

Technical Reference

**POWER PRO™**  
Digital Command Control

ATLS4

Drop-In Decoder

(soldering required)

Version 3.3

**\$29.95**

This decoder is custom designed for installation in  
**Atlas S1 S2 S3 and S4 HO Locomotives**

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

- , Silent Running™ High frequency motor drive eliminates motor hum or buzz
- , Programmable Start, Mid and Maximum speed works for all speed modes
- , Motor rating 1.3 Amp continuous, 2 Amp peak (stall)
- , Two function outputs each with an independent effects generator
- , Select from 14 different lighting effects (Mars, strobes, beacons, etc)
- , Two or Four digit addressing
- , Uploadable speed table interpolated to 128 speed steps
- , 28 and 128 Speed mode operation (always works internally at 256 steps)
- , Decoder assisted consisting
- , All forms of operations mode programming (programming on the mainline)
- , All forms of service mode programming (programming track)

Every attempt has been made to ensure this decoder complies with all applicable NMRA Standards and Recommended Practices. NMRA Conformance test results on this decoder are available on our website at [www.ncedcc.com](http://www.ncedcc.com)

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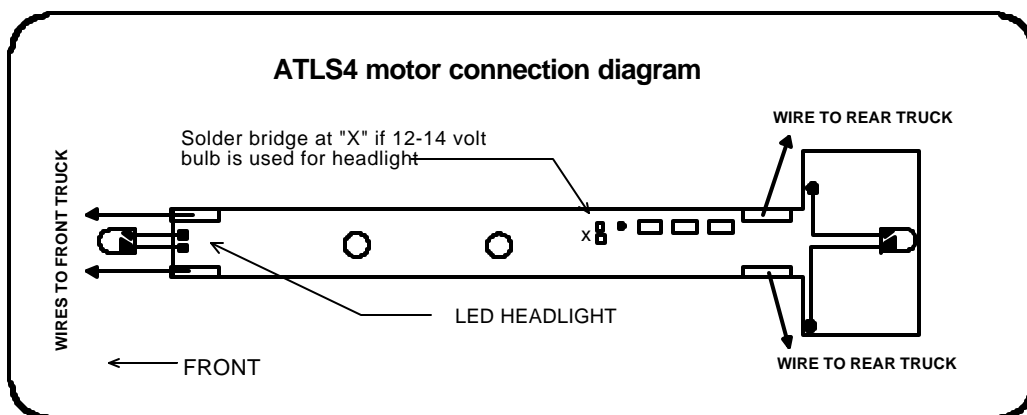
Last revised: 13 March 2002

## General Installation Procedure:

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

**DO NOT REMOVE** the small thin strip of brass that runs through the front hole in the decoder circuit board. It is fastened to the decoder by tape on the bottom of the circuit board.

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 2mm 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™ 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. Re-install the motor into the frame. Don't forget the two drive shafts (tweezers help a lot).
12. Use the **plastic 2mm 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 an 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.



## 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 .

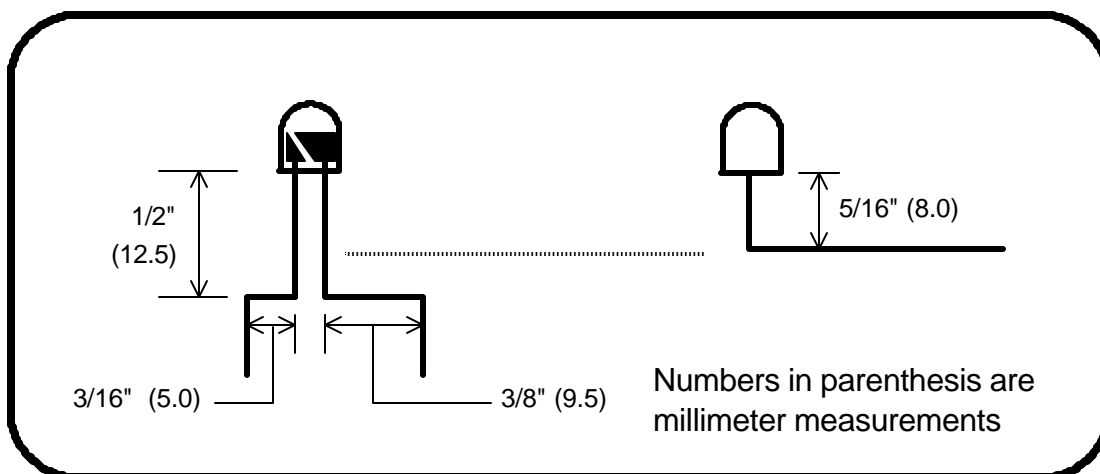
Due to the high in-rush current of incandescent grain-of-wheat type bulbs (about 10 times the normal operating current) function outputs are rated at 40mA each. We recommend Miniaturics part number 18-014-10 (2.4mm diameter 14 volt/30mA) or number 18-712-10 (1.7mm diameter 12 volt/30mA) bulbs for good results.

### There are is one option for wiring the Rear Light:

- **Use an LED:**  
Use the diagram below to bend to LED leads prior to soldering to the decoder circuit board. The holes for the rear light are indicated on the motor connection drawing (previous page).

The diagram below 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 belt leads should be about 1/8" (3mm) 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

You may want to improve or fine tune performance by adjust the starting characteristics or top speed .

### There are five CVs that define:

- The voltage at which the motor starts
- How much 'kick' the motor gets to start it turning
- The maximum speed
- The response characteristics or 'speed curve'.
- The frequency of the drive pulses to the motor

### Start Voltage - CV2 (Vstart):

Before programming the start voltage we recommend programming CV65 (Kick Start) to zero. Kick start is used to overcome the 'stiction' of the motor by giving it a voltage 'kick' when starting from a stop. We don't want it getting in the way of setting Vstart.

We prefer using Operations Mode Programming (Program on the Main) to set CV2 so the locomotive is **just able** to maintain movement at speed step 1. You can also use the programming track... it just takes a bit longer to find the right setting for CV2.

### Kick Start - CV65

After the start voltage is set . Program CV65 to provide a smooth and reliable start when you advance the throttle from stop. The high frequency drive pulses of the D408SR act more like smooth DC voltage than the low frequency pulses of a standard decoder making it harder for the decoder to overcome that starting 'stiction' of the motor. This is why the Kick start CV is needed.

If the value is too low the motor will not start moving reliably, too high and the locomotive will lurch or leap as it starts.

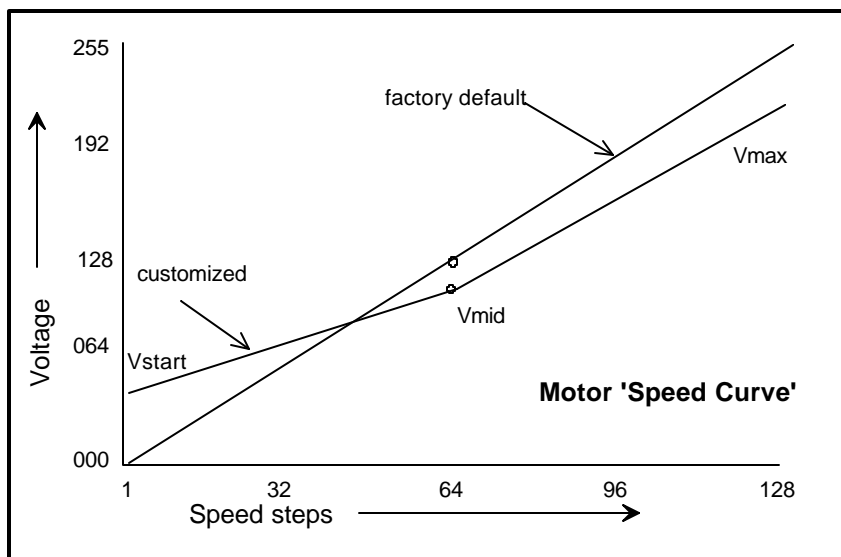
### Vmax - CV5:

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 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.

**Motor Drive Frequency - CV9:** When CV9 is set to 0 the Silent Running™ motor drive frequency of 15,625 Hz is used. If a value of 1-255 is programmed into CV9 the motor drive frequency will be calculated by the formula:  $\text{Frequency} = 1/(\text{CV9} * .000128)$ .



## Description of EFX configuration CVs

CV120 - Lighting effect configuration for output 1 (headlight).

CV121 - Lighting effect configuration for output 2 (rearlight).

Each output 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.

<b>bit weight</b>	128	64	32	16	8	4	2	1
<b>bit name</b>	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	reserved	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 <i>and</i> F2 on, bright if F0 on <i>and</i> F2 off, off if F0 off	38
60	Type 1 Left Ditch light, effect if F2 <i>and</i> F0 on, bright if F0 on <i>and</i> 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 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

## Description of function mapping CVs:

*Function mapping* can change which output wire(s) are controlled by a function command from your handheld cab. It is possible to have one command control several outputs. In the tables below each row corresponds to a function mapping CV and each column indicates an output number. A '1' under an output number means that output will be controlled by the function corresponding to the row. In the table below the factory value of CV33 is 1 which means F0 will control Output #1.

Example: Say you have output 4 set to be a Mars Light (CV123=8) and you want it to come on when the headlight (F0) is on. In the CV33 row place a '1' in Output 4 column, there is already a '1' in the Output 1 column. Now F0 will control both Output 1 and Output 4. To calculate the value that goes in to CV33 just add up the 'bit weights' for each column that has a '1' in it. In the case of our example the value will be 9. F3 has been set at the factory to control Output 4 so you may want to put 00 in to CV37 to make sure Output 4 (Mars light) doesn't come on by accident if F3 is activated.

There are more examples of function mapping on page 7.

The tables below show the original factory settings for each mapping CV. The NMRA recommended practices do not provide for mapping all functions to all outputs. The tables below are the prescribed function mapping dictated by NMRA RP-9.2.2. 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**

<b>OUTPUT NUMBER</b>	<b>2</b>	<b>1</b>
<b>Bit weight CV33-CV37</b>	<b>2</b>	<b>1</b>
CV33 F0 Fwd	0	1
CV34 F0 Rev	1	0
CV35 F1	0	0
CV36 F2	0	0
CV37 F3	0	0

## Function mapping and effects programming examples

### 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 32 (20 hex). You can optionally set CV120 to 36 is you want F8 to control the dimming instead of F4.
- ✓ Configure

### 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 40 (28 hex)
- ✓ Configure output 2 as bright in reverse dim in forward . Set CV121 to 44 (2C hex)

## Factory default values for decoder Configuration Variables (CVs)

CV	Default value		Description
	decimal	hex	
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
9	0	00	PWM frequency
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	reset/error 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	Output(s) controlled by F4
39	8	08	Output(s) controlled by F5
40	16	10	Output(s) controlled by F6
41	32	20	Output(s) controlled by F7
42	64	40	Output(s) controlled by F8
65	0	00	Kick start
67	2	02	alt spd table step 1
68	5	05	alt spd table step 2
69	7	07	alt spd table step 3

CV	Default value		Description
	decimal	hex	
70	12	0C	alt spd table step 4
71	16	10	alt spd table step 5
72	21	15	alt spd table step 6
73	26	1A	alt spd table step 7
74	30	1E	alt spd table step 8
75	35	23	alt spd table step 9
76	40	28	alt spd table step 10
77	47	2F	alt spd table step 11
78	51	33	alt spd table step 12
79	58	3B	alt spd table step 13
80	65	41	alt spd table step 14
81	72	48	alt spd table step 15
82	79	1F	alt spd table step 16
83	84	54	alt spd table step 17
84	93	5D	alt spd table step 18
85	100	64	alt spd table step 19
86	112	70	alt spd table step 20
87	121	79	alt spd table step 21
88	135	87	alt spd table step 22
89	147	93	alt spd table step 23
90	161	A1	alt spd table step 24
91	177	B1	alt spd table step 25
92	196	C4	alt spd table step 26
93	219	DB	alt spd table step 27
94	255	FF	alt spd table step 28
118	20	14	Ditch light hold time
119	255	FF	EFX page access
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

## **Configuration Variables used by ATLS4 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 128  
**CV7** Manufactuer ID. NCE = 11 (0B hex)  
**CV8** Decoder version number. This decoder is 32 which means version 3.2  
**CV9** Motor drive frequency  
- 1-255 = PWM drive frequency period in 128uS increments,  
- 0 = PWM frequency is 15,625 Hz  
**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. Bits 0-7 control F1-F8 respectively  
- each bit 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  
**CV23** acceleration rate adjust (in 7mS increments) this value is added to CV3  
**CV24** deceleration rate adjust (in 7mS increments) this value is added to CV4  
**CV29** - bit 0 1= direction of operation is reversed, 0= direction is normal  
- 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 1,3,6,7 are ignored by the decoder  
**CV33-CV42** function mapping CVs for F0-F8  
**CV65** Kick start - number of 1/1000s of a second to 'kick' motor when starting  
**CV67-CV94** Uploadable speed table steps 1-28 (128 speed mode calculates intermediate steps)  
**CV118** Ditch light hold time (in ¼ second increments) after F2 goes off.  
**CV119** Lighting effects page. Must be set to 255 for access to CVs120-127  
**CV120-CV121** Effects configuration registers for outputs 1-2

**CV NOTES:** All CV numbers not listed above are ignored.

**PROGRAMMING TRACK INFORMATION:** This decoder complies with NMRA RP-9.2.3 for all forms of paged, direct (bit and byte) and register mode programming.

**Ops mode programming (Programming on the Mainline):** Decoders do not respond to the long form ops mode programming instructions at their consist address (per RP-9.2.1). This is to avoid setting CV29 while in a consist then later wondering why the decoder now only responds to it's long address rather than the short or vice-versa.

**Tip for using consists and long (4 digit) addresses:** leave CV1 set to 3, or some other conveniently remembered address and only use the extended address (CV17, CV18) set to your desired value. This avoids mixing up normal 'short' addresses with consist addresses.

### **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 (an any payment, if required) to:

**NCE Warranty Center**

**899 Ridge Road**

**Webster, New York 14580**

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