BigSound™ PB22 Handbook

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Introduction

Dear Model Railroading Enthusiasts,

Thank you for choosing Phoenix Sound Systems to fill your railroad with sound. The PB22 system continues the 'runs anywhere, anyway' legacy of our PB Series of sound systems. The PB22 will run on DC, DCC, Battery – almost any way you can think of to run and control your locomotives.

The PB22 system, like all of our systems from the 2K2 onward, can be loaded and customized using a PC. You will need to upgrade your PC software to version 1.2.20x and ROM library files to version V1 or newer to load and save PB22 compatible files.

Happy Listening!

Getting Acquainted

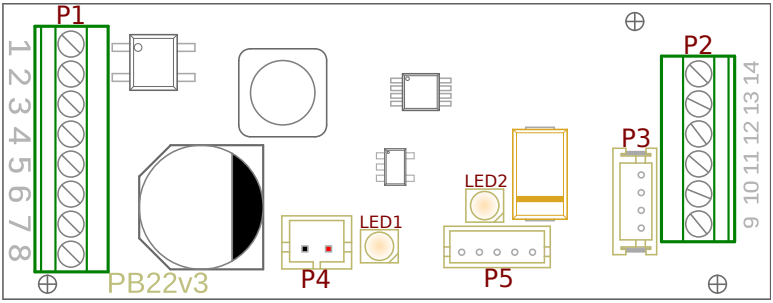
If you apply power to the speaker terminals the amplifier will be damaged and other components may be effected as well. This is a bad thing to allow to happen. This is NOT covered under warranty.

Contents

The PB22 is typically provided from Phoenix Sound Systems as a kit specific to the locomotive requested. The PB22 can also be provided in a 'board only' package – typically for the Ride On Locomotive scales or replacement for an existing system. A typical PB22 kit contains the following:

- PB22 Sound Board, tested and loaded with sound set specified
- A high quality 8 ohm speaker appropriately sized for the locomotive – please note some locomotives have a speaker factory installed that meets our quality recommendations and in those cases we do not provide a speaker.
- A 3.7V (single cell) Li-Ion rechargeable battery
- A 2.5mm Computer Access Jack
- A Momentary Toggle switch wired for volume control
- 2 Reed Switches for feature activation; 1 additional reed switch for chuff synchronization in most steam locomotives.
- 1 pair of Axle Magnets for chuff synchronization with steam kits.
- Double sided adhesive foam mounting squares or equivalent.
- This manual.

The Sound Board Connectors



Terminal	Purpose	Terminal	Purpose
1	Power/DCC	14	Trigger Ground
2	Power/DCC	13	Trigger Input 1
3	[Volume] Ground	12	Trigger Input 2
4	Volume Level	11	Trigger Input 3
5	[Volume] +5V	10	Trigger Input 4
6	Audio Line Level Out	9	Trigger Input 5
7	Speaker Out		
8	Speaker Out		

Connector: Pin	Purpose	Color	Termination
P3:1	Ground	Black	2.5mm Jack
P3:2	Expansion	White	–
P3:3	Computer Signal	Yellow	2.5mm Jack
P3:4	+5V	Red	2.5mm Jack
P4:1	Battery +	Red	Battery
P4:2	Battery -	Black	Battery
P5:1-5	*FACTORY USE*		

Initial Checkout

The Basic Bench Test

Each system is tested before shipping but we recommend that you hook things up on your workbench, play with the system and get comfortable with the components before installation.

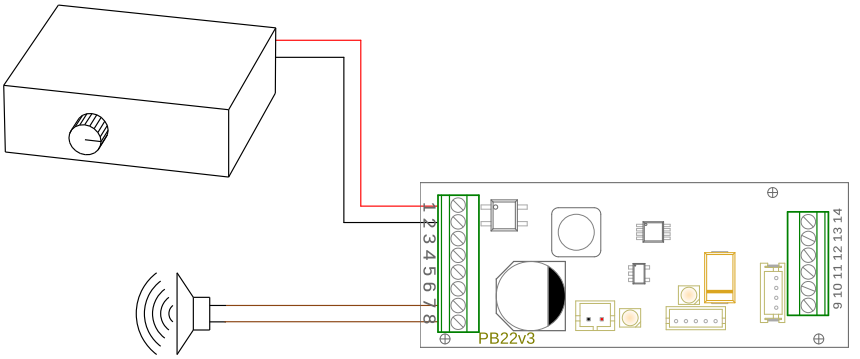
The power supply connects to Terminals 1 & 2. A power source of any polarity is acceptable. The maximum peak input voltage is 30 volts. If you are using a volume switch plug it into Terminals 3,4 & 5. The speaker connects to Terminals 7 & 8.

Until the battery is charged, you will not get sound until the external power supply reaches near 6 Volts. Also, since the board runs off the battery below 6 Volts, you will not get idle sounds and you will not be able to adjust the starting voltage until the battery is charged.

Battery charging occurs above 6 Volts (30 minutes will bring the battery up enough for normal operation). With a charged battery, the sound system should play the idle sounds for approximately 30 seconds after turning off the power supply and then shut down.

Diesels will rev up and down as you adjust the supply voltage. A steam engine system on the other hand will sit in idle (Coal Shoveling and Air Compressor play periodically) until it sees motion contacts connecting terminal 11 to ground. Each closure produces a Chuff. At first Chuff, the directional toots play and the bell starts ringing.

Steam can be configured to run off of voltage and diesel can be changed to look for wheel rotation. We initially set them up the way most modelers will use them.



Trigger Checkout

Reed Switch Speed Checkout

In order for steam to leave the idle state you will need a reed switch connected to terminals 13 & 14; you may wish to hook one up and experiment with the magnets to get an idea of the sensitivity of reed switches. This will help you decide how to mount them in the locomotive or car. Whenever the trigger (13) is connected to the trigger ground (14) the system sees motion. The first closure should play the start toots and the starting bell.

Other Trigger Checkout

If you will be using reed switches and track magnets or other triggers, such as non-DCC remote control receiver outputs or Hall Effect devices, to trigger sounds you may wish to test them out before final installation. For reed switches, hook one lead to ground and the other to the desired trigger; sweep a magnet by the switch to trigger. If you are using RC outputs, connect them as per the appropriate wiring diagram and test their response for range and reliability. The chart below shows the default trigger terminal assignments.

Default Trigger Assignments

Terminal	Diesel	Steam
9	Chatter	Chatter [*Articulated: 2nd Chuff*]
10	Detector	Blow down
11	Bell	Bell
12	Crossing Horn	Crossing Whistle
13	Unassigned	Chuff, main
14	Trigger Ground	Trigger Ground

Sounds and Effects

The following section describes the standard sound system configuration. Most sounds play automatically based on train speed, many can also be set to play from user assignable trigger inputs.

The PB22 board has five trigger inputs. The following section describes sounds which may be assigned to triggers or DCC functions. Default sounds can be changed for triggers and DCC functions with the Computer Interface. See the tables on pages 6 and 12 for factory default trigger and DCC Function assignments.

All Systems

Whistle/Horn: Toots when starting (2 forward, 3 reverse) and stopping (one toot). Crossing whistle sequence plays when you reach the Whistle/Horn play speed. You must slow down to at least 75% of the play speed in order to have it play again when you speed back up.

Bell: Plays when you first start moving and just before stopping. You must reach twice the bell stopping speed in order to replay the bell when stopping. The bell will not replay unless 30 seconds have elapsed since the last time it played.

Coupler Clank: Plays when you come to a stop in reverse; will not replay until you go forward and back up again.

Brake Screech: Plays just before stopping.

Tunnel Fade: This trigger causes the volume to fade down to a lower setting. When the input is triggered again, the volume will come back to the pre-fade setting.

Doppler: In diesel, when you trigger this input, the next time the crossing horn plays it will go thorough the pitch shift that you hear as a train is speeding toward and then away from you. Doppler is speed sensitive. In steam, triggering this effect will cause the pitch of the chuff to shift as the engine approaches and a second triggering will cause the pitch to shift back to normal.

Working/Drifting: An effect that makes the locomotive sound like it is struggling with a heavy train or coasting into a station.

Diesel Systems

Air Pop: Plays periodically during idle. Also plays while moving in SFX.
Brake Release: Plays as the engine starts moving.
Compressor: Plays periodically during idle.
Dynamic Brake: A triggered only sound. It is the sound which results from using diesel drive motors as generators.
Rev Up/Down: Causes the prime mover sound to go to the next/previous rev. The sound will return to the corresponding rev based upon speed changes.
Radio Defect (Hotbox) Detector: Plays a detector radio announcement randomly selected from a list. Can be triggered or set to play

Steam Systems

Blow Down: A longer and heavier steam release that clears out the ashes/clinkers.
Steam Release: Plays after you come to a stop.
Generator: Basically runs all the time but the engineer will shut it down if the engine sits in idle for awhile. Comes back on when voltage approaches the start voltage.
Air-Pump: Plays in idle to maintain air pressure.
Air-Pump 2: A sustained compressor run that restores depleted air pressure.
Rod clank: Plays at slow speed.
Hiss: Plays at low speed, clears the cylinders of condensation from the steam.
Coal Shoveling: Plays periodically while engine sits at idle.
Injector: Forces water into the boiler. Plays periodically while engine sits at idle.
Water Fill: In programmed mode the sound plays 10 seconds after trigger if the loco is stopped; in manual mode the sound plays when triggered.
Coal Loading: In programmed mode the sound plays 10 seconds after trigger if the loco is stopped; in manual mode the sound plays when triggered.
Mallet Mode: Plays a second set of chuffs, moving in and out of phase with the main chuff.
Second Chuff Trigger: Plays a second set of chuffs independent of the main chuff trigger.

Adjusting Settings Without a PC

All of the following adjustments can be more easily made using the Phoenix Computer Interface. You can still do a great deal of configuration without the Computer Interface. The functions that can be configured without the interface are summarized in the table below:

	Input (Terminal)	**Open** (Not Connected)	**Grounded** (Connected to Terminal 14)
10	Bell/Horn(Whistle)	Programmed	Manual
11	Input Sense	Active Low	Active High
12	Chuff (Steam) Slave Mode (Diesel)	Normal Off (normal)	Double (Mallet) On
13	Train Speed by	Voltage	Trigger

To ground terminals connect a wire between the terminal you want to ground and terminal 14.

Configuration Overview

To configure the PB22 without using the computer interface insert a “shorting plug” into the access jack before powering up the system. This will connect the computer data line (yellow) to ground (black). Any 2.5mm MONO plug will function as a “shorting plug”. Pick the configuration options you want by connecting the appropriate terminals (10-13) to terminal 14 (ground). When power is applied the PB22 will sense the short in the access jack and will adjust configuration to match the state of terminals 10-13.

Configuration Notes

For Locolinc® — You need to invert the sense of the triggers. (Whistle will be “on” except when you hold the button if you don’t do this). Follow the Manual Signaling example but in step 2 connect terminal 10 & 11 to ground.

For Double Heading — When you don’t want any signaling from the second diesel locomotive enable slave mode; for steam locomotives set the whistle and bell to manual and *do not connect the whistle and bell triggers.*

Option Selection Example: Steam Speed from Voltage

1. Connect together terminals P4:1 and P4:3. This can be easily done by inserting a 2.5mm MONO plug (“shorting plug”) into the access jack.
2. Remove ALL wires from terminals 9-13. This will select all the options in the “Open” (No Connections) column.
3. Apply power to terminals 1 and 2. The board will make sound at a constant low volume.
4. Turn power off and remove any option selection jumpers. Hook up your normal wiring.

ALL OPTION SELECTION JUMPERS MUST BE INSTALLED BEFORE YOU APPLY POWER.

THIS WILL NOT ONLY SELECT TRAIN SPEED BY VOLTAGE, BUT WILL ALSO SELECT ALL THE OTHER OPTIONS IN THE “OPEN” (NO CONNECTIONS) COLUMN WHICH ARE THE DEFAULT OPTIONS.

Option Selection Example: Manual Signaling

The normal setup is for programmed signaling. This automatically gives you the start and stop toots and a crossing whistle at a high speed. If you want to do your own signaling because you have a remote control horn button, you need to switch the horn/whistle to manual mode. In this mode, the whistle blows as long as the button is held down. This is how you would configure for manual signals:

1. Connect together terminals P4:1 and P4:3. This can be easily done by inserting a 2.5mm MONO plug (“shorting plug”) into the access jack.
2. Select the options – In this case (for Manual Signaling) connect terminal 10 to 14 (ground).
3. Apply power to terminals 1 and 2. The board will make sound at a constant low volume.
4. Turn power off and remove any option selection jumpers. Hook up your normal wiring.

EACH TIME YOU DO THE PROCEDURE YOU GET A COMPLETE SET OF OPTION SELECTIONS DEPENDING ON WHICH OF TERMINALS 10-13 ARE GROUNDED OR NOT.

Start Voltage Adjustment

In most cases you will not need to adjust the start voltage, which is the voltage at which the train begins to move and the sound changes from idle to running. In trigger mode there are some sounds that play based upon the starting voltage, even though voltage does not determine speed. To adjust the starting voltage you will need to enter configuration mode.

1. Make sure sound system is off.
2. Connect together terminals P4:1 and P4:3 (yellow and black wires). This is easily done by inserting a 2.5mm MONO plug (“shorting plug”) into the access jack.
3. Select the options you wish (see chart on page 9, refer to previous Option Selection Examples if necessary).
4. Apply power to terminals 1 & 2. The board will make sound at a preset low volume. You are now in configuration mode for Starting Voltage.
5. The volume switch adjusts the starting voltage. For each second you hold the switch, the starting voltage will adjust 1 volt in the direction of the switch. Volume Up increases the start voltage while volume down decreases.
6. Test your locomotive with the new settings before shutting it down. The starting voltage can adjust until the system shuts down.
7. When you are satisfied with the settings let the system run for at least 20 seconds before powering down. The system will not save the changes until they have been stable for 20 seconds.

If you set the Starting Voltage too near zero, the system will never idle and will not shut down until the battery is depleted. If the system is not shutting off, slightly increase the starting voltage. If the battery is removed or drained while in the never shut down condition, it is very difficult to recover without the computer interface.

Upon power up, your starting voltage should be as adjusted and the volume switch will be back in normal control the sound volume.

Rate Adjustment

The Rate is the relationship between voltage and train speed. To adjust the Rate follow the above EXCEPT remove the shorting plug after power up. The volume switch now adjusts the Rate, allowing you to match the operating characteristics of the engine.

DCC

DCC Checkout

The sound board default address is 3. Connect the sound board to your DCC source. Select address 3 on your DCC controller. Turn the speed up and down, sounds should play in coordination with the changing speed commands. The default function assignments are listed in the chart below.

DCC Function Defaults

Address: 3

Function	Diesel	Steam
F1	Bell	Bell
F2	Manual Horn	Manual Whistle
F3	Coupler Clank	Coupler Clank
F4	Crossing Horn	Crossing Whistle
F5	Detector	Coal Loading
F6	Rev Up	Water Fill
F7	Volume Up	Volume Up
F8	Volume Down	Volume Down
F9	Rev Down	Blow Down
F10	Station Announcement	Station Announcement
F11	Chatter	Chatter
F12	Shutdown	Shutdown

Control Variables (DCC CV)

The PB22 firmware supports the following Control Variables. These can be programmed on the program track (service mode) or on the main (ops mode – see note below).

OPS mode ("Programming on the Main") is not recommended for address change commands.

CV	Description	Default Value
1	Short Address	3
17	Long Address	0
18	Long Address	3
49	0 = Speed from Triggers; ≠ 0, speed from DCC	0 (Steam); 1
50	The DCC Value where motion starts.	2
51	The DCC Rate (Speed vs. Throttle)	100
52	Seconds to simulate DCC if DCC signal is lost. 0 = Forever	0
53	Seconds in idle before shutdown. 0 = Never shutdown	0

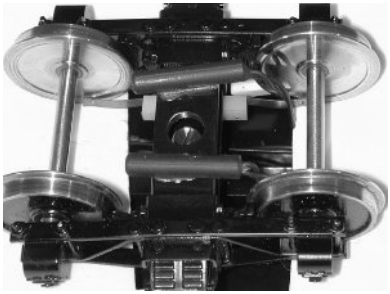
Installation Guidelines

Speaker – Use the largest speaker that can reasonably fit your available space. For best acoustics, the speaker should be sealed to the floor to isolate the front and back of the speaker cone.

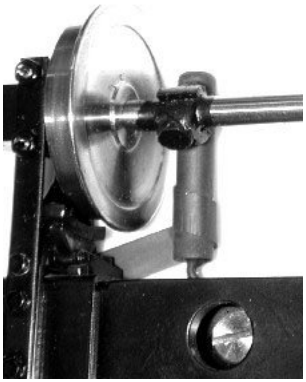
Volume Switch and Access Jack – Unobtrusive but accessible. Typically in the floor of tenders and boxcars and on the fuel tanks of diesels. Many models have movable pieces, doors, etc. where these can be hidden from view.

Mounting the Sound Board – Make sure that the sound board will not touch anything metal. We provide foam tape in our kits; many modelers prefer hook and loop tape. The sound board may get warm enough to soften hot melt glue, we do not recommend it; nor any permanent or conductive adhesive

Reed Switches – If you use track magnets and reed switches to trigger sounds and effects, keep the reed switches away from the speaker magnet and the strong motor magnets. Reed switches should ride about ¼'' above rail head and be spaced ½'' on either side of center. Reed switches may be mounted with adhesive, double sided tape or any other non-magnetic method.



Speed Sensor – You may need to experiment to get reliable triggering from a rotating axle with magnets on it. After mounting the magnets on the axle, hold the reed switch in various positions and hook something to the reed so you can tell when the switch is closed. An ohm meter with a beeper works great. You can point the reed switch directly at the axle/magnets but there will be less motion tolerance. With the magnets sweeping the side of the reed switch as shown a clearance of about 3/16'' is usually right. If you are too close you may get extra closures—one as the magnet approaches, and one as it leaves.



Mounting Hole Sizes – ¼" hole for volume switch and reed switches; 9/32" for access jack. Speaker depends upon type and location.

Troubleshooting

Wrong directional toots – Swap wires between Terminals 1 & 2 or change the track polarity using the Computer Interface.

No Sound – Start by rechecking the wiring to the speaker, volume switch, and power connector. Measure the voltage applied to the power connector when the board is on. Try raising the volume, it may have been lowered unintentionally. Check the volume switch for damage, broken connections or switch terminals touching metal.

Low Volume – If the volume is lower than your chosen setting the board may not be receiving full power at Terminals 1 & 2.

Erratic Chuffing – The axle magnets may not be mounted symmetrically. If the reed switch is not mounted to the truck, it may not align with the magnet on curves. The wires coming from the reed switch might be broken or loose. Engines with built-in mechanical contacts (Bachmann Spectrum) may require cleaning or oiling. Contact problems are the normal cause for chuffing too fast.

Whistle too frequent – The whistle plays based upon the speed reaching the whistle play speed threshold. If the train slows down in curves or at grades this may cause additional whistle triggering. Running at a slightly higher or slower speed may help. If a reed switch is used, triggering may occur due to unexpected magnetic fields such as those from the speaker; ensure the reed switch is not mounted too close to the speaker.

LED Indicators

The PB22 is equipped with two dual LED indicators for status displays for the power and battery charging systems.

LED 1 – Battery Charging

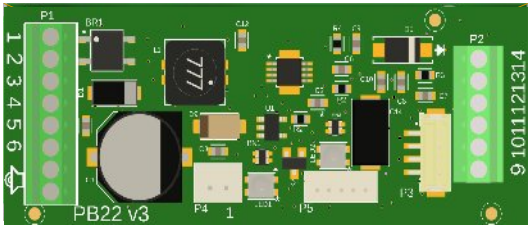
	No Power	No Battery; Not Charging; Battery Qualification	Preconditioning; Charging	Charge Complete
Green	OFF	ON	ON	OFF
Red	OFF	ON	OFF	ON

LED 2 – Internal Power Supplies

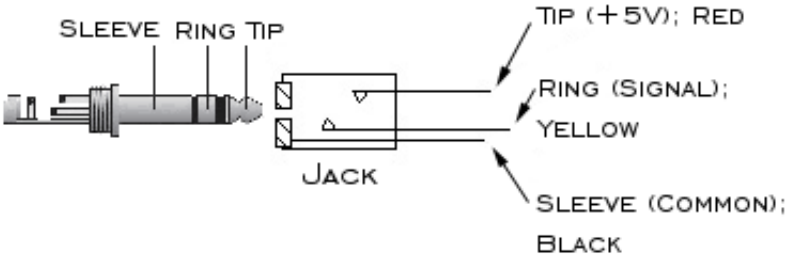
	Green	Red
ON	+5V power good	+3.3V power good
OFF	No +5V	No +3.3V

Technical Specifications

Length – 2.36 in; 60 mm
Width – 0.98 in; 25 mm
Height – 0.5 in; 12.7 mm
Maximum Track Volts – 30V.
Max Battery Input Volts – 6V.
Power Consumption – Varies with volume; can go as high as 1000mA if at max volume; typical is less than 100mA at medium volume.
Amplifier – 3 Watts maximum.
Speaker Load – 4 Ohms or greater; two 8 Ohm speakers in parallel is fine.



Access Jack Diagram

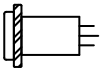


The plug is a standard 2.5mm stereo (TRS) plug. The supplied jack is fully insulated from the mounting hole. Other 2.5mm jacks may be substituted – but make sure that there is no ground path between the common to any of the power inputs (Terminal 1, 2 or Battery +).

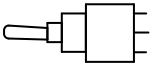
Appendix A: Wiring Diagrams

Common Symbol Key

Diode

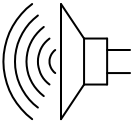


Programming Jack



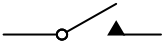
Volume Switch

Reed Switch



Speaker

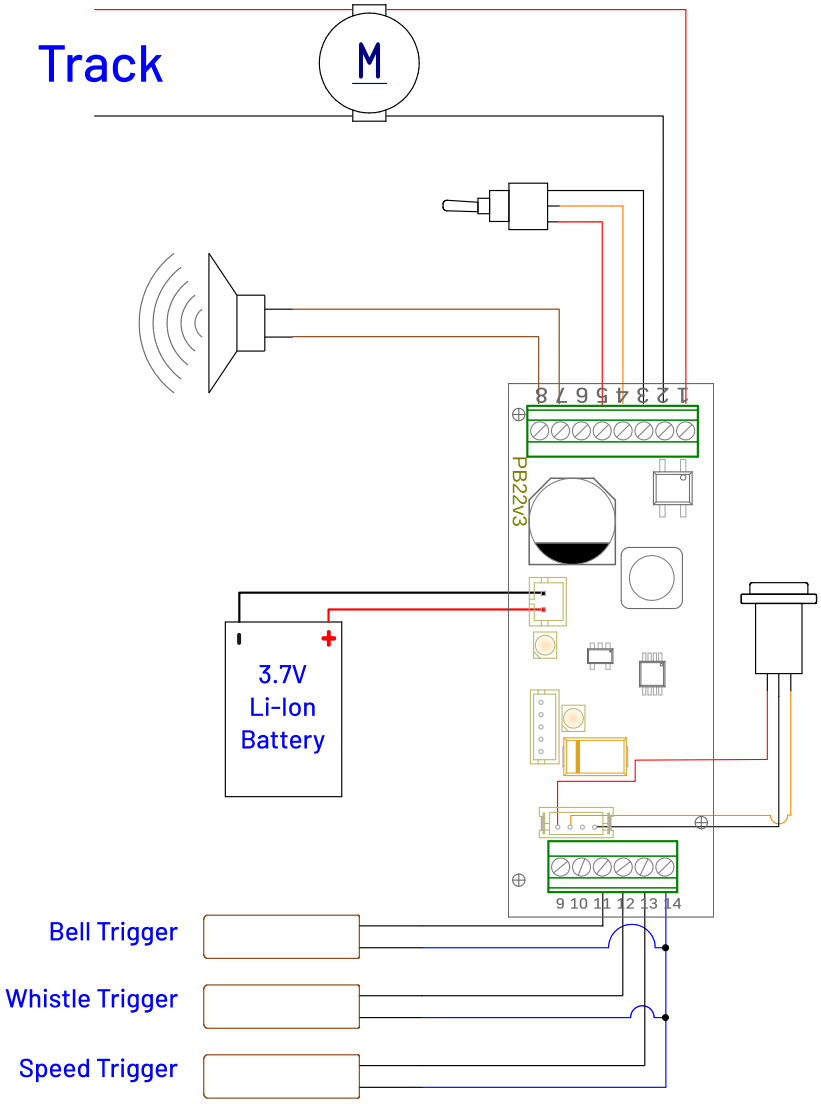
Motor



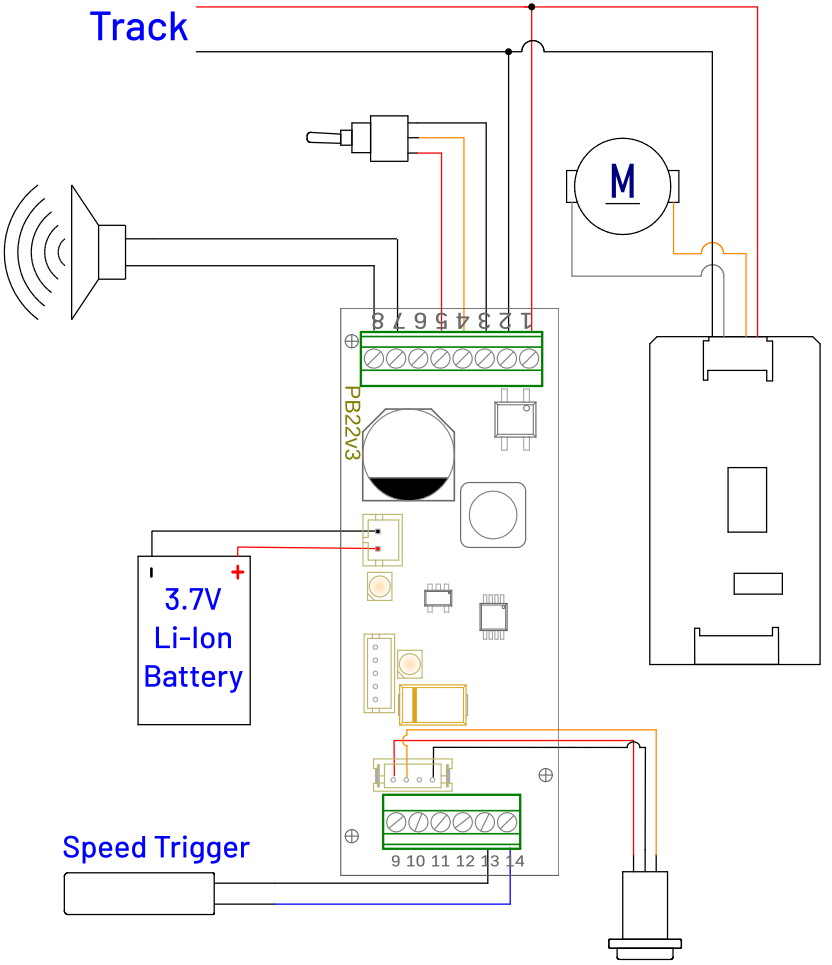
Toggle Switch

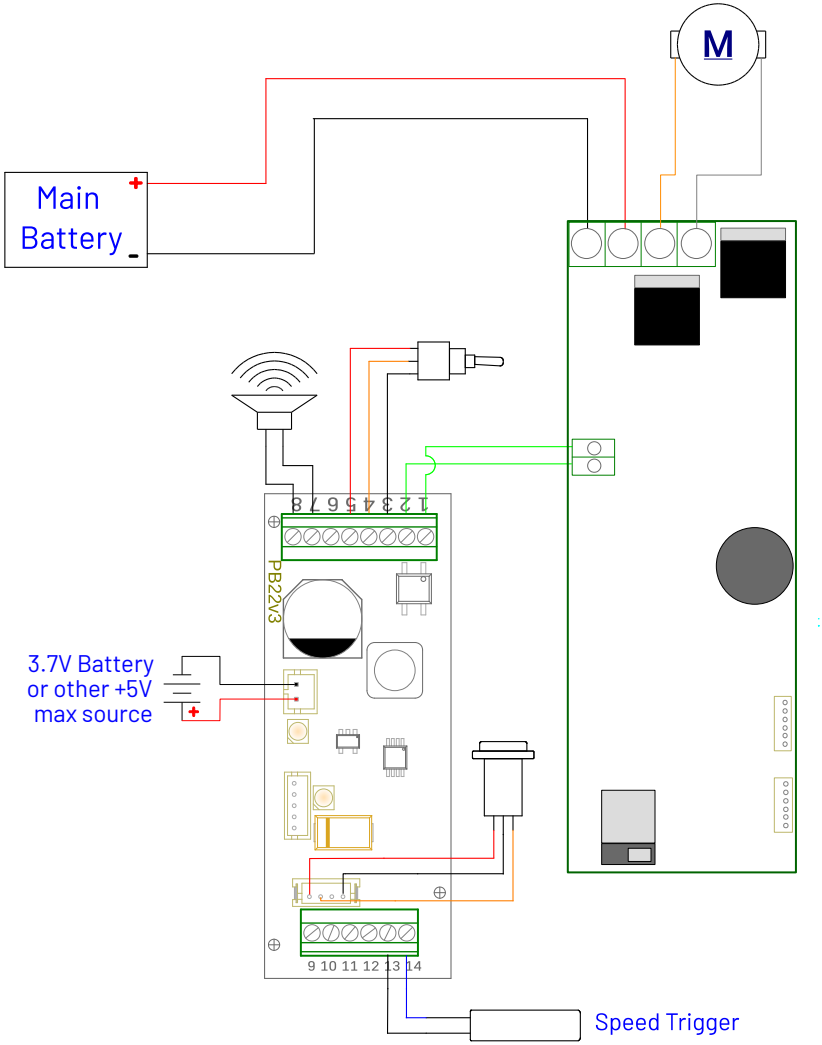
Momentary Switch

Typical DC

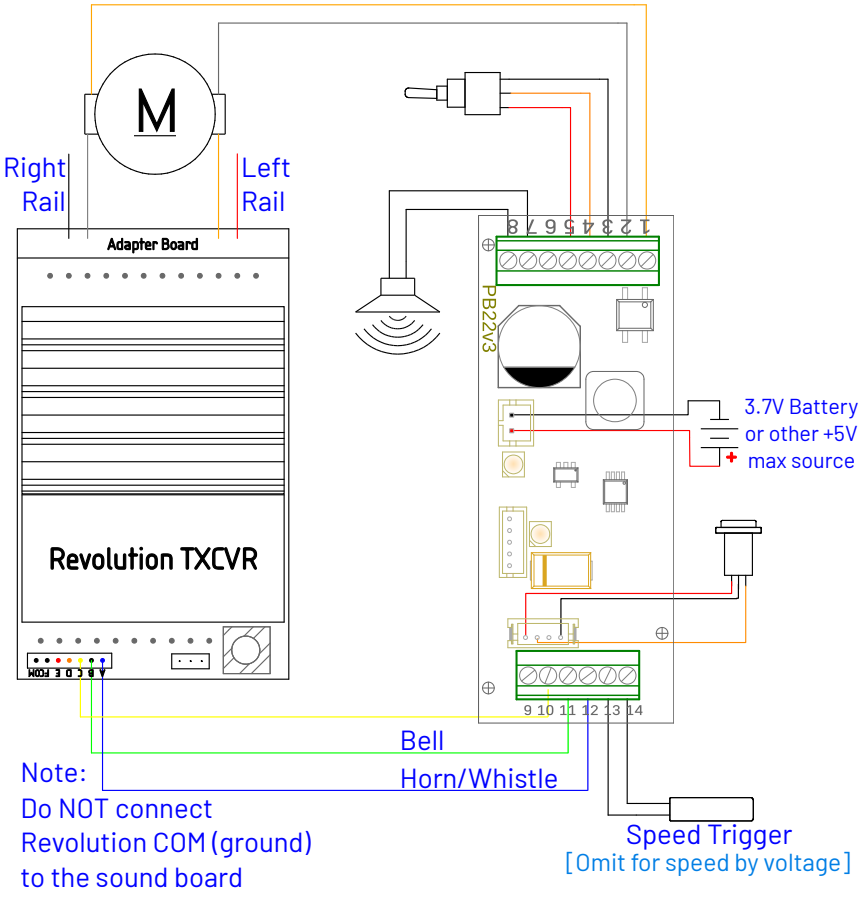

Track
M
1 2 3 4 5 6 7 8
PB22V3
3.7V
Li-Ion
Battery
9 10 11 12 13 14
Bell Trigger
Whistle Trigger
Speed Trigger

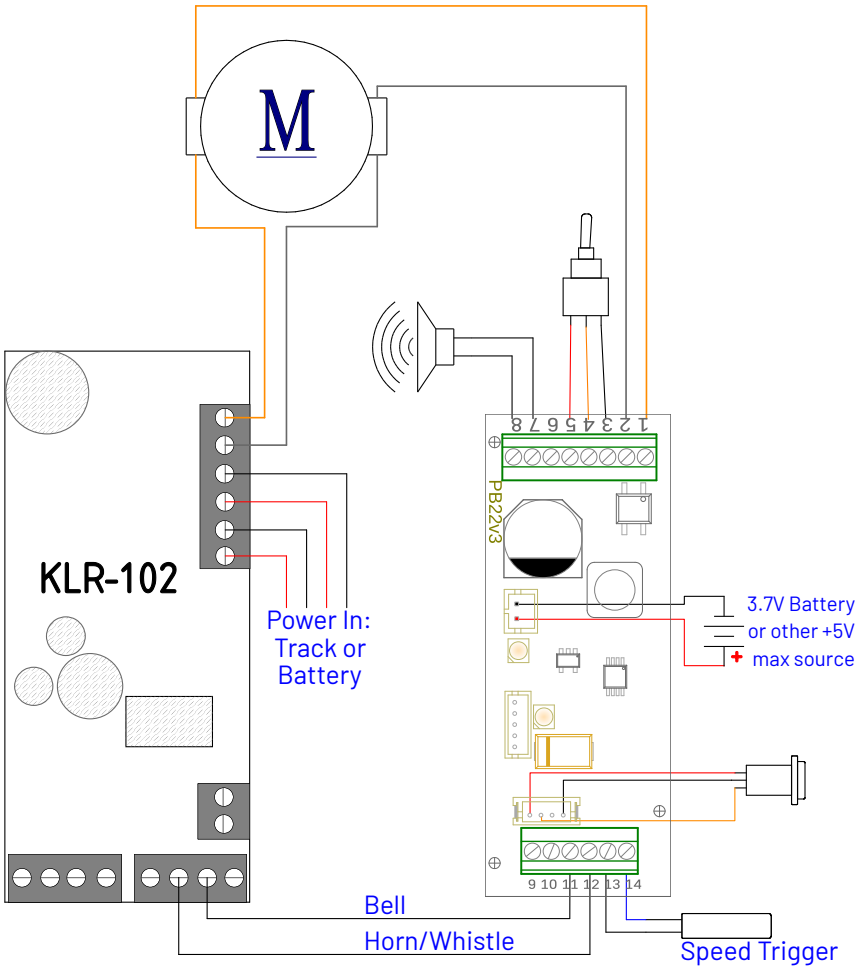
Typical DCC

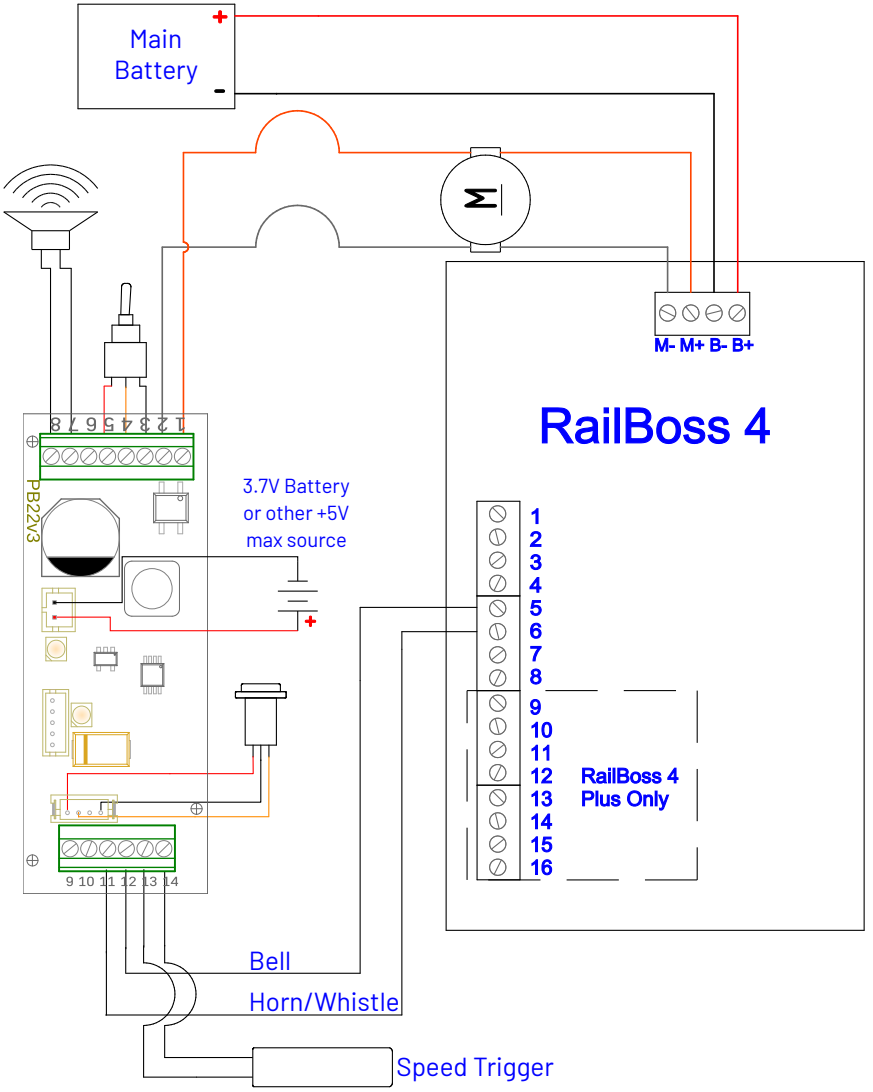

Track
M
PB22v3
1 2 3 4 5 6 7 8
3.7V
Li-Ion
Battery
+
Speed Trigger
9 10 11 12 13 14


M
Main
Battery
+
-
1 2 3 4 5 6 7 8
PB22V3
3.7V Battery
or other +5V
max source
+
9 10 11 12 13 14
Speed Trigger

Crest Train Engineer Revolution

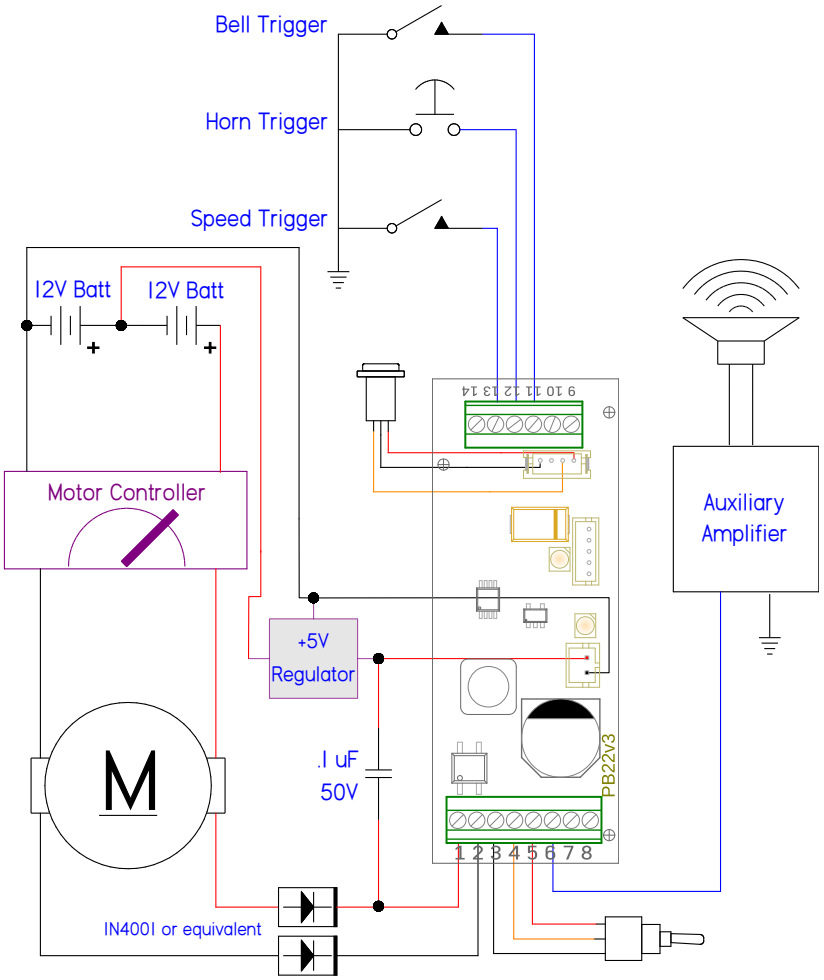



M
KLR-102
Power In:
Track or
Battery
PB22v3
1 2 3 4 5 6 7 8
9 10 11 12 13 14
3.7V Battery
or other +5V
max source
Bell
Horn/Whistle
Speed Trigger


Main
Battery
+
-
M
M- M+ B- B+
RailBoss 4
1 2 3 4 5 6 7 8
PB22V3
3.7V Battery
or other +5V
max source
+
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
RailBoss 4
Plus Only
9 10 11 12 13 14
Bell
Horn/Whistle
Speed Trigger

Basic Ride On

For additional Ride On wiring options please see the Ride On Installation Guide



Note 1: "OPTIONAL" 0.1 uF cap will start the board when battery is turned on.

Note 2: If not hooking to an electric motor move the battery wires to Terminals 1 & 2, omit diodes and cap.

Appendix B: The Computer Interface

The Computer Interface is an optional accessory that enables complete customization of all sounds.

The Computer Interface consists of a CD and USB Interface for use with Windows 2000 through Windows 11. The CD contains software to customize sounds from the Phoenix Sound library. Connecting the USB interface to the board through the access jack allows you to download sounds for different engines and change the following:

- Individual sound volumes
- Manual vs. Programmed response for bells and whistles (horns)
- Assign sounds to terminals and DCC functions
- Adjust how often a sound plays
- Change shutdown time
- Change and modify chuff rhythm, compression and tone
- Configure and fine tune for various control systems such as: AC, DC, DCC, MTS, Locolinc®, Train Engineer Revolution, RailBoss and Air Wire 900
- plus many other features you will discover as you familiarize yourself with the system

All adjustments, upgrades and sound loading can be made through the Access Jack. You will not need to take the model apart after installation is complete.

Please note: the software will run on any PC with Windows 95 or newer. It is the USB interface hardware which requires a minimum of Windows 2000. If you are using the older Phoenix Serial Cable Interface you can continue to use the updated software with your existing serial cable; Newer PCs may require the use of a USB to Serial adapter with the serial cable.

Warranty

The BigSound™ PB22 electronic board is manufactured to the highest standards using the latest assembly technology and quality, conservatively rated parts. We are dedicated to producing the world's finest sound system for years of railroading enjoyment.

The materials and operation of the BigSound™ electronic board and associated system kit components supplied by Phoenix are guaranteed to perform correctly for one year when installed and operated according to the instruction manual. In the unlikely event that your BigSound™ system fails, please call or e-mail us so that we may evaluate the situation and save any unnecessary shipping. We prefer to pre-evaluate returns, frequently there is a simple explanation for any perceived problem you may be experiencing. Repairs and or replacements covered by this warranty are at no cost. However return shipping may be charged, especially if you return your system in an engine, tender, box car or the like. A service fee may be assessed if it is determined that the failure was not due to any Phoenix supplied components.

Phoenix Sound Systems, Inc. cannot be liable for damage to the system during shipping to our facilities due to mishandling, inadequate packaging or similar circumstances beyond our control. Please be sure to package the BigSound™ in a secure, static safe manner.

Please read the handbook and any included installation notes prior to installation and operation of your BigSound™ system. Contact us if you have questions or are unsure about any aspect of installation or operation.

Damage resulting from power being applied to terminals 7 & 8 (Speaker Out) is EXPLICITLY NOT COVERED under warranty.

Physical modification of the sound board in any fashion voids this warranty. Physical modifications include but are not limited to:

- Drilling of holes in the printed circuit board for any purpose. Drilling of the circuit board may cause damage to internal layers which would not be visible to the naked eye. Custom holes could also enable the inner layers of the board to short circuit through direct contact or contact with a screw inserted into the hole.
- Removal, replacement or modification of any connectors or individual component pieces.