AirWire900™ Decoder
Model AW9D10SS - Split Supply Capable

AirWire™ 900

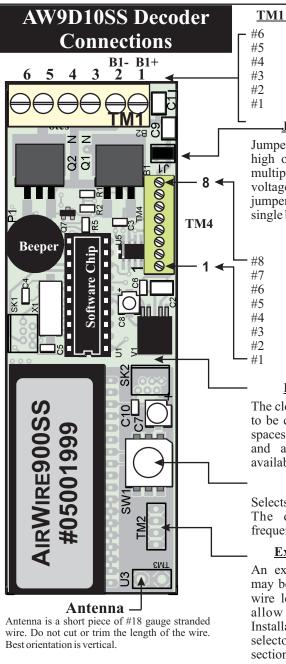*A full color version of this booklet may be downloaded from the CVP website*

Need Help? Contact Your Dealer/Installer First!
Should you have any questions regarding AirWire or instllations, your dealer is your best source of information, tips and techniques. Also, almost all dealers will do installations or can recommend good installers. It might take a little more time cost a bit more, but you'll be assured of an installation that works and works well.

WARNING
Fully charged batteries or battery packs may exceed their stated voltage by several volts. When the decoder is configured for the low voltage option, the fully charged battery pack must never exceed 18 volts. Measure a fully charged pack, prior to use, to verify it is less than or equal to 18 volts.

WARNING
Decoder is shipped with J1 jumper off the posts. J1 must be off for high voltage operation. Applying more than 18 volts to the decoder with J1 installed will destroy the decoder.

AW9D10SS Decoder Connections

B1- B1+

6 5 4 3 2 1

TM1

Beeper

Software Chip

AirWire900SS #05001999

Antenna

Antenna is a short piece of #18 gauge stranded wire. Do not cut or trim the length of the wire. Best orientation is vertical.

TM1 - Battery and Motor Terminals
#	
#6	+ Motor Terminal A
#5	+ Motor Terminal A
#4	Motor Terminal B
#3	Motor Terminal B
#2	Battery, Negative Input(-)
#1	Battery, Positive Input(+)

J1   Voltage Option Jumper
Jumper J1 allows the decoder to use either high or low battery voltage (single or multiple batteries). For split-supply, high voltage operation, remove jumper. Leave jumper **across the posts** for low voltage, single battery (up to 18V).

TM4 - Function Outputs
#	
#8	Battery, B2 Positive Input (+)
#7	Used as B+ for lamps, smoke
#6	not used
#5	Auxiliary DCC Output A
#4	Auxiliary DCC Output B
#3	Smoke Generator/Hi Current
#2	Rear Backup light
#1	Front Head light

Board Cut-Apart Location
The closely spaced holes allow the board to be cut apart for mounting in unusual spaces. An optional kit having sockets and a special interconnect cable is available to reconnect the two halves.

Frequency Selector
Selects one of 8 operating frequencies. The decoder **must** use the same frequency as the throttle.

External Selector Switch Pads
An external frequency selector switch may be wired in at this point. Limit the wire length to about 6 inches. Do not allow the wire near the antenna. Installation of an external frequency selector switch is discussed in another section.

J1 ON

J1 **ON**, across both posts for single battery operation.

J1 OFF

J1 **OFF** the posts for split battery use. Either position is OK.

Single Battery - Low Voltage Operation

Ensure that Jumper J1 is installed across the two posts. The maximum voltage for the B1 battery is 18 volts. Do not exceed this value.
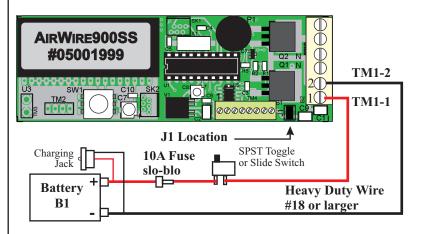
When configured for a single battery, the decoder can accept a minimum of 6 volts, up to a maximum of 18 volts at the battery input terminals, TM1, #1 and #2. **Do not reverse battery wires or decoder will be destroyed.**

The B1 battery voltage can be as low as 6 volts but can not be any higher than 18 volts. For sound decoders, a 12 volt battery works well. A lower voltage will result in lower sound volume.

Always use a cutoff switch between the battery and the locomotive. The use of a cutoff switch will insure that the battery is not discharged by the AirWire or sound decoders. when not being used. The charging jack is normally connected directly to the battery. However, it can also be connected with the fuse and/or switch if desired.

AirWire900SS #05001999

TM1-2
TM1-1
J1 Location
Charging Jack
10A Fuse slo-blo
SPST Toggle or Slide Switch
Battery B1
Heavy Duty Wire #18 or larger

Single Battery Operation Guidelines

1. Install Jumper J1. The decoder will not function without the jumper across the posts.

2. Do not use a battery voltage higher than 18 volts. Measure the fully charged battery or battery pack to insure that it is less than 18 volts before using it. It is very common for low cost chargers or faulty chargers to charge a battery to a higher voltage than the stated battery value.

3. Always use a fuse and a master cutoff switch wired as shown in the suggested diagram. Some diagrams omit these items for simplicity but they are always needed.

4. Heavy duty wire is required for battery connections. #18 AWG stranded wire is best and please use two different colors.

5. Never reverse the polarity - even for an instant. The decoder will be damaged beyond repair - and there is no warranty for this.

6. The maximum output current decreases linearly as the motor voltage increases. At 12 volts, the maximum current is 10 Amps. At 18 volts, the maximum current is 7 Amps.
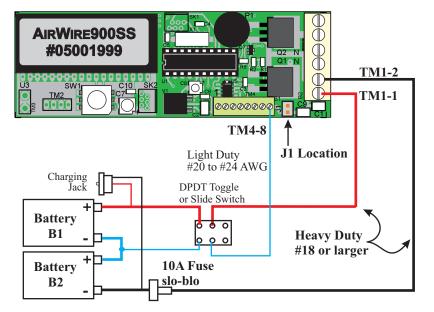
Split Battery Supply - High Voltage Operation

The decoder will support higher motor drive voltages up to 28 volts. For maximum efficiency and longest battery life, the decoder uses a split supply design. This allows up to 28 volts to be delivered to the motor while a lower voltage feeds the remaining electronics. Not only to you get longer battery life, but you now have many more battery and hookup options.

Jumper J1 Must Be Removed!

Jumper J1 must be removed when using split supplies. Applying more than 18 volts to the decoder with J1 installed will destroy the decoder.

The wiring examples used in this manual show only two batteries, B1 and B2, for the split battery option to emphasize that a center tap is needed from the battery pack. Using a pair of 12 volt batteries makes the mid-point tap between the two batteries equal to 12 volts. This is perfect for most auxiliary decoders and provides a full 24 volts to drive the motor.

Battery packs, higher than 18 volts, and with only two connections, **CAN NOT BE USED.**

AirWire900SS #05001999

TM1-2
TM1-1
TM4-8
J1 Location
Charging Jack
Light Duty #20 to #24 AWG
DPDT Toggle or Slide Switch
Battery B1
Battery B2
10A Fuse slo-blo
Heavy Duty #18 or larger

Split Battery - High Voltage Operation Guidelines

1. Remove Jumper J1. Failure to remove the jumper will result in damage to the decoder when used with the split battery option.

2. Do not allow the sum of the battery pack voltages to exceed 28 volts. With two different battery inputs, there are many hookup options. For example, you may use a 14.4 volt battery for one source and a 12 volt battery for the second. The sum of these two batteries is 26.4 which is within 28 volts. You can also use an 18 volt battery for one source and a 6 volt battery. The sum of these two equals 24 volts which is acceptable. For most applications, the use of two 12V rechargeable batteries provides 24 volts to the motor which is more than enough for most railroads and load conditions. Also, using similar batteries makes recharging easier. *continued on next page*

High Voltage Operation Guidelines - *continued*

3. Do not allow the low voltage battery to exceed 18 volts. In the above example with an 18 volt and a 6 volt battery, you may be tempted to use the 6V for the low voltage side which is the minimum input for Proper AirWire operation. However, that may be too low for a sound decoder. External sound decoder connected to the Auxiliary DCC output usually require a minimum of 9 volts for proper operation. Anything from about 9 to 15 will work fine.

3A. Minimum voltage for B2 is 6 volts. But, most sound decoders require minimum of 9 volts with 12 volts being optimum.

4. Batteries do not have to be the same voltage.

5. Always use a fuse and a master cutoff switch wired as shown in the suggested diagram. Some diagrams omit these items for clarity but they are always needed. A double-pole-double-throw switch must be used to insure complete disconnection of the batteries.

6. Heavy duty wire is required for battery connections. #18 AWG stranded wire is best and please use two different colors. The connection between the low voltage source and TM4 pin 8, can be made with small gauge wire. Tin all wires. Cover all naked wire.

7. Never reverse the polarity of the wires at the decoder - not even for an instant. This will result in instant decoder destruction. It can not be repaired. And there is no warranty protection if this occurs.

8. Keep good records of your wiring. Will you remember how you wired up a locomotive 2 years from now?

9. Verify the locomotive motor rating is suitable for the voltage you will be using. Most motors are rated at either 18 or 24 volts. Using a higher voltage on a lower voltage-rated motor will cause it to overheat and shorten its life considerably.

10. The maximum available motor current decreases linearly as the motor voltage increases. At 12 volts, the maximum current is 10 Amps. At 24 volts, the maximum current is 5 Amps. Take care not to exceed the maximum or decoder damage may occur.

11. You must use the proper charging system and connections. In general, the higher the voltage, the more expensive the charger. If in doubt, talk to your battery supplier and request their recommendations.

12. It may be better to use multiple, lower voltage battery packs than one or two large ones. The packs can be smaller and easier to fit into the locomotive. Also, smaller, lower voltage battery packs can use lower cost chargers.

Maximum Output Power Is 120 Watts

Independent of the motor voltage, the maximum output power is 120 Watts. To translate this into maximum motor current in amps, divide 120 by the battery voltage.

Maximum Motor Current (Amps) = 120/ Battery Voltage

For example, a single 12 volt battery will provide 12 volts to the motor. The maximum allowed motor current becomes 120/12 which is equal to 10 Amps.

For a split supply the motor voltage is equal to the total battery voltage, but the equation is the same. For a 24 volt motor voltage, the maximum current is 120/24 which is 5 Amps.

Batteries and Battery Sources

Sealed Lead-Acid Gel-Cells

For simplicity, sealed, lead-acid 12 volt gel-cells, are mostly used as the power source in this guide. Gel-cell batteries come in a variety of sizes and are easily obtained. The following 12 volt Power-Sonic gel-cells are from the **Mouser Electronics** catalog 800-346-6873 or www.mouser.com for online ordering.

LxWxH (inches)	Part number	Rating	Price	Connector
7.01 x 1.34 x 2.36	547-PS1220	2.0Ahr	$17.85	0.187" Faston
7.01 x 1.34 x 2.36	547-PS1229	2.9Ahr	$22.35	0.187" Faston
3.54 x 2.76 x 3.98	547-PS1250F1	5.0Ahr	$16.00	0.187" Faston
3.82 x 1.62 x 2.00	547-PS1212	1.2Ahr	$15.65	0.187" Faston

An inexpensive 12V/500mA battery charger is also available from Mouser; part number 632-GHC125003S-A and sells for $17.74. It plugs into a wall outlet and comes with alligator clips. If you want a 2.5mm plug on the charger (instead of alligator clips), order Mouser part number 632-GHC125003S-P. It is the same price. Given this charger rating, a 2.0Ahr gel-cell battery will be fully charged in about 4 hours.

NiMH, Lithium and other Exotic Chemistry Batteries

Although these batteries provide higher levels of current and can be physically smaller, they are more expensive. In addition, the proper charger must be used or the battery life will be considerably shorter. If you have an interest in exploring the use of these batteries, visit the website of "Only Battery Packs" at the following link:

www.onlybatterypacks.com

This company offers a large variety of pre-built battery packs, and individual cells to build your own packs. They also sell a variety of battery chargers and wiring harnesses.

ONLYBATTERYPACKS
N88 W16475 MAIN STREET, SUITE 200
MENOMONEE FALLS, WI 53051   (262) 255-1615

Battery Life - How Long Will Batteries Last?

This question is usually the first question asked about the AirWire System. However, there is no simple answer because the answer depends on many factors such as: battery capacity and size, type of railroad, quality of the locomotive, ambient temperature, how the railroad is operated, how many cars are pulled, how many hills and so on.

A rough idea of the battery life can be determined by dividing the battery rating which is in milliamp-hour (mAhr) or amp-hour (Ahr) by the motor current. For example, a battery pack rated at 1000 mAhr (which is the same as 1 Ahr) will power a 1 amp motor for about 1 hour. If the motor current is 2A, the lifetime is half, or about 30 minutes.

For best results, use the highest amp-hour rated batteries that space permits. Minimize the motor current by running slower, designing a railroad with minimum grades, limiting the number of cars on a train, or using multiunit consists or helper locomotives.
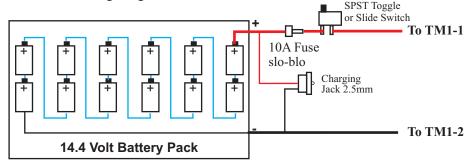
Building Your Own Battery Packs

 "Sub-C" rechargeable batteries, available from the supplier listed on the battery sources page, can be wired together to make a great battery pack. These cells come in different amp-hour ratings and sizes. Always select cells having the same amp-hour or milli-amp hour rating. NiMH or NiCad sub-C celsl are rated at about 1.2V.

To determine the number of batteries for a specific motor drive voltage, divide the desired motor drive voltage by the cell rating which is 1.2 volts. Round up any fractions. For example, a 14.2 volt pack will take 12 cells.
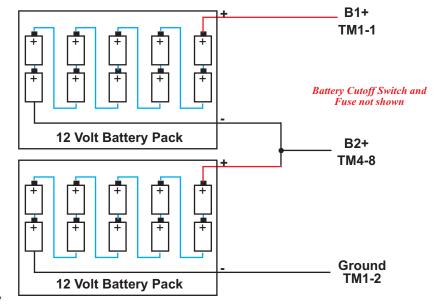
Be sure to obtain a charger capable of charging the number of cells in your home made pack. The greater the number of cells, the more expensive the charger.

Connect the cells in series, elephant style, with the positive end connecting to the next cell's negative end. Wrap the cells with plastic tape to hold them together.

Be sure and use a switch and a fuse. Verify that you have the appropriate charger for the number of cells being charged.

SPST Toggle or Slide Switch

To TM1-1

10A Fuse slo-blo

Charging Jack 2.5mm

To TM1-2

14.4 Volt Battery Pack

Two home made packs can be built for a split-supply high voltage battery. You will need to charge each pack separately. Or you can use a larger charger capable of handling all of the batteries at once. For the example below, the charge must be rated for charging 20 cells. No charging jack, switch or fuse is shown for clarity. Don't forget to include them.
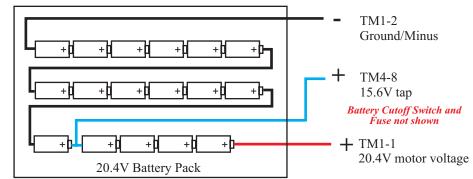
B1+
TM1-1

Battery Cutoff Switch and Fuse not shown

12 Volt Battery Pack

B2+
TM4-8

Ground
TM1-2

12 Volt Battery Pack

Building A Split Supply High Voltage Pack

A single large battery pack can be built. Just add a tap at the desired point to feed the low voltage input. Determining the number of cells is the same as for a low voltage pack.

The low-voltage tap may be placed at any location that provides between 9 and 16 volts. The most common reason for using a higher voltage tap is to allow higher sound volumes for the auxiliary sound decoder. However, the safe limit for most sound decoders is 16 volts. The example shows a 17 cell pack with a tap at the 15.6V location (13 cells x 1.2V).

The fuse, switch and charging jack are not shown for clarity. Be sure to include them.

- TM1-2
Ground/Minus

+ TM4-8
15.6V tap

Battery Cutoff Switch and Fuse not shown

+ TM1-1
20.4V motor voltage

20.4V Battery Pack

Wiring Accessories - Plugs, Jacks and Cord Sets

From the Mouser Catalog - www.mouser.com

Description	Part Number
72 inch cord, 20 gauge wire with right angle 2.5mm plug	172-4000
72 inch cord, 18 gauge wire with straight 2.5mm plug	172-4001
2.5mm threaded metal jack with long shank	163-4026
2.5mm snap-in jack (thin wall plastic only)	163-1061
2.5mm threaded metal jack with short shank	163-1025
2.5mm plug (for making your own cord)	1710-2510

NEGATIVE - Outside

POSITIVE - Center

2.5mm Plug

2.5mm Jack

172-4000

White Lettering
Outer conductor

White Dashed Line
Center + conductor

Outer   Center

Complete Wiring Example

This diagram has a complete wiring schematic for a split-battery pack and includes cut-off switches and jacks for two independent battery chargers and fuse protection. For this hookup example, the two batteries may be different voltages and may use different battery chargers.

Charger for B1

Charger jacks have the center pin as the positive. You can charge each battery one at a time, or use two chargers.

Charger for B2

B1

B2

10A Fuse
Slo-blo

**DPDT
Cut-off Switch**

The cutoff switch turns off all power to the decoder. It must be in the off position to allow charging of the batteries.

Although a double-pole-double-throw (DPDT) switch is shown, single throw (DPST) is an acceptable substitute.

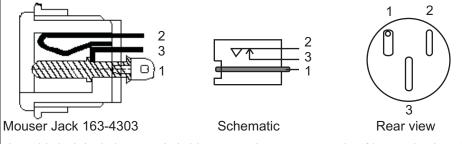**B1+   TM1-1**

B2+   TM4-8

GND   TM1-2

AIRWIRE900SS
#05001999

To Motor

TM4-4

TM4-5

black

**SPST
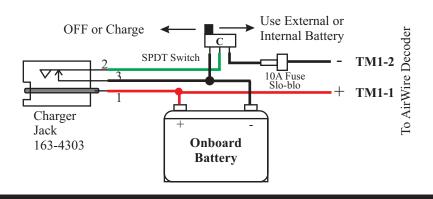Switch**

red

**DSX Sound
Decoder**

Purple

The SPST switch on the sound decoder input provides an easy way to disconnect the sound without powering down the entire decoder. This switch is optional. The small capacitor is required for the DSX decoder. See the DSX manual for additional options for using the sound decoder.

Another Type of Charger Jack

The Mouser power jack pictured may be used for both single and split power sources. Wiring the jack is not difficult and the pictures show an internal view of the jack's construction, an equivalent schematic and the rear view of the jack, showing the terminals.

Mouser Jack 163-4303   Schematic   Rear view

Since this jack includes an switchable contact, here's an example of how to hookup the Mouser jack to automatically disconnect the onboard battery from the AirWire decoder so that an external battery, or a charger can be plugged in. Since the onboard battery is completely disconnected, the auxiliary battery car can have a different battery voltage.

OFF or Charge   Use External or Internal Battery

SPDT Switch

10A Fuse
Slo-blo

Charger
Jack
163-4303

**Onboard
Battery**

To AirWire Decoder

TM1-2

TM1-1

Consider Using Battery Cars

There is plenty of room for the decoder in a locomotive but the battery installation can be tricky. For your first installation, we recommend the use of an external car to hold the batteries. Battery cars are a convenient and easy way to power your locomotive. A battery car contains only batteries, perhaps an on/off switch and a jack to which the locomotive is connected.

A fleet of battery cars allow some to be charging while others are being used. Because of the large amount of empty space in box cars, several batteries may be paralleled for longer running time. Also, the jack used to connect the locomotive to the car, is the same jack used to connect the charger.

The in-line fuse can be placed between the jack and the battery for protection against an accidental short circuit. Make sure the fuse is rated at 10 Amps and it should be a slo-blow style. The CVP fuse kit FK9 includes a 10 amp slo-blo fuse.

Simplified Installation Guidelines

Warning: Installation of the AirWire decoder does not require special tools. However, you should be comfortable with soldering and have a general idea of how your locomotive is wired, as it comes from the factory. If you are at all uneasy about these procedures, your hobbyshop can suggest installers who can do the job for you.

General Installation Guidelines

Before starting, you should have already decided on the location for the battery. Using a battery car makes for the easiest installation. You should also have decided how the battery car will connect to the locomotive. For this example the 2.5mm power cord and jack set will be used.

1. Remove the locomotive shell to expose the wiring. This may require you to remove several small screws that may be well hidden. If you encounter resistance when removing the shell, STOP. There is likely a small screw that needs to be removed or plastic tab that needs to be released. If you have questions, consult the locomotive manual or a friend that is familiar with disassembling locomotives.

2. Locate the motor or motors and identify the motor wires. In the case where the motor is mounted on the truck, there are usually 4 sets of wires. Two will go to the motor and two will go to the track wipers. Only the motor wires are needed and the track wipers should be removed. Also make sure the motor wires are disconnected from any electronics that may be inside the locomotive shell. Some motor brush power connections may be tricky, like a spring or interference fit with part of the chassis. Some locos pick up brush power from the chassis through a spring. Examine the loco carefully to determine how power moves from the track pickups to the motor.

If you intend to use the optional radio-frequency-interference (RFI) parts, now is the time to mount them. For best results, mount them directly to the terminals of the motor. The capacitor and resistor are not polarity sensitive and can be mounted in any orientation. Be sure to insulate any bare leads with heatshrink tubing. These two parts serve to reduce the electrical noise generated by the motor brushes. This noise might interfere with radio reception, especially if there is a long distance between the locomotive and the throttle.

3. Locate a place to mount the AirWire decoder. This location should provide some airflow for the power transistors near TM1. Mount the board using double-sided foam tape. Do not cover the large black power transistors near TM1. Make sure the board does not touch anything metal or it will be damaged. Mount the board so the large power transistors near TM1 have adequate airflow; see the section of managing heat buildup. There are two large black transistors on each side of the board. Under heavy loads these can become hot enough to deform plastic.

4. After mounting, make sure the antenna is vertical for best reception. The antenna can be bent such that it remains vertical if the board is mounted on its side. Keep the antenna away from anything metal. Also, the antenna should be kept away from motors. It should not be bent over the top of the decoder board.

The small antenna offers good range. For longer range, an optional longer rubber antenna mounts in place of the standard wire antenna. See the instructions that come with the optional antenna for mounting details

5. Begin the wiring by referring to the wiring diagram. When making wire connections inside the loco, use the shortest length of wire that will do the job. After the

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NEVER use RTV or other liquid adhesive to attach the decoder to the frame. That material is conductive and will destroy the decoder. Use only double-sided foam tape.

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wires are attached and insulated with heat shrink sleeving, secure them so that repeated removal and replacement of the locomotive shell won't pull the wires loose. The biggest cause of decoder failure after initial installation is wires being pulled loose and shorted to the frame when the shell is removed or replaced. Connect the motor terminals to TM1, terminals 6 and 4 or to terminals 5 and 3. These sets of terminals are paralleled and either set can be used.

Note: the + Motor output is the most positive output terminal, when the throttle is set to forward, and usually connects to the motor's + wire.

Use #18 gauge wire or larger. Always strip and tin the wire before inserting into the terminals. Untinned wires will fray and short across to adjacent terminals and destroy the board. Be neat with your wiring. Trim the wire to length. Fasten the wires out of the way and make sure the trucks can rotate freely.

6. Connect the 2.5mm power cord to TM1 with the positive lead connecting to terminal 1 and the negative wire connecting to terminal 2. Use an ohmmeter to determine which wire is connected to the center pin of the plug. Do not guess! Do not accidentally reverse the wires or the board will be destroyed. No protection diodes are used so that full battery voltage is delivered to the motor.

We strongly recommend that you use the center pin of the plug or jack to be connected to the positive terminal of the battery.

7. The headlight outputs are simple switches that apply battery voltage to the lamps when configured for a single low voltage battery. When configured for high-voltage split supply, the battery voltage connected to TM4 pin 8 will be the same as on TM4-7. Do not connect to your factory supplied locomotive lights unless you are sure the lamps have the same voltage rating as the battery. Connect the lamps as shown in the hookup diagram. Note that they share a common wire to TM4. Small wires may be used since the lamp current is relatively low. The lamp drivers are rated at 1.5 amp and are protected against short circuits and overloads.

8. If using an optional sound decoder, make sure that the manufacturers installation instructions are followed. The sound decoder wires labeled track or power connect to TM4 terminals #4 and #5. The wires labeled speaker, connect to the speaker. It may be useful to install an on/off switch in series with one of the sound decoder input wires.

9. The smoke generator output is designed for the high current loads typically found in large scale smoke generators. The driver is rated at 2.5 amps and is protected against overloads and short circuits. The driver provides a simple switch to battery minus when activated. Always insure the smoke generator voltage rating matches the battery voltage. Use #18 gauge wire. If your smoke generator has a polarity indicator, connect the + terminal to TM4, pin 7, which is the battery + voltage.

10. Before reinstalling the shell, double check all wiring and then test the locomotive for proper operation.

Here's a trick the professionals use to avoid stripping the threads in the soft plastic when reassembling the chassis and shell. Insert the screw into the hole. Turn the screw counter-clockwise (in other words, unscrew it) until it drops into the hole. This aligns the screw threads with the threads in the plastic. Now tighten until snug but do not over tighten.

The pictorials on the next couple of pages highlight the key points and limitations for the various connection options.

Motor Hookup and RFI Components

10 ohm

0.1uF 104

M

If the motor rotates the wrong direction, reverse the two motor wires. For improved reception, mount the included radio frequency interference (RFI) components as close as possible to the motor. The RFI components prevent motor noise from interfering with the radio receiver which reduces its effective range. Cover any exposed wire and leads.

Smoke Generator Wiring

#7

#3

Smoke Generator

+

The smoke unit must be rated for the selected battery voltage appearing on pin 7. The smoke generator output is a simple switch that connects battery voltage to an optional, external, smoke generator. Activation is with the throttle's 6 key, also called F6. The maximum output current is 2.5 amps. The output is protected against overloads and short circuits.

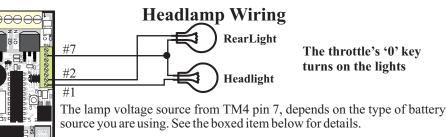If the smoke generator is polarized, connected the + terminal to the TM4, pin 7. Remember that when the smoke generator is turned on, the battery life will be less. Always turn off the smoke generator when not used or when no fluid is present to avoid damage to the generator.

Headlamp Wiring

#7

#2

#1

RearLight

Headlight

The throttle's '0' key turns on the lights

The lamp voltage source from TM4 pin 7, depends on the type of battery source you are using. See the boxed item below for details.

A maximum current of 1.5 amps can be supplied by the lamp drivers. The bulb drivers are protected against short circuits, overload and overheating.

The throttle's 0 key, also called F0, activates the lamps and the direction key determines which one is on. To always have both lamps on, independent of direction, connect pins #1 and #2 together.

With J1 across the posts, the lamp voltage source(TM4-7) is equal to the battery voltage. With J1 off the posts and split batteries are used, the B2 voltage rating is the voltage for lamps and smoke generator.
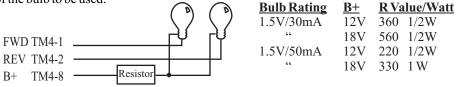
Lamp Wiring Examples

The maximum output rating for the lamp drivers is 1.5 Amps. The drivers are protected against overloading and overheating. The drivers will shut down if there rating is exceeded and will resume normal operation when the fault has been corrected. The Decoder includes automatic headlight reversing. Headlights are turned on and off with the throttle's 0 key. Two terminals on TM4, #7 and #8, provide convenient location for connections to battery + voltage. If using split batteries, B1 and B2, the lamps and other auxiliary loads are driven by the B2 battery.
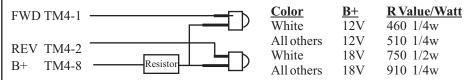
Standard 12-18 Volt Incandescent bulbs: Using bulbs that have the same voltage rating of the battery greatly simplifies installation. Multiple bulbs may be powered from a decoder's lamp output by wiring the bulbs in parallel. Use and select incandescent bulbs carefully. Inexpensive bulbs can run very hot and draw a large amount of current. This can result in damage to plastic and shortened battery life.

FWD TM4-1

REV TM4-2

B+ TM4-8

FWD TM4-1

B+ TM4-8

1.5 Volt Bulbs: Miniature, 1.5 volt bulbs must use a series limit resistor. A single limit resistor may be used as shown. This assumes that only one lamp is on at a time. Lower resistance values will increase the lamp brightness but shorten the life of the bulb. For best results, use the highest resistance compatible with bulb visibility. Always know the ratings of the bulb to be used.

FWD TM4-1

REV TM4-2

B+ TM4-8 Resistor

Bulb Rating	B+	R Value/Watt
1.5V/30mA	12V	360 1/2W
"	18V	560 1/2W
1.5V/50mA	12V	220 1/2W
"	18V	330 1 W

Light Emitting Diodes - LED: These come in all colors including white. They are very bright, run cool and have a have very long life. The LED operates from low voltage and always requires a series limit resistor. The value of the limit resistor depends on the battery voltage, the LED color and the desired brightness. Most color LEDs, are typically at full brightness with 20mA (0.02A) of current. LEDs are polarity sensitive and must be oriented properly to work. Lead length is used to indicate polarity. The longest lead is typically connected to the positive supply.

FWD TM4-1

REV TM4-2

B+ TM4-8 Resistor

Color	B+	R Value/Watt
White	12V	460 1/4w
All others	12V	510 1/4w
White	18V	750 1/2w
All others	18V	910 1/4w

For locomotives to have both front and rear lights on at the same time: Connect the FWD and REV outputs together. This allows the lamp to remain on, independent of the direction. The throttle's 0 key turns the lamps on and off. Calculate a new resistor value using the following formula:

$$R \text{ (in ohms)} = [\text{Battery Voltage}] - [\text{bulb voltage}] \div [\text{bulb current rating in Amps}]$$

$$R \text{ wattage minimum} = R \times [\text{bulb current}]^2$$

Using The DCC Booster Output

The AirWire900 decoder provides an auxiliary 1 amp DCC-Booster output suitable for driving NMRA-DCC compatible decoders. Sound decoders and function decoders are the most common users of this output, but any compatible DCC decoder may be used.

- **The maximum load supplied by the booster output is 1 Amp**
- **The DCC voltage (track voltage) is set by the B2 voltage**
- **The output is not protected against overloads or short circuits**

Using An External Sound or Function Decoder

In normal operation, the external decoder and the Airwire900 decoder have the same address. When a throttle function key is pressed, such as F2, the command is sent to the external decoder and is ignored by the AirWire motor decoder. Only F0 and F6 are responded to by the AirWire decoder. F0 controls the headlights and F6 controls the smoke unit.

The simplest and lowest cost sound decoder is the DSX Sound Decoder from Soundtraxx. Simply connect the DSX track wires, the red and black wires, to the Auxiliary DCC outputs, #4 and #5 of TM4. An on-off switch can also be included as shown. Connect the purple wires to the speaker. *If the DSX doesn't accept programming, reverse the red and black wires.*

Never allow the speaker wires to connect to the power input wires or the decoder will be damaged.

Always follow the instructions supplied with the sound decoder.

Programming Sound/Function Decoder Address

To program the external decoder's address, first connect the sound decoder to the AirWire decoder. Set the frequency to match the throttle's frequency and turn on power to both.
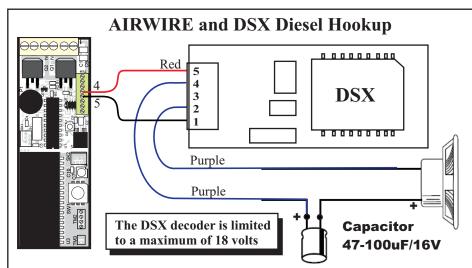
Use Service Mode programming and set both the AirWire decoder and the external decoder to the desired address. See the throttle manual for detailed instructions.

Customizing Sound/Function Decoder CVs

Once the external decoder has its desired address programmed, you may now use OPS mode programming to customize the various CVs. Remember that you must always use the appropriate locomotive address in order to transmit the programming commands to the proper locomotive.

The AirWire decoder is not affected by OPS programming directed to the external decoder's CVs.

Please refer to the appropriate sound/function decoder installation and operation manual for detailed instructions.

AIRWIRE and DSX Diesel Hookup

The DSX decoder is limited to a maximum of 18 volts

The red and black wires from the DSX decoder always connect to the AirWire decoder at terminals TM4-4 and TM4-5. However, if you discover the DSX decoder doesn't program, reverse the red and black wires.

The two purple wires go to the speaker with a capacitor connected in series with the purple wire from pin 4 of the DSX module (closest to the red wire). The other capacitor lead connects to the plus speaker terminal. If your DSX decoder comes with a "bi-polar" capacitor, polarity doesn't matter. Small wire may be used for these connections.

When using the Chuff-CAM brown wire, the return wire from the wheel/frame goes to TM4-5. If the CAM input doesn't work, move the return wire to TM4-4.

DSX Steam Hookup

DSX Pinout End View

Black	1
Purple	2
Brown	3
Purple	4
Red	5

See DSX manual for more details and options.

This hookup diagram shows the required connections between the AirWire decoder, an auxiliary function decoder, the battery and the Sierra module. Not shown are such items as the speaker, lamps and other extra wiring. See the Sierra instructions for how to connect these items.

With this simple hookup, the maximum battery voltage is 12 volts which is what Soundtrax recommends for their module. Using higher voltages can cause excessive heating.

Jumper J1 **is across** the posts on the AirWire decoder.

TM1

AIRWIRE900SS #05001999

B1 Battery 9 to 12 Volts*

Battery Cutoff Switch and Fuse not shown
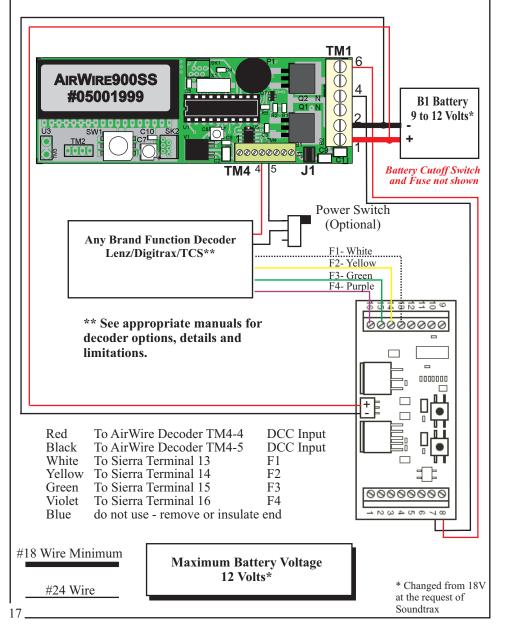
TM4 4 5 **J1**

Power Switch (Optional)

Any Brand Function Decoder Lenz/Digitrax/TCS**

F1- White
F2- Yellow
F3- Green
F4- Purple

**** See appropriate manuals for decoder options, details and limitations.**

Red	To AirWire Decoder TM4-4	DCC Input
Black	To AirWire Decoder TM4-5	DCC Input
White	To Sierra Terminal 13	F1
Yellow	To Sierra Terminal 14	F2
Green	To Sierra Terminal 15	F3
Violet	To Sierra Terminal 16	F4
Blue	do not use - remove or insulate end	

#18 Wire Minimum

#24 Wire

Maximum Battery Voltage 12 Volts*

* Changed from 18V at the request of Soundtrax
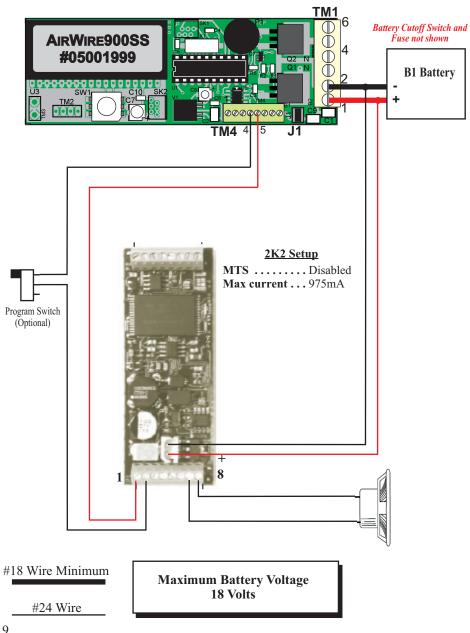
WARNING

Soundtrax no longer recommends the use of the Sierra Sound System in battery powered locomotives if the battery voltage exceeds 18 volts due to excessive heat dissipation in the sound decoder.

CVP recommends the use of the Soundtrax DSX decoder or any of the Phoenix sound systems when using greater than 18 volt power sources.

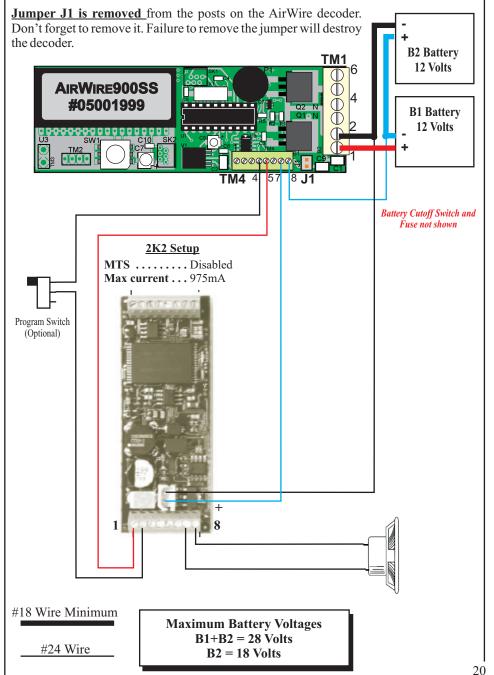## Phoenix 2K2 Sound Hookup - Single Supply 18V Max

This hookup diagram shows the required connections between the AirWire decoder, the battery and the 2K2 module. The programming switch is used to disconnect the sound module during AirWire decoder programming if necessary. Normally this switch is ON. See the 2K2 installation manual for programming information and detailed instructions for the remaining connections.

With this simple hookup, the maximum battery voltage is 18 volts.

AIRWIRE900SS
#05001999

TM1
6
4
2
1

Battery Cutoff Switch and Fuse not shown

B1 Battery
-
+

U3 SW1 C10 SK2
TM2 C7
TM3
TM4 4 5 J1

Program Switch
(Optional)

2K2 Setup
MTS . . . . Disabled
Max current . . . 975mA

1 8
+

#18 Wire Minimum

#24 Wire

**Maximum Battery Voltage
18 Volts**

Phonenix 2K2 Sound Hookup - Split Supply

This is similar to the single supply except two batteries are used with the 2K2 module fed from the center tap between the two batteries. With this hookup, motor voltage can be as high as 24 volts. See the 2K2 manual for more details about using the 2K2. Note that two 12 volt batteries are used.

Jumper J1 is removed from the posts on the AirWire decoder. Don't forget to remove it. Failure to remove the jumper will destroy the decoder.

AIRWIRE900SS
#05001999

TM1
6
4
2
1

B2 Battery
12 Volts
-
+

B1 Battery
12 Volts
-
+

Battery Cutoff Switch and Fuse not shown

U3 SW1 C10 SK2
TM2
TM3
TM4 4 5 7 8 J1

Program Switch
(Optional)

2K2 Setup
MTS . . . . Disabled
Max current . . . 975mA

1 8
+

#18 Wire Minimum

#24 Wire

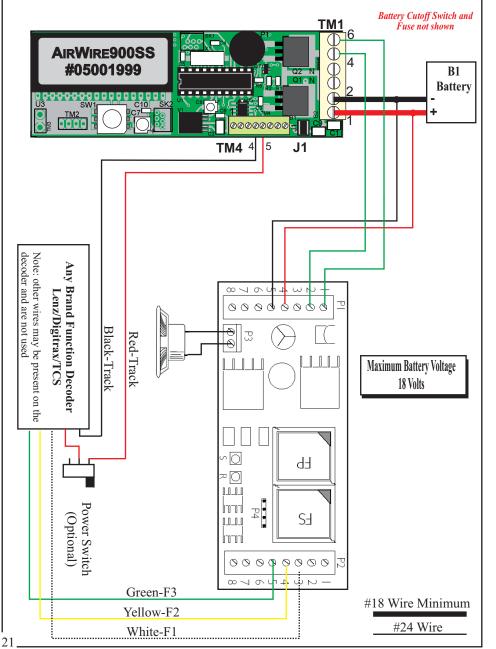**Maximum Battery Voltages
B1+B2 = 28 Volts
B2 = 18 Volts**

Phoenix BIG-SOUND 96/97 - Single Supply 18V Max

This hookup diagram shows the required connections between the AirWire decoder, the battery and the Big-Sound 96/97 module. See the Phoenix installation manual for detailed instructions for the remaining connections.

With this simple hookup, the maximum battery voltage is 18 volts.

Jumper J1 **is across** the posts on the AirWire decoder.

Battery Cutoff Switch and Fuse not shown

TM1

AIRWIRE900SS #05001999

B1 Battery
−
+

TM4 4 5 **J1**

Any Brand Function Decoder Lenz/Digitrax/TCS
Note: other wires may be present on the decoder and are not used

Black-Track
Red-Track

Power Switch (Optional)

Maximum Battery Voltage 18 Volts

Green-F3
Yellow-F2
White-F1

#18 Wire Minimum
#24 Wire

21

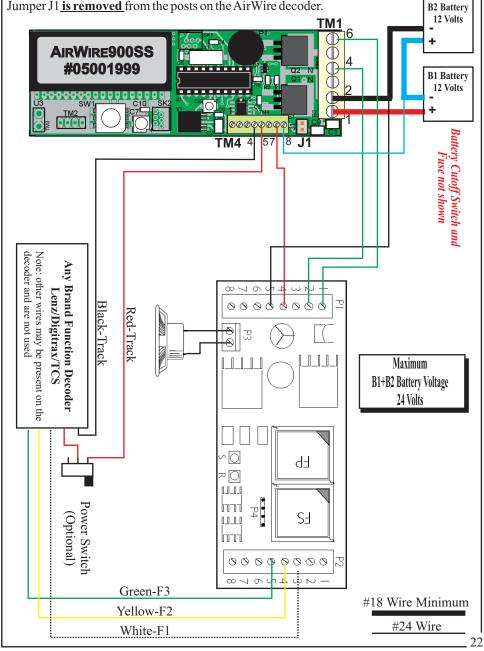## Phoenix BIG-SOUND 96/97 - Split Supply 24V Max

This is similar to the single supply except two batteries are used with the sound module fed from the center tap between the two batteries. With this hookup, motor voltage can be as high as 24 volts. See the Phoenix manual for more details about using the module features..

Note that two 12 volt batteries are used. The sum of the two battery voltages must not exceed 24 volts or damage will occur to the sound module.

Jumper J1 **is removed** from the posts on the AirWire decoder.

B2 Battery 12 Volts
−
+

TM1

AIRWIRE900SS #05001999

B1 Battery 12 Volts
−
+

TM4 4 57 8 **J1**

Battery Cutoff Switch and Fuse not shown

Any Brand Function Decoder Lenz/Digitrax/TCS
Note: other wires may be present on the decoder and are not used

Black-Track
Red-Track

Power Switch (Optional)

Maximum B1+B2 Battery Voltage 24 Volts

Green-F3
Yellow-F2
White-F1

#18 Wire Minimum
#24 Wire

22

Frequency Selector Settings

The decoder and throttle much be set to the same frequency. Each throttle/decoder pair must be on a unique frequency so as not to jam other throttles and decoders. Any frequency can be used. Use the illustrations to ensure that the decoder and throttle have matching frequencies. Notice that the small arrow on the decoder's selector switch points at the frequency number. The frequency can changed at any time and the new setting takes affect immediately. In the drawings below, the white square is the slider portion of the switch. For the T9000 throttle, use the frequency number from 0 to 7.

Note, if using a remote frequency selector, set the selector switch on #0.

Decoder	RF1300 Throttle	Decoder	RF1300 Throttle

Frequency 0 - 921.37MHz
Use 0 when using remote selector

Frequency 4 - 909.37MHz

Frequency 1 - 919.87MHz

Frequency 5 - 907.87MHz

Frequency 2 - 915.37MHz

Frequency 6 - 906.37MHz

Frequency 3 - 912.37MHz

Frequency 7 - 903.37MHz

Beware of Other Transmitters

The AirWire receiver operates in an unlicenced band shared by many other transmitters. These transmitters can and will create interference, intermittent throttle operation or complete failure of one or more of your throttle's 8 frequencies. The sources of these external interfering signals can be from your own home or from adjacent homes and businesses. They can also be from other CVP wireless throttles and controllers.

Here's a list of devices known to have cause interference problems to AirWire900 equipment: wireless devices attached to computers, TV/Radio/Entertainment-center, remote controls, cordless telephones, alarm systems, baby monitors, unlicenced personal communication devices, lawn sprinkler controllers, remote starter switches, cordless light switches, outdoor lighting controllers, toys, wireless headphones, and games. Of course, if you have additional wireless throttles, make sure each is on its own frequency. Two throttles on the same frequency will jam each other.

If you find a strong interfering signal on one or more of your frequencies, don't use those frequencies. Simply select another, different frequency.

CVs, Options and Default Values

The AirWire locomotive decoder is a combination radio receiver and decoder. It has several user changeable options that serve to improve locomotive performance or select specific actions during operation on your railroad. Each option will be discussed first and the predefined default value is shown in brackets. The maximum value allowed follows. You can use these without any changes or change them to customize your locomotive's performance. These options are stored inside the decoder and can be changed at any time. These options are called CVs and since there is more than one, a number follows to indicate which CV is being referenced.

CV1 - Locomotive Address   [3] 1-9999 Just like your house number, each locomotive needs a unique address. A handheld throttle set to the same address will send commands only to the specified locomotive. That way your locomotive can be controlled without other locomotives listening in. Each locomotive should have its own address. As delivered from the factory, each decoder always has the same default address. Most users decide to use the locomotive number, easily seen on the side of the locomotive, as the address. The address can be any number from 1 to 9999.

CV2 - Motor Starting Voltage   [0] 0 to 255 This is the voltage applied to the motor in speed step 1. You can change this value so the locomotive receives a higher voltage at speed step 1. The default is 0 which means the motor starting voltage begins at 0 volts.

CV3 - Motor Acceleration Rate   [2] 0 to 255 Sets the rate of change of speed upon acceleration. A higher value leads to a slower acceleration. The default value of 2 means there is a couple of seconds of delay when the speed is increased. A value of 0 or 1 is OK.

CV4 - Motor Deceleration Rate   [2] 0 to 255 Sets the rate of change of speed upon a decrease in throttle speed. A higher value causes the stopping time to increase which leads to longer time before the locomotive eventually come to a stop. The default value of 2 means there is a couple of seconds of delay when the speed is decreased.

If CV3 or CV4 are set to 0 or 1, a special failsafe feature is activated. If you accidentally change locomotive direction, without first setting the speed control to 0, the decoder will insert a value of 2 in both CVs in order to prevent damage to the motor or gears. If this feature is activated, the user defined values of 0 or 1 can be reloaded by momentarily turning off decoder power. We strongly recommend that the value be set to 2 or higher.

CV5 - Maximum Motor Voltage   [0] to 255 Sets the maximum voltage applied to the motor when the throttle is full on. A value of 0, 1 or 255 will always guarantee that full battery voltage is applied to the motor. The default value is 0. Some examples of values and the resulting top speed, expressed as a percentage of the maximum speeds are shown below. Adjust the values to suit your requirements. However, as the top speed is decreased, there will also be a decrease in the amount of pulling power available from your locomotive.

CV5 Value	% of Top Speed
0 or 1 or 255	100% [indicates CV5 is not used]
220	80%
190	70%
127	50%
95	38%

CVs, Options and Default Values *continued*

CV 6 - Mid Point Speed Value   **[0] to 255**   Sets the amount of voltage applied to the motor when the throttle is set at the 50% point or half way between off and full on. The combination of CV5 and CV6 makes speed adjustments and speed matching locomotives easy.

CV 8 - Reset Loco to Defaults   **[n/a]**   Sending a value of 135 resets all CVs to the factory default value. This can be done at any time. However, remember that the default address is 3.

CV 11 - Loss of Signal Timer   **[0] to 255**   Determines the amount of time the locomotive will continue to run once the throttle commands are no longer received. There may be several reasons for this to occur. For example, you may have changed the throttle's address to control another loco. Or, perhaps the locomotive is out of range of the throttle or perhaps the throttle has been turned off. Divide the value by two to determine the number of seconds before the locomotive stops. For example, a value of 20 means the locomotive will stop 10 seconds after it no longer is receiving throttle commands . The default value is 0 which means the locomotive will maintain its last received command forever; the timer never "times out."

CV29 - Decoder Setup

CV 29 - Decoder Setup [2] 0 to 51 This is a multipurpose CV whose value sets several options at once. To use the table at the bottom of page 16, select the line having the options setup that you wish to use. Load the CV29 value shown. Remember that the short or long address is automatically set and should not be loaded manually.

Motor Direction: Allows the motor direction to be reversed from default. This is handy if you discover the motor runs in the wrong direction and do not wish to disassemble the chassis to physically reverse the motor wires. Changing the electrically reverses the motor wires for you. The default is "normal."

 # Steps: Sets the decoder to provide either 14 or 28 speed steps from off to full power. The default is 28 steps.

Speed Table: There are two separate speed tables in the decoder; standard and custom. The standard is the default speed table and is permanent. The custom table is one that you can load using CV programming and enable with CV29. There are 28 entries allowed in the custom table. Working with the custom table is discussed later. The default is the standard table.

Address: This tells the decoder if the address range is from 1 to 99 which is called a short address, or from 100 to 9999 which is called a long address. The default is a short address. When a long address is used, this value is automatically changed. To use this table, select the line that has the options desired and load the value into CV29.

Service Mode programming is the only form of programming understood by the AirWire decoder.

Service Mode programming will program both the AirWire decoder and the decoder connected to the auxiliary DCC outputs.

AW9D10SS CVs and Default Values

CV#	Function		Default
1	Locomotive Address	Address	3
2	Motor Starting Voltage	MSV	0
3	Acceleration Rate	ACCL	2
4	Deceleration Rate	DECL	2
5	Maximum Voltage	Vmax	1
6	Midpoint Voltage	Vmid	1
8	Reset to factory defaults	RESET	n/a
11	Loss of Signal Timer	Packet Timeout	0
17	Extended Address	Automatic - do not use	0
18	Extended Address	Automatic - do not use	0
29	Decoder Setup	See below and page 14	2
67- 94	Custom Speed Table	See page 20 and 21	-

CV29 options and settings

See the explanations on page 12 for definitions and uses for the various CV29 values. Boxed entry is the default setting and the factory reset setting.

Address	Speed Table	# Steps	Motor Direction	CV29 Value	
Short	Standard	14	Normal	0	
Short	Standard	14	Reversed	1	
Short	**Standard**	**28**	**Normal**	**2**	default
Short	Standard	28	Reversed	3	
Short	Custom	14	Normal	16	
Short	Custom	14	Reversed	17	
Short	Custom	28	Normal	18	
Short	Custom	28	Reversed	19	
Long	Standard	14	Normal	32	
Long	Standard	14	Reversed	33	
Long	Standard	28	Normal	34	
Long	Standard	28	Reversed	35	
Long	Custom	14	Normal	48	
Long	Custom	14	Reversed	49	
Long	Custom	28	Normal	50	
Long	Custom	28	Reversed	51	

Checkout And Operation

Simplified Checkout of AirWire Decoder

1. Set frequency selector on decoder to match frequency set in throttle.

2. Turn on battery power to decoder.

3. Confirm that throttle is set to the matching frequency

4. Turn on throttle's power switch.

5. Set address on throttle to 3 by pressing # 3 #.

6. Turn up speed control, and loco will run.

7. Turn on the headlights by pressing the 0 key. The lights feature automatic reversing and will follow the direction key, even if the locomotive is stopped.

Take Care When Programming The AirWire Decoder

Service mode programming is the only form of programming supported by the AirWire decoder. This form of programming will program the AirWire decoder _**AND**_ any other decoder connected to the Auxiliary DCC output terminals. In addition, since the programming is received via the throttle's transmitter, any other decoders, that are on and sharing the same frequency also will be programmed, regardless of their assigned address.

Setting Up The Decoder - Service Mode Programming

Turn on power to the locomotive. Pick an easy to remember locomotive address. The locomotive number is typically used, or perhaps just the the last two digits of the locomotive number. For a limited number of locomotives, just the last digit is sufficient. Make sure it will be unique. Use service mode programming to set the address. Do not use OPS mode programming.

Changing CV Values for the motion decoder is best done with Service mode programming. The chart on page 16 shows the various CVs available for controlling the locomotive's performance.

Resetting Decoder To Factory Defaults

If nothing seems to work, try resetting the decoder back to the factory defaults. This is done by writing a value of 135 into CV 8 and turning the battery power off then back on. All CVs, including the address are reset to the factory defaults shown in the CV table.

Programming the Sound Decoder Address

Always program the address for the sound decoder the same time as you program the locomotive decoder. If you have installed a cut-off switch, make sure it is turned on and the sound decoder is powered before changing the address.

Fine Tuning Sound Decoders

Use OPS mode programming to fine tune the CVs of a sound decoder.

> Service Mode programming will program both the AirWire decoder and the decoder connected to the auxiliary DCC outputs.

Fine Tuning Locomotive Performance

Any or all of the available configuration variables (CVs) may be used, alone or in combination, to change how a locomotive responds to throttle commands: Motor Starting Voltage (MSV), Acceleration (Inertia) delay (ACCL), Deceleration (Momentum) delay (DECL), and loading a custom speed table.

MSV [CV#2] - This is the voltage applied to the motor in speed step number 1. Set this value so that the locomotive begins to creep in speed step 1. Higher values for this CV result in higher voltages applied to the motor.

ACCL [CV#3] - This determines the rate of change of speed upon an increase in throttle speed. Higher values result in slower rate of change - more inertia. For example with a very high value, moving the throttle from OFF to mid-range, will result in the locomotive not moving for a very long time, and when it does begin moving, its speed increase will be extremely gradual.

DECL [CV#4] - This determines the rate of change of speed upon a decrease in throttle speed. Higher values result in slower rate of change - more momentum. For example with a very high value, moving the throttle from mid-range to OFF, will result in the locomotive not stopping for a very long time, and when it does begin to slow, its speed decrease will be extremely gradual.

Speed Step Selection - The speed step setting is used to determine the number of steps between off and full on. Your decoder supports 3 different types of speed step settings, 14, 28 and 128. The 14 and 28 step options requires the programming of CV29. The third does not involve the decoder and is set by the throttle.
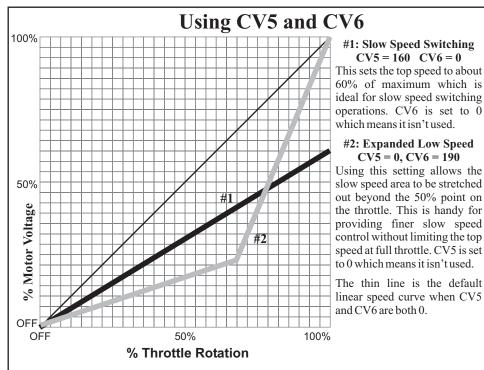
Once the selection is made, the motor starting voltage, the acceleration rate and deceleration rate CVs are used to smoothly transition between each step. However, if these two CVs are both set to zero, each speed step change will be abrupt and noticeable.

The 128 Speed Step Option can be considered "direct drive" where you have direct control of the locomotive speed. CV2 and CV 3 and CV4 are used when in the 128 speed step mode. When 128 speed step mode is in use, CV5 and CV6 are not used.. You may change between the 128 speed step mode and 14/28 mode, which is done at the throttle, without reprogramming the locomotive decoder.

Failsafe Operation - If your locomotive goes out of range of the throttle or the throttle is no longer transmitting, you can set the locomotive to either continue running or stop after a preset amount of time. The timer range is 0.5 seconds to 128 seconds. A value of zero means the locomotive runs forever, or until the battery runs down.
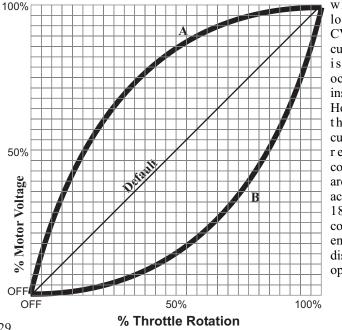
If CV11 = 0 this selects continuous operation. In other words, the locomotive continues to operate at the last received speed command forever. The assumption is that it will eventually come back into range of the locomotive. Another reason to use continuous running is because you want to control several trains with a single throttle. Changing the throttle's address to control a new address means the original address is no longer being used. This is the same as turning the throttle off or going out of range. With the decoder set to operate continuously, the locomotive will continue to run at the last received speed command. To regain control, first set the speed knob and direction close to the locomotive's current speed and then select the new address.

If CV11 value is not equal to zero, then the locomotive will come to a smooth halt after the timer value counts down to zero.

Using CV5 and CV6

#1: Slow Speed Switching
CV5 = 160   CV6 = 0

This sets the top speed to about 60% of maximum which is ideal for slow speed switching operations. CV6 is set to 0 which means it isn't used.

#2: Expanded Low Speed
CV5 = 0, CV6 = 190

Using this setting allows the slow speed area to be stretched out beyond the 50% point on the throttle. This is handy for providing finer slow speed control without limiting the top speed at full throttle. CV5 is set to 0 which means it isn't used.

The thin line is the default linear speed curve when CV5 and CV6 are both 0.

Custom Speed Table Examples

There are 28 separate CVs that are used to hold a custom speed table. Each entry represents a single speed step that is sent to the locomotive. Values are between 0 and 255 with 0 being off and 255 being 100% full speed. There is no error checking done on this table and

whatever values are loaded are used when CV29 is set to use the custom table. This feature is used for special occasions and in most installations, is not used. However, it is included for those who wish to customize the locomotive response to speed commands. Two examples are shown, A and B. The actual values are on page 18. Use the provided columns to record your entries. Programming is discussed in the throttle operation manual.
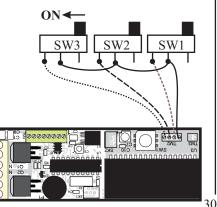
Custom Speed Table Entries

CV#	STEP	DEFAULT	A	B	YOURS	YOURS	YOURS
67	1	10	10	0			
68	2	19	50	2			
69	3	28	87	4			
70	4	37	109	6			
71	5	46	121	10			
72	6	55	135	12			
73	7	64	150	15			
74	8	73	167	17			
75	9	82	180	20			
76	10	91	191	25			
77	11	100	200	28			
78	12	109	209	35			
79	13	118	215	40			
80	14	128	220	45			
81	15	137	225	50			
82	16	146	229	60			
83	17	155	233	70			
84	18	164	237	80			
85	19	173	240	90			
86	20	182	243	100			
87	21	191	246	115			
88	22	200	248	125			
89	23	209	250	140			
90	24	218	252	160			
91	25	231	253	180			
92	26	237	237	200			
93	27	255	254	225			
94	28	255	255	255			

Installing Remote Frequency Selector Switches

To allow the use of an external selector frequency selector switch, a set of terminals, TM2, are provided on the decoder. The simplest way to make connections is to use a length of 4 conductor ribbon cable. Keep the wire as short as possible and don't exceed about 6 inches. For simplicity, a set of 3 miniature slide switches are shown. However, any type of switch can be used including another rotary switch similar to the one on the board.

Be sure to set the on-board selector switch to setting # 0 or the remote switches will not work.

Troubleshooting

This section is written assuming the locomotive was originally responding and working properly. In most cases, the cause will be something simple or down right silly. More than once we have helped users discover the power switch on the throttle. The other obvious problem is a dead battery.

No Operation, decoder doesn't respond to throttle

1. Use voltmeter to confirm battery is connected and is providing voltage to the terminals of the decoder. The positive battery lead must be connected to terminal 1 of TM1. If you discover the polarity is reversed, the decoder will be destroyed and can not be repaired.

2. If voltage is present, next check that the throttle and the decoder are set to matching frequencies.

3. If frequencies are properly set, set the throttle to the locomotive address. If this is the first use of the decoder, set the throttle to address 3. With the throttle turned on, push #, 3, then # to set it.

4. If decoder doesn't respond, try resetting it to factory defaults using the procedure described in the throttle's operation manual.

Locomotive Runs Opposite of Direction Indicator

This is caused by motor wires being reversed. Swap the two motor wires at terminal TM1. Don't use CV29 to electronically reverse the wires because the headlights will be backward to the locomotive's movement.

Locomotive Runs Slower or Can Not Pull Many Cars

Assuming your battery is fully charged, this problem might be the result of comparing your old power pack voltage to the battery voltage. Your old power pack probably provided a higher voltage than the battery. The battery voltage sets the top locomotive speed and the pulling power. You can increase the battery voltage by using the split battery option for more pulling power.

Battery Runs Down Quickly

Battery life is directly related to how much current is consumed by the locomotive and other attached loads such as sound decoders, lamps and smoke generators. Also, garden railroad locomotives require high levels of current when starting or climbing hills. All of these conditions can shorten the running time. A simple solution is to use high amp-hour rated batteries. The downside is the extra weight. The choice is yours and only you can decide

Limited Range

In addition to suspecting a weak battery, confirm that the antenna is oriented properly and has not come in contact with metal, or become bent or pinched. Best range occurs when the antenna is outside of any enclosure, especially metal. Consider using the optional external antenna for optimum, long range reception. Also see page 23 for a discussion about interfering signals and consider trying another frequency.

> **Do not allow water to contact the decoder. This will certainly cause the receive range to be much lower and may actually damage or destroy the decoder.**

Resetting AirWire Deocoder To Factory Defaults

Using the RF1300 Throttle

Follow these steps to reset your AirWire Decoder to its original factory defaults using the original AirWire Throttle:

1. It is recommended that only the AirWire decoder to be reset be powered. All other AirWire decoders that "hear" the reset command will also be reset. Although sound and other auxiliary DCC decoders should not be affected, there is no guarantee. So, disconnect or disable all other decoders before proceeding.

2. Verify that the throttle and decoder frequencies are matched. Verify that the decoder to be reset is powered on.

3. Turn off throttle's power switch.

4. Push **and hold** the 9 key.

5. Turn on the throttle power switch while continuing to press the 9 key.

6. Release the 9 key. Notice the direction indicators are alternately flashing signifying the throttle is in the programming mode.

5. One at a time, push the following keys: *, 8, *.

6. One at a time, push the following keys: #, 1, 3, 5, #.

7. Listen for the decoder to beep signifying the command has been sent.

8. Turn off the throttle to exit programming mode.

At this time, the decoder has been reset to factory defaults. It will be on address 3. Reset your throttle to address 3 to confirm that decoder has been reset.

See page 16 for all of the default values that have been restored to the decoder.

Using the New T9000 Throttle

Follow these steps to reset your AirWire Decoder to its original factory defaults using the new T9000 throttle:

1. AirWire decoders that "hear" the reset command will also be reset. Although sound and other auxiliary DCC decoders should not be affected, there is no guarantee. So, disconnect or disable all other decoders before proceeding.

2. Turn on the throttle

3. Push the SVC key then the SEL key to enter the Service mode.

4. One at a time, push the following keys: *, 8, *.

5. One at a time, push the following keys: #, 1, 3, 5, #.

6. Listen for the decoder to beep signifying the command has been sent.

7. Push the * key to return to normal operation.

At this time, the decoder has been reset to factory defaults. It will be on address 3. Set the throttle to address 3 to confirm that decoder has been reset.

See page 26 for all of the default values that have been restored to the decoder.

Heat and Hot Weather Tips
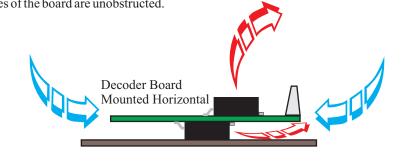## Managing Heat Build-up!

When operating the AirWire decoder near its maximum current capacity, the decoder can become as hot as a 100 Watt light bulb. Since most AirWire decoders are mounted inside plastic locomotives and rolling stock, the interior temperature can reach harmful levels leading to decoder failure unless this heat is removed. In addition to the heat generated by the decoder, a hot climate can also cause heating of the car's interior which adds to the problem. Fortunately, minimizing the heat buildup is relatively straight forward and takes advantage of the fact that hot air rises.
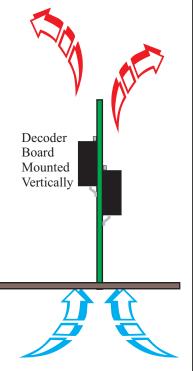
Mounting Tips

Never wrap the decoder in insulating material. Never cover or coat the decoder with RTV adhesive. Not only will this cause heat build up, but almost all adhesives are conductive, especially when uncured.

The decoder should be mounted such that the power transistors are open to free air movement. If at all possible, allow the transistors to be near an opening in the chassis or car floor. Cool air will be pulled towards the transistors as the hot air rises away from the decoder.
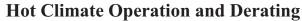
Although horizontal mounting is OK, the bottom power transistor's heat flow is obstructed by the circuit board. If possible, mount the decoder vertically such that both sides of the board are unobstructed.

Decoder
Board
Mounted
Vertically

Vertical board mounting allows better airflow

Decoder Board
Mounted Horizontal

Mounting the decoder horizontally is OK but the airflow is blocked by the board itself

Hot Climate Operation and Derating
continued from previous page
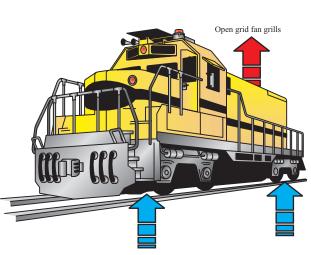
Improve Air Flow

Although locomotives and cars have many openings for air to enter, the addition of more vents on the bottom and in the roof will greatly aid heat removal. For diesels, consider opening up the grid and radiator fan housings especially if they are simply cast on. Drill additional holes in the floor. Also consider removing plastic windows, especially if the locomotive is small and the decoder is in the cab. Small muffin fans, running on 12V will help considerably providing there is room for them. Be sure and use low current fans, to minimize the battery drain.

Lower The Motor Current

Since the power dissipated by the decoder is based on the motor current and motor drive voltage, a lower top speed will decrease the motor current and decrease the heat generated by the power transistors. The easiest methods to decrease current are to lower the motor drive voltage and limit the top speed. Not only will the heat generation be less, but the batteries will last longer too. On hilly layouts, the use of multiple locomotives in a consist is much more efficient than a single locomotive, running at maximum power, straining to make it up the grade.

Derating Maximum Output Current In Hot Climates

High outdoor temperatures will result in hot interior temperatures even when there is good airflow. The current rating for the AirWire decoder was established at normal room temperature and with no airflow obstructions. When mounted in a locomotive and used outdoors on a hot day, the allowable maximum output current must be derated to insure safe operation. A very crude guideline is to lower the maximum current by 1 Amp for each 10 degree increase above room temperature (room temperature is 70 degrees F). For example, if the outdoor temperature is 100 degrees, the maximum allowable current should be decreased by about 2-3 Amps.
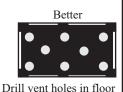
Chassis floor construction

Open grid fan grills

Fair

Don't depend on small openings to provide ventilation

Better

Drill vent holes in floor

Airflow In Modern Plastic Diesel Locomotives

Power Through The Rails - Some Considerations

The AirWire decoder is designed for battery powered operation. Although power can be supplied through the rails to the AirWire decoder, we do not recommended it. But if you insist on using something other than batteries, consider the following challenges:

Clean wheels and clean track are mandatory if power is not supplied by batteries. Battery powered outdoor locomotives never need to have wheels cleaned and never need to have the track cleaned. Don't let anybody fool you into thinking they never clean track. It is not always dirt that causes problems. Sand, mud, bugs, leaves, grass and all other manner of detritus will cause track pickup problems. If your friend has not cleaned track, don't worry, they will have to eventually.

Electrical safety is compromised the moment you replace batteries with power derived from household power and feed it onto the rails. Do you know about and know how to use a Ground-Fault-Interrupter? If not, stay with batteries - battery power is the safest form of power in the garden railway.

Wiring the track becomes a long, tiresome and boring chore. If you use battery powered locomotives, your track-wiring job reduces to zero. There is no need to worry about reverse-loops, turnout wiring, dead frogs, opposing point switch wiring, route control wiring and the many other forms of arcane torture related to wiring a railroad.

Notes

Warranty Information

This warranty covers substantial defects in materials and workmanship in the AirWire decoder.

What This Warranty Does Not Cover
This warranty does not cover any problems which result from improper installation, modifications, battery polarity reversal, improper operation, leaking batteries, excessive battery voltages, excessive motor current draw, abuse, accidents, or acts of God such as excessive heat, floods, damage caused by exposure to moisture and rain, lightning, earthquakes, volcanic events, tidal waves or hurricanes.

Warranty Duration
The coverage of this warranty lasts for 90 days. After this period, standard repair rates apply. Depending on the problem, CVP reserves the right to repair or replace.

Help, Repairs and Returns
If you have questions or need help, your first call needs to be to your dealer or installer. They are very familiar with the AirWire equipment and its use. If your dealer/installer doesn't have the answer, use the phone number below. Have your instruction manual and AirWire equipment nearby before you call during normal business hours. If you reach voice-mail, please leave a message and include your name, number and city and state. We promise to call you back.

Do not send items to us for repair without first obtaining authorization. In many cases, problems are easily solved via phone or email without the need or expense to return items to us. **If we authorize** and request you to return an item, be sure to mark the "Return Material Authorization" (RMA) number on the outside of the box. **Items sent without an RMA will be refused and returned at your expense.** You are responsible for all shipping charges.

CVP Products   415 N. Bowser, Ste. #101,   Richardson, TX 75081

Installation Accessories

Available from your dealer or direct from CVP. Prices do not include shipping or applicable sales taxes.

Split Board Kit with 3 inch flex cable   [SF3] .... $ 13.95
Split Board Kit with 6 inch flex cable   [SF6] .... $ 13.95
Split Board Kit with 12 inch flex cable   [SF12] .... $ 16.95
Split Board Kit with 18 inch flex cable   [SF18].................................. $ 19.95
This kit includes the connectors, the specified length of very thin flat flex cable and instructions. It allows the AirWire900 board to be split in to two parts: the radio receiver and the motor driver. A small flex cable connector is soldered to each board half. The thin flex cable is already pre-stripped and tinned ready for use to reconnect the two halves.

Fuse Kit   [FK9] .... $ 7.95
Includes in-line fuse holder with 18" wire leads, two 10A slo-blo fuses and hookup diagram. Provides catastrophic protection for the battery and motor driver.

Coaxial Cable, Connector and Antenna   [CA] .... $ 19.95
Includes 5 inch rigid antenna attached to 9 inches of RG174 coax cable. Cable solders to the AW9D10 board in place of the standard wire antenna. Allows antenna to be placed on top of car or locomotive for improved very long range reception.

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