



Modification of the BiRa RPS Units for the MINOS Experiment

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Version 2

I. Introduction

This is a technical note that describes a modification to the BiRa Rack Protection System (RPS) Units. The unit as designed uses switching power supply “bricks” inside. These receive 120V, 60 Hz power from an AC line cord, and generate +5V, +12V, and -12V DC for powering circuitry inside the unit. The switchers have been observed to generate noise in the form of magnetic fields, which can be picked up by sensitive analog circuitry when located nearby. The modification described below involves disconnecting the switchers, and providing power from external linear power supplies.

II. Description of Modification

The RPS unit to be modified is:

BiRa Systems, Rack Protection System, Model 8884

The DC voltage and current requirements are measured to be:

Designator	Voltage	Fuse	Current
P1 / F1	+12V	3/4 A	0.225 A
P2 / F2	-12V	1/16 A	0.045 A
P3 / F3	+12V	3/4A	0.050 A
P4 / F4	+5V	2 A	0.625 A

Table 1. Properties of the BiRa RPS Unit

Specifications for maximum current draw from the manufacturer are unavailable. The currents were measured under what is assumed to be worst-case conditions.

The modification is shown schematically in Figure 1 and Figure 2. It involves removing the AC receptacle that provides power to the switching power supply modules inside the unit, removing the fuses on the DC output side of the switching power supply modules, and inserting a wiring harness on the load side of the of the circuitry. The wiring harness has a connector, to receive DC power from an external, detachable linear supply. A new fuse is installed as part of the wiring harness.

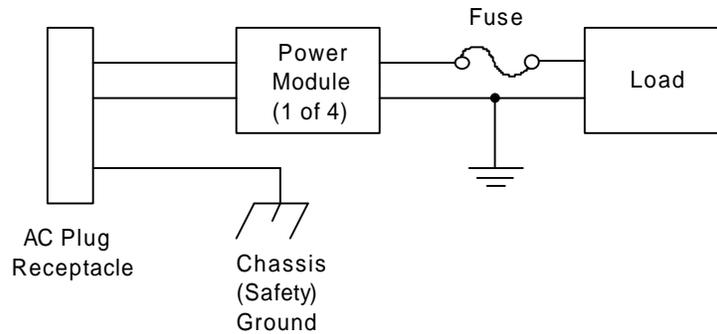


Figure 1. Original Configuration with On-Board Supplies

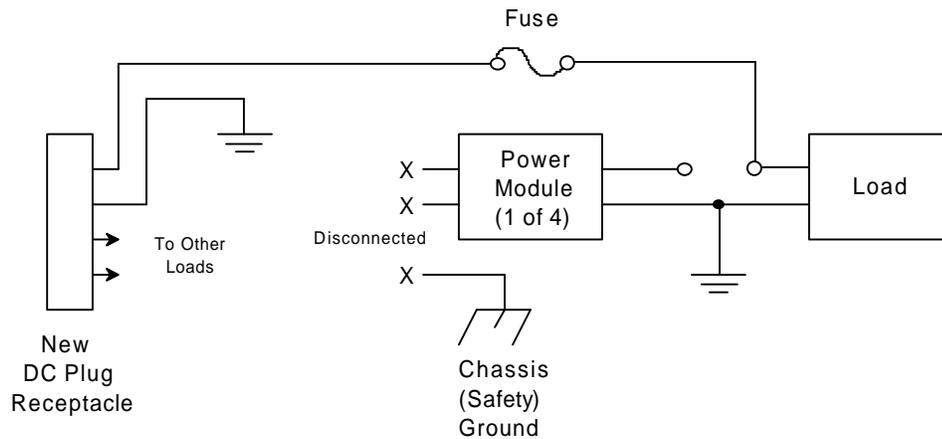


Figure 2. Modification Using External DC Power Supplies

The two +12V loads would be connected together as shown in Figure 3.

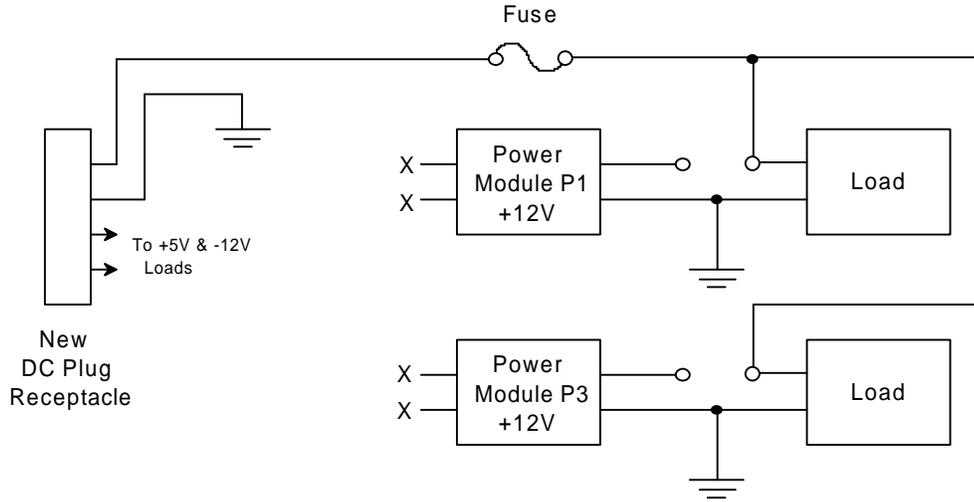


Figure 3. Connection of the Two +12V Loads

The new linear power supply is:

ELPAC Power Supply, Model WM220-1

It is a bench-top unit, with a permanent line cord and permanent 5-conductor output cord. The power supply has the following ratings for voltage and current:

Designator	Voltage	Current
White	+12V	0.5 A
Yellow	-12V	0.5 A
Red	+5V	2 A
Blue	Ground	-
Black	No Connect	-

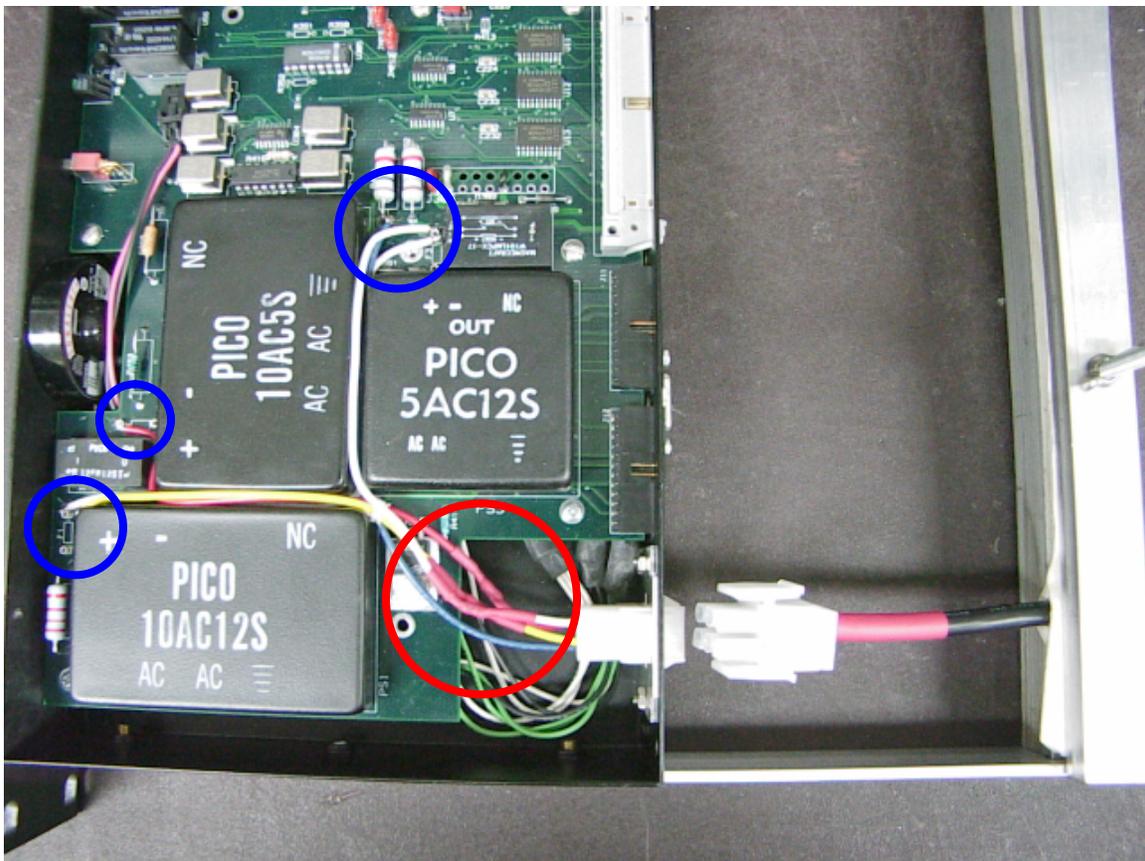
Table 2. Properties of ELPAC Power Supply

Based on the measured values of the worst-case current demand, this unit will meet the requirements, with ample headroom.

The new wiring harness uses a connector that mounts in the location of the AC receptacle. The connector receptacle mounts on the chassis using a small adapter plate. In-line fuses are part of the wire harness, and are encased in shrink-wrap. The original fuses are removed, and the wiring harness is soldered onto the load side of the pins for the fuses. See Figures 4-7.

The connector and wire harness information is:

Cable Connector (receptacle):	Tyco/AMP # 1-480705-0
Cable Connector Sockets:	Tyco/AMP # 350689-2
Chassis Connector:	Tyco/AMP # 1-480704-0
Chassis Connector Pins:	Tyco/AMP # 350690-2
Wire:	18 Ga.
Fuses:	Pico II Fuse, Fast-Acting, Type 251 Rating to Match Power Supply Outputs



**Figure 4. Overall (Top) View of Wire Harness and Connectors
Fuses Located in Red Circle.
Solder Connections to PCB in Blue Circles.**

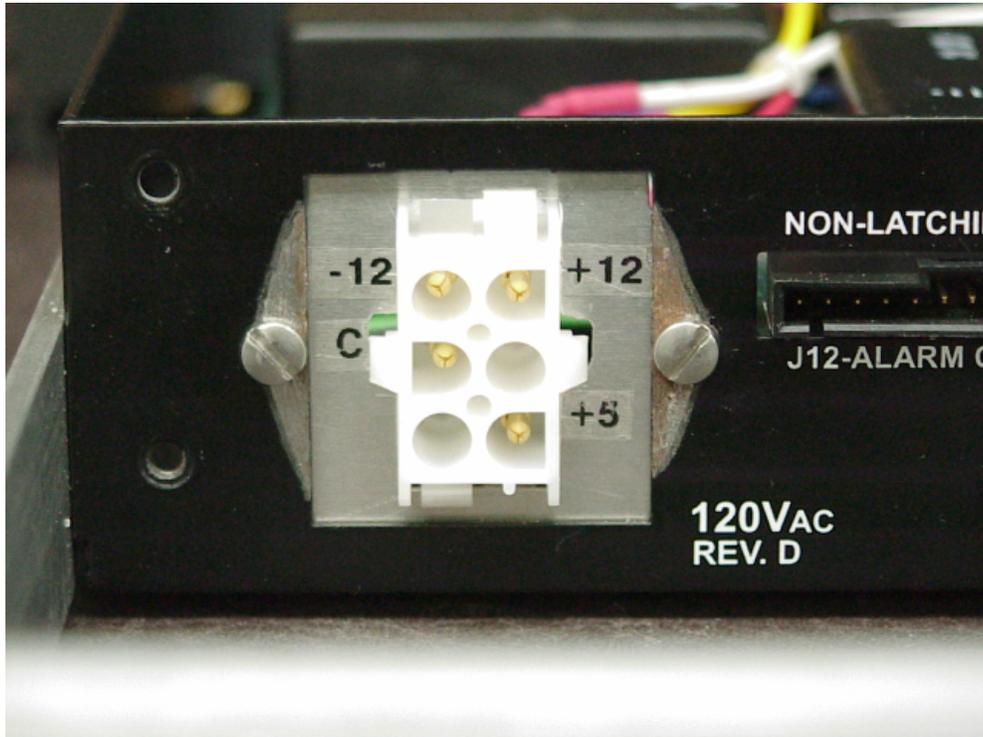


Figure 5. Rear View of Receptacle and Mounting Plate

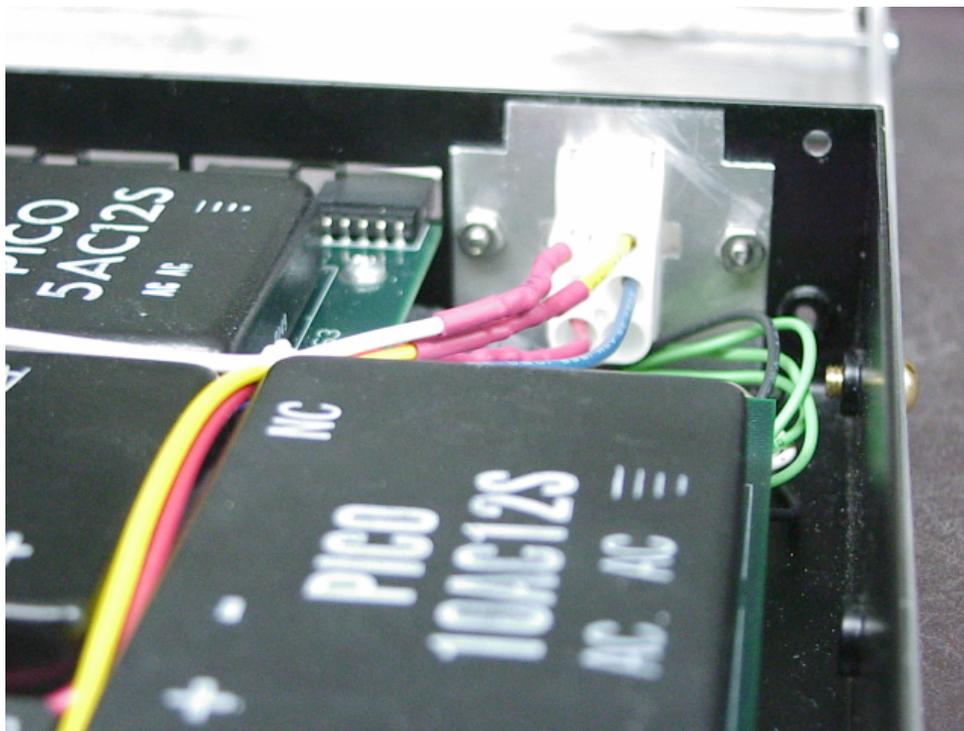


Figure 6. Interior View of Receptacle and Mounting Plate

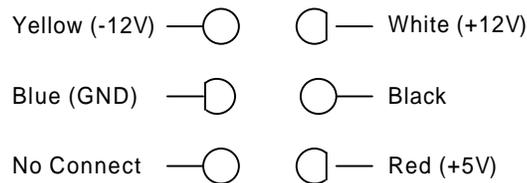


Figure 7. Power Supply with Connector

III. Modification Procedure

A. Power Supply Connector

1. Cut DIN Connector from end of power supply cable
2. Strip ~ 0.75" of the black outer casing from the end of the power supply cord.
3. Strip each of the 5 wires ~0.125".
4. Insert ¼ " shrink wrap tubing onto the cable.
5. Crimp female sockets onto the ends of the 5 wires,
The part number for the sockets is: Tyco/AMP # 350689-2. There should be no exposure of bare wires from the end of the receptacle.
6. Insert sockets into connector shell, as shown in Figure 8. The part number for the connector shell is: Tyco/AMP # 1-480705-0.



**Figure 8. Connection of Power Supply Cable Wires Into Connector Shell.
View Shown is from Rear of Connector (Cable Side.)**

7. Pull the shrink wrap tubing over the wires, as far forward toward the connector as possible. Use a heat gun to shrink the tubing onto the cable, covering up the wires. When complete, the connector should look like that shown in Figure 9.

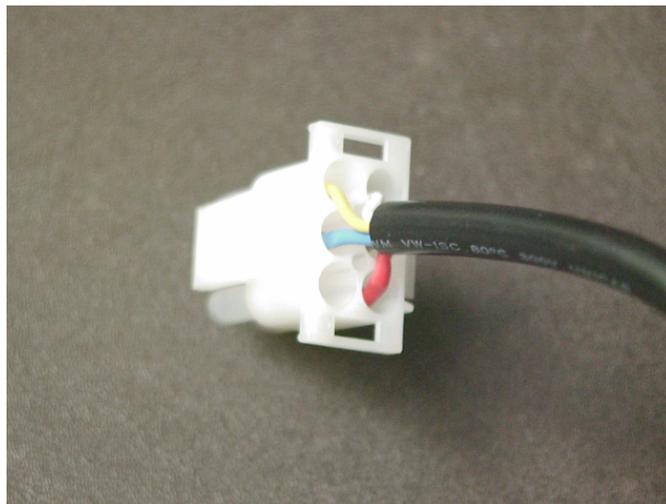


Figure 9. View of Completed Power Supply Connector.

III. Modification Procedure (Continued)

B. RPS Harness

1. Prepare the wires for the wire harness as shown in Figure 10, using the lengths and colors given in Table 3. Note the following:
 - A. Use 18 Gauge wire.
 - B. Fuses are soldered in-line with each wire, and *covered with shrink wrap tubing*. The fuses are: Pico II Fuse, Fast-Acting, Type 251.
 - C. The bodies of the fuses should be positioned ~1.5” from the end of the wire closest to the connector.
 - D. The wire colors match the power supply cable, for standardization and convenience.
 - E. Strip ~0.125” from the connector end, and ~0.125” from the end to be soldered to the load side (PCB end.)

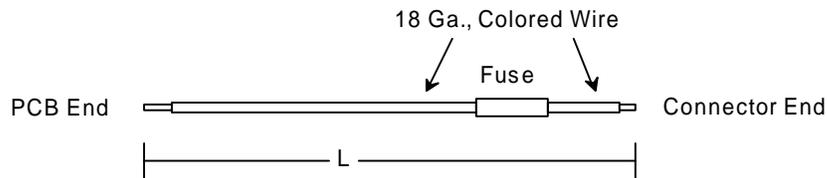


Figure 10. Preparation of Wires for Wire Harness

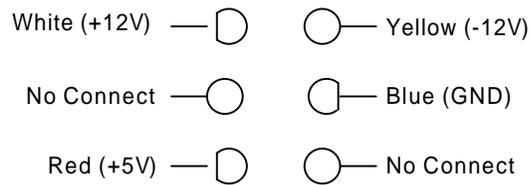
Voltage	Color	Length	Fuse
+12V	White	6.50 “	0.5 A
-12V	Yellow	6.75 “	0.5 A
+5V	Red	6.50 “	2.0 A
GND	Blue	6.25 “	-

Table 3. Parameters for Wires of Wire Harness

III. Modification Procedure (Continued)

B. RPS Harness (Continued)

2. Crimp male pins onto the connector ends of the 4 wires,
The part number for the pins is: Tyco/AMP # 350690-2. There should be no exposure of bare wires from the end of the pins.
3. Insert pins into connector shell, as shown in Figure 11. The part number for the connector shell is: Tyco/AMP # 1-480704-0. The completed harness should look like that in Figure 12.



**Figure 11. Connection of Harness Wires Into Connector Shell.
View Shown is from Rear of Connector (Harness Side.)**

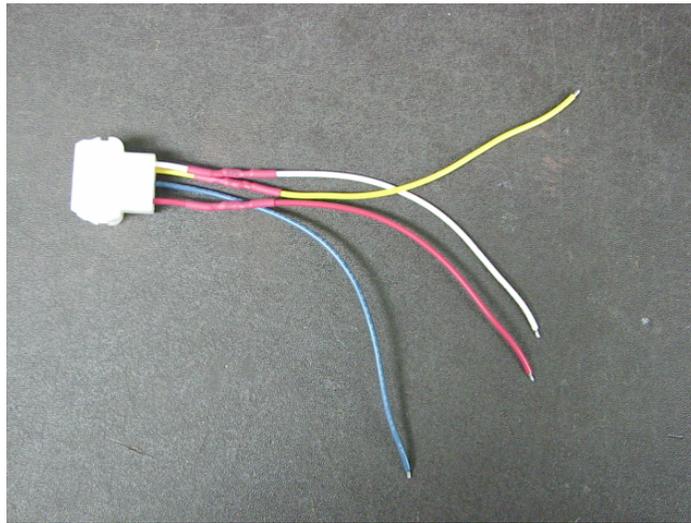


Figure 12. Completed Wire Harness

4. Insert the connector shell into the plate, as shown in Figure 5 and Figure 6.
5. Prepare an additional 18 Ga. jumper wire, 6.75" long, white in color. Strip 0.125" from the ends. This wire is for connecting the two +12V voltage points together on the printed circuit board, so no connector pins are used.

IV. Modification Procedure (Continued)

C. Installation of Harness into RPS

1. Disconnect the AC line cord from the back of the unit.
2. Remove the cover of the RPS unit. There are 3 screws on the front, and 4 on the back.
3. Disconnect the 3 wire harnesses (green, white, and black) from the AC receptacle from inside the unit. Remove the 2 screws that fasten the receptacle to the chassis, and remove the receptacle. Tuck the 3 wire harnesses into the bottom of the chassis.
4. Remove the 4 fuses from the on-board power supplies. These are labeled as given in Table 1.
5. Connect the white jumper wire (prepared as described in Part B above, step 5) between the load side F3, and the load side of F1. Solder the wire onto the sides of the fuse receptacles on the printed circuit board, as shown in Figure 4, keeping the holes free of solder.
6. Solder the wires from the wire harness onto the load side of the pins of the fuse receptacles, as given in Table 4. Refer to Figure 4 to identify the load sides of the various connections. Note the special location for connecting the ground wire.

Designator	Voltage	Location
White	+12V	F3
Yellow	-12V	F2
Red	+5V	F4
Blue	Ground	R401

Table 4. Connection Points of Wire Harness Inside the RPS

7. Install the plate holding the connector onto the inside face of the chassis where the AC receptacle had been located. Install the plate using the screws and nuts from the AC receptacle.
8. Dress the wires of the wire harness in between the on-board power supply bricks, as shown in Figure 4. Use electricians tape if necessary to hold them in place.
9. Re-install the cover of the RPS unit.