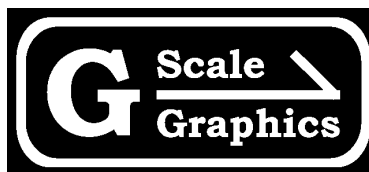


RailBoss R/C

Enhanced

Operation and Installation Manual



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Overview



This is what you get: The RailBoss R/C Enhanced board, 3-wire Rx cable, 1-wire Rx cable, and a reed switch.

RailBoss R/C is an electronic speed control designed specifically for controlling large scale trains via low cost readily available radio control systems. Any 2 or more channel radio system that provides digital proportional outputs for controlling analog servos can be used. However, RailBoss has been designed to work well with the lower cost 75 MHZ AM 2-Channel stick radios. The radio system of your choice must be purchased separately. Note: 27 MHZ and 75 MHZ are the legal FCC frequencies for operating on the ground. It is not legal to use 72 MHZ radios intended for flying model aircraft to control your trains.

RailBoss provides traditional manual radio control or fully automated station stops and back 'n forth trolley operation. It's the best of both worlds and you can swap between the two modes at will using the transmitter. Great for unattended operation during an open house.

RailBoss R/C controls the speed of your locomotive using the left stick (Channel 2 of the radio, up/down motion). As long as the stick is up (above center), the loco will accelerate. The further away from center, the faster it will accelerate. Let the stick return to center position to continue running at the present speed. Likewise, the further down you move the stick, the faster the loco will decelerate.



To complete the system, you must also supply a suitable hobby transmitter and receiver. Shown here is a typical 75 MHZ AM 2-Channel stick radio and receiver. (Shown here: Futaba Attack 2DR)

The right stick (Channel 1, left/right motion) is used to control direction of the motor and auto mode. While the loco is stopped, moving the stick full left will select reverse. Full right will select forward. While running at speed, full left held for 5 or more seconds will disable auto mode. Full right for 5 or more seconds will enable auto mode. Auto mode initiates station stops or back 'n forth trolley operations if you have the appropriate track magnets in place.

For emergency stops, full down and full left stick at the same time will cause a quick decel to a stop without worry of gear damage due to the momentum of a heavy train.

The right stick also controls the sound triggers; move right to blow the horn/whistle, left to sound the bell.

Turn off the transmitter when not in use to save the batteries. The RailBoss R/C will maintain your present speed and continue to perform station stops, if enabled.

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

Directional lighting outputs are provided for incandescent lamps and/or LEDs.

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

The RailBoss R/C consists of a circuit board (2.9" X 1.9"), two cables to connect your receiver to the RailBoss, and a reed switch for automated operations.

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.

The Radio System

The radio system is not included with the purchase of your RailBoss. It must be purchased separately. Any two or more channel radio system that provides “digital proportional” outputs for controlling analog servos can be used with the RailBoss. However, RailBoss has been designed to work well with the lower cost 75 MHz AM 2-Channel stick radios. A typical 2-channel R/C set contains the transmitter, receiver, and 2 servos; usually priced at under \$50. You won’t need the servos, so sell them back to your hobby shop for a \$10 discount. Additional receivers and crystals can be purchased, but for about the same price you can get another complete system.

The AM radios operate in the 27 MHz and 75 MHz frequency range. 75 MHz is preferred, mostly because the length of the antenna is shorter (23” long) and the higher frequencies may provide better operation. When purchasing additional receivers you will also have to purchase a plug-in crystal to match the frequency of your transmitter.

Note: 27 MHz and 75 MHz are the legal FCC frequencies for operating on the ground. It is illegal to use 72 MHz radios intended for flying model aircraft to control your trains.

AM radios get a bad rap for “glitching”. And for good reason, they do. Loss of signal and/or radio interference can be fatal when flying an airplane or driving a race car. However, the slow response times required for running our trains, allow us to filter out and design around the glitches. This allows us to use the low cost radios that the other R/C guys don’t want to use. Of course, you can still use the better and more expensive radios systems; FM, FM PCM, and Spectrum, as long as they have the digital proportional outputs.

With the simple AM radios you won’t be able to run more than one train from the same transmitter. But the same transmitter can be used to operate all of your locos using the same frequency channel, one at a time. There are many different frequency channels available within the 27 MHz and 75 MHz bands. You can run multiple trains if you have transmitter/receiver combinations using different channels.

You can purchase your radio at your local hobby shop or on-line at many sites like www.towerhobbies.com. **We highly recommend the Futaba 2DR 2-Channel 75MHz system, p/n FUTJ25**.** **The Hi-Tec Ranger II transmitter is fine, but the Hi-Tec HP-2RNB receivers that come with it have proven to be problematic with the RailBoss R/C.**



A typical 2-channel receiver with 3 connectors: CH2 (3 wire cable for power and speed), CH1 (1 wire cable for direction), Batt (not used). Note: The order of these plugs and the orientation of the cables will differ between manufacturers.

The RailBoss control board

In R/C “speak”, the RailBoss board is an ESC (Electronic Speed Control). It converts the signals intended to drive an analog servo into useful commands for operating a powerful 5 amp 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 control of your locomotive, yet provide a quick emergency stop (without stripping gears) when needed.

RailBoss provides power to your receiver and gets its commands using the two receiver cables provided. It operates over a wide range of battery voltage inputs (8-30 volts; that’s 8-20 NiMh or NiCad cells). The battery input is protected from damage due to reverse polarity, and also has an on-board resettable fuse.

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 the supplied 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.

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. Round this value up to the nearest 1.2v increment, and you have the number of cells you need.

For example: Track voltage measures 11.6V at speed. $(11.6 + 2) / 1.2 = 11.3$. You will need at least 12 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. Lights, depending on current requirements can be powered from the battery for constant lighting. Understanding existing wiring and/or circuit boards without documentation can be difficult. You may choose to just remove it all and wire directly to 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. The G-Scale Graphics "Battery Power Conversion Module makes this task easier in many cases by putting the on/off switch, fuse, and charging jack all one circuit board with screw terminals.

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. When mounting in a boxcar or tender, the antenna can be run around the inside upper perimeter of the car. **Do not cut the antenna wire to shorten it.** 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. The channel 2 cable has 3 wires, and the channel 1 cable has 1 wire. 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 (-), and Wht (data) on either side. **Note: If you have an Airtronics receiver, the Black and Red wires will need to be reversed in the supplied cable so the order will be Red, Blk, Wht.**

Installation of the RailBoss R/C 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. Double-sided foam tape on the bottom side of board or on top of the relay (large black box) 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 8v input at terminals 18(+), 19(-). Reverse polarity will not cause damage, but the RailBoss will not operate. Voltage in excess of 30V may cause damage. Battery packs of 8 to 20 cells are suitable (nominal 9.6 to 24.0V). A 20 cell pack can charge up to 30.0V. An 8 cell pack can discharge to 8.0V.

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.

This product is not intended for track power applications where polarity reverses.

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 wiring and provide screw terminals for connections.

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.

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

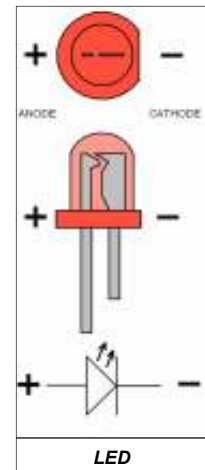
Connect directly to the motor. All other unknown circuitry should be disconnected from the motor. A maximum of 5 amps continuous current is available from the board. *Warning! At 5 amps the power transistors on the board (metal tabs) will be extremely hot. Enough to burn you if touched, or melt any plastic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

At power-up the motor output will provide a voltage to the motor that is positive on terminal 20, negative on 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 500 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. No current limiting resistors are required. To provide constant current to ONE LED, regardless of direction, jumper terminal 12 to 13, and connect the LED anode(+) to terminal 11, and the cathode(-) to either terminal 12 or 13. Multiple LEDs can be connected in series.



Sound Triggers

Opto-isolated outputs are provided for two sound triggers to a sound board. These outputs act like a reed switch, but they are polarity sensitive. Terminal 15 is triggered by Channel 1 stick left, or reed switch 1. Terminal 16 is triggered by Channel 1 stick right, or reed switch 2. (See Operation section)

In most cases the sound board will require a common ground connection and independent bell and horn/whistle connections. So terminals 14- and 16- would both be connected to the sound board common and terminals 15+ and 17+ would be connected to the bell and horn/whistle inputs respectively. When the input is switched to ground, the sound is activated.

However, if you have a sound board that requires a common power connection, the RailBoss will also accommodate that. Terminals 15+ and 17+ would both be connected to the sound board power connection. Terminals 14- and 16- would be connected to the bell and horn/whistle inputs respectively. When the input is switched to power, the sound is activated.

	RailBoss	2K2	PB9	P5T	Sierra
17	Whistle +	14	9	T6	14
16	Whistle -	16	11	Gnd	12
15	Bell +	13	8	T4	13
14	Bell -	16	11	Gnd	12

Reed Switches

Reed switch 1 at terminal 7 is required for automated stations stops. Reed switch 2 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. Only one reed switch is provided with the RailBoss. (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.

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 ON steady. 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 18+, 19-. It should measure between +8.0 and +30.0 VDC.

Transmitter / Receiver Operation

Set the trim tabs on the transmitter to mid position. The servo reversing switches should be set to “normal” for Futaba, and “reverse” for HiTec. Turn on the transmitter.

Pushing the speed stick up or down should cause the LED to flash. The further the stick is away from center the faster the flashes. If it doesn’t flash, check the speed cable (CH2) for proper connections at the receiver and at terminals 1(red), 3(wht), and 5(blk).

Pushing the direction stick full left or full right should cause the LED to flash at a rate slower than the speed stick. If it doesn't, check the direction cable (CH1) for proper connection at the receiver and at terminal 2(wht).

Reed Switches

Close the reed switch with a magnet, or 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 7,8, and 9.

Motor Direction

At power-up, direction is set to "forward", and the forward lamp (or LED) should be ON (if connected) and the reverse lamp OFF (if connected). When changing direction with the transmitter, you may hear the relay on the RailBoss click. In reverse, the reverse lamp should be ON, and the forward lamp OFF. Direction can only be changed while stopped or at very low speeds.

Manual Operation (Refer to diagram next page)

Power-Up

When the RailBoss power's up it checks for a transmitter signal. If the signal is present, it calibrates the speed stick for center position. So if the trim tabs are off center a bit, it will correct for it. If the transmitter is off, the calibration doesn't take place. If things are off too far, you may notice gradual speed changes even though the speed stick is centered, or quick stop may not work. You may wish to glue the trim tabs (both channels) at mid position to avoid the constant hassle of having to check them all the time. **For best operation, turn on the transmitter first, then the locomotive.**

At power-up, the locomotive will be stopped, ready to proceed forward, with station stops disabled.

Changing Speed

UP to increase speed. DOWN to decrease speed. The further away from center position, the faster the speed changes.

Changing Direction

Momentary full LEFT is reverse. Momentary full RIGHT is forward. This can only be done while the locomotive is at or near a full stop. This protects the locomotive from gear damage.

Emergency Stops

Full DOWN and full LEFT at the same time will make a quick stop, not instantaneous, to avoid gear damage due to the momentum of the train.

Automated Station Stops

Full LEFT disables. Full RIGHT enables. This can only be done while running at speed and the command must be held for 5 or more seconds.

Transmitter Off

The transmitter transmits continuously, whether you are doing anything or not, and your batteries won't last long. It is best to just turn off the transmitter whenever you are not actually giving a command. Your train will continue running at the same speed and performing station stops (if they were enabled).

Sounding the Bell or Whistle from the Transmitter

Full LEFT will initiate the bell sound trigger to the sound board. Full RIGHT will initiate the horn/whistle sound trigger to the sound board. The trigger outputs turn off when the stick is returned to center.

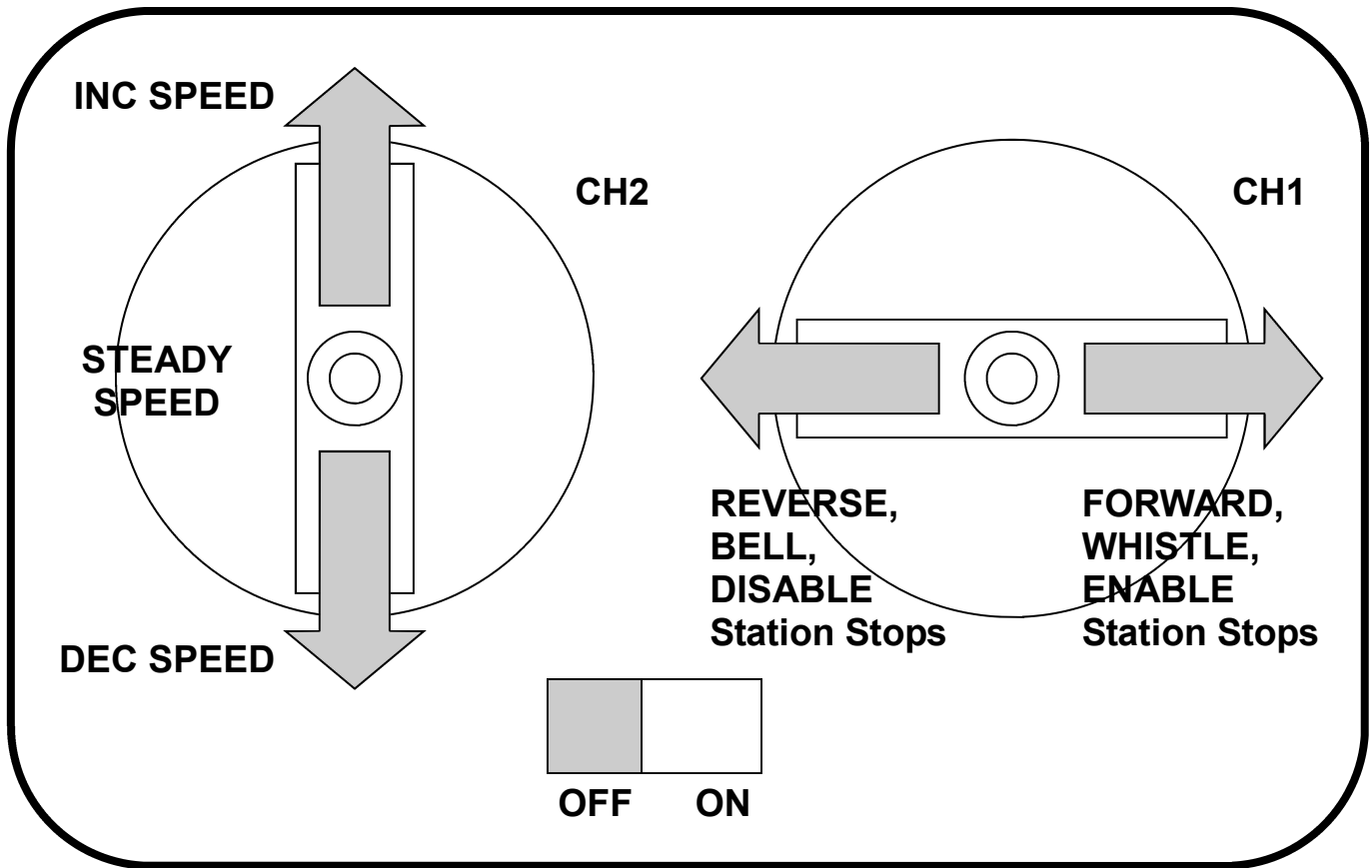
Your sound board may have options available, such as a manual bell or a programmed bell. The manual bell will turn on with LEFT stick and continue ringing until turned off with another LEFT stick. The programmed bell will turn on with a LEFT stick and then time out and turn off on its own.

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 RIGHT stick is maintained. If you have opted for the programmed grade crossing signal, a momentary RIGHT stick will initiate it.

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

Operating Procedure

Typical 2- Channel Stick Radio



Start-up: Set the trim tabs to mid position.
Turn on the transmitter first,
Then turn on the locomotive.

Speed stick (CH2) controls variable acceleration. The further the stick is moved away from center, the faster the locomotive will accelerate or decelerate.

Direction/Sound stick (CH1) works like a switch. Push it either full LEFT or full RIGHT.
Direction can only be changed when the locomotive is at a full stop.

Station Stops can be enabled or disabled only while the locomotive is running at speed.
Hold the stick full LEFT or RIGHT for at least 5 seconds.

Quick Stop: Speed full DOWN and Direction full LEFT

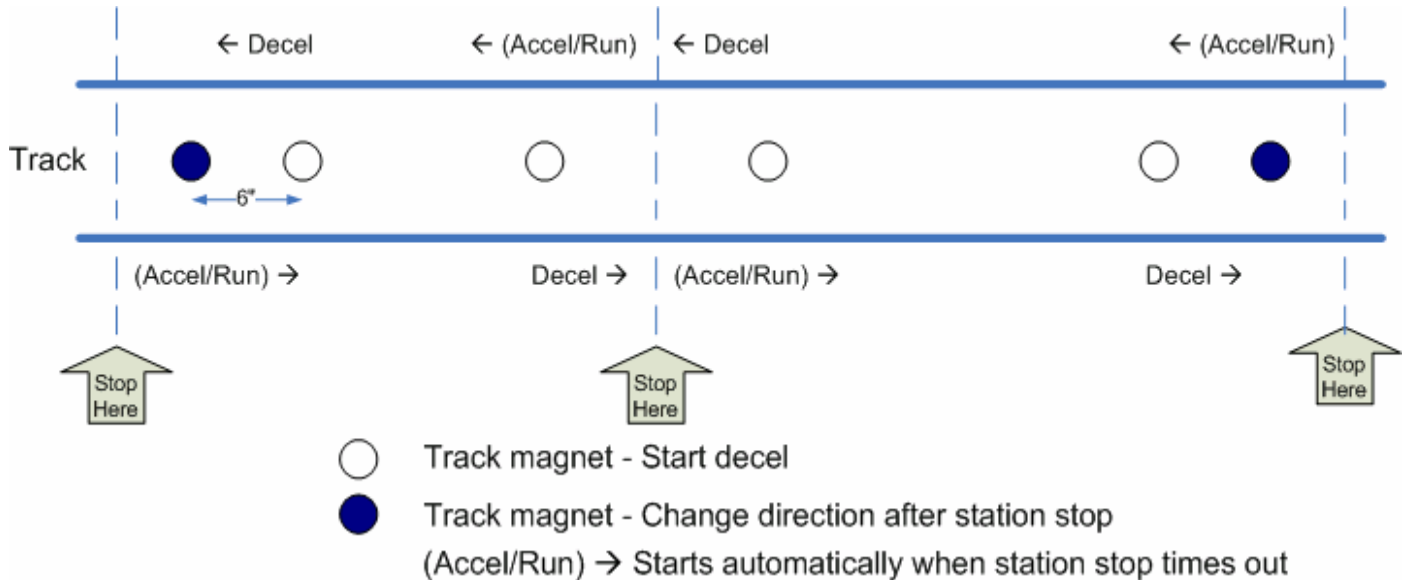
Disable Station Stops while stopped at a station: Speed full UP

Turn OFF the transmitter unless you are actually sending a command.
This will save the batteries.

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: You should provide for 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.

Station stops are enabled from the transmitter with a full RIGHT stick command for at least 5 seconds, or disabled with a full LEFT stick command for at least 5 seconds. During a station stop, you cannot change directions or use the sound triggers. However, in an emergency, you can give a full UP stick command to leave the station and regain manual control. This also disables station stops.

Sound Systems

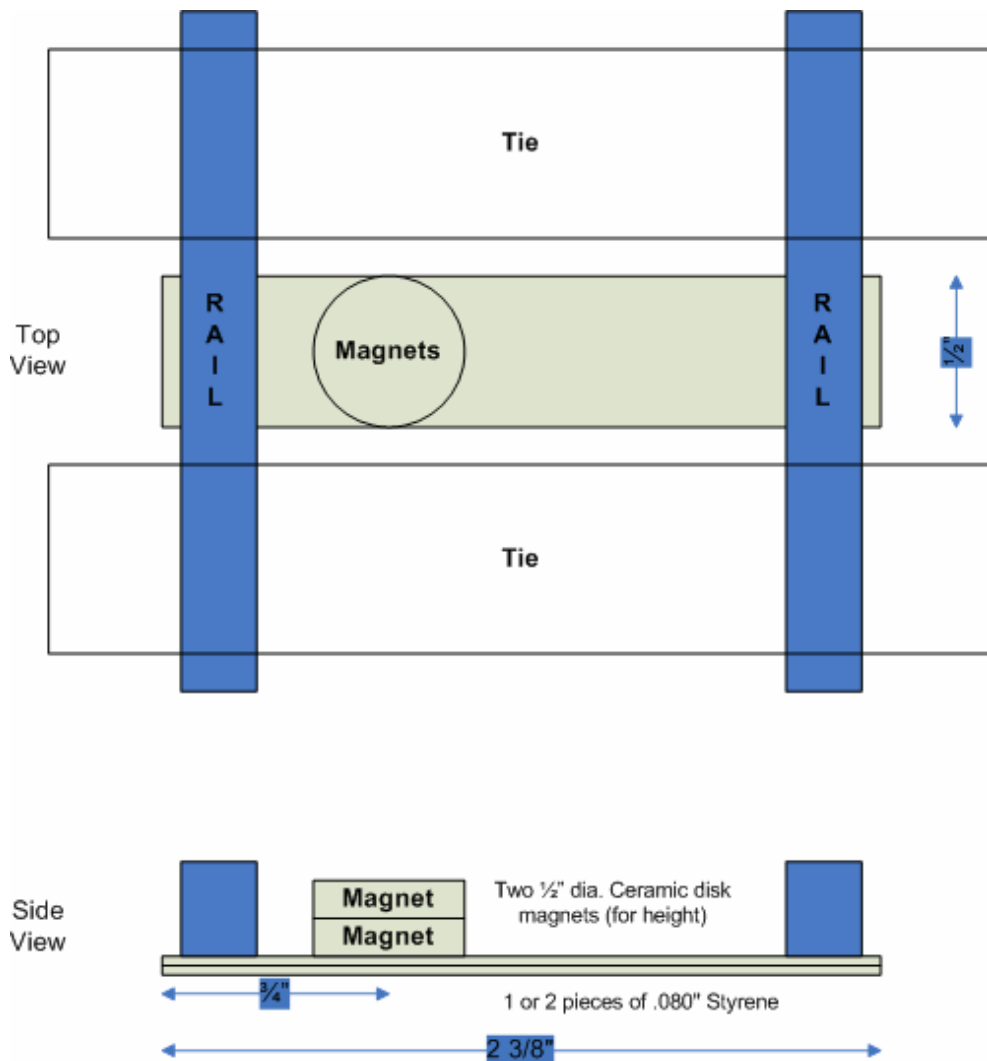
"But I already use magnets to trigger my sound system!" You may have existing track magnets used to trigger the bell and whistle of your sound system. For example; whistle magnet on the right, bell on the left. RailBoss can share these same magnets fairly easily. Install your RailBoss reed switch on 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 7,9) 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.

Or, it can be connected as Reed switch 2 (terminals 8,9) 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.



Trouble Shooting Automated Operation

- 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

Programming

Some of the operating parameters of the Enhanced RailBoss 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

Motor Starting Voltage

Use this to eliminate the delay to start of motion after giving the increase speed command from a full stop. Set it as high as you can without the loco moving on power-up. But if the loco has a jerky start, try lowering it a bit.

Parameter 3

Motor Max Voltage/Speed

Use this to keep the train on the track when your little ones have the throttle! Or maybe you have a much larger battery than needed to run your train at prototypical speeds.

Parameter 4

Whistle Operation from Reed Switch 2

Reed switch 2, at terminals 8&9, triggers the output at terminals 16&17. 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 5

Manual Whistle Operation from the transmitter

Since changing direction requires the use of the same stick (channel) as the sound triggers, you will get a bell trigger when changing direction to reverse, and a whistle when changing to forward. Hence, selecting forward prior to giving the increase speed command, will result in a whistle. If you have your sound board programmed for a grade crossing whistle, this may not be desirable. This parameter allows you to disable the manual whistle until you get up to speed.

Also please note: If you want to manually operate the bell as you leave the station, make sure you select forward again before giving the increase speed command, or you will find your train going in reverse!

If you have a manual whistle programmed in your sound board, you will likely want full control of it at all times.

Parameter 6

Station Stops & Bell from Reed Switch 1

Reed switch 1, at terminals 7&9, initiates a station stop, if enabled from the transmitter, and also triggers the output at terminals 14&15, normally connected to the bell trigger of your sound board. Like the random whistle function described in Parameter 4, 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 6 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 7

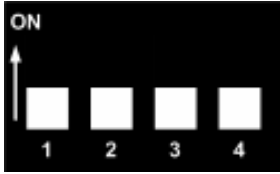
Throttle Accel/Decel Rate (R/C Channel 2)

The left stick is the throttle. It has a variable acceleration rate; i.e. moving it just slightly off center will increase speed at a slow rate, and the further you move the stick away from center, the faster the loco will accelerate. However, when you give it full stick, it may be too fast or too slow for you, so you can change it here. Technically, the slowest rate, option 1 gives you the best resolution for speed control (256 steps), but you should find all options satisfactory.

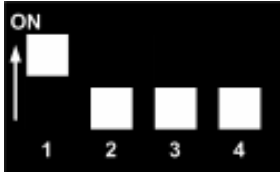
Parameters 8-15

Are not used at this time

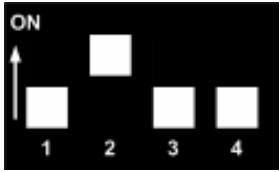
Selecting these parameters on the DIP switch while in programming mode will result in the LED staying off; no flashing. Just select a valid parameter to continue programming.



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

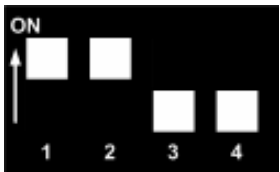


Option	Parameter 1 - Station Stop Accel/Decel Time
1	Fastest
2	
3	[factory setting]
4	
5	Slowest

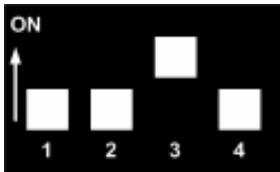


Option	Parameter 2 - Motor Starting Voltage
1	0% of battery voltage [factory setting]
2	5%
3	10%
4	15%
5	20%
6	25%

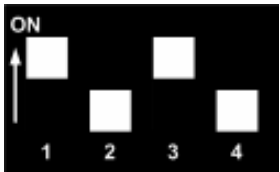
DIP Switch



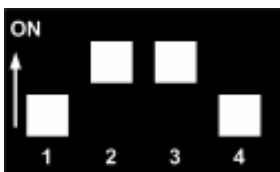
Option	Parameter 3 - Motor Max Voltage/Speed
1	100% of battery voltage [factory setting]
2	75%
3	50%



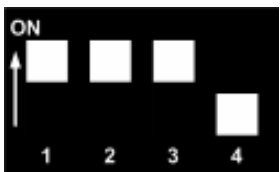
Option	Parameter 4 - Whistle Operation from Reed Switch 2
1	100%, normal operation [factory setting]
2	75%, Reed Switch triggers whistle 75% of the time
3	50%, Reed Switch triggers whistle 50% of the time
4	25%, Reed Switch triggers whistle 25% of the time
5	0%, Reed switch triggered whistle is disabled



Option	Parameter 5 - Manual Whistle Operation from Tx
1	Disabled during stops and low speeds [factory setting]
2	Enabled at all times



Option	Parameter 6 - Station Stops & Bell from Reed Switch 1
1	100% / Trolley mode [factory setting]
2	75%, Reed Switch triggers SS/Bell 75% of the time
3	50%, Reed Switch triggers SS/Bell 50% of the time
4	25%, Reed Switch triggers SS/Bell 25% of the time



Option	Parameter 7 - Throttle Accel/Decel Rate (R/C Ch 2)
1	Slowest - 256 speed steps
2	[factory setting] - 128 speed steps
3	Fastest - 64 speed steps

Programming Procedure

User configurable parameters can be programmed using the 4-position DIP switch, on-board push-button switch, and on-board LED.

Enter Programming Mode

With power on, 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 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 power.

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

Trouble Shooting Manual Radio Operation

- Nothing seems to be working ...
Check the power. The LED should be ON. You should measure between 8 and 30 volts DC applied to terminals 18(+), 19(-).
You should measure 5 volts DC on terminals 1(+), 5(-)
Verify all wiring connections. If there is a short circuit in the motor wiring or on the board, the on-board circuit breaker will trip. Check the large yellow rectangular device on the circuit board (PTC) to see if it is hot. It will automatically reset when the short has been removed. If you can measure the 5 volts above, the breaker is not tripped.
- The transmitter / receiver doesn't work at all
Check the batteries in the transmitter and make sure the antenna is fully extended.
Check the receiver wiring: A connector may be backwards or plugged into the wrong place.
- The speed commands are backwards ...
If your transmitter has Normal/Reverse switch or setting for CH2, change it. Futaba should be "normal", HiTec should be "reverse".
- The direction commands are backwards ...
Reverse the wires at the motor output, terminals 20 & 21. Or, if your transmitter has Normal/Reverse switch or setting for CH1, change it. Futaba should be "normal", HiTec should be "reverse".
- 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 need more cells/voltage.
- 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.
- After making an automated station stop, the train never leaves.
This may occur if you are using a HiTec HP-2RNB receiver. They are very susceptible to electrical noise. We recommend you switch to a Futaba 132JE or similar receiver.

(Also, see Testing on page 6)

Enhanced RailBoss R/C Specifications

Board Revision "New"

Mechanical

Physical Size: PCB – 2.9" X 1.9", Max component height – 1.0". Weight: 1.6 oz.
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 18+,19-)
8.0V min to 30.0V max
8-20 cell battery packs
Nominal 9.6V to 24.0V battery packs (1.2V per cell)
8 cells can discharge to 8.0V (1.0V per cell)
20 cells can charge to 30.0V (1.5V per cell)
Over current protection - PTC (automatically resets upon removal of fault)
Reverse polarity protection (prevents damage, but will not operate)

Power Consumption (due to board, no motor load)
Forward motor direction: < 30 ma (30V supply)
Reverse motor direction: < 130 ma (Relay energized, 30V supply))

Motor Output (Terminals 20,21)
5 amps max, continuous
PWM (Pulse Width Modulated), 20 KHZ
Polarity reversal via relay contacts
Max amplitude: Battery voltage minus driver loss
Typical voltage loss across driver: 0.2V @15V, 1.5A: 0.6V @15V, 5.0A.

+5V output to Receiver (Terminals 1+,5-)
Do not connect any other loads to this supply. Not intended for customer use.

Control Inputs

Receiver Data Outputs CH1 (Direction, Terminal 2), CH2 (Speed, Terminal 3)
Digital Proportional servo data from any standard hobby radio
Reed Switches, normally open, momentary close
Bell/Station stops, Terminal 7,9
Whistle, Terminal 8,9

Control Outputs

Sound Triggers: Opto-isolated
Whistle/Horn: Terminal 17+(collector), 16-(emitter)
Bell: Terminal 15+(collector), 14-(emitter)

LED/Lamp Drivers: Max load = 500 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 (not supplied by G-Scale Graphics)

A hobby radio with at least 2 digital proportional outputs (analog servo outputs) on the receiver is required to operate the RailBoss control board. RailBoss has been designed for reliable operation using low cost 2-Channel 75 MHZ AM hobby radios (or other frequencies applicable to your area).

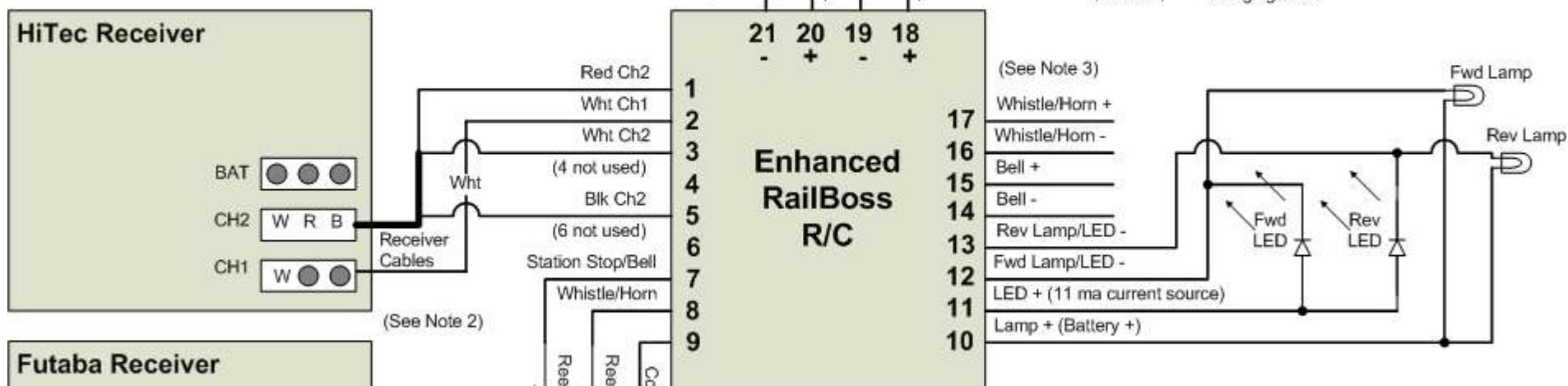
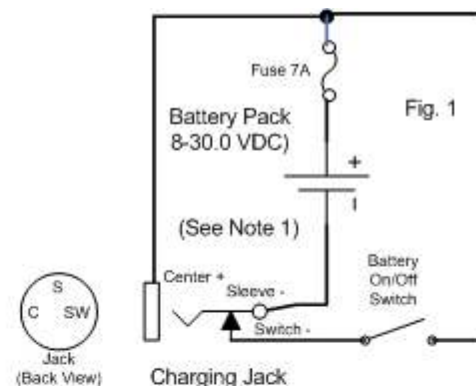
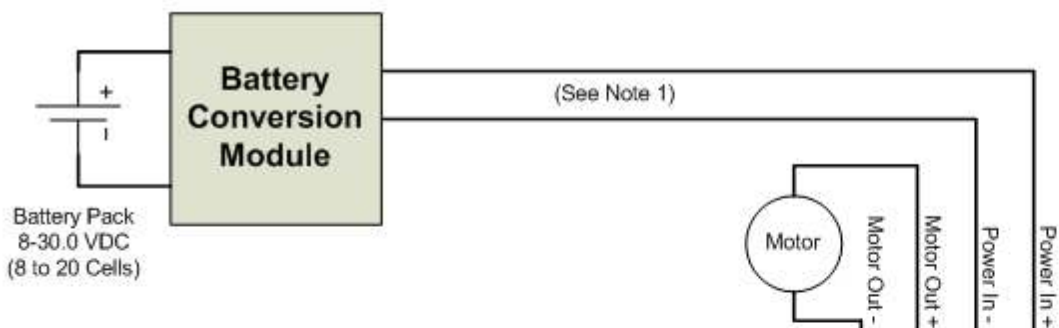
Firmware (Factory programmable)

"Enhanced R/C"

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)

Enhanced RailBoss R/C Wiring Diagrams



Notes

1) The circuit in Fig 1, or variations of it, may be substituted for the Battery Conversion Module. The RailBoss has a 7A resettable fuse on-board, but an external fast acting fuse is also recommended.

Power input is protected from reverse polarity damage, but the RailBoss will not operate.

2) 3-wire cable to CH2, 1-wire cable to CH1, BAT plug is not used. White wires (data) to the left.

3) Opto-Isolated sound triggers connect to the reed switch inputs of your sound board. Typically, the - wires connect to sound board common (Gnd) and the + wires to the bell and whistle inputs. In some cases, it may be the other way around. Whistle/horn is RC Ch1 Right, Bell is RC Ch1 Left.