Technical Reference

ONY'S RAIN XCHANGE **SW9**

P2K-SW9

Drop-In Decoder

<u>AUTO-REVERSING HEADLIGHT</u>

Dimensions:
1.95 x .830 x .120 inches
50 x 21 x 3.0 mm

$29.95

This decoder is designed for easy installation in
Lifelike Proto 2000 SW9/SW1200 Locomotives

This is an EPF (extended packet format) decoder supporting:
- √ Convenient form factor provides easy "drop in" installation
- √ Four digit address (long)
- √ Uploadable speed table with programmable motor drive frequency
- √ 128 Speed mode operation
- √ Decoder assisted consisting
- √ All forms of operations mode programming (programming on the mainline)
- √ Programmable Start Voltage works for all speed modes
- √ Motor rating 1.3 Amp continuous, 2 Amp peak (stall)
- √ Three function outputs rated for up to 40mA incandescent bulbs
- √ EU version - auto-reversing headlights
- √ F1 simulates rotating beacon

**Every attempt has been made to ensure this decoder complies with
all applicable NMRA Standards and Recommended Practices**

Configuration Variables used by the SW9 Decoder

Configuration variables are the 'official' name for adjustable parameters in the decoder

CV1   **Short address**. Valid values range from 1 to 127.

CV2   **Vstart**. This value added to all speed steps of the "factory speed table", 1 count = about 1% of full voltage when using the normal speed table. If the uploadable speed table is used the percentage varies with the frequency of PWM motor control in CV9.

CV3   **Acceleration rate** (each unit = 32mS between speed steps) 254 max. Available in 14/28 speed modes only.

CV4   **Deceleration rate** (each unit = 32mS between speed steps) 254 max. Available in 14/28 speed modes only.

CV9   **PWM frequency**. This CV determinesthe total PWM period for the uploadable speed table. Each unit = 128uS this allows a frequency of 30hz to 279hz. 279hz comes from using each speed = 1 count this yields: max speed = 28*128us for a 3.58mS period which equals 279hz.

CV17   **Long address** high order 6 bits
-       bit 6,7 always= 1
-       bits 0-5 are upper 6 bits of 14 bit address

CV18   **Long address** low order byte

CV19   **Consist address.** 8 bit address, when active the consist responds to all commands addressed to it the same as it would to it's normal long/short address. Note: the normal long/short address is still active for all non-speed/direction commands (especially useful for headlight and other function controls of individual locomotives while in consist). If the consist address is set to 0 or 128 then the consist is inactive.

        bits 0-6   7 bit consist address (1-127)

        bit 7   0= consist direction is normal, 1= consist direction is reversed

CV23   **Acceleration adjust**. This value is added to the value in CV3 at power up or when reprogrammed

CV24   **Deceleration adjust**. This value is added to the value in CV4 at power up or when reprogrammed

CV29   **Decoder Configuration** byte
- bit 0   1= direction of operation is reversed, 0= direction is normal
- bit 1   1= use 28 speeds mode, 0= 14 speed mode
- bit 2   1= Analog conversion enabled. 0 = disable analog mode
- bit 4   1= use alternate (uploadable) speed table, 0= use normal speed table
- bit 5   1= use long address (CV17,18) do not use CV1, 0= use short address CV1 not CV17,18
- bits 3,6 and 7 are not used

Table of commonly used values for CV29

Value for CV29 decimal	hex	Long/Short Address	Uploadable/Factory Speed table	Analog Conversion	14 or 28 Speed mode
0	0	Short	Factory	no	14
2	2	Short	Factory	no	28
4	4	Short	Factory	yes	14
6	6	Short	Factory	yes	28
16	10	Short	Uploadable	no	14
18	12	Short	Uploadable	no	28
20	14	Short	Uploadable	yes	14
22	16	Short	Uploadable	yes	28
32	20	Long	Factory	no	14
34	22	Long	Factory	no	28
36	24	Long	Factory	yes	14
38	26	Long	Factory	yes	28
48	30	Long	Uploadable	no	14
50	32	Long	Uploadable	no	28
52	32	Long	Uploadable	yes	14
54	36	Long	Uploadable	yes	28

Note: If you want the locomotive to operate in the opposite direction increase the indicated value for CV29 by one. (Hex numbers are provided for Digitrax users)

UPLOADABLE SPEED TABLE CVs

CV66   Speed step 0 of uploadable table (Must be 0 for proper operation

CV67-CV94 Speed step 1 to 28 of uploadable speed t

PROGRAMMING TRACK INFORMATION: This decoder complies with NMRA RP-9.2.3 for both paged mode 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).

Tip for using consists and extended 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.
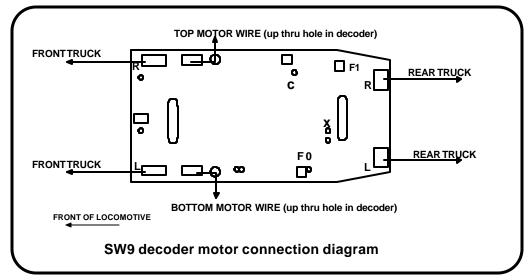
Factory default values for decoder Configuration Variables (CVs)

Digitrax users: Use hex values all other systems use normal decimal numbers

CV	Default value in decimal	hex	Description	CV	Default value in decimal	hex	Description
1	3	3	short address	74	23	17	alt spd table step 8
2	4	4	start voltage	75	27	1B	alt spd table step 9
3	0	0	acceleration	76	31	1F	alt spd table step 10
4	0	0	deceleration	77	36	24	alt spd table step 11
9	195	C3	PWM frequency	78	39	27	alt spd table step 12
17	192	C0	long address high byte	79	44	2C	alt spd table step 13
18	0	0	long address low byte	80	50	32	alt spd table step 14
19	0	0	consist address	81	55	37	alt spd table step 15
23	0	0	acceleration adjust	82	60	3C	alt spd table step 16
24	0	0	deceleration adjust	83	64	40	alt spd table step 17
29	6	6	decoder configuration	84	71	47	alt spd table step 18
30	0	0	error register	85	77	4D	alt spd table step 19
Speed Table Follows				86	86	56	alt spd table step 20
66	0	0	alt spd table step 0	87	93	5D	alt spd table step 21
67	2	2	alt spd table step 1	88	103	67	alt spd table step 22
68	4	4	alt spd table step 2	89	112	70	alt spd table step 23
69	5	5	alt spd table step 3	90	123	7B	alt spd table step 24
70	9	9	alt spd table step 4	91	135	87	alt spd table step 25
71	12	0C	alt spd table step 5	92	150	96	alt spd table step 26
72	16	10	alt spd table step 6	93	168	A8	alt spd table step 27
73	20	14	alt spd table step 7	94	195	C3	alt spd table step 28

General Installation Procedure (see the lighting installation options on following pages before actually installing the decoder):

- √ Remove the shell from your locomotive
- √ Cut the wires soldered to the existing locomotive circuit board. Cut as close as possible to the circuit board.
- √ Unclip the circuit board from the plastic motor mount bosses and discard.
- √ Install the decoder component side up with the narrow end toward the rear of the locomotive. If you want to use a white LED for the headlight see the section on connecting the lights to see where to solder it *before* mounting the decoder.
- √ Refer to the motor connection diagram below. Trim the locomotive wires to length as they are soldered to the decoder. Strip about 1/8" of the insulation off the end of each wire and tin the end. (To "tin" a wire melt a little solder on the end to keep the individual strands wire together). There is already a small amount of solder applied to each solder pad on the decoder. Just place the tinned wire on its solder pad and touch your soldering iron to the tinned wire and pad to solder the wire in place. Leave about 1/4" slack in the motor leads and wires from the front truck. Leave about 1/2-3/4" slack in the rear truck wires. Watch for shorts!

SW9 decoder motor connection diagram

- √ Ensure the decoder is properly seated on the motor bosses

Now is a good time to test the locomotive before installing the lights and 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 <u>before</u> trying it on full track power. If you have a Digitrax, Lenz Set-02 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 to wire in the lights.

Wiring the Lights:

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 Miniatronics 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.

The P2K-SW9 decoder ships from the factory with **three** usable function outputs, Headlight, Rearlight and an optional rotary (flashing) beacon activated as F1. Remove the front light and its associated brass tabs from inside the body shell.
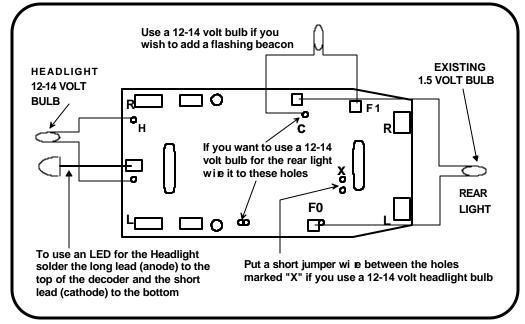**There are three options available for wiring the Headlight:**
- **12 or 14 volt bulb**:Wire a 12 - 14 volt bulb to the holes indicated in the drawing below Solder short jumper wire between the holes marked with an "X" to connect the function output to the Headlight bulb (or just solder the wire marked "H" to the lower "X" hole).
- **White LED:** Solder white LED (part number CMD204UWC0ND from Digikey Electronics 1-800-DIGIKEY) to the solder pads at the fron of the decoder. The long lead (anode) od the LED solders to the top pad of the decoder. Be sure to insulate the lower lead with shrink tubing or line the groove in the locomotive weight with a strip of black tape to keep the LED from shorting to the frame.   There is already a 1K resistor installed on the decoder for the LED.
- **Use the existing 1.5 volt bulb:** This installation requires a 270 Ohm 1 Watt resistor required installed in one of leads of the existing bulb. This resistor is physically large and may generate enough heat to melt the shell of the locomotive.

There are two options for wiring the Rear Light:
- **Use the existing 1.5 volt bulb:** Remove the brass tabs from the inside of loco shell and from the rear light wires. Tin the end of the wires and solder them to the pads marked F0 and * on the decoder. A 100 Ohm resistor is already mounted the the bottom of the decoder to limit the voltage at the bulb. This bulb is powered with "half wave" power and the resistor is sized to properly dissipate the heat when the decoder is operated at normal (12-16 volt) track voltage.
- **12 or 14 volt bulb:** Wire a 12 - 14 volt bulb to the holes indicated in the drawing below for a 12-14 volt rear light
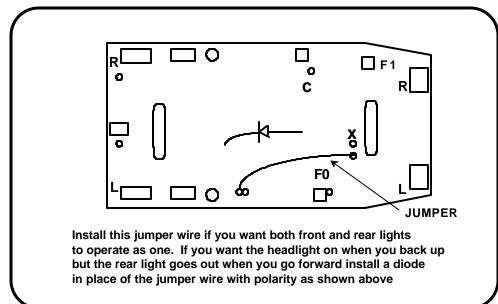
Optional rotary beacon:
If your prototype has a rotary beacon you can add an additional 12 volt bulb connected to

the holes marked "C" and "F1". The beacon is controlled by F1.   The function is designed to use an incandescent bulb. (Miniatronics sells red bulbs) If you use a red LED an appropriate series resistor will also be required.   The effect may not be as good with an LED.

Wiring for non-directional lighting:

- Install a jumper wire as shown below for the headlight and the rear light to be on when the headlight is activated.
- Install a diode with the anode (unbanded end) toward the lower "X" hole if you want the head light to be on in both directions of travel and the rear light to come on only in reverse.

Install this jumper wire if you want both front and rear lights to operate as one. If you want the headlight on when you back up but the rear light goes out when you go forward install a diode in place of the jumper wire with polarity as shown above

This decoder is covered by our guarantee.   Details of this guarantee are available from your dealer or by writing to NCE Corporation 1260 creek Street Suite 100, Webster, NY 14580.