The DIGITAL plus STANDARD+ locomotive decoder is suitable for all DC locomotives with continuous current draw of 1.0 Amp. or less. The characteristics of the decoder are:

* Super smooth and silent high frequency back-emf motor control
* Full RailCom NMRA DCC Bi-directional support
* Three function outputs rated at 100mA each
* Each function output supports F0-F28 with simplified function mapping
* Directional or independent lighting with dimming and special effects.
* Support for automatic uncoupling control
* Adjustable precision stopping control
* Low speed gear for switching operations
* Selectable for operation with 14/27, or 28/128 speed steps
* Operation on conventional DC layouts is possible or can be disabled
* Motor output = 1A continuous, 1.8A max, > 5 A stall.
* Motor and function outputs protected
* Support for Advanced Consist Control and Extended Addressing
* Support for programming on the mainline (operations mode programming)
* Support for all form of programming as described in NMRA RP-9.2.3
* Supports service mode decoder lock
* Size: L 1.0" x W 0.61"x H 0.13" L 25mm x W 15.4mm x H 3.3mm

STANDARD+ Silent-Back EMF DCC Decoder

Art. No. 10231-01
Ed. 2 August 2009

Digital plus by Lenz®

STANDARD+ features

The following contains a short introduction of the features of the STANDARD+ decoder as well as information on how to use them.

Capacity and protection equipment

The motor output has a current-carrying capacity of up to 1A . The short-term maximum current-carrying capacity is 1.8A. The decoder is protected against short circuits. In case of a fault, a bit is set in CV30, defining the type of fault that occurred. This bit can be cleared via setting this CV30 to 0. This protection allows the STANDARD+ decoder to work with motors that have very high stall currents.

Maximum continuous current-carrying capacity of total decoder	1.0 Amps
Motor output - Continuous / peak motor / locked rotor stall	1.0 Amps / 1.4 Amps / > 5 Amps
Function output A, B, and C	100 mA each
Total current-carrying capacity of function outputs	300 mA

High Frequency Back EMF Motor control

STANDARD+ decoders have a very smooth and quiet high-frequency motor control (23kHz). If necessary, the performance of the decoder can be optimized to one of 6 specific motor types in the locomotive using CV50. These motor types include parameter sets which have been specially adapted to the respective models. In addition, it is possible to perform additional fine-tuning via CV113 or CV114 when selecting motor types 4 or 5. If desired you can switch off both the high-frequency drive as well as the control system itself. You can still use CV9 to adjust the repetition rate.

The minimum (CV2), maximum (CV5) and mid (CV6) speeds can be set; automatically adapting the speed parameters dynamically to ensure a smooth curve. (User defined unique speed curve, also supported).

The decoder also has what we refer to as a EMF switch which makes it possible to further adjust the decoder to different motor types. Depending on the motor type used, it is possible that a digitally controlled locomotive cannot reach an adequate maximum speed compared to a locomotive in conventional operation. If this is the case, activate your EMF switch by setting Bit 6 in CV 50. The locomotive will then reach a higher maximum speed while the minimum speed is also slightly increased.

Special Features

Function F4 (function assignment can be altered in CV59) is used to disable the acceleration and braking delay as well as the constant braking

distance during operation. The delays are disabled as long as the function is active.

Switching speed function

The switching speed halves the current speed facilitating particularly sensitive control during the switching process. Use function 3 (function setting, can be altered in CV58) to enable and disable the switching speed. If the switching speed is enabled, the constant braking distance is disabled. Switching speed is enabled as long as the function is active.

Constant braking distance

During the transition from an active speed step to speed step 0 (e.g. moving the speed control knob to the left limit-stop (LH90)), the locomotive can travel a settable, pre-defined braking distance. This braking distance does not depend on the speed of the locomotive/train.

Enable the constant braking distance function (this requires setting Bit 0(1) in CV51. If this bit is not set, the decoder will use the normal speed-dependent braking delay.

The braking distance is defined by the value set in CV52. Since the motors and gear ratios of locomotives vary, the braking distance differs from locomotive to locomotive even if the same value is set in CV52.

Use a short test section to measure how long your locomotive's braking distance will be with a given value set in CV52. Start with the default value (100) in CV52.

Accelerate your locomotive until it has reached average speed.

At a chosen point in time, set the speed to 0 using the LH90's rotary throttle or the < key on the LH100, until the speed is set to 0 (if using the LH100, do not press key <>! (This results in a locomotive-specific emergency stop and the delays in the locomotive decoder will not be enabled!).

Measure the covered braking distance, then increase or decrease the value in CV52 (in steps of 10) and carry out another measurement. You will thus create a table which will indicate the braking distances in relation to the values set in CV52.

Important advice: The constant braking distance is only effective if the speed is changed to 0. If the speed is decreased from e.g. 28 to 10, the speed-dependent delay from CV4 becomes effective.

The constant braking distance is disabled while the switching speed function is switched on (default setting F3), or if the function to disable acceleration/deceleration is activated (default setting F4). Either of these two features can also be used if you wish to interrupt a constant braking process prematurely. Note: The constant braking distance does not function in analogue DC mode.

Mapping function outputs

For each function output you can define which DCC function is used to switch the function outputs on or off. The outputs A, B and C can be allocated to function F0 and F1 (direction-dependent) or functions F2 to F28 as desired. This is allocated in CVs 33 to 47 and CVs 129 to 144.

Lighting effect at function outputs

The lighting effect for the function outputs A and B is set in CV60 and for the function output C in CV62. If you wish to switch the effects with a function of the digital system, you can make the allocations to functions F1 to F8 in CV61 (for function outputs A and B) and CV64 (for function output C). The effects available are shown in the table of the supported CVs further below.

RailCom

The STANDARD+ is equipped with RailCom technology. In addition to the locomotive address, other data (e.g. speed, CV content) can be transmitted from the locomotive via the track back to the system. The information sent is received by a RailCom detector and then displayed. Which data the decoder is to send is set in CV28. Set Bit 4 in CV29 to enable the transmission function.

Installing the STANDARD+ decoder

A locomotive that runs well under DC will run exceptionally well under DCC. Replace worn out motor brushes and burned out light bulbs. Clean any dirt or oxidation from the wheels and pickups, and make sure that electrical contact is good. Now is also a good time to lubricate your locomotive.

Some advice on installing the decoder:

Although the STANDARD+ decoder has many internal safeguards to prevent damage, you must not allow any metal part of the locomotive to touch the surface components of the decoder. This could cause a direct internal short circuit and the decoder will be destroyed. **The motor brushes MUST also be completely isolated from the rail pickup**. Achieving isolation may require some different approaches on different locomotives, perhaps unsoldering wires or placing a thin piece of insulating plastic between the motor and the locomotive frame. If you have a VOM, check for infinite resistance between the motor and all the wheels. Take special note that a short might occur when the loco body is reinstalled.

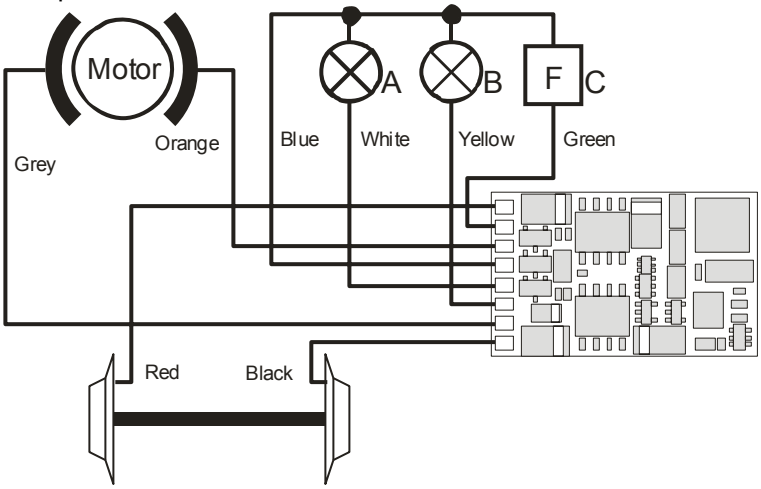
DO NOT WRAP decoder with electrical tape or shrink wrap!

Doing so will impede air circulation and degrade the performance of the decoder. Instead, put electrical tape over any part of the locomotive frame or body that might touch the decoder and use double sided foam mounting tape to mount the decoder. This will prevent short circuits without 'suffocating' the decoder.

The STANDARD+ decoder can not be set up for simultaneous use for 2-rail pickup and overhead cantenary or trolley operation. If the locomotive is turned the wrong way, the decoder could get twice the track voltage, which would destroy it!

Wiring Options

There are two wiring options for installing the STANDARD+, depending on how the locomotive is constructed. The functions could be connected with their common to the decoder's floating common (blue wire) as shown below or one rail can be used as a common. A mixture of both options is also possible.



If the bulbs for the directional headlights are floating (isolated against wheel pick up and chassis) and connected according to above figure, they will shine brighter compared to using the rail as a common and the directional headlights will function while operating on conventional DC layouts.

Step by Step Installation

If the locomotive has a NMRA 8 pin socket and the decoder has a 8 pin NMRA medium plug harness, simply remove the dummy plug from the locomotive's socket and plug in the decoder. The following instructions apply if you need to install the wired version.

Two wires connect the decoder to the motor. Make sure that the motor is electrically isolated from both track pickups:

- Orange wire to the motor terminal that was previously connected to the right rail (Pin #1).
- Gray wire to the motor terminal that was previously connected to the left rail (Pin #5).

Two wires connect the decoder to the track electrical pickups:

- Red wire to right rail pickup (Pin #8).
- Black wire to the left rail pickup (Pin #4).

Four wires connect the headlights and functions to the decoder:

- White wire (Pin #6) to the forward headlight or the function controlled by Output A. If the bulb is isolated, connect the blue wire (Pin #7) to the other terminal.
- Yellow wire (Pin #2) to the rear headlight or the function controlled by Output B. If the bulb or function is isolated, then connect the blue wire (Pin #7) to the other terminal.
- Green wire (Pin #3) to function controlled by Output C. If the bulb is isolated, connect the blue wire (Pin #7) to the other terminal.

NOTE: For the connection of the LEDs, note that the blue cable is the positive pole (anode side of the LED) and the function output is the negative pole (cathode side of the LED). The voltage at the function output is approx. 16 V. Please do not forget the necessary protective resistor.

Place the locomotive on the programming track (without its shell) and read the address. ***Do not subject the locomotive to full voltage track power until you obtain the correct "03" address read-out.*** The decoder is programmed factory default to the address 03. If you have connected the decoder correctly thus far, you should now be able to read the address. If you are not able to do so, it is possible that you have made a mistake when connecting the cables. Check the cable connections and change them as required.

Configuring the STANDARD+ Decoder

The locomotive address, acceleration and deceleration delay, and all other features of the locomotive decoder can be changed as often as desired by reprogramming the decoder. The features are "stored" permanently in special locations. These locations are called "configuration variables" or simply "CVs". The values are configured electronically, which means that it is not necessary to open the locomotive again after the decoder has been installed.

You can alter the content of CVs both through "Programming in operational mode (PoM)" (except for CV1, CV17 and CV18) or "Programming on the programming track". For detailed instructions on how to program using the above-mentioned devices, please refer to the operating manuals which accompany those devices.

The decoder is programmed from the factory for operation with address 3 and 28 speed steps. The decoder can be used with these basic CVs as purchased. All configurations can, of course, be changed.

Resetting the decoder

If you wish to reset all the decoder CVs to its factory setting, enter value 33 in CV8. The CVs of a connected S.U.S.I. module are not reset!

*Please note: Some CVs (such as CV29) have specific meanings for each bit. The bit assignments in this table use a bit numbering scheme of 0-7 to correspond the NMRA convention for universal bit numbering. Many handhelds (such as the DIGITAL plus LH100 handheld) use a scheme of 1-8 to refer to the individual bits rather than 0-7. (Bit 0 in this table is displayed as a"1" on LH100 handheld, Bit 1 is identified as "2".) The bit numbers in **()** within these tables contain the LH100 bit numbers.*

**Note: in the range field the numbers in the [ ] are decimal.

CV	Value / Bit	Meaning	Factory Settings
1	1-127	Basic locomotive address. This number is used to call up locomotives in the Digital plus by Lenz ® system. The use of range 1-99 is recommended for operation with Digital plus by Lenz® devices. When writing this CV, CV19 (multiple traction address) is automatically deleted in the decoder and Bit 6 (use of extended address) is deleted in CV29.	3
2	0-255	Minimum speed (starting voltage) Vmin	1
3	0-255	Starting delay	6
4	0-255	Braking delay	5
5	0-255	Maximum speed	254
6	0-255	Mid speed Vmid	48
7	-	Version number	93
8	-	Manufacturer's ID	99
9	0-63	Repeat rate	15
17	192-231	Extended locomotive address, high-order byte	192
18	0-255	Extended locomotive address, low-order byte	100
19	1-99	Multiple traction address	0
28	Bit	RailCom configuration	3(dec)
	1 (0)	1 channel 1 release for address broadcast	1
	2 (1)	1 channel 2 release for data and	1

		command acknowledge	
29	Bit	Settings 1	14 (dec)
	1 (0)	Direction of travel 0 normal: locomotive drives forward if the arrow on the manual control points up. 1 interchanged: locomotive drives forward if the arrow on the manual control points down.	0
	2 (1)	Running-notches mode: 0 Operation with 14 or 27 running notches. This setting is chosen for digital systems which do not support the 28 running-notches mode. 1 Operation with 28 or 128 running notches. This setting is chosen for digital systems which support the 28/128 running-notches mode.	1
	3 (2)	Operational mode: 0 Locomotive only runs in digital operation. 1 Locomotive runs both in digital and conventional operation, flying splice possible.	1
	4 (3)	0 RailCom transmission disabled 1 RailCom transmission enabled	1
	5 (4)	0 factory pre-set speed curve is used 1 User defined speed curve is used	0
	6 (5)	0 Decoder uses basic address (from CV1) 1 Decoder uses extended address (from CV17 and CV18)	0
	7-8(6-7)	Not used	0
30	Bit	Fault display	0 (dec)
	1 (0)	1 Light short-circuit	0
	2 (1)	1 Overheating	0
	3 (2)	1 Motor short-circuit	0

CV 33 – 47	Range of values	Function mapping for function outputs: In order to allocate a function of the digital system to a function output, look for the section where the row of the desired function meets the column of the desired function output. Enter the number found in the respective CV. Ex-works settings are shown in bold print.				Ex-works setting
CV		Function output:	A	B	C	
33	0-7	F0 forward	**1**	2	4	1
34	0-7	F0 backward	1	**2**	4	2
35	0-7	Function 1 forward	1	2	**4**	4
36	0-7	Function 2	1	2	4	0
37	0-7	Function 3	1	2	4	0
38	0-7	Function 4	1	2	4	0
39	0-7	Function 5	1	2	4	0
40	0-7	Function 6	1	2	4	0
41	0-7	Function 7	1	2	4	0
42	0-7	Function 8	1	2	4	0
43	0-7	Function 9	1	2	4	0
44	0-7	Function 10	1	2	4	0
45	0-7	Function 11	1	2	4	0
46	0-7	Function 12	1	2	4	0
47	0-7	Function 1 backward	1	2	4	4
50	Bit	Motor configuration				0 (dec)
	1-3 (0-2)	Select motor type 0-5, enter as decimal number				
	4,5 (3,4)	not used				
	6 (5)	0 EMF switch inactive 1 EMF switch active				0
	7 (6)	0 Control switched on 1 Control switched off				0
	8 (7)	0 High-frequency motor control (approx. 23 kHz) 1 Low-frequency motor control (approx. 19 Hz)				0
51	Bit	Braking configuration				0 (dec)

	1-5 (0-4)	not used	0
	6 (5)	1 Stopping with DC independent of the polarity (only if Bit 3 is deleted in CV29).	0
	7 (6)	Not used	0
	8 (7)	1 Constant braking distance activated	
52	0-255	Braking distance with activated constant braking distance	50
55	0-255	Sets brightness at function outputs A and C, 255=max	255
56	0-255	Sets brightness at function output B, 255=max	255
57 - 59, 61, 64		Function mapping: Each bit of the CV stands for a function of the digital system: Bit 1(0) for function 1, Bit 2(1) for function 2 and so on up to Bit 8(7) for function 8. If you wish to allocate a function to the dimming, the respective bit must be set.	
57	0-255	Dimming (no ex-works setting)	0
58	0-255	Shunting speed (ex-works setting F3)	4
59	0-255	Switching off the delay (ex-works setting F4)	8
60	0-255	Lighting effect at function outputs A and B. The units digit of the value stands for function output A, the tens digit for function output B: 0 No effect 1 Marslight 2 Gyrolight 3 Strobe 4 Double strobe	0
61	0-255	Function mapping: lighting effect at function outputs A and B	0
62	0-15	Lighting effect at function output C. The units digit of the value stands for function output C: 0 No effect 1 Flashing 2 Flickering type 1 (smooth)	0
63		Flashing frequency for function output C: default approx. 1 sec, f = 1 / (0.03 * (1 + CV63))	32

64		Function mapping: lighting effect at function output C				0
67..94	0-255	Values for characteristic speed line, default = ex-works speed line				
113	0-255	Minimum PWM value, control for motor types 4 or 5				40
114	0-255	Change duty cycle for motor type 4 or 5				10
128		Service number (Please read out the number)				-1
		Function mapping F13 – F28 to outputs				
CV		function output:	A	B	C	
129	0-7	Function 13	1	2	4	0
130	0-7	Function 14	1	2	4	0
131	0-7	Function 15	1	2	4	0
132	0-7	Function 16	1	2	4	0
133	0-7	Function 17	1	2	4	0
134	0-7	Function 18	1	2	4	0
135	0-7	Function 19	1	2	4	0
136	0-7	Function 20	1	2	4	0
137	0-7	Function 21	1	2	4	0
138	0-7	Function 22	1	2	4	0
139	0-7	Function 23	1	2	4	0
140	0-7	Function 24	1	2	4	0
141	0-7	Function 25	1	2	4	0
142	0-7	Function 26	1	2	4	0
143	0-7	Function 27	1	2	4	0
144	0-7	Function 28	1	2	4	0
145	0-7	Function allocation coupling control forward				0
		Function output A = 1 Function output B = 2 Function output C = 4				
146	0-7	Function allocation coupling control backward				0
		Function output A = 1 Function output B = 2 Function output C = 4				
147	0-255	Kick duration: Can be set in multiples of 0.016 seconds. The default setting is 30x0.016 seconds = 0.48 seconds.				30
148	0-255	Locomotive movement during decoupling. Settable in multiples of 0.016 seconds. The				80

		default setting is 80x0.016 seconds = 1.28 seconds.	

North American Warranty

Lenz GmbH does everything it can do to ensure that its products are free from defects and will operate for the life of your model railroad equipment. From time to time even the best engineered products fail either due to a faulty part or from accidental mistakes in installation. To protect your investment in Digital plus products, Lenz GmbH offers a very aggressive 10 year Limited Warranty.

This warranty is not valid if the user has altered, intentionally misused the Digital Plus product, or removed the product's protection, for example the heat shrink from decoders and other devices. In this case a service charge will be applied for all repairs or replacements. Should the user desire to alter a Digital Plus Product, they should contact Lenz GmbH for prior authorization.

Year One: A full repair or replacement will be provided to the original purchaser for any item that that has failed due to manufacturer defects or failures caused by accidental user installation problems. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturer's discretion. The user must pay for shipping to an authorized Lenz GmbH warranty center.

Year 2 and 3: A full replacement for any item will be provided that has failed due to manufacturer defects. If the failure was caused by accidental user installation or use, a minimal service charge may be imposed. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturer's discretion. The user must pay shipping to and from the authorized Lenz GmbH warranty center during this portion of the warranty period.

Year 4-10: A minimal service charge will be placed on each item that has failed due to manufacturer defects and/or accidental user installation problems. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturer's discretion. The user must pay shipping to and from the authorized Lenz GmbH warranty center during this portion of the warranty period.

Please contact your dealer or authorized Lenz GmbH warranty center for specific instructions and current service charges prior to returning any equipment for repair.

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This equipment complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CE Please save this manual for future reference!