Pocket RailBoss Plus

2.4GHz R/C
for Large Scale Trains

Operation and Installation Manual

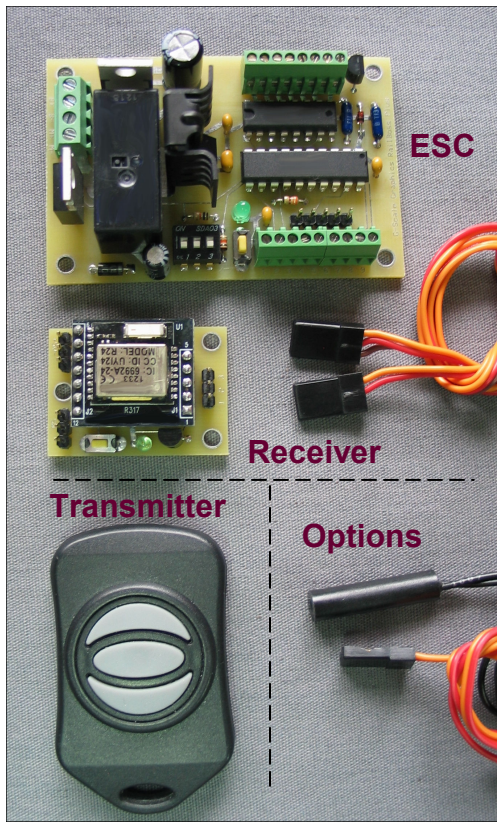# Contents

Overview

ESC

Receiver

Transmitter

Options

The complete system: ESC (Electronic Speed Control), Receiver & cables, Transmitter, and optional reed switch for station stops and cable for a remote learn button.

The Pocket RailBoss Plus is an electronic speed control designed specifically for controlling large scale trains using a small 2.4GHZ key fob transmitter. The RailBoss R/C system provides extreme flexibility in the way you control your trains. You have full manual radio control of all the speed, direction, and sound functions; along with semi-automatic control of station stop and sound functions, all selectable from the transmitter. Or you can just sit back and let your train run automatically; making station stops now and then, and blowing the whistle on occasion.

In addition to controlling speed via raise lower buttons, the 3-button transmitter can also control loco direction, four sound triggers, momentum on/off, track whistle on/off, station stops on/off, and more.

Automate your layout with automated station stops, or back 'n forth trolley operation. Gain control over your track magnet triggered sounds. You decide when and how often they are activated.

A low battery warning function for use with today's lithium battery technologies (Li-Ion & Li-Po) lets you get the train back home before it stops dead somewhere out on the layout due to the protection circuit built into the battery pack.

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

The 2.4GHz key fob radio has no frequencies or channels to worry about. *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 of 100 feet or more, line-of-sight, is sufficient for typical operation in most garden rail-

roads. And best of all, the transmitter fits in your pocket, or on your keychain.

A powerful little micro-controller handles all of the control logic and sends signals to a 5 amp motor driver, which is enough to handle most locomotives pulling a full train. Typical current draw for one loco motor is less than 1 amp.

This little 3-button keyfob transmitter controls more than 15 functions.

Directional lighting outputs are provided for incandescent lamps and/or LEDs without the need for added resistors.

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

The Pocket RailBoss ESC kit consists of the control board (2.9" X 1.9"), the Pocket Receiver board (1.4" X 1.0"), two cables to connect the receiver to the RailBoss, and PCB spacers to assist with board mounting. The Pocket RailBoss key fob transmitter is sold separately. A reed switch for automated station stops is optional (the Bell reed from your sound system can be used for station stops and the bell). An optional remote learn cable for a remote learn button allows quick change of transmitters without accessing the receiver board.

To complete your battery power conversion, you will also need to provide a power on/off switch, charging jack, battery pack, 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. We also have cables available for: battery connections, and loco to tender or trailing car to loco (2 wire or 4 wire).

(Note to RailBoss Plus owners: Use of the key fob transmitter will require a software upgrade to your board.)

The Radio System

The Pocket RailBoss uses a 2.4GHZ key fob transmitter and receiver rated for 350 feet line-of-site by the manufacture. In our testing, with this system installed in a locomotive, we would conservatively rate the range as 100 feet line -of-site. While the range of the 2.4GHZ hobby stick radios is much better, usually not requiring line-of-sight for proper operation, the range of this key fob system is more than adequate for walk-around or short range operation.

Like the hobby radios, this system requires a simple binding procedure; press the "Learn" button on the receiver, then any button on the TX, and that's it. Your loco will now respond to your transmitter and no others. Unlike the proportional hobby radio throttles, there are no throttle calibration procedures to deal with.

The same transmitter can be used to control your entire fleet of locos, any one at a time. Just turn on the one you want to run, and the others off. Since the transmitter is so small, you can easily have more than one in your pocket to run multiple trains. Just color code them.

Your receiver (loco) can also learn more than 1 transmitter (up to 60). For example, this would each member of the family to have their own transmitter for the family loco.

To pass control of the loco from one transmitter to another, you need to erase the list of transmitters from the receiver's memory, hold down the Learn button for 10 or more seconds. The receiver's LED will flash rapidly to indicate the list was erased. You can now learn a different transmitter by pressing the Learn button and then any button on the new transmitter.

The transmitter uses a long lasting replaceable CR2032 coin cell battery. No on/off switch, always ready to use.

Interference from locomotive motors or other radio/noise sources is not a problem. No filters or special antenna placement is required.
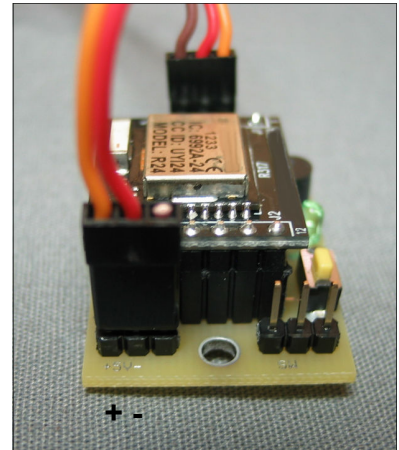
Receiver Cables are provided. A 2-wire cable from the RailBoss provides power to the receiver. A 3-wire cable from the receiver to the RailBoss provides the 3 button data signals. The "Learn" button on the Pocket Receiver board is used to bind the receiver and the transmitter. However, an optional 2-wire cable can be used with a remote "Learn" button (not supplied), which would allow you to move a loco from one transmitter to another, without having to access the receiver board.

Power cable:
Connect Orn (+) to the left.

Data cable:
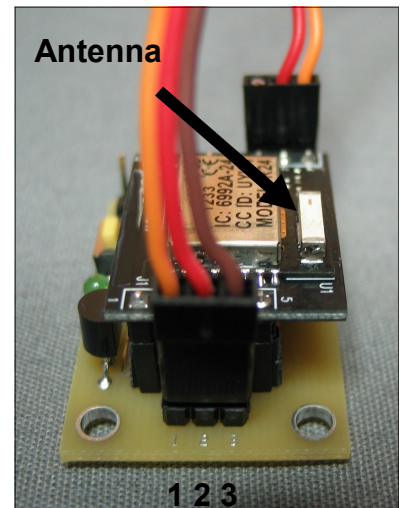**Connect Orn (1) to the left.**

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. Adding momentum to the throttle enhances the prototypical operation. Momentum is fully programmable, and can be turned on and off via the transmitter to assist with switching operations.

RailBoss provides power to the receiver and gets its R/C commands via receiver cables provided. It operates over a wide range of battery input voltage (7-25V, i.e. 2-6 Lithium cells, or 7-16 NiMh/NiCad cells). The battery input is protected from damage due to reverse polarity.

RailBoss has directional lighting outputs capable of driving incandescent lamps or LEDs without the need for user supplied resistors. Lamps are powered from the battery voltage. LEDs 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 programming procedures and low battery warning.

RailBoss can also be used to perform unlimited station stops and/or back 'n forth point to point operations using track magnets. This function can be enabled or disabled at will via the transmitter. Upon detecting a track magnet via a reed switch, the train will automatically decelerate to a smooth stop, wait for a pre-determined amount of time, then accelerate back to the same speed it was running before.

RailBoss gives you more control over your sound system. Four sound triggers can be controlled manually from the transmitter. The bell and whistle sounds can also be triggered from track magnets.

RailBoss adds interest and intrigue to your layout by randomizing the automated events. Both station stops and the automatic whistle can be programmed to operate statistically; i.e. they will only occur a certain percentage of the time, as determined by your needs. They can also be enabled or disabled via the transmitter during operation.

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 8 different parameters, each with many options available.

RailBoss also allows the operating characteristics of the throttle to be customized for maximum speed control, minimum starting voltage, 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.
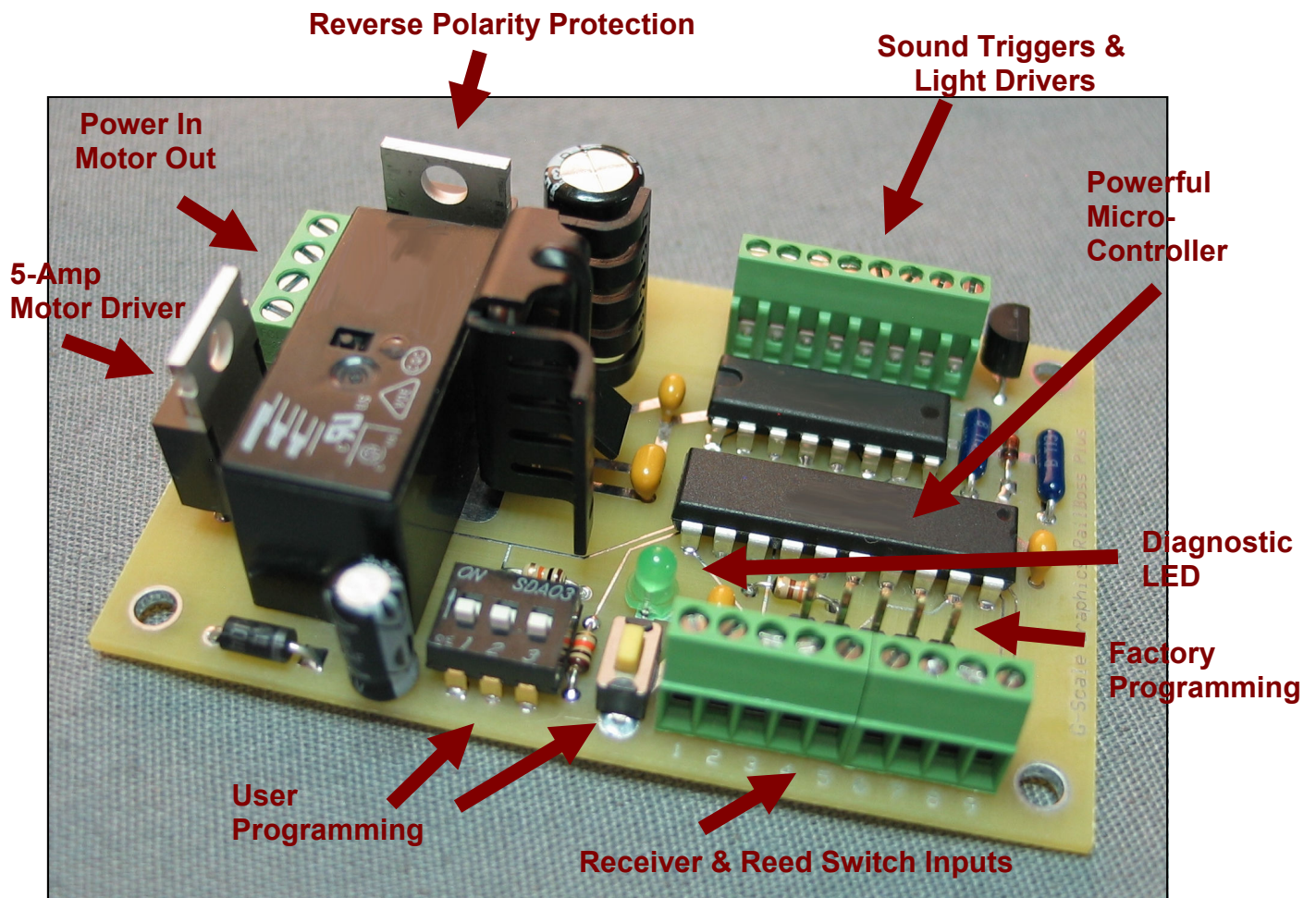
Installation

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 X 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

In theory, the receiver should be mounted as far away from the motor as possible, and as high up as possible, but it's not critical. Plug the supplied cables into the receiver (see photos on page 4). When looking at the edge of the board, the orange wire goes to the left on all connectors. Connect per the wiring diagram at the end of this manual. The remote learn cable is optional. You can connect this to a momentary push-button switch to facilitate changing from one transmitter to another without having to access the receiver board.

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+ (18), B- (19). 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 25V may damage circuit board components. Battery packs of 7 to 16 NiMh/NiCad cells or 2 to 6 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.

A 5-amp fuse in-line with the battery input is recommended. This is also included in the G-Scale Graphics "Battery Conversion module"

Motor Output

Connect 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+ (20), negative on M- (21). This is intended to be the forward direction of the locomotive.

Directional Lighting Outputs

Lamps: Terminal 10 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 10. 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 11 provides an 11ma current source for LEDs. No current limiting resistors are required. Connect LEDs; terminal 11 to the anodes(+), and terminals 12 and 13 to the cathodes(-) of the forward and reverse LEDs respectively. To provide constant current to ONE LED, regardless of direction, jumper terminal 12 to 13, and con-

nect the LED anode(+) to terminal 11, and the cathode(-) to either terminal 12 or 13. Multiple LEDs can be connected in series.

Sound Triggers
Outputs are provided for up to four 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. The T1 output needs to be connected to the whistle and T2 to the bell in order for the RailBoss automation to work properly. T3 and T4 can be anything you like. *Wiring diagrams for specific sound systems are available on our website.*

Reed Switches
The bell reed switch at terminal 4 is required for automated stations stops. The whistle reed switch at terminal 6 is only required when using the RailBoss to modify the behavior of your sound board when using track magnets. The same two reed switches can operate both the RailBoss and your sound board. (See Operation section)

Reed switches must be installed within 1/4" of track magnets, in either a horizontal or vertical orientation. You can usually mount them on the underside of a truck in the horizontal position parallel with the track. Silicone adhesive works well. Or, they can be vertically mounted through a 1/4" diameter hole in the floor of the vehicle. Do not mount the reed switch below the level of rail tops, as it will hit the rails in turnouts.

LED

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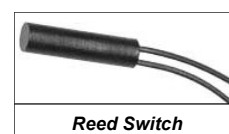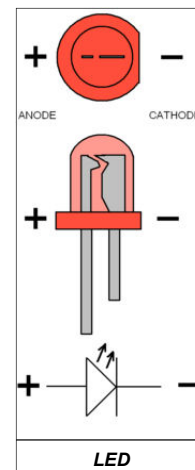
Setup and Testing
The on-board green LED can be used to check out your wiring and most of the board functions. This should be all you need to get going, but if you are still having problems and you have a volt-ohm meter you can also take the measurements indicated below.

Power-up (RailBoss LED ON)
When power is first applied to the board, the LED should be ON. 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+ (18), B- (19). It should measure between +7.0 and +25.0 VDC. The LED on the receiver will be OFF.

Transmitter / Receiver Setup
There are no channels or frequencies to worry about. Your receiver will only respond to your transmitter, and no others.

Each receiver must "Learn" the one or more transmitters it is expected to respond to. 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, and power to the receiver via the 2-wire power cable from the RailBoss.

Apply power/ The receiver LED is normally OFF. Press the Learn button on the receiver board (not the RailBoss). The LED on the receiver should turn ON. Now press any button on the transmitter you want to "Learn". The receiver will blink the LED 3 times indicating it was successful.

Every time you learn a new transmitter, it is added to a list of learned transmitters in the receiver. So, multiple transmitters can be used to control the same loco, if desired. However, if you want to transfer control from one transmitter to another, disabling the first transmitter, you first need to clear the learned list in the receiver. This is simple done by holding down the learn button on the receiver for 10 or more seconds. When complete, the receiver LED will flash rapidly. Now you can learn the new transmitter by pressing the learn button, and a button on the new transmitter.

Pressing any button on the transmitter should cause the RailBoss LED to turn off.

The transmitter is powered by a CR2032 coin cell battery, accessible by carefully prying open the case.

Outputs
At RailBoss power-up, direction is set to "forward". The Front Light should be ON (if connected) and the Reverse Light should be OFF. When changing direction with the transmitter (by holding the Stop button), you may hear the

relay on the RailBoss click. In reverse, the Reverse Light should be ON, and the Front Light OFF. Direction can only be changed while stopped. If loco is operating backwards from this, reverse the motor wiring at M+,M-.

<u>Reed Switches</u>
Close the reed switch with a magnet, or by moving the loco over a track magnet, will cause the LED to turn off while the contacts are closed. If not, check the wiring at terminals 4,6, and 9.

Manual Operation   (Refer to diagram next page)

Power-Up
At power-up, the locomotive will be stopped, ready to proceed forward. Momentum is on, station stops are disabled and auto track whistle is enabled.

Setting Direction
Pressing and holding the Stop button for 1 second or more while stopped will change the direction of the locomotive. This is a toggle action; if in forward it will change to reverse. If in reverse it will change to forward. Observe the front light of the loco to determine present direction.

Directional Lighting
Front Light is only ON in forward, Rear Light is only ON in reverse.

Setting Speed
The Raise and Lower buttons will change the speed setting. Momentary presses for small speed changes, or hold the button down to ramp speed up or down. 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.

Momentum
"Momentum" is a delayed response to a change in speed setting. This simulates the slow response of a heavy train. Clicking the Stop button three times will toggle momentum on/off. Turn it off for a quicker response during switching moves.

Emergency Stops
Holding the Stop button for more than 1 second while running will make a quick stop, but not instantaneous. This avoids gear damage due to the real momentum of the train.

Manually Triggering Sounds from the Transmitter
Sound triggers require multiple button presses. All sound triggers start with either one or two momentary presses (clicks) and then either the Raise or Lower button (see chart next page). The most often used (Whistle and Bell) are the easiest to use.

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

Automated Whistle/Horn Triggers from Track Magnets
The track activated whistle can be toggled on/off from the transmitter. This is useful when the automated whistle gets annoying or you just want quiet operation. Hold both the Stop and the Raise buttons for 1 second.

Automated Station Stops
Automated station stops can also be toggled on/off from the transmitter. Hold both the Stop and the Lower buttons for 1 second.

Throttle Programming
You can program the min and max throttle speeds (voltage). Most motors require more than 0 volts to get moving, so if you set the min speed just slightly less than what it takes to make the loco move, you will eliminate the delay in getting the loco moving. Max speed setting is useful for setting a safe maximum speed to avoid derailments when children are operating the loco.

To enter throttle programming mode, hold both the Raise and Lower buttons for 1 second. You will now have full speed control from 0 to 100% battery voltage. Note: You must re-enter throttle programming to store new settings for each of the following functions (Min Speed, Max Speed, and Reset Defaults).

Pocket RailBoss Plus

Button Command Summary

**How to read the table:**

Stop, Raise
Means you press Stop then press Raise in sequence.

Stop AND Raise
Means you press both buttons at the same time.

Commands used most often are the easiest to use. Those not used very often require more button presses. But all are logically related and fairly easy to remember after you've used them awhile.

To get started, print out this page as a reference.

Antenna

Raise

Stop

Lower
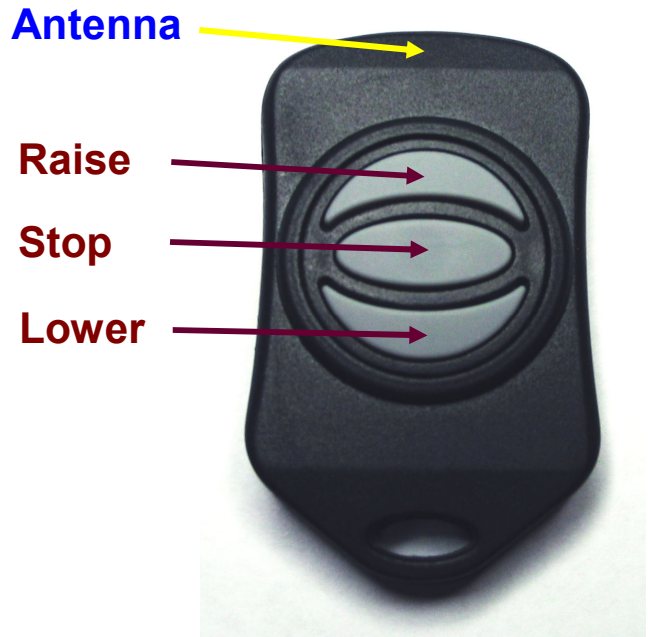
Hold with Antenna Up

Raise	Raise Speed
Stop, Raise	Sound Trigger 1 (Whistle)
Stop, Stop, Raise	Sound Trigger 3
Stop AND Raise	Toggle Track Whistle On/Off
Stop (Hold)	Quick Stop when running Change Direction when stopped
Stop, Stop, Stop (3 clicks)	Toggle Momentum On/Off
Lower	Lower Speed
Stop, Lower	Sound Trigger 2 (Bell)
Stop, Stop, Lower	Sound Trigger 4
Stop AND Lower	Toggle Station Stops On/Off
Raise AND Lower	Enter Throttle Programming Mode *(PCB LED and Front Light blinking fast)*
Use Raise/Lower to set desired speed over full range.	
Stop AND Raise	Set the Maximum Speed (>=50%)　(& Exit)
Stop AND Lower	Set the Minimum Speed　(<50%)　(& Exit)
Raise AND Stop AND Lower	Reset Min/Max Speeds to full range (& Exit)
Stop (Hold)	Exit Throttle Programming mode

To set min speed, use the Raise button to just barely get the loco moving. Then use the Lower button to just Stop it. Press Stop and Lower buttons for 1 second to record the min speed setting and exit throttle programming (Speed must be less than 50% battery voltage).

To set max speed, use the Raise and Lower buttons to run the loco at the desired speed. Press Stop and Raise buttons for 1 second to record the max speed setting and exit throttle programming (Speed must be greater than 50% battery voltage).

To return to default throttle settings (min speed = 0% voltage, max speed = 100% voltage) and exit throttle programming, press Raise, Stop, and Lower buttons at the same time for 1 second.

Low Battery Voltage Warning
When NiMh or NiCad batteries start running down, they usually give a noticeable decrease in speed before giving out completely. Plenty of time to get the train back home or to the desired charging location.

With lithium batteries, things are different. They need protection from over discharge, so many lithium-ion battery packs have a built-in protection circuit that shuts off the battery when it discharges to a predetermined voltage. This happens with no warning, and your train stops instantly; in the tunnel or on the mountain, etc. Lithium-polymer batteries don't usually have the built-in protection, but must have some protection to avoid damage.

The purpose of the low voltage warning function is to give you full run-time on your battery pack, but warn you when you have only a few minutes left to get the train back to the desired location under power.

Low Voltage Warning: The throttle setting is automatically reduced by 50%, the Front Light starts flashing, and you have no control using the Raise/Lower buttons. This gets your attention. You can then restore full control by pressing the Stop button. The front light will continue to flash reminding you the battery is very low. This setting is programmable via DIP switch parameter 7. It may take some experimentation to get the desired result; i.e. X minutes of run time before the battery circuit shuts you down.

Hard Cutoff: If the battery voltage falls below 3.0 volts per cell, the RailBoss will shut off power to everything it has control of (motor and lights). However, the sound system and other accessories may still be drawing power. This setting is intended for use with Lithium-Polymer batteries, or Lithium-Ion batteries without built-in protection.

This function can be disabled or customized using DIP switch parameters 6 and 7: i.e. number of cells and voltage level.

Warning: Neither the Low Voltage Warning nor the Hard Cutoff will function until programming parameter 6 is properly setup. It is the user's responsibility to determine the proper number of lithium cells in the battery pack being used and select the proper option, thus enabling both functions.

These functions serve as a warning only! It the user's responsibility to intervene promptly after the warning and safely disconnect the battery pack to avoid damage.

Trouble Shooting Manual Operation

- Nothing seems to be working …
  Check the power. The RailBoss LED should be ON. You should measure between 7 and 25 volts DC applied to terminals B+ (18), B- (19).
  You should measure 5 volts DC on terminals 1(+), 5(-)
  Verify all wiring connections.

  Repeat the "Learning" process for the transmitter and receiver. The Receiver LED should come on when you press the receiver button, and then flash 3 times when it detects a button press on the transmitter.

- Erratic throttle behavior? Reset throttle to default full range values using throttle programming procedure (See Throttle Programming).

- My locomotive just quits, then it will start working again after awhile.
  The control board may be overheating; especially if it is a hot day and your battery voltage is greater than about 15 volts. Increase ventilation to the control board, or reduce your battery voltage, if possible.

- The transmitter / receiver doesn't work at all
  Did the receiver successfully "Learn" the transmitter?
  Check the battery in the transmitter. It should measure at least 2.8 volts (3.0 volts nominal).
  Check the receiver wiring: A connector may be backwards or plugged into the wrong place. The orange wires should be to the left, both on the 2-wire power input connector and the 3-wire data output (1,2,3) connector.

- The loco doesn't start moving until I hold the Raise button for a long time.
  The voltage is ramping from 0 volts to that required to move the loco. You can eliminate this dead time by programming the Min Speed setting to a higher value. (See Throttle Programming).

- The loco starts moving as soon as I turn it on.
  Program the Min Speed setting to a lower value.

- The locos runs in reverse at power up, even though the front light is ON.
  Reverse the wires at the motor output, terminals M+ (20) & M- (21).
  Check setting for Direction Control parameter 5.

- 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 or the Max Speed setting. You need more cells/voltage or you may need to restore the default throttle programming settings.

- I can't get full throttle ...
  The throttle programming function has a "Max Speed" function. This may need to be reset.

- The PCB LED and lights turn off as soon as I turn on the RailBoss ...
  The RailBoss is shutting down due to low battery voltage (less than 3.0 volts per cell). Disable or reprogram the Low Voltage Warning parameter (6) for the proper battery size.

Automated Operation

An automated station stop slows down the train, waits at the station for a predetermined time, then accelerates back to its original running speed. Station stops add interest to your open house or public displays.

Automated operation is easily achieved with the RailBoss R/C Control. You just need to add a reed switch to your locomotive and place some track magnets on your layout.
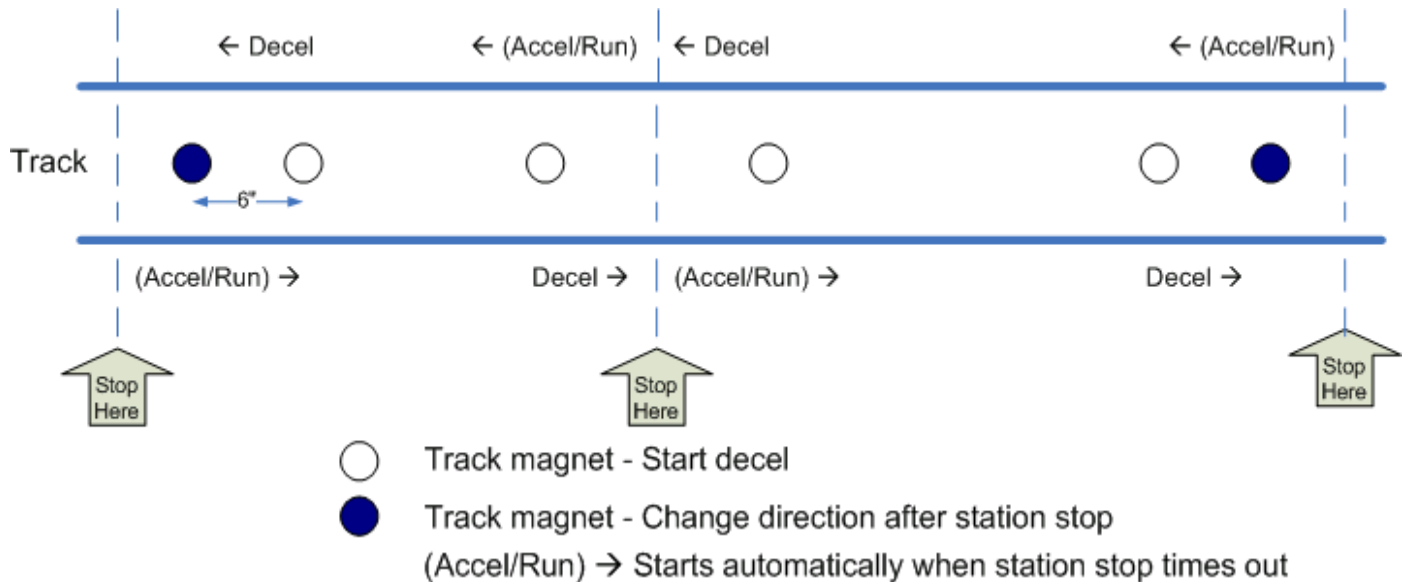
Automated station stops are initiated by a track magnet placed ahead of the station. The magnet initiates deceleration to a stop. You can make as many stops as you like, one magnet per station. When running in both directions, two magnets per station are required, one for each direction. Place the magnets such that the loco stops at the same location when running from either direction. The magnet in front of the locomotive when leaving the station will be ignored.

The distance the magnet is located from the station will depend on your running speed. Some trial and error will be required to find the proper location and/or speed.

Automated reversing is accomplished using a second magnet placed about 6" after the decel magnet. This second trigger will cause the loco to depart the station in the opposite direction. Magnet spacing requirements vary with speed of the loco. 6" or greater is a good starting point. As long as the second magnet is crossed prior to coming to a full stop, it should work. *Caution: Provide end of track bumpers or wheels chocks, just in case.*

Radio Shack 1/2" round ceramic magnets make good track magnets. They can be glued to the top of a rail tie or placed between the ties. Any magnet of suitable size and strength can be used. But they must be located no more than 1/4" from the reed switch passing overhead. Track magnets mounted higher than the rail tops will be susceptible to damage by track cleaners and snow plows. We recommend using movable magnets (next page).

Station stops are enabled or disabled from the transmitter while the train is running (see Button Command Summary). During a station stop, transmitter commands are disabled. However, you can give a Raise speed command to leave the station early. Station stops are enabled at power-on.

Sound Systems

"But I already use magnets to trigger my sound system!" You may have existing track magnets used to trigger the bell and whistle of your sound system. For example; whistle magnet on the right, bell on the left. RailBoss can share these same magnets fairly easily. Install your RailBoss reed switch on the same side you use to trigger the bell. The bell will ring as you approach the station, and the whistle will still blow in your favorite locations.
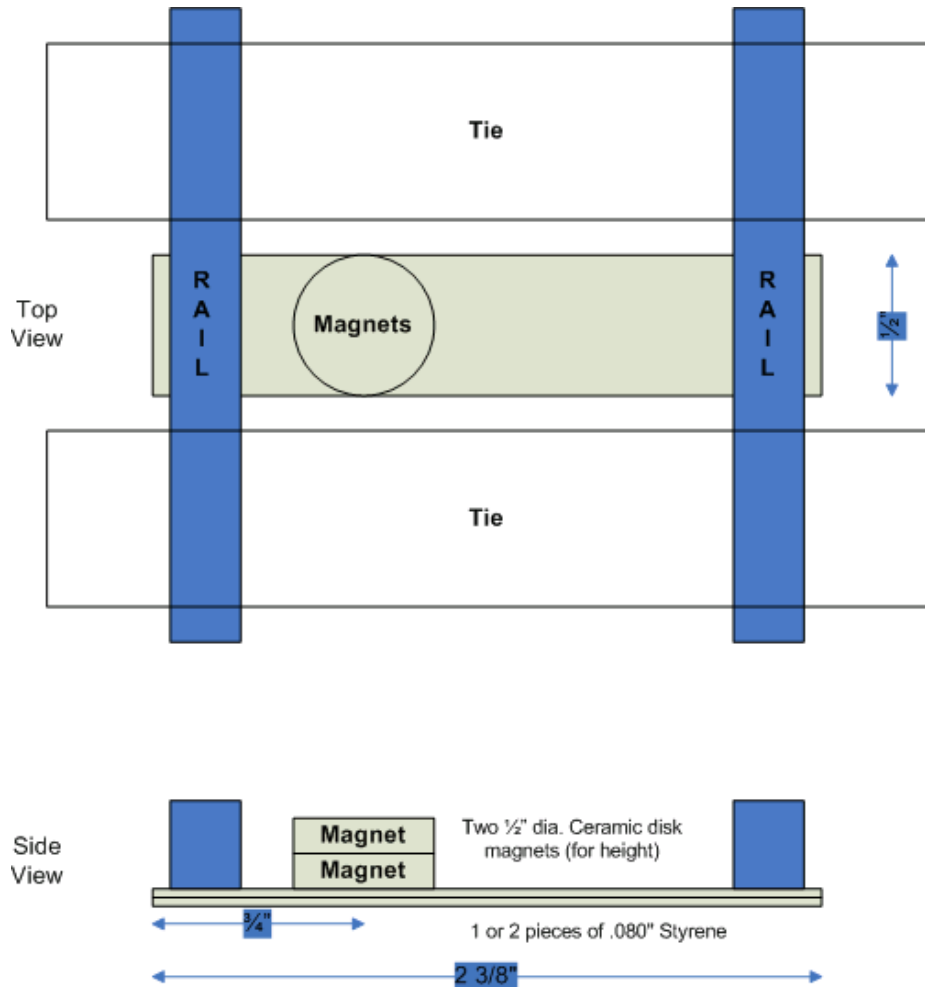
There are several ways to connect your reed switches. Reed switch 1 (terminals 4,9) is required for automated station stops. Reed switch 1 will also trigger the bell (if so desired) via the bell sound trigger output to the sound

board. The whistle reed switch can remain connected to your sound board, in parallel with the RailBoss sound trigger, and it will operate as normal.

Reed switch 2 (terminals 6,9) and trigger the sound board via the whistle sound trigger. The advantage here is, the RailBoss has some optional randomization functions, which will only sound the whistle a certain percentage of the time the reed switch passes over the track magnet. The result? No more repetitive whistle blowing, lap after lap. It reduces the overall noise, and makes things less predictable.

Movable Magnets

Being able to easily move your magnets to new track locations makes it much easier to set up your station stops, or change things as the need arises. If you just place a loose magnet in between ties, the metal of the loco may pick it up as it passes. Glue your magnets to a strip of styrene as shown. When placed under the rails, the magnet will stay in place. Magnet can be on the left or right by simply rotating the strip.

Top View

Side View

Two ½" dia. Ceramic disk magnets (for height)

1 or 2 pieces of .080" Styrene

Trouble Shooting Automated Operation

- Make sure you have enabled station stops from the transmitter.
- Loco fails to stop after crossing a single decel magnet. Verify proper installation of reed switch and magnet.
- If the loco fails to reverse after *crossing* two magnets, the magnets are too close together and/or the loco speed is too fast. *(Hence the need to protect the end of point-to-point track with a bumper or derail).*
- The loco will also fail to reverse if the magnets are too far apart and/or the loco is running too slow. It will cross the first magnet, but stop prior to the second, and treat it as a station stop.
- If you can't get the loco to make a proper intermediate station stop in both directions after making the above adjustments, it may be due to excessive grade of the track. Intermediate station stops work best with a flat approach from both directions but should tolerate 3% grades.
- The location of the station stop changes over time. Magnet locations are only precise for one given speed setting. As the battery discharges, the loco will slow somewhat, even though the speed setting has not been changed. This effects the stopping distance after a magnet trigger.

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
Station Stop Dwell Time
The elapsed time spent from a full stop at the station to departure.

Parameter 1
Station Stop Accel/Decel Time
The time it takes to decelerate to a full stop after crossing the station stop magnet. Use this adjustment not only to make the stop look prototypical, but also to match the characteristics of other locomotives making station stops using the same magnets. Thus, you don't have to move the magnets for each locomotive.

Parameter 2
Whistle Operation via Reed Switch
The reed switch at terminals 6&9, triggers the output at terminal 14. By connecting your whistle/horn reed switch to the RailBoss, instead of directly to the sound board, the RailBoss can now control its operation. The whistle/horn, especially the grade crossing whistle, gets pretty annoying in a hurry if it sounds every X seconds, lap after lap, all day long at your open house. This parameter allows you to control the percentage of time, that it actually sounds;. e.g. at the 50% setting, after crossing the whistle magnet 10 times, the whistle will have only sounded about 5 times. The triggers are random events, and thus very unpredictable, adding character, and a bit of mystery to your layout.

Parameter 3
Station Stops & Bell Operation via Reed Switch
The reed switch at terminals 4&9, initiates a station stop, if enabled from the transmitter, and also triggers the output at terminal 15, normally connected to the bell trigger of you sound board. Like the random whistle function described in Parameter 2, you can randomize your station stops, adding interest for you and your visitors.

Note: When operating in point-to-point trolley mode, using the reversing magnets, you must have parameter 3 set for 100%. Otherwise, the loco will run off the end of the track, as the RailBoss will ignore the magnets X% of the time.

Parameter 4
Throttle Momentum
This parameter sets the amount of momentum applied to the throttle when the momentum function is turned ON. "Momentum" is the length of time it takes to accelerate or decelerate while holding down the Raise or Lower buttons.

Parameter 5
Direction Control
Loco normally runs in the forward direction at power-up. Set this for reverse at power up to run a loco backwards in a consist with other locos.

Parameter 6
Number of Battery Cells
This enables low battery warning and determines the basic voltage of your battery pack; 3.7 volts per cell.

Parameter 7
Low Battery Warning Voltage
This setting finely tunes the warning voltage. Trial and error will determine the best setting.

DIP Switch Programming Procedure

User configurable parameters can be programmed using the 3-position DIP switch, on-board push-button switch, and on-board LED.

Enter Programming Mode
DIP programming mode can only be entered at power-up. Hold the button down on the RailBoss board (not the receiver) and then turn on the power. Release the button. The LED will begin flashing. Note: If you press the button *after* power as been applied to the RailBoss, it will go into low battery warning and flash the LED.

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 seconds 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
To exit programming mode and return to normal control, 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.***

Switch position 1 has a value of **1**
Switch position 2 has a value of **2**
Switch position 3 has a value of **4**

The switch setting shown here is set for parameter 6:
Switch 1 = 0 (off)
Switch 2 = 2 (on)
Switch 3 = 4 (on)   for a total of 0 + 2 + 4 = 6

DIP Switch
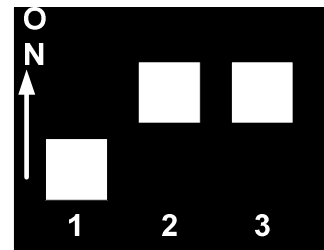
Pocket RailBoss Plus
DIP Switch Programming

Option	Parameter 0 - Station Stop Dwell Time
1	15 secs
2	30 secs [factory setting]
3	45 secs
4	60 secs

Option	Parameter 1 - Station Stop Accel/Decel Time
1	Fastest
2	Faster
3	[factory setting]
4	Slower
5	Slowest

Option	Parameter 2 - Whistle Operation from Reed Switch
1	100% (Always triggers via track magnet) [factory setting]
2	75%
3	50%
4	25%
5	0% (Disabled)

Option	Parameter 3 - Station Stops & Bell from Reed Switch
1	100% (Always triggers) / Trolley mode [factory setting]
2	75%
3	50%
4	25%

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

Option	Parameter 5 - Direction Control
1	Forward at power up [factory setting]
2	Reverse at power up

Option	Parameter 6 - No. of Lithium Battery Cells (3.7V ea.)
1	Disable Low Battery Warning [factory setting]
2	2 Cells, 7.4V
3	3 Cells, 11.1V
4	4 Cells, 14.8V
5	5 Cells, 18.5V
6	6 Cells, 22.2V
7	7 Cells, 25.9V

Option	Parameter 7 - Low Battery Warning Voltage
1	Lowest Voltage, least run-time after warning
2	
3	
4	
5	[Factory Setting]
6	
7	Nominal Voltage, most run-time after warning

Pocket RailBoss Plus

Pocket RailBoss Plus - Hardware Specifications
RailBoss Board Revision "B"
Pocket Receiver Board Revision "New"

Mechanical
>> RailBoss Plus Board
> Physical Size: PCB – 2.9" X 1.9", Max component height – 1.0".
> User Connections: Screw clamp terminal strips accept individual wires, 30 to 20 AWG.
>>> Requires a 1/16" or 5/64" slotted screwdriver
>> Pocket Receiver Board
> Physical Size: PCB – 1.4" X 1.0", Max component height – 1.0".
> User Connections: 2 and 3 wire R/C cables

Electrical
> Power Input from battery pack (Terminals B+,B-)
>> 7V min to 25V max
>>> 7-16 NiMh/NiCad cells (1.2V per cell), Nominal 8.4V to 19.2V
>>> 2-6 Lithium-Ion or Lithium-Polymer cells (3.7V per cell), Nominal 7.4V to 22.2V
>> Reverse polarity protection (prevents damage, but will not operate)

> Power Consumption (due to board and receiver, no motor load)
>> Forward motor direction: 55 ma
>> Reverse motor direction: 125 ma

> Motor Output (Terminals M+, M-)
>> 5 amps max, continuous, over the full input voltage range (7-25V)
>> PWM (Pulse Width Modulated), 20 KHZ
>> Polarity reversal via relay contacts
>> Max amplitude: Battery voltage minus driver loss
>> Max voltage loss across driver: < 0.4V @ 1.0A, < 1.5V @ 5A

> +5V output to Receiver (Terminals 1+,5-)
>> For use as shown in wiring diagram only. No other loads should be connected to this 5V supply.

Control Inputs
>> 3 Receiver Data Inputs; Buttons 1,2,3
>> Reed Switches, normally open, momentary close
>>> Bell/Station stops, Terminal 4,9
>>> Whistle, Terminal 6,9

Control Outputs
>> Sound Triggers: 4 open collector Darlington pairs. 200ma max each.

>> LED/Lamp Drivers: Max load = 200 ma
>> LED current source: Terminal 11 = 11 ma
>> Lamp voltage source: Terminal 10 = battery voltage at power input
>> Forward Lamp/LED-(open collector) Terminal 12
>> Reverse Lamp/LED-(open collector) Terminal 13

Radio Rx and Tx
CE / ETSI / IC & FCC certified and approved.
2.4GHZ, motor noise and interference tolerant, built-in antenna.
Typical range 100 feet, line-of-sight when mounted in a locomotive or trailing car.
Tx battery: CR2032

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
> Charging Jack: 2.5mm I.D., 5.5mm O.D., 5A, w/switch (mating power plug: Radio Shack #274-1573

Warranty - 12 months from date of purchase. Post warranty repairs can be made for a modest fee.
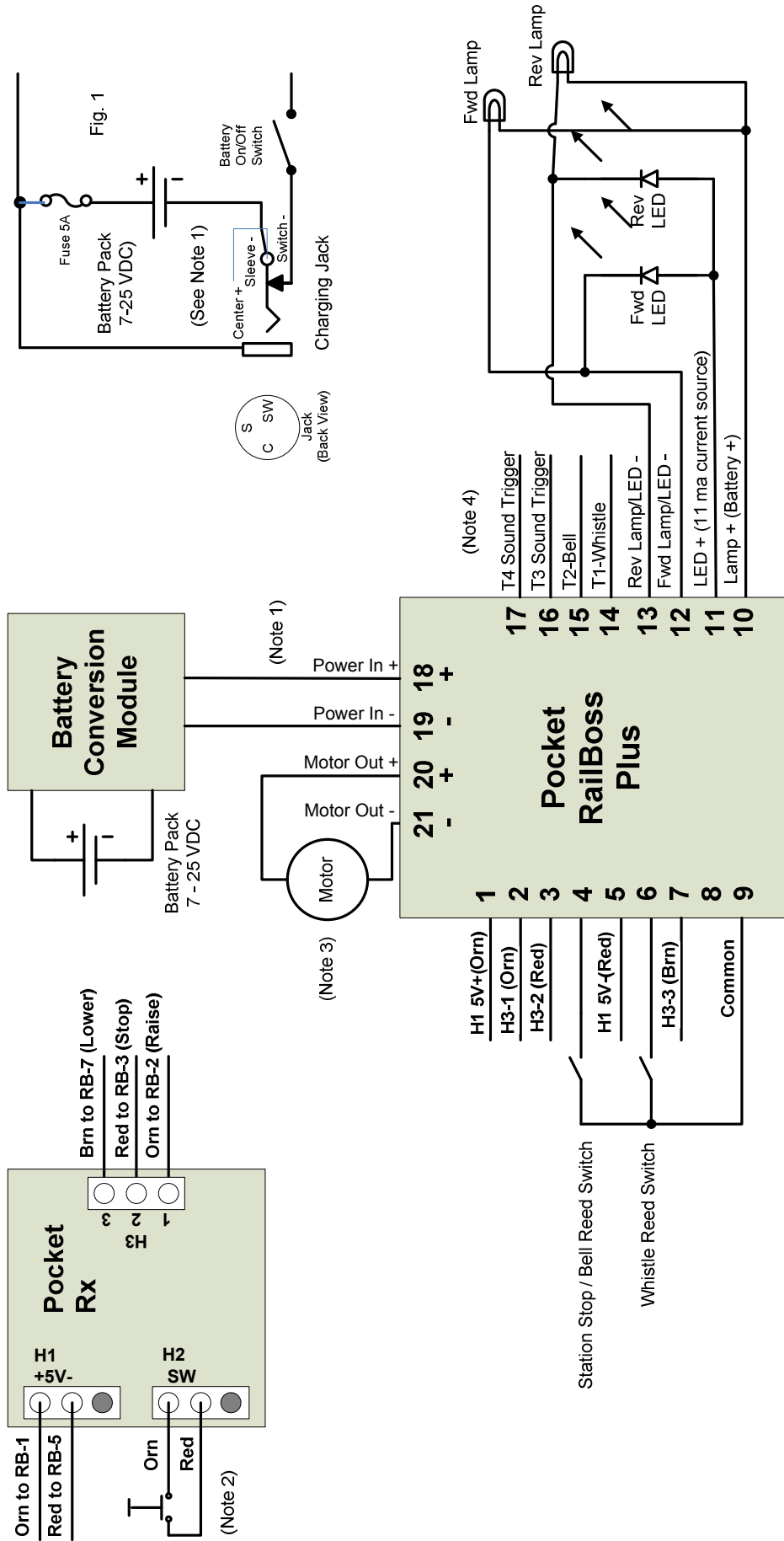
2.4GHZ RailBoss R/C Product Comparison

Control System	Pocket RailBoss Basic	Pocket RailBoss Plus	Basic RailBoss	RailBoss Plus
R/C Channels	3	3	5	5
Speed Control	Push Buttons	Push Buttons	Proportional Stick	Proportional Stick
Tx Control Range	Key fob /Good	Key fob /Good	Hobby Radio / Excellent	Hobby Radio / Excellent
Momentum Control	X	X	X	X
Sound Triggers	*2*	4	*2*	4
Directional Lighting	*X*	X	*X*	X
Two Train Operation From One Tx			X	X
Low Lithium Battery Warning		X		X
Automated Station Stops	X	X		X
Random Track Whistle		X		X

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

Both the key fob pocket transmitters and the hobby 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 time for the 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 hobby transmitters are much better, 100 to 300 feet, and usually no problems with obstacles.

Pocket RailBoss Plus - Wiring Diagram

Pocket Rx

H1 +5V-
H2 SW

Orn to RB-1
Red to RB-5
Orn
Red
(Note 2)

H3
3 2 1
Brn to RB-7 (Lower)
Red to RB-3 (Stop)
Orn to RB-2 (Raise)

Battery Conversion Module

Battery Pack 7 - 25 VDC

(Note 1)

Power In +
Power In -
Motor Out +
Motor Out -

Motor

(Note 3)

Pocket RailBoss Plus

18 +
19 -
20 +
21 -

1 H1 5V+(Orn)
2 H3-1 (Orn)
3 H3-2 (Red)
4
5 H1 5V-(Red)
6
7 H3-3 (Brn)
8
9 Common

10 Lamp + (Battery +)
11 LED + (11 ma current source)
12 Fwd Lamp/LED -
13 Rev Lamp/LED -
14 T1-Whistle
15 T2-Bell
16 T3 Sound Trigger
17 T4 Sound Trigger

(Note 4)

Station Stop / Bell Reed Switch
Whistle Reed Switch

Fwd Lamp
Rev Lamp
Fwd LED
Rev LED

Fig. 1

Fuse 5A
Battery Pack 7-25 VDC
(See Note 1)
Center + Sleeve -
Switch -
Battery On/Off Switch
Charging Jack

S SW
C
Jack (Back View)

Notes

1) The circuit in Fig 1, or variations of it, may be substituted for the Battery Conversion Module. Power input is protected from reverse polarity damage, but the RailBoss will not operate.

2) Optional: A Momentary SPST (normally open) push-button switch may be used as a remote transmitter learn button. This makes reassigning a transmitter to a different locomotive more convenient. The button on the Pocket Rx does the same thing.

3) 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.

4) 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.