



SDN144K1E SoundFX™

N Scale

Drop in Mobile Decoder for Kato N Scale SD40-2 and similar Locomotives. Preloaded with selectable SD40-2 or GE-Evolution Sound Schemes (Phase II)

SDN144K1E: Drop in Decoder with SoundFX™
1 Amp/1.25 Amp Peak, 4 FX³
200ma Functions, Includes
13mm 8 Ohm round Speaker

Features:

- **Digitrax SoundFX™ Sound System** -Your locomotives will sound in scale like the real thing with SoundFX™
 - Customizable 8 Bit Sound**
 - 3 simultaneous voices**
 - Downloadable Sound** with Digitrax PR2/3 and SoundLoader software
 - 4 Megabit Onboard Sound Memory**
 - 1 Watt Sound Output**
 - Cam input**-synchronized steam-chuff option for steam loco use
- **Drop in Light board replacement** for easy install.
- **Factory 13mm round 8 ohm speaker**, and 100uF prewired capacitor
- **Fully customizable** with downloadable sound schemes and other after-market speakers for many different locomotives.
- **Smart Power Management**-no more booster or programmer shutdowns! No extra equipment needed to program or run
- **SoundFX™** does not require an external rate sensor to vary workload.
- **Digitrax LocoMotion® System**-Your locomotives look like the real thing. The Digitrax LocoMotion® System makes them run like the real thing, too!
- **SuperSonic** motor drive for silent operation.
- **Digitrax FX³ Functions**-Control lights and functions for prototypical lighting effects and on/off control:
- **Transponder ID Equipped** ready for transponding on your Layout
- **Program CV's using any Digitrax Compatible Control system** without having to buy any extra equipment
- **Direct mode programming**
- **Operations Mode Programming**
- **Decoder Reset CV** with or without speed table reset.
- **Motor Isolation Protection** helps prevent damage to your decoder.
- **Basic, Advanced & UniVersal Consisting**
- **2 Digit and 4 Digit Addressing**
- **DCC Compatible**
- **Digitrax “no worries” warranty**
- **FCC Part 15, Class B RFI compliant**

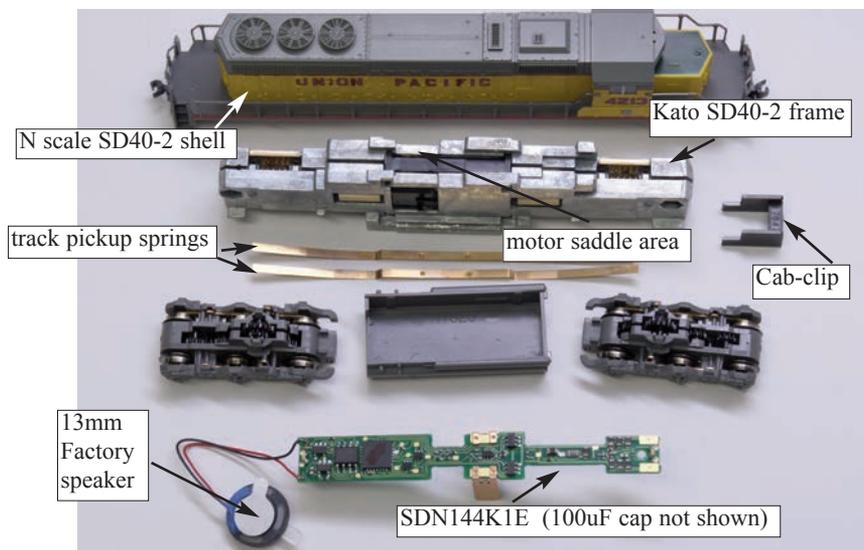
Parts List

- 1 SDN144K1E Decoder drop-in with Sound FX™
- 1 Factory wired 13mm round 8 Ohm speaker and 100 uF capacitor.
- 1 Instruction sheet

Installation Information

See the Digitrax Decoder Manual for complete decoder test procedures, installation instructions, programming and technical information. Digitrax manuals and instructions are updated periodically. Please visit www.digitrax.com for the latest versions, technical updates and additional locomotive-specific installation instructions. . Machining or modification of frames requires some skill and patience, as they are easily damaged. After market pre-machined frames may be available for some locomotives.

Figure 1: SDN144K1E installation in Kato N- SD40-2 frame preparation.



1. Carefully remove the Kato SD40-2 shell parts. Remove the factory analog light PCB, trucks, drive shafts, motor and all parts and carefully save these in the correct order for re-installation. This should leave a bare frame ready to be modified to accommodate the speaker.
2. The factory 13mm speaker is mounted in the diesel tank in this example installation in **Figure 1**. Carefully open an e.g. 1/2" hole 0.150" deep through the diesel tank area of the bare frame as shown in **Figure 2**. If using a drill or mill, be sure to clamp the frames correctly. With a dremel grinder etc., open up the full e.g. 0.150" depth of the hole diameter so that the 13mm speaker will fit snugly and clear the diesel tank cover. Using a

grinding or cutting tool carefully cut a shallow 0.028" outside groove that will allow the speaker wires to pass down the e.g.; left frame side, inside the track spring and across to the center of the frame at the rear of the diesel tank, as shown in **Figure 3**.

3. Reinstall the parts from step 1 in reverse order, substituting the SDN144K1E decoder with added motor clips, for the factory light PCB. Make sure to place some of the supplied Kapton tape under the motor saddle to ensure the motor clips cannot short to the frames. Place the 13mm speaker in the mounting location created in step 2, with the magnet side facing out and ensure the speaker wires do not cause any binding problems and the insulation is not damaged. Note that the frame halves are energized with track voltage so no wires or metal speaker parts should short to these. Be sure to inspect the speaker diaphragm for magnetic debris, dirt or damage, which will affect sound quality. Other speaker(s) may be substituted and mounted in combinations as long as the total impedance on the black/red speaker

Figure 2: Kato SD40-2 -speaker mount hole in tank

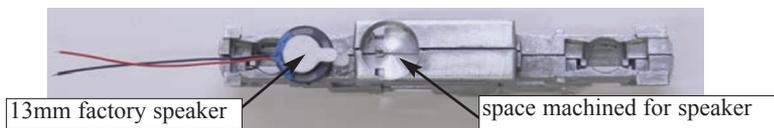
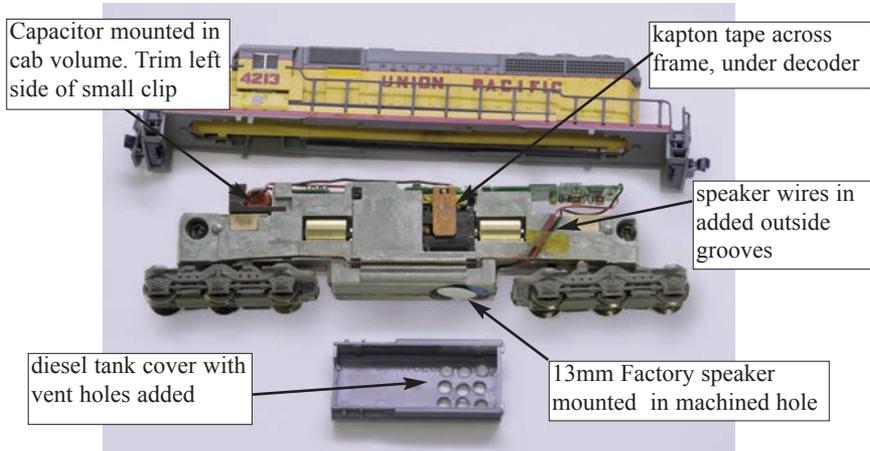


Figure 3: SDN144K1E Decoder installation in Kato SD40-2 - reassembly.



wires is greater than 8ohms.

4. (Optional) Functions for other lights etc., may connected to the pads identified in **Figure 4**. These function leads effectively switch the track voltage, so LED's and 1.5V lamps will need current setting resistors installed externally as required.
5. In a SD40-2 unit installation the wired 100uF/25V electrolytic energy stor-

age capacitor will fit inside the cab volume if the cab-clip is trimmed (or left out). Trim down the height of the left side cab-clip arm to allow the capacitor to sit inside when reassembled. Be sure that the capacitor case and leads do not short to the frame or damage to the decoder may result. The capacitor leads should be carefully formed past the front led and on top of the decoder so the shell can be put back without pinching wires.

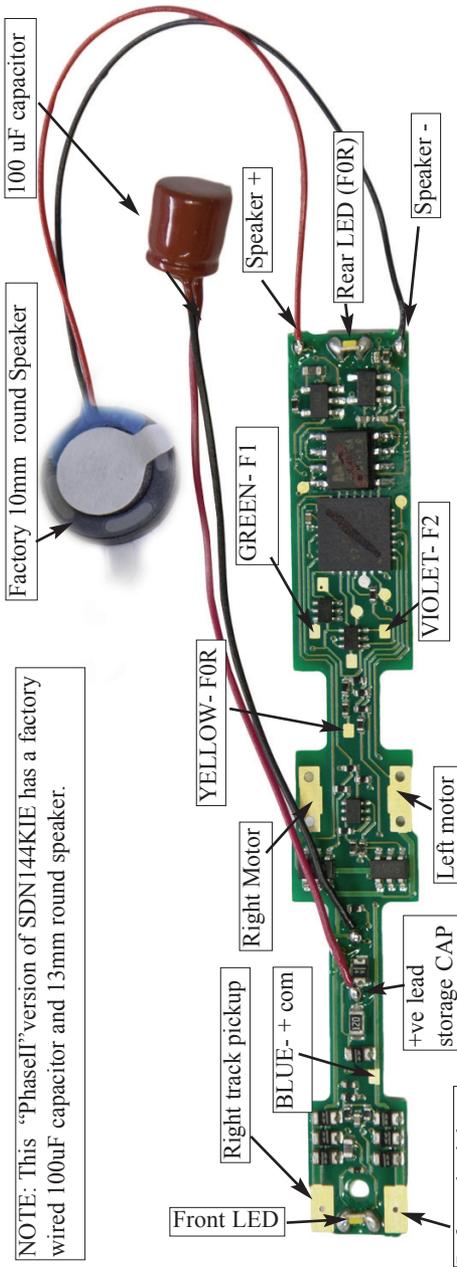
6. Inspect the installation before testing the sounds and replacing the shell. In particular ***Ensure motor clips make proper contact with the motor tabs and do not short to the frames.***
7. Connect to active DCC track power from a compatible DCC system and select the factory default address 03 to enable sounds for testing
8. Be sure F8 (mute) is OFF to allow sound output, and then press F1(bell) or F2 (whistle/horn) ON to hear these associated sounds.
9. Customize sounds by programming Sound CV's to adjust the desired configurations, as shown in the following tables of Sound FX CVs. CV60=0 sound scheme is an SD40-2 and CV60=1 is an GE-Evo. Other locomotives may be downloaded from the Digitrax web site and conveniently programmed using a PR3 programmer. This "K1" form-factor PCB may be used in a number of other N scale locomotives by applying a little modeling ingenuity in choosing a speaker and capacitor location.

Speaker Mounting and baffle or enclosures.

The sound performance of any attached speaker(s) is greatly affected by the mounting system and required baffle or rear enclosure space. Depending on the locomotive model and construction and speaker chosen it may be necessary to modify the frame or parts of the internal shell to make room for one or more speakers and enclosure.

For the Kato N scale SD40-2 installation shown here the whole body acts as a sound baffle. Obviously the space inside this N-scale locomotive is limited since the frame is configured for maximum weight and pulling effort, and the installation shown here is just one variation of the possible locations for a speaker.

The baffle is used to isolate the speaker diaphragm front sound waves from the "out of phase" rear sound waves. This minimizes sound cancellation, particularly at lower frequencies. For most efficient sound generation, the cubic space of the baffle should be as large as practically possible, and the baffle walls should be acoustically rigid so not to allow acoustic interference. be sure that there is a tight seal from the speaker sides to the wall of the baffle. In this example the speaker should fit snugly in the mount hole. Of course, you can substitute an alternate after-market speaker of the maximum size for the locomotive you have. For example, you can wire in the SDN144K1E in a modern HO-scale locomotive with a high-efficiency can style motor as long as the stall current is less than 1 amp at the track voltage in use. In this case it is possible



NOTE: This "PhaseI" version of SDN144K1E has a factory wired 100uF capacitor and 13mm round speaker.

Figure 4: SDN144K1E pads and wiring.

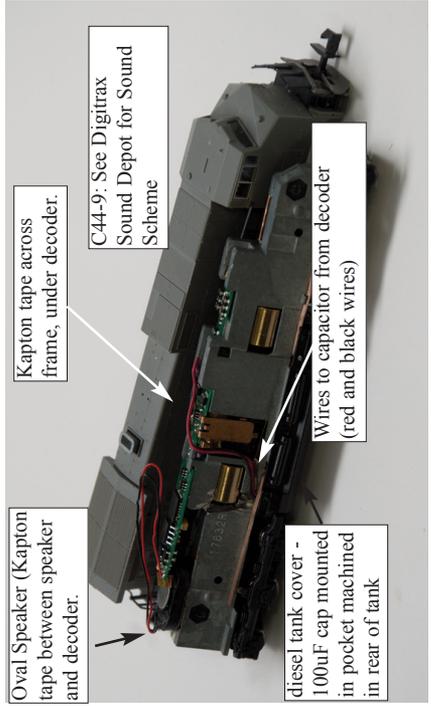


Figure 5: C44-9- 10x18mm speaker in back-frame top modified to fit



Figure 6: SD70ACE- showing a 10x18mm speaker in upper rear.



to change to a larger speaker(s) that has a “high bass” or similar enhancement. For best operation it is important to use the factory wired 100uF storage capacitor to help overcome pickup dropouts due to dirty track.

Using this decoder in other locomotives

The factory supplied SDN144K1E sound project is for an SD40-2 (default) or GE-Evo diesel locomotive, selectable with the value in CV60. If you want to install it in a different locomotive, such as; C44W-9, ES44 or SD70ACe etc, you can simply load a different sound project for that type of locomotive. For all installations it is likely that the frames and/or shells may need modification, and it is possible to use another after-market 8ohm speaker e.g. 10x18mm to allow an easier install.

Customizing Your Decoder

Your Digitrax SDN144K1E Sound FX decoder is ready to run and will operate and generate sound using address 03 with no additional programming. On your Digitrax system, simply select the locomotive’s address and the sound will start. On some DCC systems, it is necessary to select the locomotive address AND send a command to start the sounds.

For a more prototypical railroading experience, your decoder can be customized for your specific locomotive by programming some of the Configuration Variables, or CVs, available. Digitrax Sound decoders can be programmed using either the paged mode or operations mode method on a programming track or with the operations mode using the main line. See the Digitrax Decoder Manual or the Digitrax web site for more information.

Initial Test and Programming: This decoder is preprogrammed and tested with an SD40-2 diesel locomotive sound scheme, and is ready to operate on factory default address 03. Before customizing the decoder it is useful to run it on the factory default address 03 to check the installation. The following sections show how to change the locomotive address and customize the decoder

For more information on general decoder installation and programming techniques and examples visit the www.digitrax.com

Changing the Decoder Address

The first CV most people change is the decoder address. This allows you to independently control each loco with a unique address. Digitrax decoders are shipped with CV01 (AD2), the two digit address, set to 03. Following is a brief description of how to change the decoder address with a Digitrax DT series throttle. See your Starter Set Manual for complete programming instructions.

1. Place the loco on the programming track. Go into Program Mode on your system.



On DT400/DT402 press **PROG**. On DT300, DT100 & DT200 press **RUN/STOP & FN/F0**.

2. Choose AD2 for 2 digit addressing or AD4 for 4 digit addressing (DT400/DT402 and DT300). (Ad for DT100 & DT200, see set manual for 4 digit instructions).
3. Choose the address you want to set up for the decoder.
4. Complete address programming. On DT400/DT402 press **ENTER**. On DT300, DT100 & DT200 press **SEL**.

Note: CV29 must also be programmed to enable 4 digit addressing, this is done automatically by the DT400/DT402 & DT300 but not on earlier throttles.

Digitrax LocoMotion® System

Your locomotives look like the real thing, now you can make them run like the real thing, too. Digitrax decoders incorporate torque compensation for smooth as silk operation. You can also program CVs that control momentum, 3 step and 128 step speed tables, switching speed, normal direction of travel, scaleable speed stabilization and more to take full advantage of the Digitrax LocoMotion® System.

Momentum-CV03 & CV04

Momentum is part of the LocoMotion® System. Acceleration is controlled by CV03 and deceleration by CV04. Both come from the factory set to 000. A range of 000 to 031 is available for both accel and decel. Try CV03:003 and CV04:000 as a starting point for experimenting with momentum.

Speed Tables-How the Loco Responds to the Throttle

With Digitrax LocoMotion®, there are two types of speed tables: 3 Step Tables and High Resolution 28 Step Tables. Please see your Decoder Manual for a discussion of the 28 Step Tables. The 3 Step Tables are set up by programming 3 CVs: Start Voltage (CV02), Mid point Voltage (CV06) and Max Voltage

Loco Type	V Start CV02	V Mid CV06	V Max CV05
Switcher Concentrated low speed. Limited top speed	002	038	064
Road Switcher Prototypical top speed w/evenly distributed curve from 0 to top speed	002	048	098
Mainline Loco Quick increase to cruising speed then levels off to prototypical top speed.	002	128	154

(CV05). These values are set at 000 at the factory. All have a range of values from 000 to 255. We recommend the following CV values as a starting point for experimenting with speed tables.



Other LocoMotion® Features: Switching Speed, Normal Direction of Travel & Scaleable Speed Stabilization (Back EMF) Features

Switching speed is controlled by CV54. The factory setting is 000 for OFF. To turn on the switching speed feature, program CV54 to a value of 001. When this feature is on, use F6 to activate and deactivate switching speed. With the feature on the throttle's target speed is effectively reduced by about 50% and the effects of accel and decel programmed into the decoder are reduced by 1/4. This is useful for yard switching operations.

Normal Direction of Travel is controlled by CV29. See your decoder manual for additional information on the settings for CV29.

Decoder Reset CV08

Decoder reset lets you reset all CV values to the initial factory settings. To reset all CV values, program CV08 to a value of 008. You also have the option of resetting all values except the 28 speed step tables. To do this, program CV08 to a value of 009.

Digitrax SoundFX™ System

Digitrax SoundFX™ lets you make your locos sound in scale like the real thing!

The SoundFX™ sound CVs in the range of CV140 to CV256 let you customize your decoder without having to reprogram or change the installed sound scheme.

Standard decoder CVs in the range of CV01 to CV120 operate the same as for a non-sound FX³ Digitrax decoders (they control motor and light functions etc.) CV58 is used as Master Volume, and CV60 is used to select an alternate scheme, if provided in the sound project.

Sound CV155 is provided to select Diesel engine “notching” modes. The default of CV155= 00 provides “automatic notching” that changes the diesel RPM settings at 8 distinct throttle speeds that are controlled by Sound CV132.

Sound CV155=01 selects “semi-automatic notching” mode that allows F6 ON to increase the notch from the current throttle setting and F7 ON to decrease back towards the lowest current throttle notch setting.

Sound CV155=02 selects “manual notching” mode that allows F6 ON to increase the notch setting and F7 ON to decrease the notch setting irrespective of the throttle setting, which controls just the motor speed.

The decoder's sound scheme can be reloaded using a Digitrax PR2 or PR3 programmer and a sound project file (for example AC4400.spj) from the Digitrax Sound Depot web site. Typical sound downloads take between 50 and 100 seconds depending on the project complexity and file size.

The following tables show the CVs used in this decoder version and how it is set up at the factory to operate various sounds using your throttle.



CV#	Used For	Range [default val]
01	2 Digit Address	[03]
11	Sound Time Out, 06 = Sound ends when loco address is de-selected, 00=Sound stays on after loco is de-selected	[06]
29	Configuration	[06]
49	Forward Light (FOF) -Headlight	[0]
50	Reverse Light (FOR) -Reverse Light	[0]
51	Function 1	[0]
52	Function 2	[0]
58	Master Volume (F8 ON used for Muting)	0-15 [9]
60	Factory Scheme Select: 0=SD40-2 diesel, 1=GE-Evo diesel	[0]
132	Notch Rate	[127]
135	Mute Volume	[0]
140	Prime Mover Volume	0-64 [60]
141	Bell Volume (Min=0, Max=64)	[25]
142	Horn Volume (Min=0, Max=64)	[60]
143	Time-Scattered Air Effects Volume	0-64 [30]
145	Misc Vols	0-64 [40]
146	Bell Ring Rate (1=24 milliseconds)	1-100 [07]
147	Air Drier Rate (1-about 2 seconds)	1-64 [02]
148	Compressor Run Rate	[30]
149	Air Compressor On Time	[20]
150	Horn Setup. Default=0, Alternate Horns= 1, 2, 3 Playable Horn versions =128, 129, 130, 131	[0]
151	Auto Coupler Sequence Threshold Value-Peak speed to allow auto coupler/brake when direction change occurs and F3 is ON	0-64 [48]
152	Project Author ID, Digitrax=221	[221]
153	Project ID, SD40-2/GE-Evo dual scheme	[23]
155	Notching/Slip Mode: 00=Automatic, 01=Semi-Automatic, 02=Manual	[00]

Sound FX DC Operation Mode



Function #	Used For	Notes
F0	Lights	
F1	Bell	
F2	Horn/Whistle	CV150 selects horn
F3	Coupler crash	Auto coupler/brake set by CV151 max speed
F4	Air feature disable	F4 off enables pop-off, drier and starts compressor
F5	Diesel = Dynamic brake Fans	
F6	Diesel = Notch Up	Notch UP if CV155=01 or 02
F7	Crossing Gate Airhorn or; Diesel = Notch DOWN	Notch DOWN, if CV155 = 01 or 02 (Crossing Gate Horn active if CV155=0)
F8	Mute Control	F8 ON is muted
F9	Brake squeal	
F10	Crossing Gate Airhorn Sequence	
F11	Handbrake	
F12		

Digitrax SoundFX™ decoders will operate on smooth DC power. The sound will not start until approximately 5 volts is applied to the track and there will be no “start up sound.”

SDN144K1E Troubleshooting

If the sound does not start in the decoder

1. Make sure you have selected the locomotive address on a throttle. The sound will not run unless the locomotive is addressed in the system. Make sure F8 is **OFF**.
2. Check your installation to make sure the decoder is installed properly.

If the sound output sounds distorted



1. Check the speaker cone for magnetic debris that may have collected there. Debris on the speaker will cause a loss of sound quality and must be removed.
2. Be sure that the CV58 volume is not set at a level that is too high for the speaker being used. For impedances below 32ohms (e.g. 8 to 30 ohms) set this volume setting lower to ensure the 1 watt output rating is not exceeded.

If the sound in your decoder shuts down after you stop it and you are not using a Digitrax system for control. On some DCC systems decoders are not addressed by DCC packets after the locomotive is set to 0 speed. In this case after the CV11 timeout elapses (6 second default), sound will “shutdown.” To defeat this feature, set CV11=00 to remove the timeout and shutdown. *To make sounds, the decoder must have a command addressed to it at least once.*

If you have trouble reading back CV's on the programming track, this may be due to insufficient current draw on the SDN144K1E motor or function leads. Of course you can always just re-program the CV value into a CV to get the desired results, even though reading CV's might not work.

OPS mode is recommended for writing to (programming) all CVs except CV01, CV17 & CV18 (2 digit and 4 digit addresses). If a second DCC decoder is present that is not Sound FX compatible then correct read back of CV data is not possible, since the NMRA CV read back was not designed for multiple decoder read back.

The SDN144K1E plays an GE-Evo Diesel scheme, but I want the default SD40-2 scheme. If the factory scheme has not been erased, program CV60 to a value of 0 to reselect the SD40-2 scheme. Alternatively set CV60 to 01 to change to the GE-Evo sound scheme.

I have loaded a new scheme but the CV's and Functions are not what I expected. Load the sound project you programmed and then select the “view>project description” menu and then read the text file on the screen that defines how that project in particular uses CV's and Functions for sound generation and configuration. Even without a programmer you can get SoundLoader and the sound projects from the Digitrax web site and review the descriptions on your compatible PC.

My speaker does not have a polarity mark. Speaker Polarity is simply used to ensure when more than one speaker is being used that they can be wired or “phased” so the input causes the diaphragm to move in the same direction. It can be ignored in a single speaker case.

When using my LT1 and test kit when I blow the Horn the decoder resets. Using the LT1 test kit and protection resistor is good to check the decoder is safely connected, but when a loud sound like a horn is activated the protection resistor limits the available power too much, so the decoder resets. Simply test full volume sounds on normal track power after connections check OK. If volume overloads decoder and loco slows, set CV57=0 to turn off BEMF.

Warranty & Repair

Digitrax gives a one year “No Worries” Warranty against manufacturing defects and accidental customer damage on all Digitrax products.

That's it! A simple, straightforward warranty with no tricky language!

Visit www.digitrax.com for complete warranty details and instructions for returning items for repair.



SDN144K1E Sound and Function Decoder
Wired Sound+Function Decoder
 for N scale narrow body diesel locomotives

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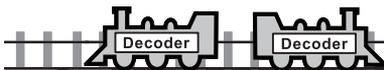
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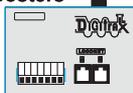
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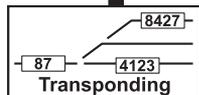
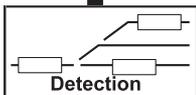
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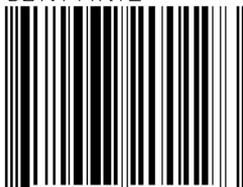
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