

Decoder Installation Considerations

Before we can attempt to fit a decoder to a locomotive we have to consider the following:

1. Loco condition
2. Motor Ampere draw test
3. Decoder selection
4. Location planning
5. Pre installation tests
6. Wiring diagram
7. Loco preparation
8. Decoder preparation
9. Tests during installation
10. Post installation tests
11. Trouble shooting
12. No matter how eager you are to get that unit going - **TAKE YOUR TIME** and do not skip a step!

1. Loco condition

- 1.1 Is it a good runner
- 1.2 Remember DCC cannot improve the performance of a bad runner - it can only make a good runner perform excellent!
- 1.3 Insure that there is no mechanical binding in gear towers or valve gear?
- 1.4 Are all current pick-up wheels clean?
- 1.5 Do we have a good current pick-up path?

2. Motor Ampere draw test

- 2.1 The decoder must have an amp rating in excess of the locos amp draw under stall condition
- 2.2 To determine this amp draw place the loco on a dc test track fitted with a volt and amp meter. Remove the loco's body and while holding the flywheel or drive shaft wind up the control rapidly for a short period to max 12-14VDC. Read the amp drawn and multiply by 1.2 to give you the desired decoder rating in amp continuous.

3. Decoder selection

- 3.1 PnP - PC board replacement – (Atlas/Kato RS4/5)
- 3.2 PnP - NMRA 8-Pin Plug – (KATO SD50)
- 3.3 JST 9 Pin Harness – (Athearn Genesis Diesel/Steam)
- 3.4 Hardwire – (Lima Electric/Diesel)
- 3.5 Amp rating
- 3.6 Physical size

4. Location planning

- 4.1 This is usually the most time consuming aspect and really one needs to take ones time. Once you started to modify a unit it is usually too late to change course of action!
- 4.2 Ideally the decoder should get plenty of fresh air!
- 4.3 Where/how do we route the wires?
- 4.4 What do we do with wires not used?

- 4.5 What lights have to be connected & how?
- 4.6 Any other functions to be connected like smoke unit, sound generator etc.

5. Pre installation tests

- 5.1 In order not to invalidate the manufacturers warranty we need to test the decoder as per the instruction card in the decoder packing.
- 5.2 The loco's motor brushes must be checked for a totally open circuit with a multi meter
- 5.3 Test the electrical path from the wheel to the point where the decoder leads are to be attached with a continuity meter

6. Wiring Diagram

- 6.1 Carefully study the diagram provided in the decoder packet, and plan the connections correctly based on colour coding.
- 6.2 Remember Red will connect to RH rail viewed in direction of travel.
- 6.3 Right/Red/Orange/+
- 6.4 Left/Black/Grey/-
- 6.5 The motor plus on a DC (Analog) loco is always the one, which is connected to the RH rail.
- 6.6 Light/Function connections if applicable.

NMRA - DCC Plug Assignments

Orange / Motor + * 1	●	●	8 Right track / Red
Yellow / Rev.light 2	●	●	7 Function + / Blue
Extra Function** 3	●	●	6 Fwd.light / White
Black / Left track 4	●	●	5 Motor - / Grey

* Pin 1 may be indicated by ▸ or •

** No connection, - Green/Violet/Brown - not used.

TABLE I: Digitrax Mobile Decoder Wire Colors

What the wires are for	Wire Color
Power Pick-up Right (Engineer's Side)	Red
Power Pick-up Left (Fireman's Side)	Black
Motor + Right Brush	Orange
Motor - Left Brush	Gray
F0(Fwd)-Forward Light	White
F0(Rev)-Reverse Light	Yellow
Lamp Common	Blue
F1-Function 1	Green
F2-Function 2	Violet
F3-Function 3	Brown
F4-Function 4	White w/ Yellow Stripe
F5-Function 5	White w/ Green Stripe
F6-Function 6	White w/ Blue Stripe

Figure 1: Digitrax Decoder Wiring Diagram

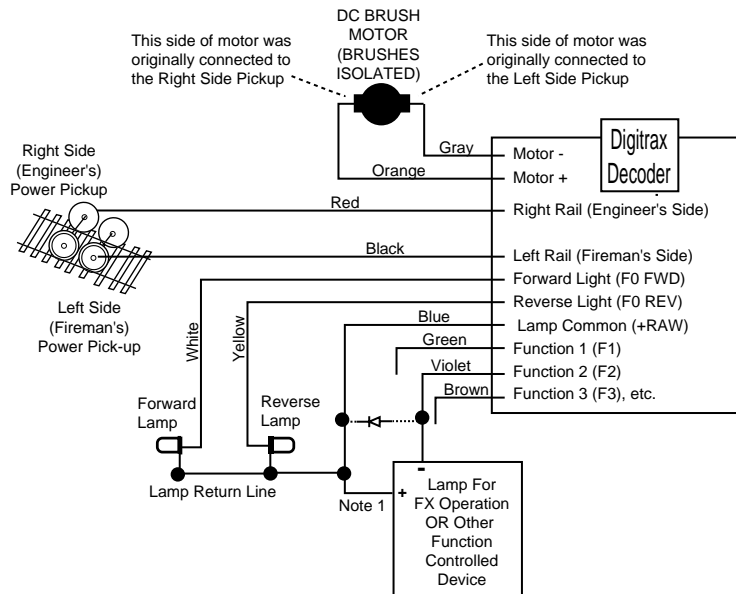


Figure 1 Notes:

Do not exceed the decoder's total function output current rating. If lamp common is not used, connect function power to either track power pick up. The directional light function "Lamp Return Line" can be hooked to lamp common as shown or to either track pick-up.

See **Figure 2: Lamp Wiring Specifics** for details of wiring 12-16V lamps, 1.5V lamps and LEDs for use with and without the lamp common wire.

Figure 2: Lamp Wiring Specifics

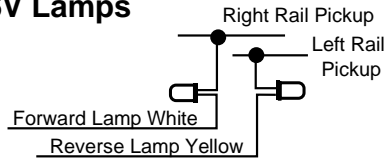
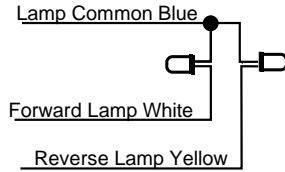
Operation with Lamp
Common Connected

Operation without Lamp
Common Connected

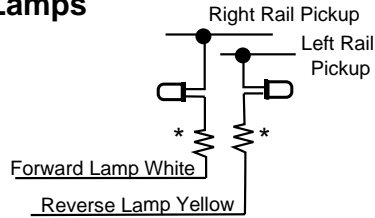
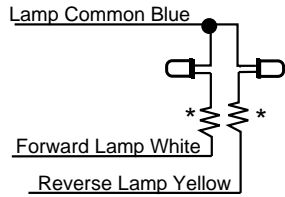
Lamp brightness won't be affected by operation of analog locos on the layout. This is the preferred wiring method but, in some locomotives (particularly in N-Scale and smaller HO units) it may not be convenient to wire the lights with lamp common.

Lamp brightness will change depending on the direction of the analog locomotive being operated on the layout. If you don't run analog engines on your layout, you won't notice any difference between these two ways of connecting the lights.

12V to 16V Lamps

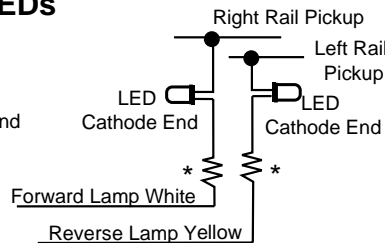
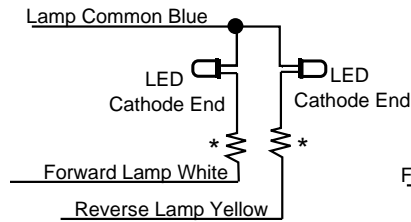


1.5V Lamps



*Note: Current setting resistor to suit the lamp used. Typically 560 ohm 1/4 watt for grain of rice and 250 ohm 1/4 watt for grain of wheat. Lower resistance values will increase the lamp brightness, minimum value is 100 ohms.

LEDs



* Note: LEDs are sensitive to polarity when hooked up. Typical resistor 680 ohm 1/4 watt.

Transponder equipped decoders must be hooked up with lamp common connected for proper operation.

7. Loco preparation

- 7.1 Depending on the type of decoder selected the loco may have to be worked on to make space for the decoder.
- 7.2 If any machining (dremmeling) is required the total disassembly of the chassis is required and all parts must be washed after machining to ensure no cuttings get into gears, electric connections or pierce wire isolations.

8. Decoder preparation

- 8.1 Measure what length each of the harness wires has to be, trim and pre tin the ends with rosin core solder
- 8.2 We need some electrical or masking tape to bundle wires and keep them out of harms way
- 8.3 We need double-sided sticky tape (mirror tape) to hold the decoder in place.
- 8.4 We need shrink tubing to insulate spliced connections and we can also use it to protect ends of unused wires, or to bundle long wires.

9. Tests during installation

- 9.1 Check for solder splats bridging traces or contacts
- 9.2 Ensure no wires are pinched or squashed
- 9.3 Ensure no wires are touching any mechanism or flywheels
- 9.4 Double and treble check that you connected the correct colour wire to the correct point

10. Post installation tests

- 10.1 If a decoder with a JST plug is fitted remove the decoder from the harness and test for an open circuit between all contacts – then fit a dummy plug and test run on a DC track.
- 10.2 Test run the loco with decoder fitted on a DC track - she should run in the correct direction albeit needing a slightly higher control setting.
- 10.3 If direction or light operation is incorrect re-check motor connections orange & gray and rail pick-up red & black.

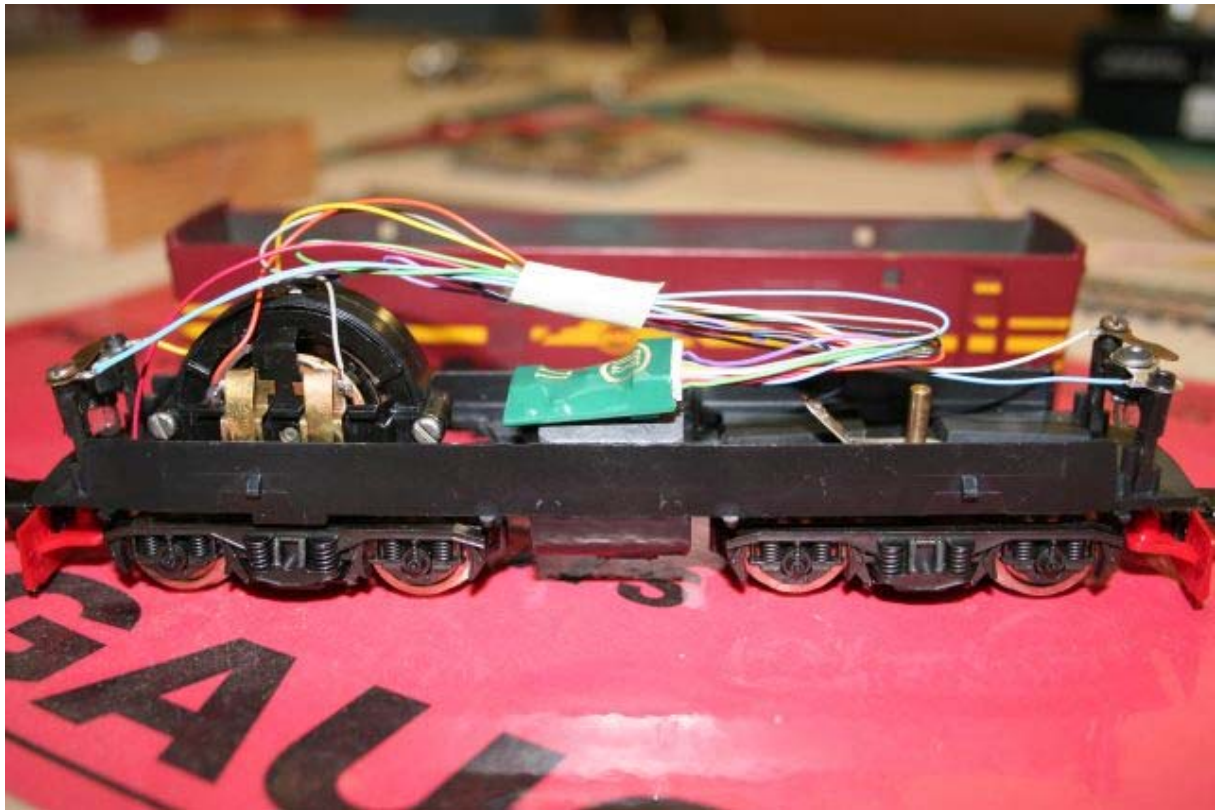
- 10.4 If everything checks out you may take it to the DCC track programming track and program the primary address. If there is a problem with your install the programmer will return an error code.
- 10.5 You now can place the loco on a DCC powered track for a test run under DCC
- 10.6 If on placing the loco on the DCC track both headlights come on and blink steady, take it off immediately and re-check your install for a short between decoder leads.
- 10.7 With your Throttle select the loco's address and switch on the headlight.
- 10.8 At last you are ready to go on your test run.

11. Trouble shooting

- 11.1 If you followed above steps explicitly you should not experience any malfunctions or failures.
- 11.2 However if you do - start at step one again and follow each step once more checking that you done as planned.
- 11.3 Your two biggest enemies here are complacency and an attitude of "I've done it exactly as the instructions say".



Atlas (Kato) RS1 fitted with Digitrax PnP DH150 decoder during the presentation



TCS Decoder Fitted to a Lima SAR Class 5E1 Electric Unit

Please Note:

Contrary to the advice given in point 12 below, this conversion was done quickly during the demo to be able to demonstrate the operational tests of the decoder installation in the short time available. Although the installation is electronically and mechanically sound one would possibly shorten the decoder harness wires to make the install look neater, even though this will not be visible once the body is put back on the chassis.

12. No matter how eager you are to get that unit going - TAKE YOUR TIME and do not skip a step!

13. Forthcoming attractions:

13.1 Watch this space for the next installment on CV programming.

Presented to SAG on 21.04.2007 by John Burkhardt

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