RailPro Analog Kit with MPM and Speaker (RAKS-1)

User Manual

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www.RingEngineering.com   **Revision 1.04**

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Introduction

This kit includes all the necessary electronics to add sound, motor, and light control to your G scale locomotive and will allow control with analog (DC) power supply. It also has magnet pickup so you can place magnets in your track for the purpose of playing a sound or turning on a light effect when the train goes over the magnets. Further you can Radio Control a locomotive with this kit installed if you obtain a RailPro Handheld Controller or use the RailPro Computer Interface and the HC Simulator Software.

Please read all warnings and instructions before installation and use. For the latest information including the latest revision of this manual please visit our Internet site at *www.RingEngineering.com*. It is important that you check for the latest revision of this Instruction Manual on the Internet. Go to RailPro, Products, then RAKS-1.

Warnings

⚠️ **WARNING:** Only use power supplies that have been tested by Ring Engineering to power your RailPro equipped locomotive. Below is a link to a list of powers supplies tested by Ring Engineering.

⚠️ **WARNING:** Maximum Operating Voltage is 28 Volts. Absolute Maximum Voltage 30.0V.

⚠️ **WARNING:** If this module is wired incorrectly, or the maximum allowed voltage is exceeded, it is possible that enough heat can be generated to ignite flammable material, which could possibly cause a fire. The use of improper resistors for LEDs or low voltage lights is one possible source of this danger.

⚠️ **WARNING:** You can be burnt by the locomotive module heatsink if you touch it. You should not touch the module until the power has been removed for at least 30 minutes to allow it to cool to a temperature that would be safe to handle.

⚠️ **WARNING:** Do not open or remove the enclosure.

⚠️ **WARNING:** The power supply used to power your LM-4S-G must have short circuit protection and the short circuit protection should not exceed 12 amps.

⚠️ **WARNING:** Temperature: Operating 32F to 90F, Storage 0F - 110F

⚠️ **WARNING:** Operate and store in dry environment only.
Relative Humidity: Operating 20% to 90% non-condensing, Storage 10% to 95% non-condensing

⚠️ **WARNING:** This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

⚠️ **WARNING:** This product contains small parts and is not recommended for persons under fourteen (14) years of age.

⚠️ **WARNING:** Magnets included with this product can cause bodily injury or property damage if handled incorrectly. Magnets can have strong attraction which can be a pinch hazard. Keep away from people wearing electronic medical implants or other medical devices, items that are sensitive to magnet fields such as credit or debit cards, hard drives, magnetic tape, CRT TVs, monitors, etc.

IMPORTANT: This user manual only covers the use of LM-4S-G with an analog controller. Please see LM-4S-G user manual for applications like Radio Controlled, Battery powered, DCC controlled etc.

Below is a link to a list of power supplies that Ring Engineering has tested with RailPro locomotive modules.
https://www.ringengineering.com/PowerSuppliesTestedWithRailProLocomtiveModules.htm

Specifications
Maximum Power Input Voltage: 28 Volts (Absolute Maximum Voltage 30.0V)
Maximum Motor Stall Current: 8 Amps
Maximum Output Current on any Single Light Output: 500mA.
Maximum Output Current on all Light Outputs Combined: 500mA.
Audio Output Power: 13 Watts into a 4 ohm load. 7.4 Watts into an 8 ohm load.

Installation

⚠️ When done correctly, we are confident that RailPro can be installed in most G scale locomotives and it will perform as expected. However, installing a RailPro module in your locomotive is done at your own risk. Ring Engineering will not be responsible for any incidental or consequential damages to your equipment or property.

We will describe two different types of installations as far as wiring is concerned.

Installation #1 is a simpler installation that only adds sounds and motor control. With this install you can operate the locomotive with analog or radio control but the lights will not be connected to the RailPro locomotive module so radio control will only operate sounds and motor.

Installation #2 is a full install that will allow both analog control of motor and sounds, and radio control of motor, sounds, and lights!

To start you mount the Locomotive Module and the MPM Module.

Mount the LM-4S-G in your Locomotive

IMPORTANT: Module must be mounted level with the RailPro logo pointing straight up in order for it to have proper heat dissipation. You need to be sure there is 1/8 inch of space on the sides of module and a 1/2 inch of space above the module for proper cooling. The LM-4S-G module can be attached to the locomotive with double face tape attached to the bottom of the LM-4S-G module.
TIP: If the auto set for the Motor Full Load current auto sets to less than 1500mA you can mount the module in any orientation.
TIP: Mounting the module higher in the locomotive and away from metal parts may extend its radio range.

Mount the MPM Module

The MPM should be located low on the locomotive so it is close to the track where the magnets are to be located. The MPM module can be mounted horizontally or vertically. A good location is inside the locomotive fuel tank if it will fit in the fuel tank. The MPM should be no more than about 3/8 of an inch above the rail head for it to dependably pick up the magnets in the track.

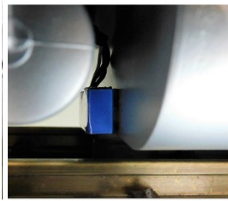MPM module is self adhesive. Remove the red protector and stick it in place.

Possible MPM Module Mounting Locations

Sample MPM Module Mounting Locations

Horizontal Mount Inside Fuel Tank

Vertical Mount Inside Fuel Tank

Vertical Mount Outside Fuel Tank

IMPORTANT: The MPM module must be centered between the left and right side of the locomotive. The MPM should not be off by more than about a 1/16 of an inch from left to right of the center of the locomotive.

IMPORTANT: The MPM module should be mounted as far away as possible from a speaker or other magnets. Speakers have magnets and if the MPM is too close to a speaker magnet, or any other magnet, the MPM may not trigger.

IMPORTANT: The MPM is not water proof and should not get wet.

TIP: If the MPM is not mounted inside the locomotive, and has any chance of getting wet, you can apply silicon sealant to the connector side and opposite side of the MPM connector to add significant water resistance to it.

TIP: The MPM Module can be located in other places beside in the fuel tank or near the fuel tank. For example, a MPM may be placed under a coupler box.

IMPORTANT: Be sure the bottom of the MPM Module is above the rail head. If it is not above the rail head, it will hit the track on the first turnout it encounters or can hit the rail head on curved sections of track because of the overhang when going through curved sections of track.

Installation #1 - Add Analog and Radio Control of Sounds and Motor (Simpler Wiring)

Typical Wiring Diagram for Sounds and Motor Control
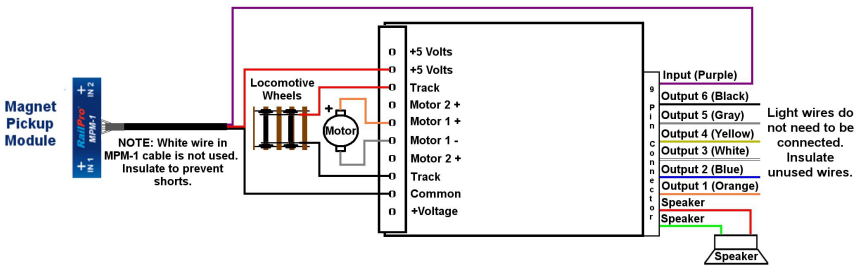
IMPORTANT: The below installation steps are basically for most USA Trains locomotives. You likely can do similar steps to add Sound and Motor Control to other manufacturers locomotives.

Step 1 – Connect the two Track Power Wires to the Locomotive Module

In most USA Trains, there is red and black wires in the the fuel tank (label sound on USA circuit board). Connect then to the locomotive module Track Inputs.
IMPORTANT: Check continuity of the two wires you are going to connect to the locomotive Track Input connectors and verify they are connected to the locomotive left and right track pickups (locomotive left and right wheels) and nothing else.
IMPORTANT: Be sure the track pickup wires are not connected to the motor wires.

CAUTION: If you connect the track pickup or motor wires incorrectly, you will likely damage the locomotive module. Damage from wiring errors is not covered by the warranty.

Step 2 – Connect the Motor Wires to the Locomotive Module
The 4 motor leads need taken loose from the USA Trains circuit board and connected to the LM-4S-G Motor Outputs.

Step 3 – Plug in the MPM Module with supplied Wiring Harness

NOTE: The 6 pin MPM connector and 9 pin locomotive module connector are keyed and cannot be plugged in upside down.

Step 4 – Connect Speaker Wires and Finish Up
To complete installation please skip to the section " Connect Speaker and Finish Up"

Installation #2 - Add Analog and Radio Control of Sounds, Motor and Lights (More Complex Wiring than Installation #1)

Step 1 – Remove Unneeded Circuit Boards
You can remove any circuit board(s) from your locomotive leaving only the motor(s), lights, and speaker(s). The LM-4S-G has all the electronics necessary to run your locomotive motor(s), lights, speaker(s) and no other circuit boards are necessary. Locomotives may have light boards that have only the lights and dropping resistors on them. In most cases it is wise to keep such light boards with dropping resistors in place.

⚠ Some manufacturers have a special circuit board for the smoke unit and that circuit board needs to be kept in the locomotive and properly connected. Connecting a LM-4S-G output directly to a smoke unit that needs a circuit board to protect the smoke unit from burning out, can damage the smoke unit and may become a fire hazard.

Step 2 - Connect the Wiring

Plug the MPM supplied cable into the MPM module and connect the rest of the wires as shown.

Typical Wiring Diagram for MPM
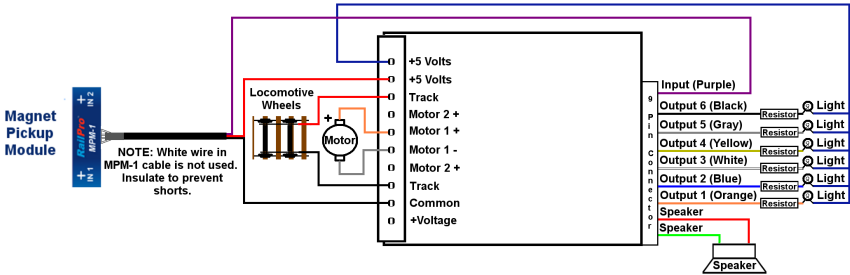
WARNING: Using LED's without resistors can damage the LED's!
Use 200 Ohm 1/4W for 10mA or 100 Ohm 1/4W for 20mA.
The above resistor values are only correct for a White LED (3 Volt)
that is powered by the +5 volt supply.
WARNING: If you use the wrong resistor, it is possible to generate
enough heat to ignite flammable material, and possibly cause a fire.

NOTE: The MPM connector is keyed and cannot be plugged in upside down.

IMPORTANT: If you already have a RailPro wiring harness in the locomotive, you need to remove the old wiring harness and use the included wiring harness.

IMPORTANT: At minimum you must connect the following for analog control. You must connect the motor wires, the two track pickup wires, the two speaker wires, and the MPM wires (Plug in MPM module and connect +5V and Com wires).

TIP: It is recommended to connect the front and back lights to the LM-4S-G module because LM-4S-G controls them with fade on and off light effects which is more prototypical than being controlled from analog voltage.

TIP: It is best to connect all the lights if the locomotive may be Radio Controlled. A RailPro Radio Controller can use all the lights.

Step 3 – Connect Motor(s)

IMPORTANT: Only attach wires to the screw terminals that are between 18 and 26 AWG.
IMPORTANT: You should solder the ends of any stranded wires to prevent a strand from getting into an adjacent screw terminal which would cause a short.

Step 4 – Connect the Lights

IMPORTANT: If your light bulbs are LEDs or low voltage bulbs you will need to

be sure to add the dropping resistors as shown in the wiring diagram for low voltage lights.

 WARNING: If your lights need resistors and you do not include them, you can damage your lights.

IMPORTANT: It is best to connect any lights to the five volt source. Many G scale locomotives have light boards that are designed for five volts. Ask your locomotive manufacturer what voltage is required for their lights.

TIP: You do not need the resistors if your lights are five volt lights.

TIP: You can remove any unused wires from the nine pin connector by lifting the keeper on the connector and sliding the wire out of the connector. It is wise to keep the wires and if you need them later you can slide the wires back into the connector.

Step 5 – Connect the Track Pickup Wires

⚠️ The voltage of the power source must be less than your locomotive motor rating.

To complete installation please see the section below "Connect Speaker and Finish Up"

Connect Speaker and Finish up

Connect Speaker(s)

⚠️ An 8 ohm speaker that is rated for less than 7 watts or a 4 ohm speaker that is rated for less than 13 watts may be damaged by the LM-4S-G and could become a fire hazard.

IMPORTANT: The speaker should be installed in an enclosure for proper sound. Any air leaks can cause a loss in sound quality.

Finishing Up Installation - Double Check Your Wiring
Be sure all the wires are connected to the proper terminals and there are no short circuits.

⚠️ If this module is wired incorrectly it can cause a fire and can be damaged. An improperly wired module is not covered under the warranty.

IMPORTANT: Check carefully between the screw terminals to be sure all strands of stranded wires are in the correct terminal and no stray strands are accidentally in the adjacent screw terminal. That will cause a short circuit and can damage the module.

Place the Magnets in the Track

Place the supplied magnets in the track as shown below. The magnet should be up against the rail and in between the track ties. The magnets can be held in place by using adhesives like epoxy or hot glue. Magnet adhesives are not included.
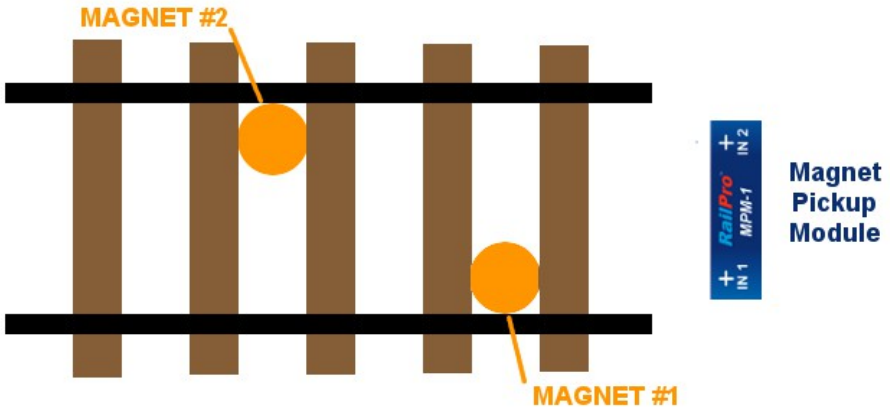
IMPORTANT: The top of the magnets should be between 1/8 to 1/4 inch above the top of the ties and must be below the rail head height.

IMPORTANT: You should test and verify that the magnets properly trigger the MPM in all your locomotives before using adhesive to attach them to the track. You may use strong tape to hold them in place while testing. After the position and height is good, then you can use adhesive to hold them in place more permanently.

WARNING: Please keep in mind that a speaker in the bottom of the loco can pull with significant strength. If the magnets are not held in location well enough, they can come loose and stick to the bottom of your locomotive which may cause a derailment.

TIP: It is best to place magnets in straight sections of track and with several inches of space to the nearest curve. It is best to avoid placing magnets on curved sections of track. A locomotive on a curved section of track will overhang and the MPM may not be close to the center of the track. Placing magnets on a curved section of track can make it more difficult to place the magnets such that they dependably trigger the MPM.

The LM-4S-G in this kit is programmed to have the MPM enabled and input #1 is set to play the Bell and Input #2 is set to play a crossing sound. You can use the Computer Interface Module (Model #CI-1) to change the MPM #1 and #2 inputs to play whatever sound or turn on whatever light effect you want.

IMPORTANT: You can use your RailPro locomotive at this point with out programming the LM-4S-G but it is recommended that you get a Computer

Interface Module (Model #CI-1) and set the Motor Full Load Current before using the LM-4S-G. The default setting for Motor Full Load is a maximum value and setting it properly can provide more protection for your locomotive motors. Please see the section 'Programming the Locomotive Module' for details on how to set the Motor Full Load Current.

Operation Instructions

Basic Operation (Startup, Forward, Reverse, and Stopping)
Set the Speed (voltage) on your analog controller to zero.

Place the locomotive with LM-4S-G module installed on your track.

Slowly increase the speed (voltage) on your analog controller until you hear the engine startup sound play. When you hear it, stop increasing the speed (voltage) and wait until the start sound stops playing.

Increase the Speed (voltage) to begin motion.

Decrease the Speed (voltage) until the locomotive stops moving. When the locomotive stops moving, stop decreasing the Speed (voltage). With some voltage applied (about 10 volts) the engine sounds will continue playing and lights and sounds can remain on while the locomotive is not moving.

Flip the reverse switch then increase the speed (voltage) to change directions.

Changing the Sound Volume
Set the Speed (voltage) on your analog controller so the engine sounds are playing but the locomotive is not moving.

Flip the reverse switch five times at a fairly fast rate (about half a second per direction change). On the fifth direction change, you will hear the bell sound start playing. It will start at a low volume then slowly get louder. When the volume is at the level you want, flip the reverse switch one more time to set the sound volume to the current sound volume.

IMPORTANT: Radio Control supersedes analog operation. To use analog control, Radio Control must be turned off or at least not actively controlling the locomotive.

Analog Operation Features

- When you start forward you will hear two long horn blasts and the bell will play for several seconds.

- When you start in reverse direction you will hear three short horn blasts and the bell will play for several seconds.

- While the power is applied the locomotive will make auxiliary sounds like air compressor and let-off sounds.

- If you change directions and begin movement quickly, the horn is not played. This is to allow switching operations without the horn constantly going off.

- If you flip the reverse switch while the locomotive is running at speed, the locomotive will slow down, change directions, and speed back up. It will not hammer the drive train like a normal analog controlled locomotive when the reverse switch is flipped.

IMPORTANT: Analog operation does not work well with analog controllers that do not have a reverse switch separate from the speed control. On controllers that do not have a separate reverse switch, you typically turn the knob clock wise to go forward and counter clock wise to go reverse. Since the single knob controllers force you to go to zero speed (zero volts) before changing direction, the sounds stop and restart when you change directions which is not prototypical.

Radio Controlling your Locomotive

This is truly an outstanding feature of having a RailPro module in your locomotive for analog sounds. You can very easily Radio Control your locomotive! Simply obtain a RailPro Handheld Controller, power up the locomotive, and Press the 'Find Product' button on the Handheld Controller! A locomotive picture will load from your locomotive to the Handheld Controller. Then you just touch the picture of the locomotive you want to operate! All you need to do is turn your analog

power supply most of the way up (do not exceed LM-4S-G maximum voltage rating) and use the Handheld Controller to run your trains! So simple and so enjoyable!!! You can easily operate several locomotives from one Handheld Controller! You can set each locomotive to run at different speeds and even run in different directions! Changing control from one locomotive to another locomotive is accomplished by simply touching the picture of the locomotive you want to control!

Programming the Locomotive Module

You can use the Ring Engineering Computer Interface Module (CI-1) and Ring Engineering PC Software to change the sounds and other settings.

The CI-1 is a USB dongle that adds RailPro Radio Communication to a PC.

Sounds such as the bell, horn, primemover etc, can be changed.
Settings like acceleration, deceleration, and much more can be changed too!

There is no need to remove the shell of the locomotive or the need for a programming cable because the changes are made by radio control!

Step 1 – Power up the Module

Step 2 – Press 'Find Product' on your RailPro Controller

Step 3 – Enter the Locomotive Road Number

From the "Control Locomotive" page you can press the "Adjust Setups" button (round button on the left side of the screen) to view the "Locomotive Setup" page. As with most RailPro products you can give this product a name and a password from this screen.

TIP: Notice the name we gave the locomotive on the page above is 9523 UP. Although you can name your locomotive anything, it is wise to give them good names. You should put the road number first and any letters after the numbers so they sort correctly when using the select locomotive from list option.
TIP: You can leave the password field blank if you do not need password protection. A password can prevent other RailPro controllers from controlling your products.

Step 4 – Set the Motor Full Load Current

This is the only setting you should set before using your RailPro equipped locomotive. By setting the motor full load current, you setup the locomotive module to: 1) Allow multiple locomotives to run well when linked together with Radio Control and 2) Allow the module to detect and report motor faults if necessary.

1. On your RailPro controller's Main Page press the "Locomotives" button. Touch the picture of the locomotive to take control of the locomotive.
2. Press the "Adjustments" button (round button on the left side of the screen). Then press "Next Page" button until you see the "Motor Full Load Current" button. Then press the "Motor Full Load Current" Button then press the "Yes" button when it asks to "Use auto set?"
3. Press the "Start Test" button and wait until the test finishes.
4. Press "Exit Page" button and press the "Save" button.

⚠️ During the test your locomotive will run at full speed and a G locomotive can pull with a lot of force so be prepared to hold on tight.

⚠️ During the test your locomotive may run at full speed backward. So be prepared for it to go in either direction. If your locomotive runs backward, go into the adjustments and change the motor direction and run the test again.

⚠️ If the 'Motor Full Load Current' sets to above 1500mA, the module must be oriented level with the RailPro logo on the module label pointing straight up, and the specified space around the module must be maintained to promote proper heat dissipation. See Installation instructions Step 3 for mounting details.

IMPORTANT: If you are using battery power, you need to be sure the battery is always at the same voltage (same amount of charge) before setting the Motor Full Load Current. You can check your battery voltage on the handheld controller locomotive information page.   You should run the battery down to the same voltage before setting the Motor Full Load Current. Recommended battery voltage before setting Motor Full Load Current is 12.7 volts for 4 series LiPo and 16.0 volts for 5 series LiPo.

Step 5 - Setup the MPM in the Locomotive Setup

If you want the MPM to turn on sounds or light effects other than the default settings you may want to change the MPM setup. You can make MPM track magnet pickup IN #1 or In # 2 activate any User Defined Button on the Control Locomotive Page. Since you can setup the User Defined Buttons to play any sounds or turn on any light effects, you can setup the locomotive module to play any sound or turn on any light effect you want when MPM In #1 or In #2 goes over a track magnet.

Go to the locomotive setup and then to the 'Loco Setup MPM' page and enable the MPM to see the page below.
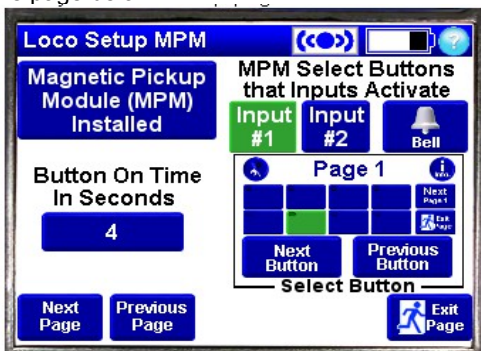
On the MPM Setup page you press either "Input #1" or "Input #2" button to select that input for setup. Then you use the Next and Previous buttons to select any one of the User Defined Buttons to activate when that input is triggered by a

magnet. The Button On Time in seconds changes how long the button will be active.

In the example above, Input #1 is selected for editing. The User Defined Bell button is selected to be activated when the magnet goes over Input #1 location on the MPM module. When Input #1 detects the magnet, the bell will be played for 4 seconds.

If you wanted the bell in the above example to play for 8 seconds, simply change the 'Button On time In Seconds' from 4 instead of 8.

Please see RailPro Handheld Controller user manual (such as HC-2 User Manual) for instructions to setup locomotive module User Defined Buttons. https://www.ringengineering.com/RailPro/Documents/HC-2UsersManual.pdf

TIP: You can select User Defined Buttons that are configured for sounds or light effects.

TIP: If you want to play a sound or activate a light effect that is not currently setup on a User Defined Button, then change a User Defined Button to the sound or light effect that you want then select that User Defined Button in the MPM setup page.

Step 6 – See User Manuals for Changing Sounds, Pictures, etc.

TIP: You can customize the locomotive module settings if you want to. You can load a picture of your locomotive, change sounds, light effects, change the User Defined Buttons, and much more. Please see the RailPro Assistant user manual (online only) www.ringengineering.com/RailProAssistantSoftware.htm and the RailPro Handheld Controller user manual for setup details. www.ringengineering.com/HC-2.htm

Below are links to our internet site with more information on the CI-1 and the HC Simulator and RailPro Assistant programs.

Computer Interface (Adds Direct Radio Communications to a PC)
https://www.ringengineering.com/CI-1.htm

HC Simulator (PC Program)
https://www.ringengineering.com/RailProHcSimulatorSoftware.htm

RailPro Assistant (PC Program)
https://www.ringengineering.com/RailProAssistantSoftware.htm

Warranty

Limited One Year Warranty

Ring Engineering, Inc. (Ring Engineering) warrants that for a period of one year from the date of purchase, this product will be free from defects in material and workmanship. Ring Engineering, at its option, will repair or replace this product or any component of the product found to be defective during the warranty period. Replacement will be made with new or remanufactured product or component. If the product is no longer available, replacement may be made with a similar product of equal or greater value. This is your exclusive warranty.

This warranty is valid for the original retail purchaser from the date of initial retail purchase and is not transferable. Ring Engineering dealers, distributors, or retail stores selling Ring Engineering products do not have the right to alter, modify, or any way change the terms and conditions of this warranty.

The warranty does not cover normal wear of parts or damage resulting from negligent misuse or modification of the product. Further, the warranty does not cover Acts of God, such as fire, flood, hurricanes, and tornadoes.

Ring Engineering shall not be liable for any incidental or consequential damages caused by the breach of any express or implied warranty or condition. Except to the extent prohibited by applicable law, any implied warranty of merchantability or fitness for a particular purpose is limited in duration to the duration of the above warranty. Ring Engineering disclaims all other warranties or conditions, express or implied statutory or otherwise. Some states or jurisdictions do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

> To obtain warranty service contact Ring Engineering at:
> Email: info@ringengineering.com
> or Phone (219) 322-0279
> to get a return authorization and return instructions.

If your Ring Engineering product is not covered by warranty, or has been damaged, an estimate of repair costs or replacement costs will be provided to you for approval prior to servicing or replacement.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.