packet format) decoder supporting:

- Silent Running(TM) 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)
- Both function outputs have lighting effects generators
- Select from 15 different lighting effects (Mars, strobes, beacon, flicker, etc)
- Lighting outputs can be mapped to different functions
- Uploadable speed table interpolated to 128 speed steps
- Decoder assisted consist
- Support for all forms of DCC programming
- Decoder programming lock mechanism
- Brake on DC feature assists automatic train control

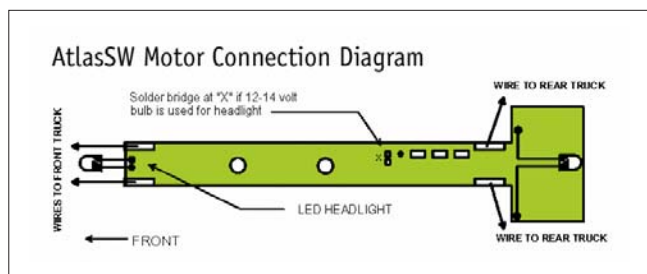


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## General Installation Procedure

Please see the lighting installation options on the following page before actually installing the decoder.

1. Remove the body shell from your locomotive. The cab comes off first then the main body.
2. Unsolder the 4 wires from the existing locomotive circuit board.
3. Unscrew and discard the circuit board.
4. Lift the weight off the motor and place it aside.
5. Place a mark on the motor noting which way is up (this is important).
6. Unscrew the motor from the locomotive frame. There is one 2 mm screw holding the motor to the frame on the bottom of the locomotive. Hold the motor in place while removing the screw so that it doesn't fall out.
7. Carefully lift the motor from the frame (the two drive shafts will fall out, don't lose them)
8. Cut the supplied Kapton(TM) tape to 1.5" long (35mm)
9. Cover the bottom of the motor with the tape. Wrap the excess up both sides and both ends of the motor.
10. Using a sharp tool such as a hobby knife pierce a small hole in the tape to open the screw hole on the bottom of the motor
11. Reinstall the motor into the frame. Don't forget the two drive shafts (tweezers help a lot).
12. Use the plastic 2 mm screw provided with the decoder to fasten the motor to the frame.
13. Replace the upper chassis weight on the motor. The open ended notch in the weight is the front and the open hole should expose the top motor brush.
14. Install the decoder with the "10122 REV A" side up. If you want to use a LED for the rear headlight see the section on connecting the lights to see how to bend the leads and solder it before mounting the decoder.
15. Refer to the motor connection diagram below. There is already a small amount of solder applied to each solder pad on the decoder. Place a truck pickup the wire on its corresponding solder pad and touch your soldering iron to the wire and pad to solder the wire in place. Watch for shorts to the frame or holes on the circuit board!
16. Ensure the decoder is properly seated in the shallow channel of the upper weight.
17. Now is a good time to test the locomotive before replacing the body shell. Double check your wiring and make sure 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. Always test your decoder installation on a current limited programming track before trying it on full track power. If you have a Digitrax, Lenz or MRC system that does not provide current limited programming use a 100 Ohm resistor in series with one of the track leads and listen for the "click" that verifies correct operation as you program the decoder. Test run the locomotive on your main line or test track to verify that it runs correctly. After initial testing is complete it's time put the body shell on the chassis and switch some cars.



## Factory Default Values for Decoder Configuration Variables (CVs)

CV	Default value decimal	hex	Description	CV	Default value decimal	hex	Description
1	3	03	short address	69	0	0	alt spd table step 3
2	0	00	start voltage	70	0	0	alt spd table step 4
3	0	00	acceleration	71	0	0	alt spd table step 5
4	0	00	deceleration	72	0	0	alt spd table step 6
5	0	00	maximum speed	73	0	0	alt spd table step 7
6	0	00	mid speed	74	0	0	alt spd table step 8
7	35	23	decoder version	75	0	0	alt spd table step 9
11	0	00	Packet timeout value	76	0	0	alt spd table step 10
15	0	00	Programming "key"	77	0	0	alt spd table step 11
16	0	00	Programming "lock"	78	0	0	alt spd table step 12
17	192	C0	long address high byte	79	0	0	alt spd table step 13
18	0	00	long address low byte	80	0	0	alt spd table step 14
19	0	00	consist address	81	0	0	alt spd table step 15
21	255	FF	consist functions F1-F8	82	0	0	alt spd table step 16
22	63	3F	consist function FLF,FLR	83	0	0	alt spd table step 17
23	0	00	acceleration adjust	84	0	0	alt spd table step 18
24	0	00	deceleration adjust	85	0	0	alt spd table step 19
29	6	06	decoder configuration	86	0	0	alt spd table step 20
30	0	00	error/reset register	87	0	0	alt spd table step 21
33	1	01	Output(s) controlled by F0	88	0	0	alt spd table step 22
34	2	02	Output(s) controlled by F0	89	0	0	alt spd table step 23
35	4	04	Output(s) controlled by F1	90	0	0	alt spd table step 24
36	8	08	Output(s) controlled by F2	91	0	0	alt spd table step 25
37	16	10	Output(s) controlled by F3	92	0	0	alt spd table step 26
38	4	04		93	0	0	alt spd table step 27
39	8	08		94	0	0	alt spd table step 28
40	16	10		95	0	0	reverse trim
41	0	0	not used	116	0	0	torque kick rate
42	0	0	not used	117	0	0	torque kick strength
67	0	0	alt spd table step 1	118	20	14	ditch light hold time
68	0	0	alt spd table step 2	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.

## Description of EFX configuration CVs

**CV120** - Lighting effect configuration for output 1 (headlight).  
**CV121** - Lighting effect configuration for output 2 (rear 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 directional in real life.

bit weight	128	64	32	16	8	4	2	1
bit name	LED <sup>1</sup>	---	Effect configuration				REV <sup>2</sup>	FWD <sup>3</sup>

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	Gyalight	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

- Functions are designed to use 12-16 Volt 30-40 mA incandescent lamps. If you are using a white LED (with 1K limiting resistor) add 128 to the CV value.
- If you want the function to be active only in the reverse direction add 2 to the CV value
- If you want the function to be active only in the forward direction add 1 to the CV value

## Wiring the Lights

**There are two options available for wiring the Headlight:**

- LED (white preferred):* Solder a white LED (part number CMD204UWC-ND from Digikey Electronics 1-800-DIGIKEY or Miniaturics part number 12-300-02) to the solder pads at the front of the decoder. The long lead (anode) of the LED solders to the square pad of the decoder. There is already a 1.5 k resistor installed on the decoder for the LED.
- 12 or 14 Volt bulb:* Wire a 12 - 14 Volt bulb to the two holes at the front of the decoder. Create a solder “bridge” between the two solder pads marked with an “X”. This will connect the function output directly headlight bulb bypassing the three ‘471’ (470 Ohm) resistors on the top of the decoder circuit board . Due to the high inrush current of incandescent grain-of-wheat type bulbs (about 10 times the normal operating current) function outputs are rated at 40 mA each. We recommend Miniaturics part number 18-014-10 (2.4 mm diameter 14 Volt/30 mA) or number 18-712-10 (1.7 mm diameter 12 Volt/30mA) bulbs for good results.

**There is one option for wiring the Rear Light:**

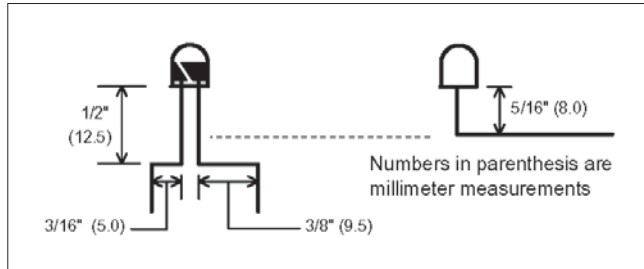
- Use a LED:* Use the diagram (next page) to bend the LED leads prior to soldering to the decoder circuit board. The holes for the rear light are indicated on the motor connection drawing above. The following diagram is approximately full size. Bend the leads as shown in the left half of the diagram noting the polarity of the LED. The anode (longer lead) is on the left. Next, orient the LED as shown in the left half of the diagram and bend the free end of the leads down at a point 5/16” from the LED body as indicated in the right half of the diagram. The ‘horizontal’ portions of the leads should be about 1/8” (3 mm) off the surface of the circuit board. After soldering trim the excess lead length from the bottom of the decoder. Make sure the bare leads do not short to any components on the decoder top.

## 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



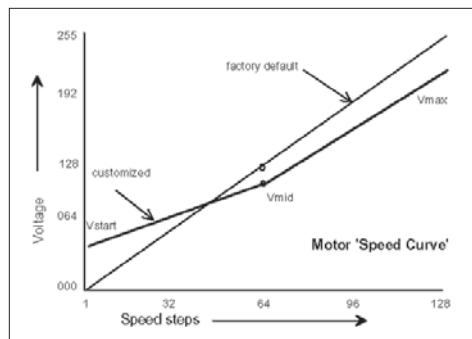
Wiring the Rear Light

**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 then 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 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 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 1/2 full voltage to the motor at top speed. 192 will provide about 3/4 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 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.

## Effects programming (and function mapping) examples

### Mars Light

What we want to do:

- Use output 2 (yellow wire) for a Mars light.
- It is to be on in the forward direction only

How to do it:

- Set Output 2 is to be activated by F1, set CV35 to 2
- Make sure F0 no longer controls output 2, set CV34 to 0)
- Configure output 2 as a forward only Mars light. Set CV121 to 9. We get the value of 9 by using 8 (Mars Light) plus 1 (output operates only in forward direction)

### 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 to 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 32 (20 hex). You can optionally set CV120 to 36 if 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 44 (2C hex).
- Configure output 2 as bright in reverse, dim in forward. Set CV121 to 40 (28 hex).