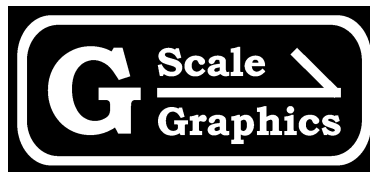
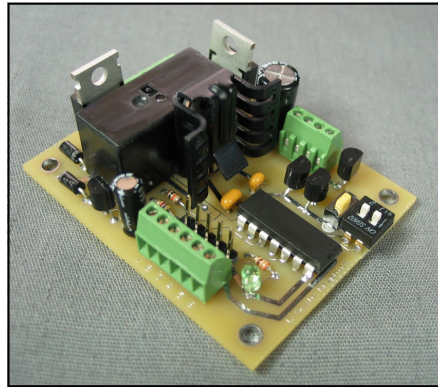


Basic

RailBoss

2.4GHz Hobby

Operation and Installation Manual



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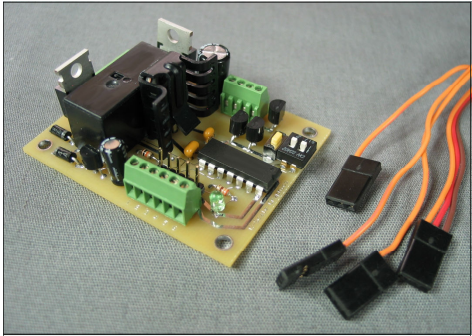
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Overview



What you get: Basic RailBoss board and 4 R/C cables.

The 2.4GHz Basic RailBoss R/C is an electronic speed control designed specifically for controlling large scale trains using low cost readily available 4 or 5 Channel 2.4GHz hobby radios. The RailBoss R/C system provides extreme flexibility in the way you control your trains. You have full manual radio control of all the basic speed functions; speed, direction, and momentum. Control all of your trains from the same transmitter, one or two at a time. Two programmable outputs can be configured for directional lighting or up to two sound triggers.

Many aspects of the throttle are programmable to match your specific needs; i.e. double-heading locos, realistic response, and speed limiting for children.

2.4GHz technology, DSSS (Direct Sequence Spread Spectrum) and FHSS (Frequency Hopping Spread Spectrum) have completely changed the way radio controlled hobbies operate. No longer do you have to worry about frequencies or channels. *Your* transmitter controls *your* receiver (or receivers) and no one else's. The radio interference generated by the electric motors powering our locos is no longer a problem. Radio range no longer needs to be discussed, because it is far greater than needed, under all conditions. And with antennae lengths of only 1", installations are simple. But best of all, this technology is now available at low cost.

The Basic RailBoss controls your locomotive using a standard 4 or 5 channel stick transmitter. For a Mode 2 radio, the left stick controls the speed functions: proportional throttle and momentum. The right stick controls direction, and manual sound triggers. The right stick also has many other uses, as explained in detail later.

Turn off the transmitter when not in use to save the transmitter batteries. The RailBoss will maintain your present speed.

A powerful little micro-controller handles all of the control logic and sends signals to the 5 amp motor driver, which is enough to handle most locomotives pulling a full train.

Directional lighting outputs are provided for incandescent lamps and/or LEDs without the need for added resistors. These same two outputs can be configured to provide up to two sound triggers.

User programmable options give you control over many of the operating parameters, without a computer.

The Basic RailBoss R/C kit consists of a circuit board and four cables to connect your receiver to the RailBoss. You need to supply the 2.4GHZ transmitter and receiver.

As with all G-Scale Graphics controls, an on-board diagnostic LED can assist you with trouble shooting wiring or other problems.

To complete your battery power conversion, you will also need to provide a power on/off switch, charging jack, battery pack, fuse, and battery charger. To make this task easier, we recommend our "Battery Conversion Module", which contains a power on/off switch, charging jack, and fast acting fuse. This simplifies the wiring and eliminates most of the soldering. It also provides power distribution to your sound board and other accessories.



To complete the system, you must supply a suitable 2.4GHZ transmitter and receiver. Shown here is the Spektrum AR500 Rx (left) and DX5E Tx (right), but other systems may be used.

The Radio System

The radio transmitter is not included with the purchase of your RailBoss, but is readily available on-line or at your local hobby shop. G-Scale Graphics can supply a compatible low cost receivers.

The RailBoss is designed to operate using 2.4GHZ 4-Channel radios with a proportional throttle stick. 2.4GHZ technology has revolutionized radio control. Details of how DSSS (Direct Sequence Spread Spectrum) and FHSS (Frequency Hopping Spread Spectrum) work are beyond the scope of this manual, but here is the short version ... the radio is constantly changing frequencies and comparing signals at a high rate of speed, often using dual antennae or dual receivers. The results are ...

- Radio range far exceeding the needs of garden railroading under most conditions.
- NO interference from locomotive motors or other radio/noise sources. No filters or special antenna care required.
- Multiple operators can run at the same time without the need for frequency or channel assignments. Your receivers will only respond to your transmitter due to a "Binding" process.
- Multiple receivers bound to the same transmitter will respond to the same commands. This allows for double-heading and multiple-loco operations.

One transmitter can be used to run all of your trains using one or more locomotives per train. You can run up to two trains at the same time from one transmitter. More than two trains at the same time will require additional transmitters. The receiver aboard each train must be bound to its respective transmitter.

Note: Simultaneous operation of two trains requires a transmitter with a toggle switch. These are usually sold as 5-Channel.

During the "Binding" process, the receiver reads the transmitter's unique identification code. From then on, it will only respond to commands identified by that code. Binding is fairly simple and only needs to be done once. Refer to your transmitter manual for details.

Note: Bind with throttle in the full DOWN position in order for RailBoss to work properly with the Tx off.

The RailBoss supplies the power to the receiver through the 3-wire cable, so no connections are required to the BAT/BIND terminals. These terminals will only be used if a binding plug is required during the binding process.

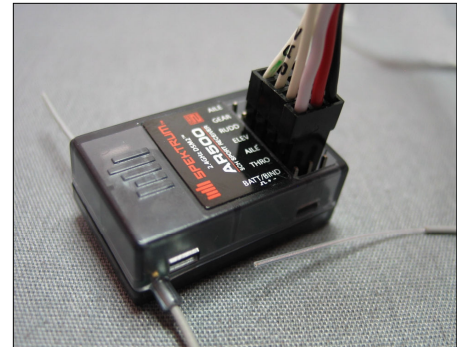
The 2.4GHZ antennae work well in just about any orientation. If your receiver is mounted inside a metal body, you may obtain the best reception by routing the antenna outside of the metal body, but this usually isn't needed.

See list of "Recommended Radio Systems" at the end of this manual.

The RailBoss Control Board

RailBoss is an ESC (Electronic Speed Control). It converts the signals intended to drive an analog servo into useful commands for operating a powerful PWM (pulse width modulation) motor driver. It differs from the ESCs designed for R/C cars because the RailBoss is designed to allow nice slow prototypical speed control of your locomotive using the proportional throttle stick and 256 speed steps; i.e. the position of the throttle stick corresponds to the speed of the locomotive from minimum to maximum. Adding momentum to the throttle enhances the prototypical operation. Momentum is fully programmable, and can be turned off via the transmitter to assist with switching operations.

RailBoss provides power to your receiver and gets its R/C commands using the four receiver cables provided. It operates over a wide range of battery input voltage; 7-30V (2-7 Lithium cells, or 8-20 NiMh/NiCad cells). The battery input is protected from damage due to reverse polarity.



Connect R/C cables with the white (or orange) wire towards the inside of the Rx. The BAT/BIND slot remains open, unless being used for binding.

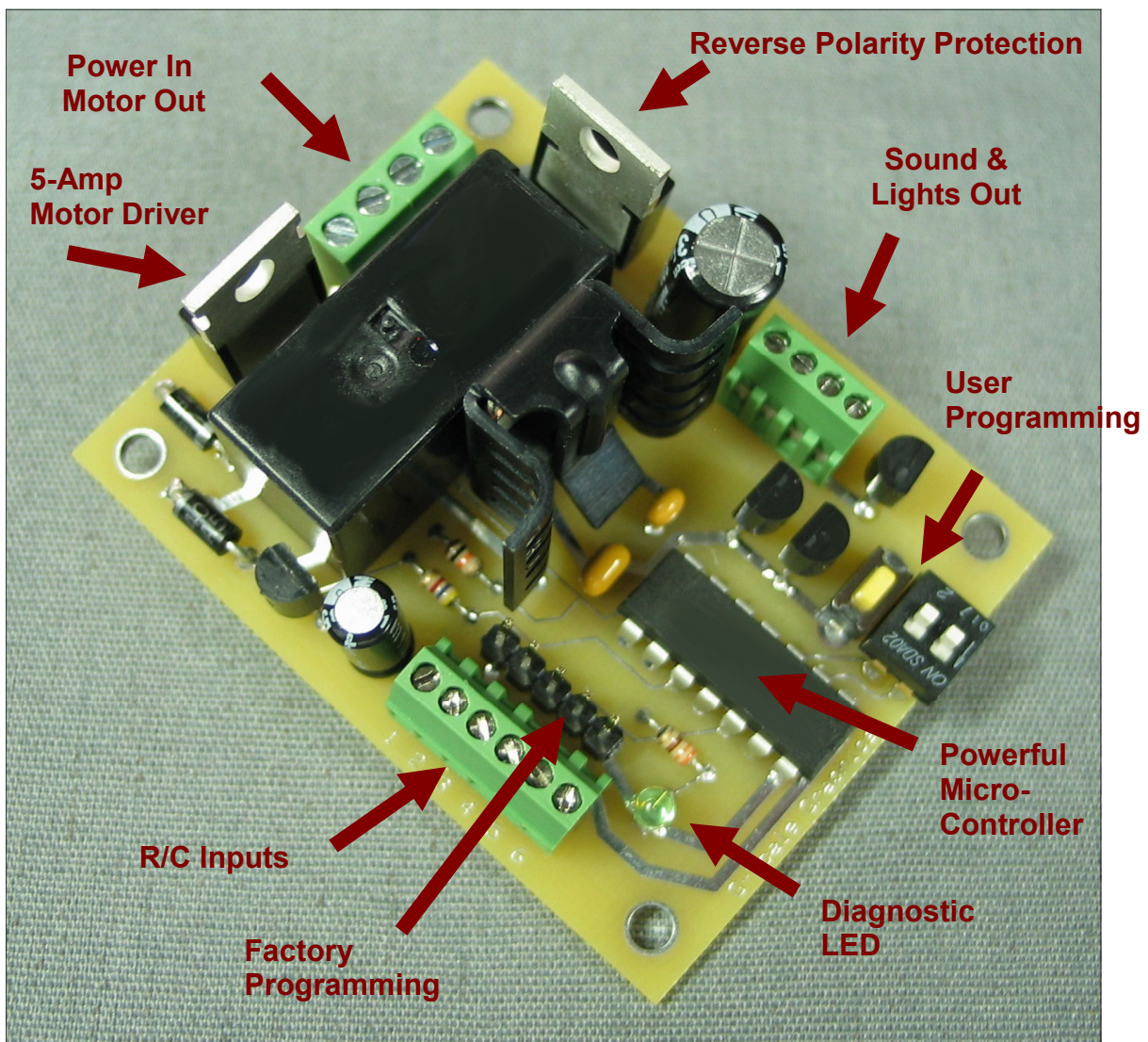
RailBoss has directional lighting outputs capable of driving incandescent lamps or LEDs without the need for user supplied resistors. Lamps (or LEDs with resistors) are powered from the battery voltage. LEDs without resistors are powered from a current source. The front and rear lights follow the direction of the locomotive. The front light is also used as feedback to the operator during start-up, calibration, and programming procedures.

RailBoss can also control your sound system. Two sound triggers can be controlled manually from the transmitter. The bell and whistle sounds can also be triggered from track magnets.

RailBoss allows the user to customize many operating parameters to meet the needs of their layout. An on-board DIP switch, push-button, and LED control up to 4 different parameters, each with many options available.

RailBoss also allows the operating characteristics of the throttle to be customized for maximum speed control resolution, and speed matching of locomotives.

RailBoss provides an on-board diagnostic LED to assist you with the installation and troubleshooting of your system. In most cases, it will eliminate the need for using a meter.



Installation

Track Power to Battery Power Conversion

All track powered locomotives are very simple, electrically. Track power is picked up from the rails via pickups and usually connected directly to the motor. Sometimes there are switches in the circuit to reverse polarity or turn off track power. These connections need to be modified in order to properly connect the battery powered driver board.

Converting to battery power consists of these basic steps.

1. Determine battery voltage requirements.

Before you disturb any wiring, run your locomotive at the fastest speed you like to run on your layout and measure the track voltage. Add at least 2 volts to this measurement to account for low batteries and driver losses. If using NiCad or NiMh batteries, round this value up to the nearest 1.2v increment, and you have the number of cells you need. For lithium cells, round up to the nearest 3.7v increment.

For example: Track voltage measures 11.6V at speed. $(11.6 + 2) / 1.2 = 11.3$. You will need at least 12 NiMh cells. $12 \times 1.2V = 14.4V$. (14.4V is a popular value for steam locomotives. Many critters can run on 12V. Diesels usually require 18V or more).

2. Disconnect the track power pickups.

By isolating your locomotive from track power, you can run more than one locomotive on the same track at the same time, either battery powered or track powered. If you don't do this, your battery will be directly connected to your track power supply, resulting in damage. Note that in doing this, you have also removed power from all lighting circuits, smoke units, and any other accessories that were running from track power. For battery power, smoke units are usually not used due to the high current requirements that will quickly drain the battery pack. Understanding existing wiring and/or circuit boards without documentation can be difficult. You may choose to just remove it all and wire directly to the things you can see and understand.

3. Find a direct connection to the motor.

The output of the controller needs to be connected directly to the motor. All other control boards and switches should be removed from the circuit. Depending on the design of the locomotive, this may be an extremely simple process, or it may be difficult. Some motor blocks make it very simple. You will find two pairs of wires. One set goes to the track pickups, and the other goes to the motor. You can verify which pair goes to the track pickups using a continuity checker or ohmmeter. Track pickups will have continuity from one pin to one set of wheels. The motor will read a small resistance value across the two wires (e.g. 18 ohms). Simply disconnect the track pickup pair and connect the motor pair to the controller.

4. Install the discrete components and wire them together

(battery pack, power on/off switch, fuses, charging jack, controller, Receiver, and lights)

Installing the new components is a packaging exercise. Where will it all fit? Space for the battery pack and control board and receiver is usually the biggest consideration. For smaller locos you may need to install some of all of the system in a trailing car. The G-Scale Graphics "Battery Power Conversion Module" makes installation easier in many cases by putting the on/off switch, fuse, and charging jack all one small circuit board with screw terminals to eliminate soldering.

Wiring

Always use stranded wire and tin the ends with solder prior to making any connections. Wiring for the power input and motor output circuitry on terminals 18 thru 21 needs to be heavier gauge wire (20 or 22 Ga.) Any wiring connections or splices not directly connected to a component must be covered. Use heat shrink tubing or wire nuts.

Skills

All connections to the RailBoss Control can be made via screw terminals. However, basic wiring and soldering skills may be required to make proper connections to the power on/off switch and charging jack. Some drilling and minor fabrication or modifications to the unit under conversion may also be required.

Tools & Materials

A low wattage soldering iron, side cutters, needle-nose pliers, wire strippers, a 1/16" or 5/64" slotted screwdriver, resin core solder, 22 Ga. Wire, and heat shrink tubing are recommended to properly complete the wiring. A suitable drill and double-sided foam tape may be useful for mounting components.

Installation of the Receiver

The receiver should be mounted as far away from the motor as possible, and as high up as possible. If you have a receiver with dual antennas, ideally they should be mounted in perpendicular planes, but this isn't critical. 2.4GHZ antennas are only about 1" long. If you have one that appears to be about 12" long, it is really a coaxial cable 11" long, with the last 1" acting as the antenna. **Do not cut the antenna wire to shorten it.** The length just allows you to position the 2nd antenna away from the first. You may also have a receiver that has a "satellite" receiver with its own antenna. Just mount it away from the other receiver, if possible, but again not critical. Plug the supplied cables into the receiver. These are standard R/C connectors that are "supposedly" polarized to only plug in one way, but in many cases they will go in either way. Consult the receiver manual for your system to insure proper orientation, but normally the data wire (single white wire) goes towards the inside of the receiver. Connect per the wiring diagram at the end of this manual. The 3-wire cable is built to standards used by Futaba, HiTec, and JR Radios (Red (+) in the middle, with Blk or Brn (-), and Wht or Orn (data) on either side.

Installation of the RailBoss Control Board

The RailBoss board can be mounted most anywhere, but allow space for access to wiring, and no metal should be in contact with the board. The power components (heat sink and large metal tabs) will get hot, so keep them out of direct contact with plastic. Holes in the corners of the board can be used for PCB stand-offs. Make sure the stand-offs don't touch any circuit board components. Or double-sided foam tape on the bottom side of board can be used to secure the board to a plastic surface. Handle the board by the edges, avoiding direct contact with the circuitry. Static electricity can damage the components. Try to ground yourself by touching something metal prior to handling the board. Refer to the wiring diagrams at the end of this manual.

Power Input (Battery)

The RailBoss Control will not function below 7v input at terminals B+, B-. Reverse polarity will not cause damage, but the RailBoss will not operate. ***This product is not intended for track power applications where polarity reverses.***

The higher the battery voltage the more heat the RailBoss heat sink will produce. Voltage in excess of 30V will damage circuit board components. Battery packs of 8 to 20 NiMH/NiCad cells, or 2 to 7 Lithium-Ion/Polymer cells are suitable.

Warning! The heat sink on the voltage regulator may be extremely hot, especially when running in reverse. Enough to burn you if touched, or melt any plastic it comes in contact with.

When making wiring connections to the battery pack, use extreme caution to avoid shorting the leads together. Do not connect the battery to the circuit until all other wiring has been completed. The battery pack should have a quick disconnect connector for safety and ease of replacement.

The power on/off switch can be located on the floor under the loco. If you have a critter, the charging jack can also be floor mounted, since you will probably take it off the track for charging. For a full size locomotive and/or tender, you may want to locate the charging jack on the end of the car to enable charging in place on the track. The switch in the charging jack isolates the battery from all other electronics when a jack is plugged in, regardless of the position of the power on/off switch. Note: A G-Scale Graphics "Battery Conversion module" will greatly simplify the power input wiring and provide screw terminals for connections.

The RailBoss Control board contains a circuit breaker to protect the battery pack from short circuits **after** the battery input has been properly connected to the board. It will automatically reset when the fault is cleared.

Motor Output

Connect terminals M+, M- directly to the motor. All other unknown circuitry should be disconnected from the motor. A maximum of 5 amps continuous current is available from the board. *Warning! At max current the power transistors on the board (metal tabs) will be extremely hot. Enough to burn you if touched, or melt any plastic they come in contact with.*

At power-up the motor output will provide a voltage to the motor that is positive on terminal M+, negative on M-. This is intended to be the forward direction of the locomotive.

Directional Lighting Outputs

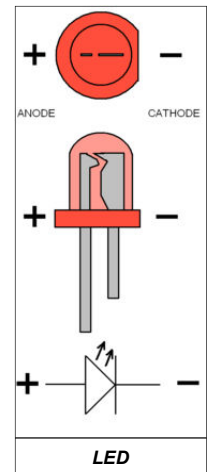
Lamps: Terminal 7 provides battery power for Incandescent lamps. So the voltage rating of your lamps must match the battery voltage. When battery voltage exceeds the lamp rating, use a resistor of appropriate value in

series with terminal 7. Multiple lamps may be connected in parallel, but total current draw for either the FWD or REV output should not exceed 200 ma.

LEDs: Terminal 8 provides an 11ma current source for LEDs. No current limiting resistors are required. Connect LEDs; terminal 8 to the anodes(+), and terminals 9 and 10 to the cathodes (-) of the forward and reverse LEDs respectively. To provide constant current to ONE LED, regardless of direction, jumper terminal 9 to 10, and connect the LED anode(+) to terminal 7, and the cathode(-) to either terminal 12 or 13. Multiple LEDs can be connected in series. If you already have resistors in series with the LEDs, use the voltage output at terminal 7.

Sound Triggers

Outputs are provided for up to two sound triggers to a sound board. These are open collector outputs that pull the sound board input low to common (ground) to trigger the sound. All triggers are momentary. The battery common (-), connected to both the RailBoss and the sound board is the return path. Sound 1 and Sound 2 can be connected directly to the sound board inputs. *Wiring diagrams for specific sound systems are available on our website.*



Note: *The above outputs are user configurable. You cannot use the same terminal for both lights/LEDs and a sound trigger at the same time.*

Setup and Testing

The on-board green LED can be used to check out your wiring and most of the board functions. This should be all you need to get going, but if you are still having problems and you have a volt-ohm meter you can also take the measurements indicated below.

Power-up (LED ON)

When power is first applied to the board, the LED should be flashing a “heartbeat”; i.e. very short ON pulses. This tells you the power input polarity is correct and the RailBoss Control’s 5V power supply is working. Measure +5.0 +- 0.5 VDC at terminal 1+, 5-. If there is a problem, check the voltage and polarity at terminals B+, B-. It should measure between +7.0 and +30.0 VDC.

Transmitter / Receiver Setup

Specific information for the various radio systems is available on our web site.

Review the transmitter diagrams on the following pages to determine which style of transmitter you have; i.e. Mode 1 with the throttle on the right, or Mode 2 with the throttle on the left, and get acquainted with the functions of each stick.

The settings for the transmitter servo reversing switches will vary depending on the radio system. The trim tabs should ALWAYS be in the mid position. There is no need to ever change them.

Binding -

Each receiver must be “Bound” to its associated transmitter following the radio manufacture's procedure. This only needs to be done once, or whenever reassigning a receiver/loco to a new transmitter. The minimum connections required for this process are power to the RailBoss, which applies power to the receiver via the 3-wire Throttle cable. A binding plug may also be required in the BAT/Bind position of the receiver. Refer to your transmitter’s manual for binding instructions.

Calibration - (Important)

Each receiver and RailBoss must be calibrated to work with its associated transmitter. If you have a Front Light connected to the RailBoss board, this procedure can be done without actually accessing the RailBoss board. Otherwise the LED on the RailBoss board will need to be visible during this procedure.

1. Power-up the RailBoss/Receiver. Observe the PCB LED and the Front Light flashing a “Heartbeat” (short ON pulses).
2. While holding the Tx Direction stick in the full down position, turn on the Tx. Wait for the LED/Front Light to turn ON solid, and then release the stick to center position.
3. The LED/Front Light will now be flashing at a fast pace, indicating you are in the calibration mode.

Forward/Neutral/Reverse - From Neutral, one UP command to get into forward. One DOWN command to get back into neutral, and another DOWN command to get into reverse. One UP to get back to neutral. When in neutral, the throttle stick is disabled and you must return it to the full down position in order to change direction. This feature is useful for a transmitter within reach of young children.

Directional Lighting (if configured by the user)

Front Light is ON in forward, Rear Light is ON in reverse, and both Front and Rear Lights are OFF in neutral.

Setting Speed

The throttle stick sets the speed (motor voltage) of the locomotive to the Min Speed setting when full down, and to the Max Speed setting when full up. Everything in between is proportional to the stick position, using 256 speed steps. Min and Max Speed settings are set in Throttle Programming mode. The default settings are Min Speed = 0% battery voltage, and Max Speed = 100% battery voltage.

Turning off the transmitter while running causes the locomotive to continue running at the same speed. This is very convenient for saving transmitter batteries. However, if the throttle stick is moved to a different speed setting while the Transmitter is off, the locomotive will accelerate or decelerate to the new speed setting when the Transmitter is turned back on.

Momentum (Rx "Rudder" connected to RailBoss terminal 4)

"Momentum" is a delayed response to a change in speed setting. This simulates the slow response of a heavy train. The throttle stick is used to switch momentum On and Off.

A momentary LEFT turns momentum OFF. Actually, a small amount of momentum is always applied to prevent gear damage due to rapid throttle stick movement. You may want to turn momentum OFF while doing switching and coupling operations.

A momentary RIGHT turns momentum ON. This engages the momentum rate set via DIP programming parameter 0 (*Factory setting is NO momentum*). This allows you to set the throttle for the desired running speed and watch the train slowly accelerate to that speed.

Momentary commands for momentum should be about 1 second long to insure proper operation.

Multiple Train Operation (Rx "Gear" or "Switch" connected to RailBoss terminal 4)

Note: Simultaneous operation of two trains requires a transmitter with a toggle switch. These are usually sold as 5-channel.

Two independent locomotives can be controlled from the same transmitter using the channel 5 switch on the transmitter (Gear toggle switch on a Spektrum transmitter). The Ch 5 switch can be in either position (on or off) when the first loco is powered up. That position will control the first loco.

To add another loco while the first is running (or just powered up), flip the switch to the other position and turn on the second loco. The switch now determines which loco you can control with the Tx. The other loco will continue in the same state as when you flipped the switch.

Since there is only one proportional speed setting stick and two locos, likely running at different speeds, it is up to the operator to adjust the speed stick to the proper setting after switching locos. Upon flipping the Ch 5 switch there is a short delay, in which you can move the speed stick to an appropriate setting for the oncoming loco before the new speed setting actually takes effect. This will minimize speed changes to the oncoming loco. For example: If you had just finished switching in the yard, and that loco is at a stop, the delay allows you to switch over to the loco running on the mainline, and move the throttle to running speed during the delay so the mainline loco doesn't immediately try to stop when the Ch 5 switch is flipped.

Running two trains on the same loop can be tricky. But this feature is very useful for moving a loco in the yard while another one is running elsewhere.

When terminal 4 is connected for two train operation, momentum can no longer be enabled and disabled using the rudder stick. It is always enabled. So program the desired rate using the DIP switch parameter 0.

Emergency Stops

Holding the Momentum stick FULL LEFT for more than 2 seconds will make a quick stop, but not instantaneous. This avoids gear damage due to the real momentum of the train. Return the throttle to full the down position to restore operation. This command is useful when you can't remember if momentum was turned on or not and have no time to think about it.

Transmitter Off

The transmitter transmits continuously, whether you are doing anything or not, and this is just a continuous drain on the transmitter batteries. You can turn off the transmitter at any time and the train will continue running at the same speed. Control will be restored when you turn it back on, following a delay to re-establish the communications link (the delay may be quite long for some radios). If the throttle stick is moved while the transmitter off, speed will be changed to the new speed setting when transmitter is turned back on.

Manually triggering sounds from the Transmitter (If configured by the user)

A momentary full LEFT of the direction stick will activate the "Sound 2" output.

A momentary full RIGHT of the direction stick will activate the "Sound 1" output.

Momentary commands should be about 1 second long to insure proper operation.

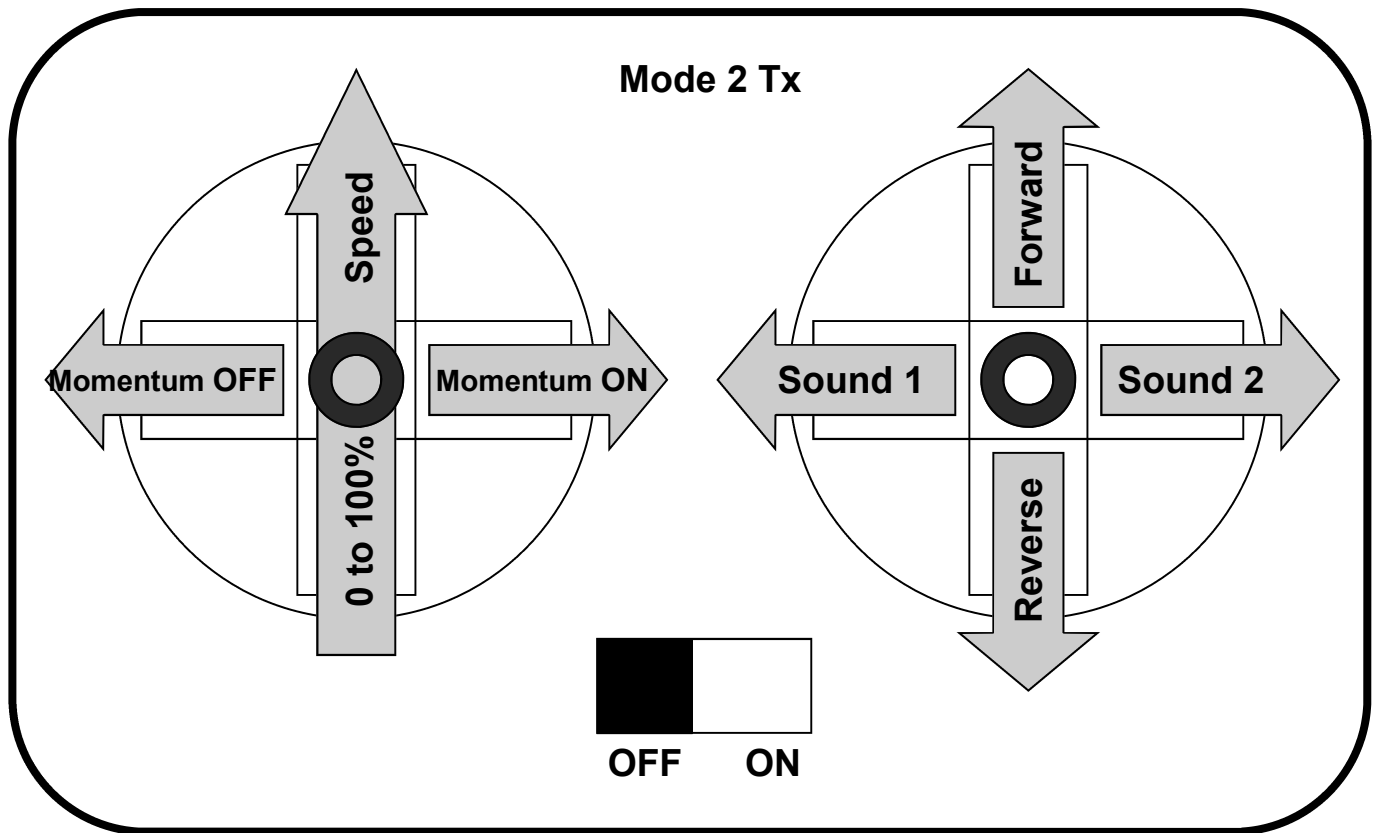
Your sound board may have options available, such as a manual bell or a programmed bell. The manual bell will turn on with a momentary command and continue ringing until turned off with another momentary command. The programmed bell will turn on with a momentary command and then time out and turn off on its own.

If you want to sound your own whistle signals from the transmitter, you should set your sound board for the manual whistle option. The horn or whistle will sound as long as the command is maintained. If you have opted for the programmed grade crossing signal, a momentary command will initiate it.

In order to use the manual sound triggers, the sound trigger outputs must be connected to your sound board.

4- Channel Stick Transmitter

(Mode 2, Throttle on the Left)

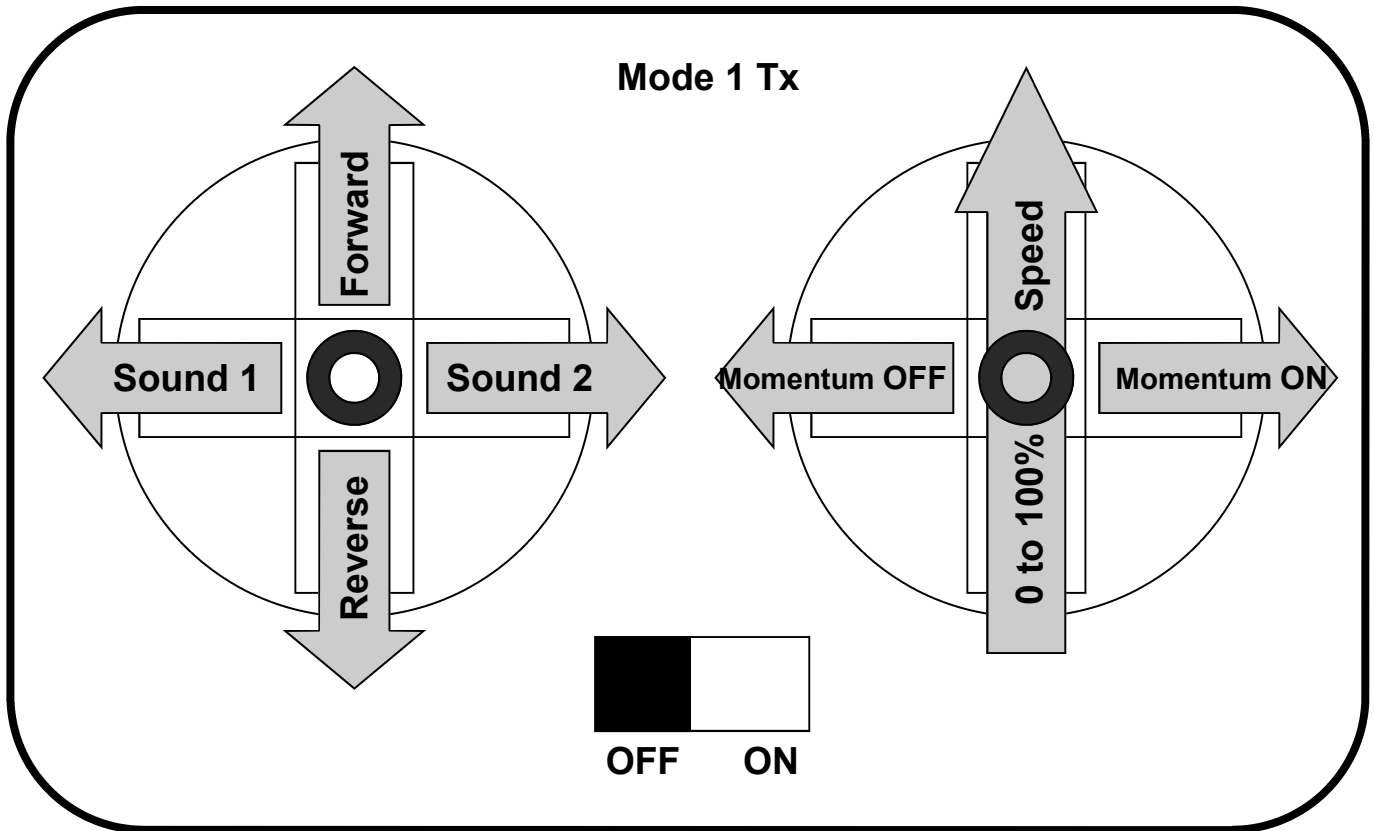


Command Summary (Mode 2 Tx, most common in USA)

Left Stick		R/C Channel
Throttle/Speed	0 to 100% Speed Proportional to stick position Full Down = 0%, Full Up = 100%	Throttle
Momentum	Momentary Left = Off, Momentary Right = On	Rudder
Right Stick		
While fully stopped		
Direction	Momentary Up = Forward, Momentary Down = Reverse	Elevator
During Tx Power On	Hold Up to enter "Speed Programming" mode	Elevator
	Hold Down to enter "Throttle Stick Calibration" mode	Elevator
Manual Sounds	Momentary Left = Sound 1, Momentary Right = Sound 2	Aileron
Tx Power On/Off	Power Off while running maintains speed and automation Power On while running restores manual control	

4- Channel Stick Transmitter

(Mode 1, Throttle on the Right)



Command Summary (Mode 1 Tx)

Right Stick		R/C Channel
Throttle/Speed	0 to 100% Speed Proportional to stick position Full Down = 0%, Full Up = 100%	Throttle
Momentum	Momentary Left = Off, Momentary Right = On	Aileron
Left Stick		
While fully stopped		
Direction	Momentary Up = Forward, Momentary Down = Reverse	Elevator
During Tx Power On	Hold Up to enter "Speed Programming" mode	Elevator
	Hold Down to enter "Throttle Stick Calibration" mode	Elevator
Manual Sounds	Momentary Left = Sound 1, Momentary Right = Sound 2	Rudder
Tx Power On/Off	Power Off while running maintains speed and automation Power On while running restores manual control	

Trouble Shooting Manual Operation

- Nothing seems to be working ...
 - Check the power. The LED should be flashing a “heartbeat”. You should measure between 7 and 30 volts DC applied to terminals B+,B-.
 - You should measure 5 volts DC on terminals 1(+), 5(-)
 - Verify all wiring connections.
 - Repeat the “Binding” process for the transmitter and receiver. The Receiver LED should come on a few seconds (2-20 secs) after turning on the transmitter.
- **Did you successfully do the throttle calibration procedure on page 9? Do it again. This step alone will solve most problems.**
- After getting the 3 ready flashes, the motor goes to full speed with no control.
 - Use Throttle Programming Command (5) to reset throttle to default values. (page 21).
- The transmitter / receiver doesn't work at all
 - Check the batteries in the transmitter.
 - Check the receiver wiring: A connector may be backwards or plugged into the wrong place. The white wires should be towards the inside of the receiver.
 - Did you successfully bind the receiver to the transmitter?
- One or more of the control sticks work backwards ...
 - Make sure the transmitter servo reversing switches are all set for “Normal”.
- The loco doesn't start moving until I move the throttle stick is way off the bottom ...
 - Recalibrate the throttle stick.
 - Program the Min Speed setting to a higher value.
- The loco starts moving even though I have the throttle stick at full down ...
 - Program the Min Speed setting to a lower value.
- The direction commands are backwards ...
 - Reverse the wires at the motor output, terminals M+, M-, or change the Motor Polarity using the Throttle Programming Command (4).
 - Make sure the transmitter servo reversing switches are all set for “Normal”.
- The loco won't run as fast as I like even though I keep trying to increase the speed setting ...
 - Maximum speed is determined by your battery voltage. You may need more cells/voltage.
 - You may need to restore the default throttle programming settings (page 21).
- The speed setting seems to be changing on me...
 - The “Speed Setting” is actually a “% of battery voltage setting”. Hence, as the battery voltage decreases during discharge, the speed will slow down some. Also, changes in load, such as adding more rolling stock to the train, will decrease speed slightly.
- The PCB LED and lights turn off as soon as I turn on the transmitter ...

(Also, see Testing on page 8)

DIP Switch Programming

Some of the operating parameters of the RailBoss Plus can be modified to meet your individual needs. No programming is necessary to get your system up and running, only to modify it, if so desired.

User configurable parameters can be programmed using the 4-position DIP switch, on-board push-button switch, and on-board LED. The DIP switch selects the parameter to be programmed, and the LED flashes the currently selected option. See the programming chart following this discussion for specific instructions.

Parameter 0

Throttle Momentum

This parameter sets the amount of momentum applied to the throttle when the momentum function is turned ON.

Parameter 1

Direction Control

This determines how the direction stick commands will operate.

Forward/Reverse: Up for Forward, Down for Reverse. The throttle is always engaged.

Forward/Neutral/Reverse: Up for Forward, down back to Neutral, down again to get into Reverse. Up is back to neutral. The throttle is disabled while in Neutral.

Parameter 2

Determines the functions for the two outputs at terminals 9 and 10. They can be set for directional lighting outputs, or sound triggers.

Parameter 3

Determines how the sound triggers will operate. Momentary; the output is triggered as long as you hold the stick. Typically used for whistles or other pre-programmed sounds. Latching; the output changes state each time you use the stick. Typically used to keep the bell on until you want to turn it off.

DIP Switch Programming Procedure

User configurable parameters can be programmed using the 2-position DIP switch, on-board push-button switch, and on-board LED.

Enter Programming Mode

DIP programming mode can only be accessed at power-up, prior to linking the Tx/Rx. With RailBoss power on, and the Transmitter off, momentarily press the yellow push-button located next to the DIP switch. The LED will begin flashing.

Select Parameter

Select the parameter you wish to view or program using the DIP switch. (the white square indicates position of the switch; e.g. for parameter 0, all switches are in the down or off position.)

View Current Option Code

The LED will repeatedly flash the option code for the currently selected parameter; e.g. two flashes followed by a pause indicate option 2.

Change the Option Code

Momentarily press the push-button during the pause to advance the option to the next higher number, until you get the desired number of flashes.

Save the Option Code

Press and hold down the push-button for about 4 secs until the LED starts flashing rapidly, which indicates the save is complete.

Select the next Parameter

Repeat the above as needed to view or make changes to other parameters. Note: If an invalid parameter number is selected, the LED will stop flashing.

Exit Programming Mode

Turn off RailBoss power.

Upon return to power, the new options will be activated.

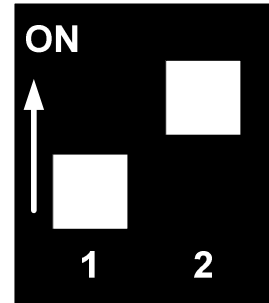
The DIP switch sets a binary number. Each switch, when turned on, has a different value. When added together, they give you the parameter number. **But don't worry! All you need to do is look at the pictures on the next page, and set the switch accordingly.**

DIP Switch

Switch position 1 has a value of 1 (when On)
 Switch position 2 has a value of 2 (when On)

The switch setting shown here is set for parameter 6:

Switch 1 = 0 (off)
 Switch 2 = 2 (on) for a total of 0 + 2 = 2



2.4GHZ Basic RailBoss

Option	Parameter 0 - Throttle Momentum
1	Fastest Response (Off) - (factory setting)
2	Faster
3	Medium
4	Slower
5	Slowest

Option	Parameter 1 - Direction Control
1	Forward / Reverse (No Neutral) [factory setting]
2	Forward / Neutral / Reverse

Option	Parameter 2 - Output Configuration
1	Forward / Reverse Lighting
2	Forward Light / Sound Trigger 1—(factory setting)
3	Sound Triggers 1 and 2
4	Sound Trigger 2 / Reverse Light

Option	Parameter 3 - Sound Configuration
1	Sound 1 and Sound 2: Momentary
2	Sound 1 Latching, Sound 2 Momentary
3	Sound 1 Momentary, Sound 2 Latching
4	Sound 1 and Sound 2: Latching

2.4GHZ Basic RailBoss

Throttle Programming Functions

Characteristics of the throttle can be changed to meet your operating requirements. Most of you will never need this. But if you do, with a little reading and some practice, you should find it fairly easy to do.

Zero Speed / Starting Voltage (1)

This setting determines the % of battery voltage applied to the motor when the throttle stick is at the full down position. Many locomotive motors require a certain amount a voltage to get started. Hence, the throttle stick will have to be moved up a ways before the train starts moving. Increase the Starting Voltage until the train just starts moving, and then back it down slightly. Now the train will start moving at the bottom of the throttle stick travel.

Max Speed / Voltage (2)

This setting determines the % of battery voltage applied to the motor when the throttle stick is at the full up position. Setting a Max Speed of less than 100% is useful for speed limiting your locomotive; e.g. when children are running the train.

Speed Matching (1,2)

If you intend to double-head or power your train with multiple locomotives, you will need to match the speed characteristics of each locomotive to the other. i.e. they all need to run at close to the same speed, regardless of throttle position. This can be done adjusting the Zero Speed and Max Speed settings as required for each locomotive.

Active Throttle (3)

There are two ways to change settings. 1) With a "Dead Throttle", using the throttle stick to indicate the desired % of battery voltage (0-100% battery voltage = 0 to 100% Throttle Stick position). Or 2) With an "Active Throttle", controlling speed of the locomotive to visualize the setting. **Warning: When using active throttle programming, there is no momentum applied to the throttle. Speed response will be quick, so use care in changing the throttle stick position.** This is a toggled setting. Each time it is saved, it will change the state; from Active to Dead or, Dead to Active.

Motor Polarity (4)

When running multiple unit locos, you may want to run one unit facing backwards from the other. This setting allows you to reverse the polarity of the motor, so both units will move in the same direction. This is a toggled setting. Each time it is saved, it will change the state; from Normal to Reversed, or Reversed to Normal.

Default Settings (5)

Don't worry! In the event things get messed up, you can always restore them back to the default factory settings.

User Settings (6,7)

Once you get a setup you like, save it. This allows you to continue experimenting or changing things depending on what you are doing at the time. Then get back your settings with one command. Starting Voltage, Max Speed, Active Throttle, and Motor Polarity settings will be saved.

Throttle Programming Procedure

Power-up the Control/Receiver (Rx).

The PCB LED and the Front Light (if equipped) will start blinking a "heartbeat" (quick on time, long off time) to indicate that power is on and it is waiting for the transmitter.

Power-up the Transmitter (Tx) while holding the direction stick UP. Continue to hold it UP until the PCB LED stays ON solid. This may take anywhere from 5 to 90 secs (the amount of time it takes for the Tx to link with the Rx).

When the direction stick is released the PCB LED and Front Light will turn off, indicating it is ready for Throttle Programming.

If "Active Throttle" is enabled, you will be able to control the speed of the locomotive in the forward direction only. Caution: There will be no momentum and throttle response will be quick.

If “Active Throttle” is disabled, you will use the throttle to set the % of battery voltage desired. The stroke of the throttle stick represents 0 to 100% battery voltage.

To program a speed point, set the throttle to the desired speed or position. Then give **X** momentary UP commands using the direction stick to save setting **X**. The lights will flash once for each UP command.

After entering the number of UPs for your command, pause and wait for the RailBoss to acknowledge the entry by flashing the LED and Front Light **X** times, indicating your setting has been successfully saved. They will not flash if you entered an invalid number.

No flashing may also indicate an invalid request; for example; you tried to set Max Speed at a throttle position less than the current Min Speed setting.

You can program any of the 7 Throttle functions in any order you like, as many as you like while in Throttle Programming mode.

To exit this mode, the Throttle stick must be at the full down position. Then, **give a momentary DOWN command using the direction stick**. The RailBoss will flash the Front Light 3 times, indicating you are ready to run using the new settings.

Example: Set the Starting Voltage.

After entering the Throttle Programming mode, the Front Light goes out. Set the throttle stick for the desired speed or position. Give one momentary UP command using the direction stick. The RailBoss will flash the Front Light once, indicating the new value has been saved. Return the throttle to full down. Give a momentary DOWN command on the direction stick to exit Throttle Programming mode. The Front Light will flash 3 times indicating you are ready to run. You should now have the new Starting Voltage setting you programmed when the throttle is at the full down position.

Practice the programming sequence by restoring default settings using command 5.

Throttle Programming Command Summary

Momentary UP Commands on the Direction Stick	Function	Default Setting
1	Zero Speed / Starting Voltage (% battery voltage, throttle stick down)	0%
2	Max Speed / Max Voltage (% battery voltage, throttle stick up)	100%
3	Toggle Active Throttle On/Off	Off
4	Toggle Motor Polarity Normal/Reverse	Normal
5	Restore Default Settings (1-4 above)	
6	Restore User Settings (Saved by 7 below)	Same as 1-4 defaults until changed by user
7	Save User Settings (as programmed using functions 1-4 above)	
Enter Throttle Programming	Power-On Tx while holding Direction stick full UP	Wait for solid light, then release
Exit Throttle Programming	Throttle full Down and Momentary Down on Direction stick.	Three flashes indicate ready to run with new settings

Basic RailBoss R/C Specifications

Board Revision "D"

Mechanical

Physical Size: PCB – 2.4" X 1.9", Max component height – 1.0". Weight: 1.3oz.
User Connections: Screw clamp terminal strips accept individual wires, 30 to 20 AWG.
Requires a 1/16" or 5/64" slotted screwdriver

Electrical

Power Input from battery pack (Terminals B+,B-)
7.0V min to 30.0V max
8-20 cell NiMH or NiCad battery packs
2-7 cell Lithium Ion or Li-Po battery packs

Over current protection - PTC (automatically resets upon removal of fault)
Reverse polarity protection

Power Consumption (due to board, no motor load)
Forward motor direction: < 50 ma (30V supply)
Reverse motor direction: < 150 ma (Relay energized, 30V supply))

Motor Output (Terminals M+,M-)
5 amps max, continuous
PWM (Pulse Width Modulated)
Polarity reversal via relay contacts
Max amplitude: Battery voltage minus driver loss
Typical voltage loss across driver: 0.1V @14.4V, 1A: 0.3V @24.0V, 2.5A.

Control Outputs

LED/Lamp/Sound Drivers: Max load = 500 ma
LED current source: Terminal 8 = 11 ma
Lamp voltage source: Terminal 7 = battery voltage at power input
Forward Lamp/LED-(open collector) Terminal 9
Reverse Lamp/LED-(open collector) Terminal 10

Control Inputs

4 Receiver Data Inputs; Elevator/Direction, Throttle/Speed, Rudder/Momentum, Ailerons/Sound,
and Channel 5 toggle switch required for simultaneous two train operation.
Digital Proportional servo data from any standard hobby radio, 3V or 5V logic

Radio Rx and Tx (not supplied by G-Scale Graphics)

Any 5-channel digital proportional radio system will probably work in general, but only those systems recommended by G-Scale Graphics have been tested for 100% compatibility. See next page for specifics.

Battery Power Accessories (available from G-Scale Graphics)

Battery Conversion Module; (built-in Power on/off Sw, Charging Jack, 5A fuse, power distribution)
Power On/Off Switch: Sub-Miniature w/short handle, SPDT (On-On), 3A, 28 VDC (drill 3/16" hole)
Charging Jack: 2.5mm, 5A, w/switch (drill 5/16" hole)

2.4GHZ RailBoss R/C Product Comparison

Control System	RailBoss 4	Pocket RailBoss Basic	Pocket RailBoss Plus	Hobby Basic RailBoss	Hobby RailBoss Plus
2.4 GHZ * Radio Transmitter	6-Button Handheld Tx	3 Button Key Fob Tx	3 Button Key Fob Tx	4 or 5 Channel Hobby Stick Radio	4 or 5 Channel Hobby Stick Radio
Rx / ESC Configuration	Integrated ESC/Rx	Separate Rx & ESC	Separate Rx & ESC	Separate Rx & ESC	Separate Rx & ESC
Radio Components	Transmitter and Receivers supplied by G-Scale Graphics	Transmitter and Receivers supplied by G-Scale Graphics	Transmitter and Receivers supplied by G-Scale Graphics	Transmitter and Receivers must be purchased separately	Transmitter and Receivers must be purchased separately
Speed Control	Push Buttons	Push Buttons	Push Buttons	Proportional Stick	Proportional Stick
Tx Control Range	Excellent	Good	Good	Excellent	Excellent
Momentum Control	X	X	X	X	X
Sound Triggers	4	*2*	4	*2*	4
Directional Lighting	X	*X*	X	*X*	X
Two Train Operation From One Tx				X	X
Low Lithium Battery Warning	X		X		X
Automated Station Stops	X	X	X		X
Random Track Whistle	X		X		X

* The radio systems used in each of our RailBoss R/C systems operate at 2.4GHZ. However, they are NOT compatible with each other. The RailBoss 4 transmitter may only be used with a RailBoss 4 control board, Key Fob Tx only with the Pocket RailBoss, and Hobby radios only with the hobby RailBoss boards and receivers.

All of our 2.4GHZ radio transmitters are “bound” to the receivers. No channel or frequency selections to worry about. No motor noise suppression or special antenna placement required. You can control all of your trains from the same transmitter (one at a time for the RailBoss 4 and Pocket, one or two at a time with the hobby radios). You can double head. Or you can control individual trains with individual transmitters. It is your choice.

The key fob transmitters have a very acceptable range of about 100 feet, line of sight when installed in a loco or trailing car. The RailBoss 4 and hobby transmitters are much better, 100 to 300 feet, and usually no problems with obstacles.

** 2 outputs are available for any combination of sound triggers or lighting. User programmable.

Recommended Radio Systems

We do not sell radio transmitters, but we do sell DSM2 compatible receivers. There are many low cost 2.4 GHZ hobby radios available, with more coming all the time. Only 4-Channels are required, with one being a digital proportional throttle. Either Mode 1 (throttle on the right) or Mode 2 (throttle on the left). Simultaneous operation of two trains requires a 5th channel controlled via a toggle switch on the transmitter.

2.4GHz is approved for both surface and air use.

In most cases, installing the receiver in a metal body will still work. But you may want to select one with an extended antenna. The last inch is the actual antenna, which may need to protrude outside of the metal body.

Spektrum

Any of the products in the Spektrum DX line will work, however, the DX5E is the most economical. This line is assumed to be of the highest quality and most reliable.

DX5E Transmitter	\$59	www.HorizonHobbies.com or Local Hobby Shop
G-Scale Graphics DSM2 compatible Receiver	\$15	

Many DSM2 compatible receivers are available that will work with Spektrum transmitters	\$8 to \$19
TargetHobby.com	AR6100, AR6100E
HobbyKing.com	Orange Rx

And others ...

Note: Spektrum receivers with the "SmartSafe" failsafe feature are not fully compatible with the RailBoss, including the *genuine* Spektrum AR6100 and AR600 purchased from your local hobby shop.

These will also work ...

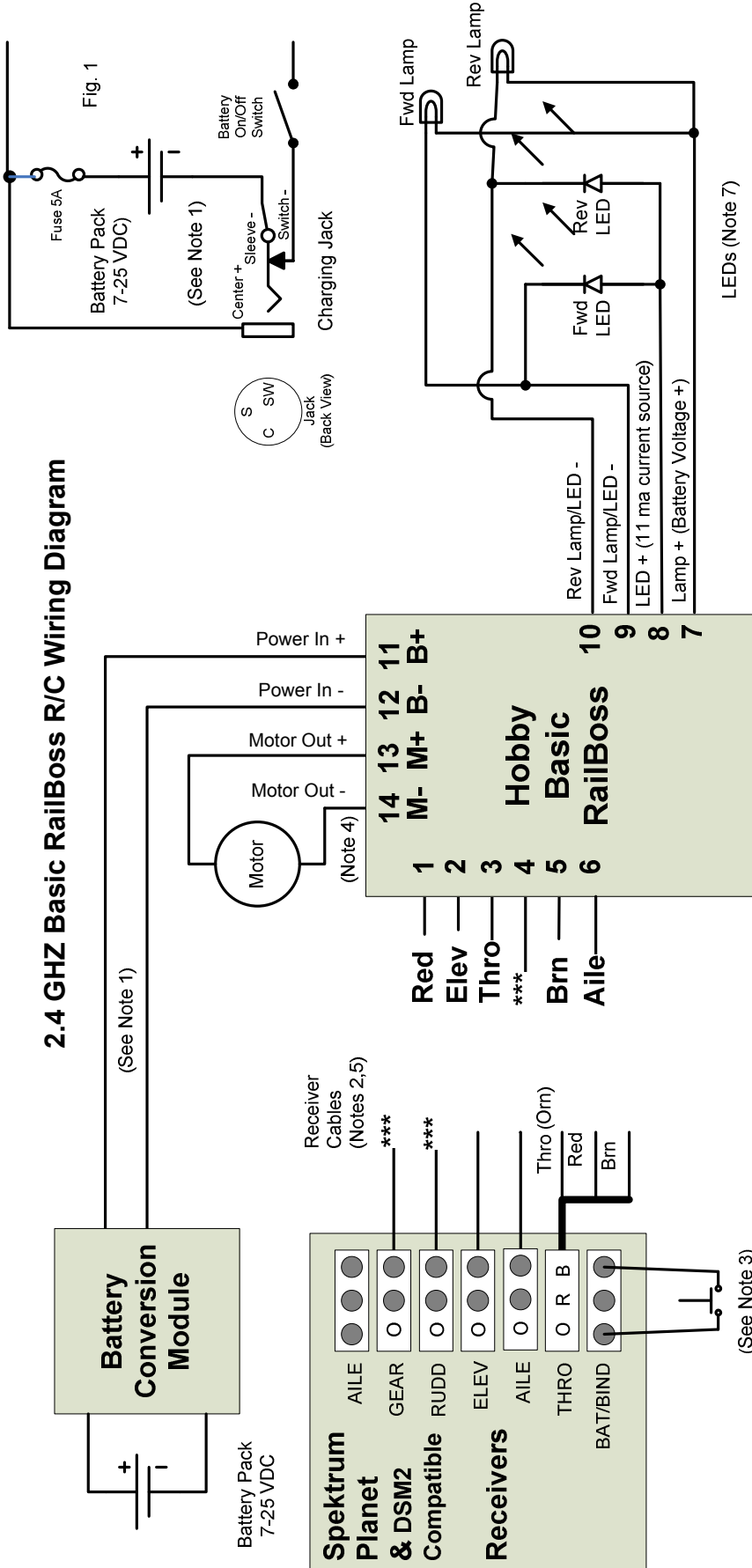
Spektrum

DX6i Used by many for radio control of live steam locomotives

Hobby King 2.4GHZ

Hobby King T6A 6-Channel Transmitter and Receiver	<\$32	www.HobbyCity.com
Hobby King 6-Channel Receiver	<\$10	
Hobby King OrangeRx T-Six 2.4GHZ DSM2 6Ch programmable transmitter w/10 model memory		\$65

2.4 GHZ Basic RailBoss R/C Wiring Diagram



10 _____ Sound Trigger 1
 9 _____ Sound Trigger 2
 _____ User Configurable Outputs (Note 8)

Notes

- 1) The circuit in Fig 1, or variations of it, may be substituted for the Battery Conversion Module (BCM). When not using the BCM, a fast acting 5 amp fuse in-line with the battery is recommended. Power input is protected from reverse polarity damage, but the RailBoss will not operate.
- 2) Rx cables: White or Orange wires to inside pin of Rx (top pin for Rx with end pins). The BAT plug is not used, except for binding receivers. Wiring shown is for a Mode 2 Tx. For Mode 1, swap the Rudd and Aile connections at the RailBoss. Rx cables come in two different color combinations: White,Red,Black or Orange,Red,Brown. White or Orange is the signal to the RailBoss. Red is +5V. Black or Brown is Common.
- 3) Optional: A Momentary SPST (normally open) push-button switch may be connected across the inside and outside BAT pins for use as a remote binding switch with Spektrum receivers only.
- 4) Do not connect the RailBoss Motor output directly to a Sierra Sound board (others are OK). You must use an RCS SSI-12V5 isolation board. The RailBoss Bell and Whistle outputs are compatible.
- 5) Momentum function for all transmitters: Connect terminal 4 to Rudder on Rx. Two train operation for 5 or more channel Tx (Spektrum DX5e, DX6i): Connect terminal 4 to Switch on Rx.
- 6) Sound trigger outputs do NOT require a separate ground or common connection to the sound board. That path is completed through the battery input wiring.
- 7) For LEDs with resistors already wired in, use Lamp + (Battery voltage). No resistors, use LED +.
- 8) Each individual output can be used for a light or a sound trigger, but not both at the same time. See DIP programming parameter 2. For sound, connect to desired input of the sound board. No other connections are needed. Common return is through the battery +.

