Installation / Operation Manual

Linear Power Supply

Resonance Technology, Inc.

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Medical-Grade Linear Power Supply
for Innovative MRI-Compatible Virtual Entertainment System

Notice:

Table of Contents

1. Safety Information

At Resonance Technology, Inc., patient safety is our top priority. Please review this section completely as its contents are vital to the safety of the installer, the clinician/operator, and the patient.

1.1. Important Warnings for Installer, Operator, and Patient Safety

WARNING:

During the Linear Power Supply installation, care must be taken to ensure that the included base plate is secured to the MRI room floor. The base plate and Linear Power Supply must be located outside the 200-Gauss line for safety.

Please refer to the installation section of this manual for details.

1.2. Use Restrictions

Shelf-Life and System Maintenance Service Schedule

The Linear Power Supply carries a one year original manufacturer warranty included with the CinemaVision, Serene Sound, or VisuaStim System that this was included with, and a shelf life of two years from the date of installation. Optional extended warranty may be purchased for the system which will include this power supply.

Restrictions on Using Non-Resonance Technology, Inc. Components with the Linear Power Supply

The original manufacturer's warranty will be voided if any non-Resonance Technology, Inc. equipment is connected to this power supply. In addition, Resonance Technology, Inc. cannot be held responsible or liable for any unauthorized use of this equipment. If you have any questions about how to operate this product, please read this user manual or call Resonance Technology, Inc. customer service at (818) 882-1997 or email support@mrivideo.com.

1.3. MRI Environment Hazards

Installation of materials inside the MRI suite must be done with extreme caution and only by authorized personnel. Care must be taken to keep ferromagnetic materials such as tools, filter plates, screws, etc. at least three meters (approximately 10 feet) away from the energized magnet. Absolutely no work should be done near the filter panel when a scan is in progress.

NOTE: All cabling inside the MRI environment should either be connected or terminated properly. Failure to do so may result in skin burns related to RF energy. All cables should be run straight and never looped, as this may also cause serious skin burns inside the MRI room.

In addition, no persons with ferromagnetic prosthetic devices such as pacemakers or joint replacements should enter the MRI suite at any time. Extremely high magnetic forces have the potential to dislodge ferrous items at high velocities that can result in serious injury or death.

1 Safety Information

Only system components explicitly designated for use in the MRI suite should be placed inside the MRI suite. Components not designated for use inside the MRI suite may present a projectile hazard and can become airborne, causing property damage, serious bodily injury, or death. Please refer to the installation block diagram to determine which components belong inside the MRI suite.

Resonance Technology, Inc. will not be held liable for any injuries or property damage which may occur as the result of improper use or installation of this product. By agreeing to this notice, users certify that they are familiar with basic safety procedures in an MRI room environment and that they have read and understand these safety precautions.

For questions regarding installation procedures or this manual, Resonance Technology, Inc. technical support staff may be reached Monday through Friday 8 a.m. to 5 p.m., Pacific Standard Time at (818) 882-1997, or by email at support@mrivideo.com.

1.4. General Warnings for Electronic Products

Electric shock

Failure to observe all operating and maintenance instructions may cause damage to this product and may result in property damage and/or injury or death from electric shock, fire, or other cause.

Do not disassemble this product.

Only Resonance Technology, Inc. trained and authorized personnel should perform all required service for this product. Failure to comply with this warning may result in property damage, injury and/or death from electric shock, fire, or other cause.

Avoid exposing this product to extreme environments.

This product may be damaged by high temperatures, direct sunlight exposure, by dropping this product, or by other mechanical shock. Do not expose this product to rain or excessive moisture. Avoid these conditions as the video goggle lenses may become damaged and may result in eye fatigue to the patient.

Unplug this product when not in use for long periods of time.

Always unplug this product when not in use for extended periods of time or during MRI maintenance. Leave connected if used daily.

1.5. Labeling Used to Indicate Device Safety

Type BF Applied Part

Devices that have conductive contact with the patient or have applied parts that are fixed in medium or long term contact with the patient.

MR-Safe Device

Device considered **safe** for use anywhere inside the magnet room.

MR Conditionally-Safe Device

Device considered **safe** in the MR room **under certain conditions**.

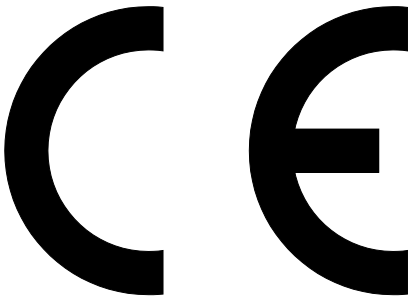
MR Unsafe Device

Device considered **unsafe** for use in the MR room. These items should not be taken inside the MR room due to being a projectile hazard in the magnetic field.

1 Safety Information

1.6. Medical Device Safety Approvals

The Linear Power Supply has the following safety certifications:



2. Installation Materials

Your system comes complete with all the necessary components to complete the system installation at your facility. The following checklists are provided for materials verification purposes.

2.1. Control Room Components

Part Number	Quantity	Description
RTC-LPS	1	Linear Power Supply Installation / Operation Manual (this manual)

2.2. Magnet Room Components

Part Number	Quantity	Description
RTC-650-300-000-001	1	MRI Medical Linear Power Supply
RTC-101-239-001-001	1	Transducer DC Power cable – 3 meters (~10')
RTC-101-306-003-000	1	Hospital Grade AC Power Cord (US/Canada) 110-120V
RTC-ALS-HGC		Hospital Grade AC Power Cord (Europe/Asia) 220-240V

2.3. Installation Items

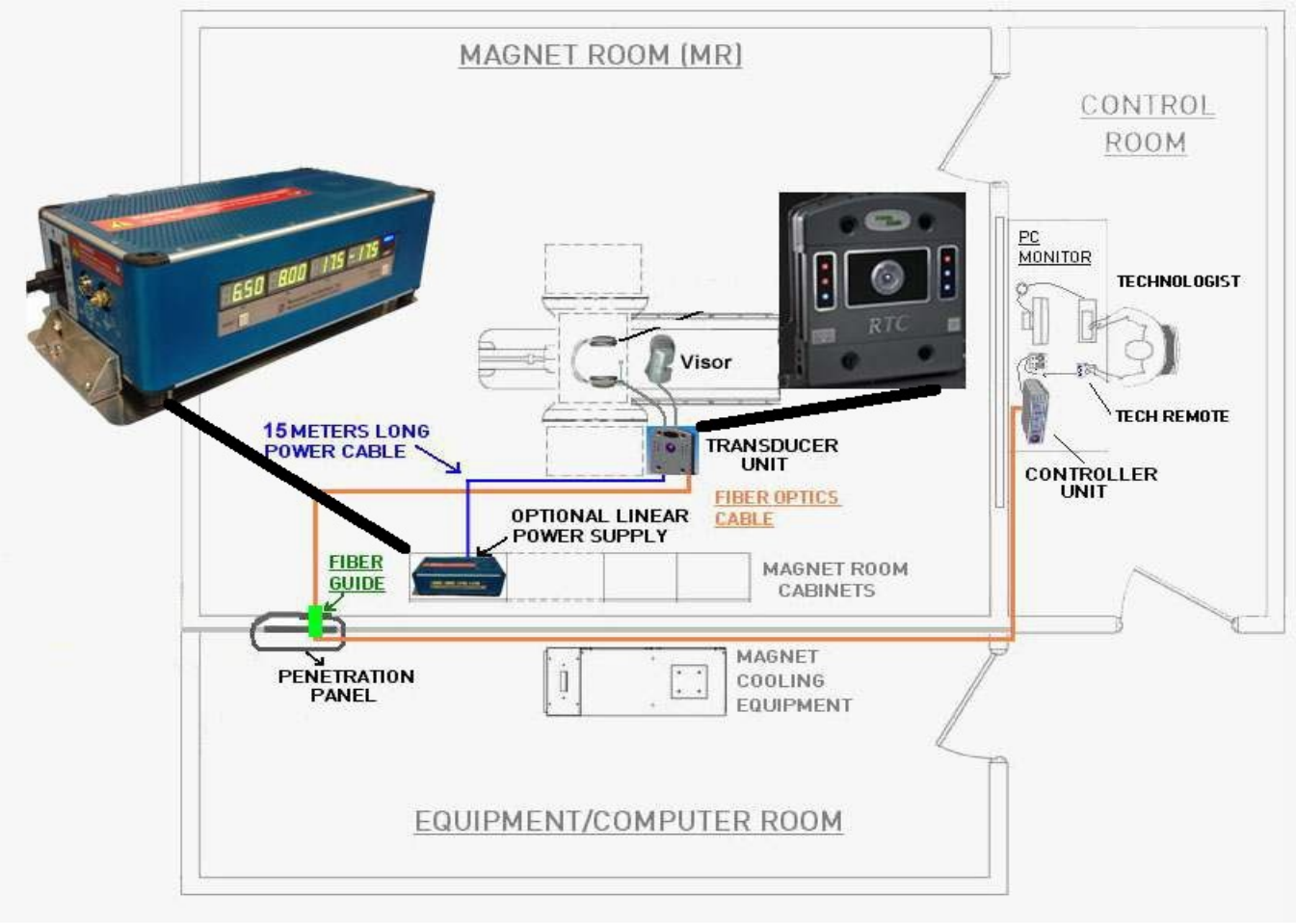
Part Number	Quantity	Description
RTV-108	1	High-performance Silicone Adhesive

3. Room Layout Overview for Installation

WARNING: Absolutely no ferromagnetic tools should be brought inside the MRI Suite!

While no tools, other than tie wraps, are required to install the power supply in the MRI suite, absolutely all ferromagnetic tools remain outside of, and away from the door leading to, the MRI suite.

Below is a typical MRI setup. Your individual installation may vary somewhat, but it will generally be spaced into three areas: Control Room, Computer/Equipment Room and MRI Suite or Magnet Room.



The Control Room setup consists of placement and connection of the Controller, Technologist Remote Control, and stimulus computer with video monitor (not included). The fiber optic cable is routed from your system's Controller in the Control Room through the filter panel waveguide in the Equipment room to your systems Transducer inside the Magnet Room. Inside the Magnet Room, the patient is fitted with your systems audio headset and video goggles. Linear Medical Power Supply can be securely installed inside the Magnet Room outside the 200-Gauss line.

(Video goggles only supported by VisuaStim and CinemaVision)

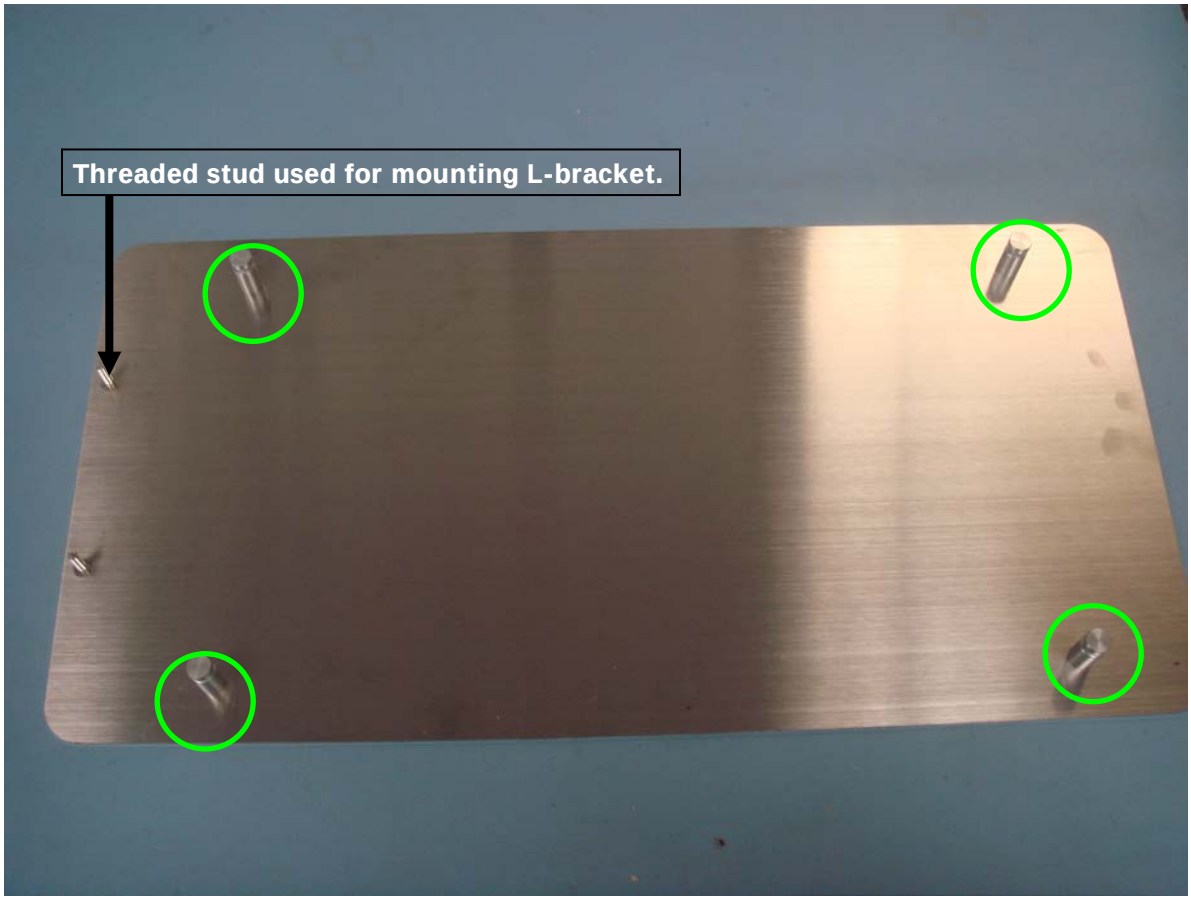
With the exception of the audio headset and visor goggles all the Magnet Room components of your system must be installed to the side of the magnet shroud and never in line with the bore. Additionally, these components should be placed in an area not heavily trafficked to keep them from being damaged.

4. Installation Procedure

WARNING: Always remember to keep the Linear Power Supply and base plate at a safe distance from the magnet, at least beyond the 200-Gauss line.

4.1. Attaching the Linear Power Supply to the Base Plate

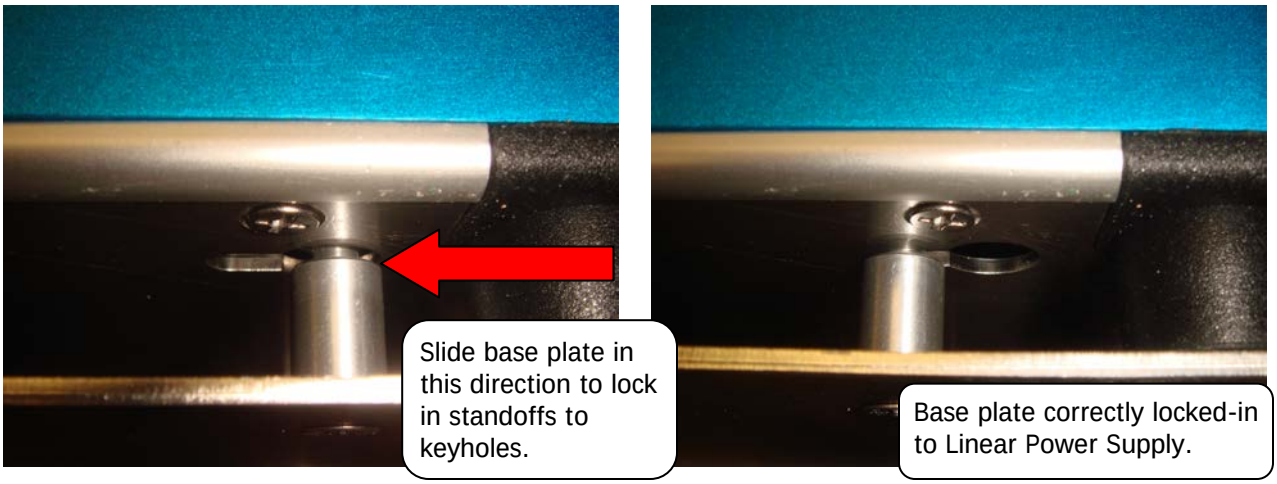
4.1.1. Take note of the stand-off locations and the threaded studs on the base plate as indicated below.



4.1.2. Insert standoffs of base plate into keyhole notches in power supply as shown below. Make sure all standoffs are fully inserted to their corresponding keyholes. Orient base plate in such a way that the threaded standoffs are facing power inlet connections.

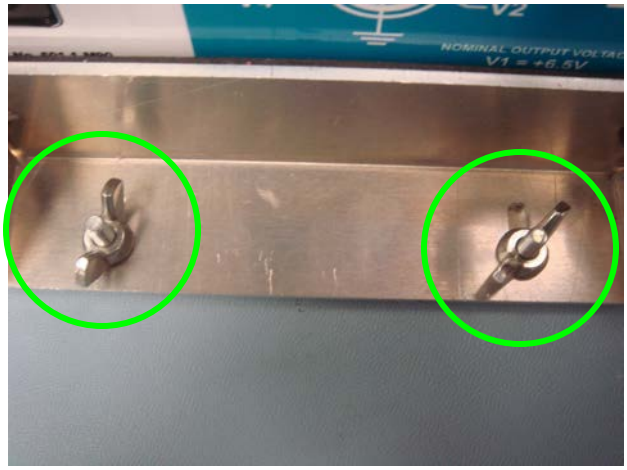
4.1.3. Slide the base plate forward so the standoffs lock into the keyholes.

4 Installation Procedure



4.1.4. Secure power supply to base plate by placing the L-bracket and pressing against power supply to secure in place.

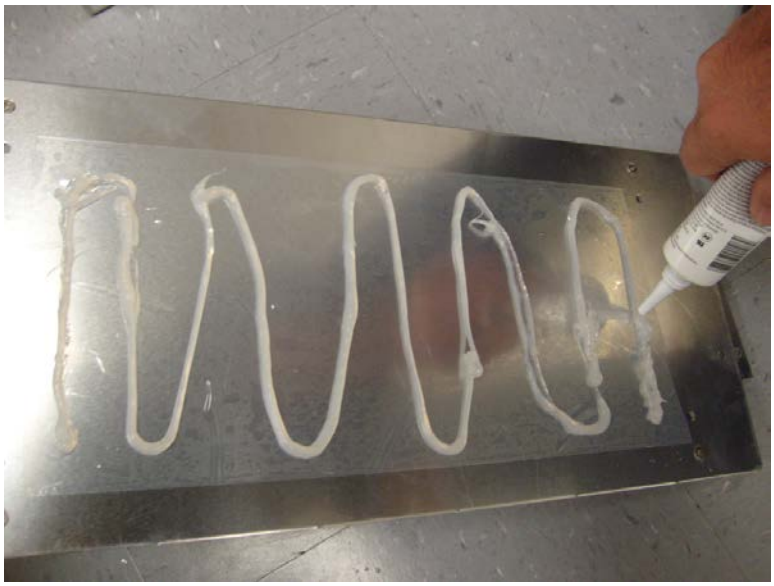
4.1.5. Hand-tighten the wing-nuts as shown.



4 Installation Procedure

4.2. Securing the Base Plate to the Magnet Room Floor

4.2.1. Spread a large amount of high-performance silicone adhesive (RTV-108) on bottom of the Linear Power Supply base plate.



4.2.2. Turn over the Linear Power Supply with attached base plate and set it in desired position on floor (beyond 200-Gauss line). Note that you need to apply slight pressure so that the adhesive spreads evenly and adheres firmly to the floor.

4.2.3. For best results, allow the silicone to cure at least 24 hours. Verify unit is making as much contact as possible to the floor.

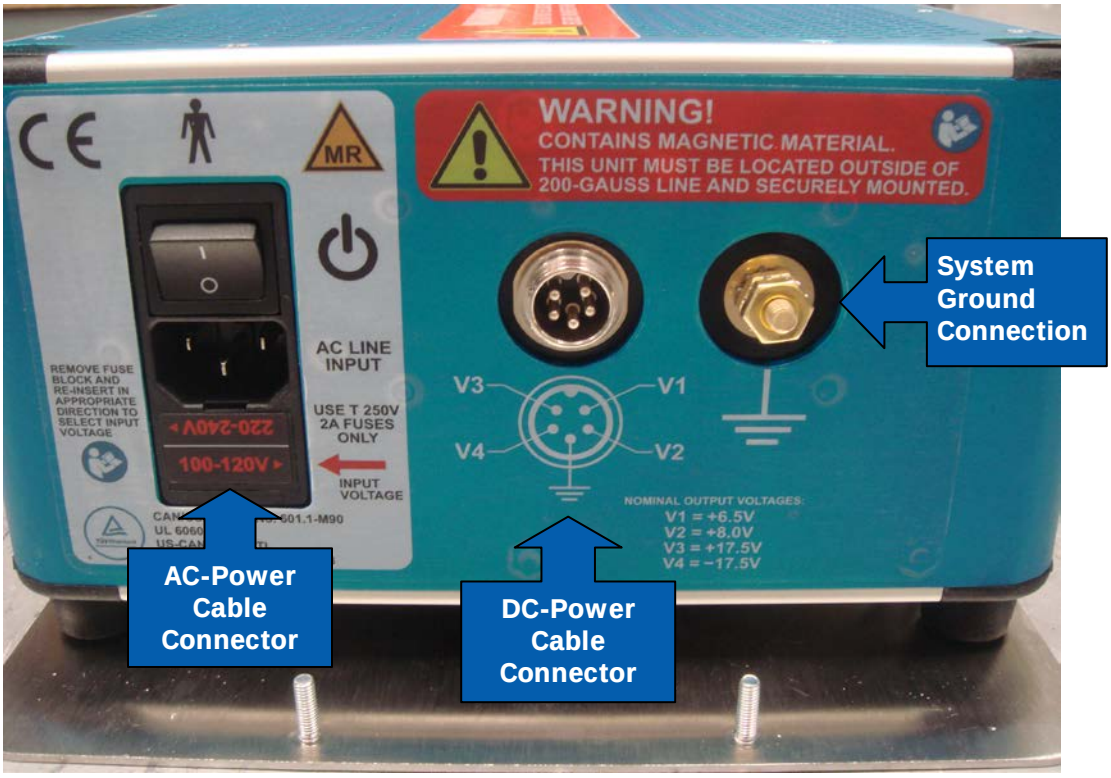
4 Installation Procedure

4.3. Connecting Power

4.3.1. Verify that the power switch on the Linear Power Supply is in the OFF position.

4.3.2. Verify that the input voltage setting is set to the correct value, either 115V or 220V. See Section 5 for instructions to change input voltage.

4.3.3. Connect the AC and DC power cables to the Linear Power Supply to the connectors indicated.



4.3.4. The Linear Power Supply comes with a system ground connection (as shown above) that may be connected to the facility and/or magnet ground.

4.3.5. Verify the AC-Power cable is fully inserted properly. Verify the DC-Power cable is fully inserted and the nut securing the connector on the Linear Power Supply is hand-tightened clockwise.

5. Operation

5.1. Start Up Procedure

5.1.1. When first powered ON, the front panel will display the word “Starting”, followed by device serial number and finally the voltage readings.

5.1.2. The Linear Power Supply provides a method to check voltages and electrical current for each voltage rail and internal temperature readings. Press the DISPLAY SELECT button to toggle between voltage, current, and temperature.

NOTE: For reference, nominal voltage outputs are indicated on the side label beneath the DC power connection. Nominal current readings will be dependent on the system being powered.

Voltage display.

Current display.

Temperature display.

5.1.3. After one minute, the display will turn off, but the power is still active. Press the DISPLAY SELECT button to re-activate the display.

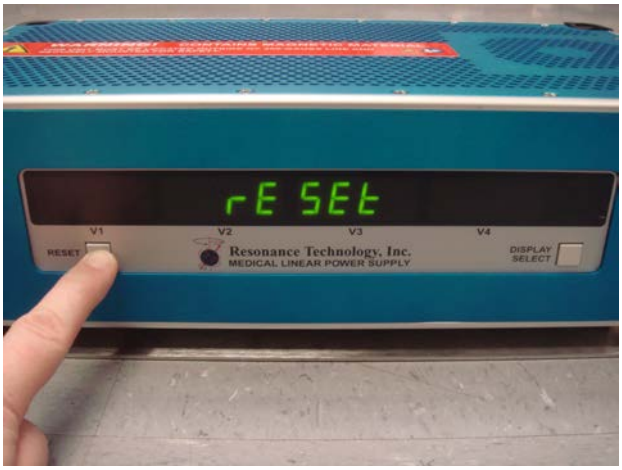
5.1.4. During normal usage, the top lid fan is designed to vary in speed to cool the components inside. When temperature increases inside the unit, the fan will compensate by increasing speed.

5 Operation

5.2. Overload and RESET

5.2.1. If an overload condition shuts down the power supply, a message is displayed in the front panel as shown below-left. The overload ("OL") indication will appear on the display of the voltage rail that is out of range (V1, V2, etc.). This may be an indication of a temporary condition imposed on the supply by the connected device. If this occurs, press and hold the RESET button until you see a reset message on the display as shown below-right. This will restart the power supply. If the overload recurs, please turn the power supply OFF and follow the Troubleshooting procedure in section 7 of this manual.

Overload indication.



Reset function.

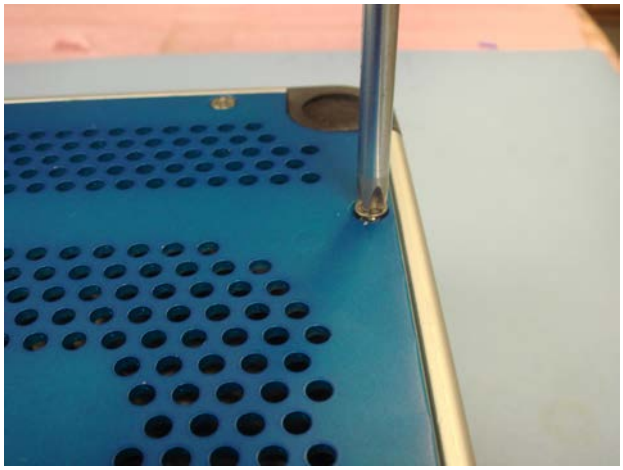
6. How to Replace the Power Supply Fuses

If there is a need to replace a blown fuse at the AC power supply inlet, perform the following steps for fuse replacement:

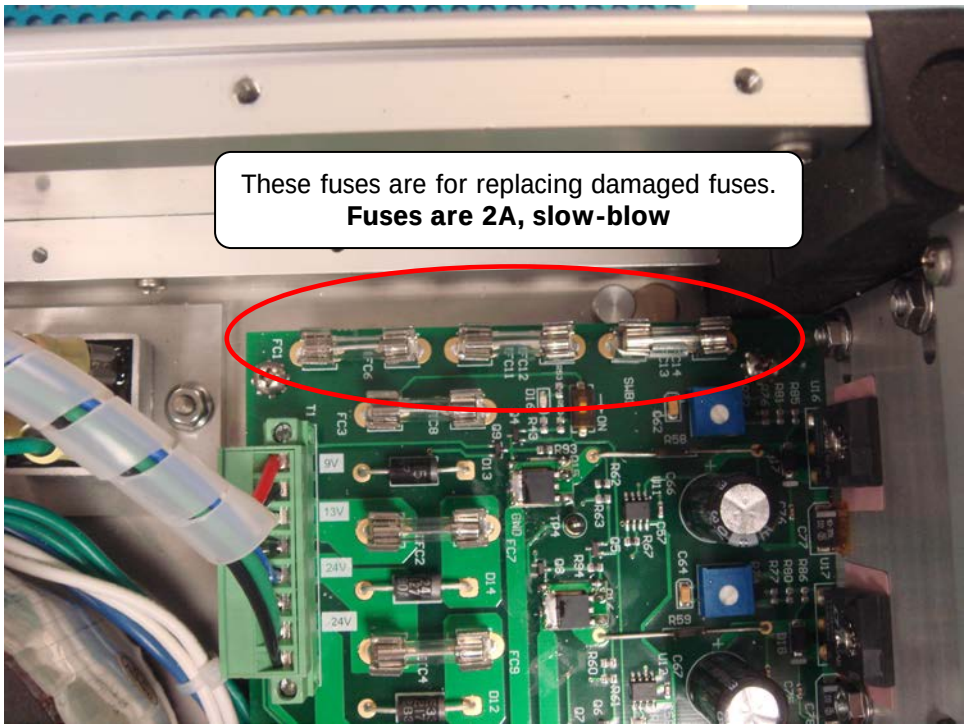
6.1. Turn off the AC power and disconnect the AC power cord from the Linear Power Supply AC power inlet.

6.2. Use a Phillips screwdriver to remove the top screws attaching the lid to the Linear Power Supply as shown below-left.

6.3. Set the lid on a safe surface, being careful not to damage the fan assembly cable as shown below-right.



6.4. The spare fuses are located on the upper-right-hand area on the inside of the Linear Power Supply board, with the power connectors facing to the left.



6.5. Use an available spare fuse by carefully pulling it from its holder.

6 How to Replace the Power Supply Fuses

6.6. Use a small flat-head screw driver to pry open the fuse tray.

6.7. Remove the blown fuse and replace it with the new spare fuse. **The fuse type must be 2A/250V, slow-blow.**

6.8. Put the fuse tray back in paying attention to the desired voltage 120/240 VAC. Make sure that the desired operating voltage is aligned with the label on the power supply. The text on the fuse tray which is right-side up is the effective voltage. The tray may be reversed to change the voltage.

WARNING: Using the wrong operating voltage may result in permanent damage to the Linear Power Supply.

6.9. Carefully replace the Linear Power Supply top lid and secure it with the Phillips screws which you had previously removed.

6.10. Reconnect the AC power cable into the AC power inlet.

6.11. Once again, verify voltage setting is set correctly.

6.12. Power ON the Linear Power Supply.

6.13. Power ON sequence as described in section 5.1..

7. Troubleshooting

7.1. Safety First

7.1.1. The following section requires a safety-first mentality. It is meant as a basic troubleshooting guide for diagnosis of common issues encountered while using this product. It is the responsibility of the personnel following this procedure to insure all safety precautions are appropriately addressed.

7.1.2. Do not proceed if you feel uncomfortable following these guidelines. Please contact Resonance Technology, Inc. for Technical Support and any questions you might have.

7.2. Troubleshooting

7.2.1. The list below addresses the most common problems encountered while using the Linear Power Supply:

- ***No power is delivered to the connected device***
  - Power OFF the Linear Power Supply and disconnect AC power cable and DC power cable.
  - Verify power outlet from your facility is working correctly.
  - Verify the fuse setting for input voltage in Linear Power Supply is compatible with the voltage output from your facility.
    - If voltage settings do not match, it is possible either a fuse is blown or you may need to change the input voltage configuration. Reference section 6.
  - Reconnect AC power cable only.
    - Does the unit power on correctly as specified in section 5, Operation?
      - If yes, continue with troubleshooting.
      - If no, contact Resonance Technology, Inc for Technical Support.
    - The voltages displayed are within specifications? (see section 8, Specifications).
      - If yes, continue with troubleshooting.
      - If no, contact Resonance Technology, Inc. for Technical Support.
  - Verify DC power cables by following the troubleshooting guidelines under "*Testing DC power cables*".
  - Power OFF the Linear Power Supply
    - Reconnect the DC power cable to Transducer in magnet room and power ON.
    - Does the problem reoccur?
      - If yes, the issue may lie on the connected device. Contact Resonance Technology, Inc. for further instructions.
      - If no, then the issue might be an intermittent problem or might've been fixed by cycling power on the devices and reassuring cables are correctly attached.
  - If problem arises again, contact Resonance Technology, Inc. for more information.
- ***"OL" is displayed on the front panel***
  - This indicates an Over Load condition. Power OFF the Linear Power Supply.
  - Disconnect DC power cable.

- Verify Linear Power Supply's voltage input is set correctly, according to the voltage supplied from your facilities' wall outlet.
- Power ON the Linear Power Supply (DC power cable disconnected).
  - Does the unit power on correctly as specified in section 5, Operation?
    - If yes, continue with troubleshooting.
    - If no, contact Resonance Technology, Inc for Technical Support.
  - The voltages displayed on front panel are within specifications? (see section 8, Specifications).
    - If yes, continue with troubleshooting.
    - If no, contact Resonance Technology, Inc. for Technical Support.
- Continue troubleshooting by following the instructions "*Testing DC power cables*" in this troubleshooting section.

- ***Fan is making excessive noise***
  - It is normal for the device to make a reasonable amount of noise during normal operation. Fan speed changes in direct relation to power requirements of the system.
  - Inspection of the fan, as viewed from outside the Linear Power Supply, can provide hints of other causes of fan noise:
    - If fan is heavily covered in dust, follow the procedure to remove top cover outlined in sections 6.1 to 6.3.
    - Clean fan and remove attached dust.

    NOTE: Do not use any type of liquid or conductive material to clean fan. Electronics in device are sensitive and can cause damage.

- ***Fuse is blown***
  - Follow the instructions in section 6 from this manual to replace fuse.

- ***Push button to switch voltage/current not working***
  - Cycle power on the Linear Power Supply and verify start up sequence, as described in section 5 from this manual, is correct.
  - If the problem persist, it is likely the button is malfunctioning and unit needs to be returned to manufacturer for repair. Contact Resonance Technology, Inc. for Return Material Authorization number.

- ***Testing DC power cables***
  - Power OFF the Linear Power Supply.
  - Disconnect the DC power cable from the Transducer unit in magnet room.
    - Verify cable does not come in contact with any conductive material during the tests.
  - Connect DC power cable to Linear Power Supply.
    - Verify cable is fully inserted into connector and screwed in place.
  - Power ON the Linear Power Supply.
    - Toggle the DISPLAY SELECT button on the side of the Linear Power Supply and select voltages.

- Verify voltages are within specifications as displayed on front panel (see section 8.2)
- If the voltages are not within specifications, stop troubleshooting and contact Resonance Technology, Inc. for further assistance.

▪ Does the problem reoccur?

- If yes, the issue may lie on the power cable. Contact Resonance Technology, Inc. for further instructions.
- If no, the problem may be caused by another unknown factor or may be intermittent. Continue with troubleshooting or call Resonance Technology, Inc. for further assistance.

7.3. How-to Section

a. How to check for voltages using a voltage meter:
   i. Tools required: multi-meter capable of measuring voltages up to at least 20 Vdc and leads.
   ii. Procedure
      1. Verify power supply is turned OFF.
      2. Verify the inlet power fuse is not blown (see section 6).
      3. Disconnect the DC power cable connected to the Transducer.
      4. Measurement of voltages can only be done by using the DC power cable (side normally connected to Transducer).
         a. Reference the nominal voltages from diagram in front of the power supply (see picture from section 4.3.3).
         b. Place the ground lead from the multi-meter to pin 3 of round connector.
         c. Systematically measure the voltages (pins 1, 2, 4, 5).
         d. Once completed, turn OFF the Linear Power Supply before reconnecting to Transducer.

b. How to secure Linear Power supply
   i. If the Linear Power Supply is to be installed inside the magnet room:
      1. Verify a generous amount of silicone adhesive (P/N RTV-108) is applied to the plate. Reference section 4.2.1.
      2. When plate is to be adhered to the floor, verify the silicone adhesive completely spreads by applying necessary pressure on the plate.
      3. Allow sufficient cure time for silicone (24 hours)
      4. Continue following instructions from section 4.2 onward.
   ii. If the Linear Power Supply is to be installed outside the magnet room (outside a high magnetic field area).
      1. Linear Power Supply needs to be placed near a power outlet due to the length of the AC power cord.
      2. Allow for sufficient ventilation and as dust-free as possible. Over time dust can collect and cause problems in the future.
   iii. DC power cable should be fully inserted and screwed in at all times during normal usage. Bad or loose connection may result in intermittent problems in the system.

c. How to check the Serial Number of the Linear Power Supply
   i. The serial number sticker is located on the sides of the power supply.
   ii. You can also cycle power on the Linear Power Supply. The serial number should be display within a few seconds of power up.

7 Troubleshooting

7.4. Frequently ask Questions

a. Fan is making too much noise
   i. Fan noise is normal during normal usage and is usually low enough to not interfere with surrounding environment. If you believe the noise is in excess, follow the guidelines in troubleshooting section under "*Fan is making excessive noise, more than 'normal'*"

b. Display panel not displaying information
   i. It is normal for the display to turn OFF after power on sequence is complete. If you cycle power on the Linear Power Supply but the display panel does not turn ON, follow the guidelines in troubleshooting section under "*No power is delivered to the connected device*".

c. Current measurement on display is showing up as 0.0.
   i. Not all voltages are utilized for every system. Identify your system and validate current is being measured for the voltage(s) they do use:

System	Nominal Current draw for each voltage			
	V1 = 6.50	**V2 = 8.0**	**V3 = +17.5**	**V4 = -17.5**
CinemaVision	0.0	0.37 to 0.7	0.79 to 0.91	0.20 to 0.30
VisuaStim	0.0	0.32 to 0.51	0.49 to 0.62	0.25 to 0.32
Serene Sound	0.22	0.03 to 0.18	0.42 to 0.52	0.19 to 0.28

   ii. The current consumption listed above is an estimated value. All measurements are within ±%10.
   iii. Voltages, as displayed on the Linear Power Supply, may vary by ± %5.
   iv. In case the voltages are considerably out of range from above listed value and tolerances, contact Resonance Technology, Inc. for further assistance.

8. Specifications

8.1. Physical Characteristics

Dimensions:	15.7” x 8.5” x 4.9” [400mm x 215mm x 125mm] 16.6” x 8.5” x 5.0” [420mm x 215mm x 127mm] with base plate
Weight:	22 lbs. [9.8kg]

8.2. Electrical Characteristics

Power Input:	110-120 VAC or 220-240 VAC, 50/60 Hz, 2A Max.
Power Output:	Proprietary 5-pin DC power connector
Pin-out:	Pin 1 = +17.5 Volts nominal, 2A Max. Pin 2 = -17.5 Volts nominal, 2A Max. Pin 3 = DC ground Pin 4 = +8.0 Volts nominal, 2A Max. Pin 5 = +6.5 Volts nominal, 2A Max.
Power Dissipation:	300W Max.

9. Support Information

If you have any questions regarding the system use or installation, please don't hesitate to call Resonance Technology, Inc. Customer Service Department. Service and technical support staff may be reached Monday through Friday 8 A.M. to 5 P.M., Pacific Standard Time (USA) at +1 (818) 882-1997, or e-mail to support@mrivideo.com.

9 Support Information

Resonance Technology, Inc. Product Recycling Program:

Resonance Technology Inc. actively supports the protection of the environment by efficiently recycling all our electronic products. Our everyday pollution prevention activities reduce the need for electronic waste to go into landfills. At Resonance Technology Inc. we are committed to our customers, our communities and to everyone's environment. In light of the above, Resonance Technology, Inc. recommends that all our customers return their undesired, obsolete, or unused Resonance Technology, Inc. equipment to the following address for recycling:

Resonance Technology, Inc.
Attn: Product Recycling Program
18121 Parthenia Street
Northridge, CA. 91325

Notes