

TS-940 Supply Upgrade Kit Board Assembly

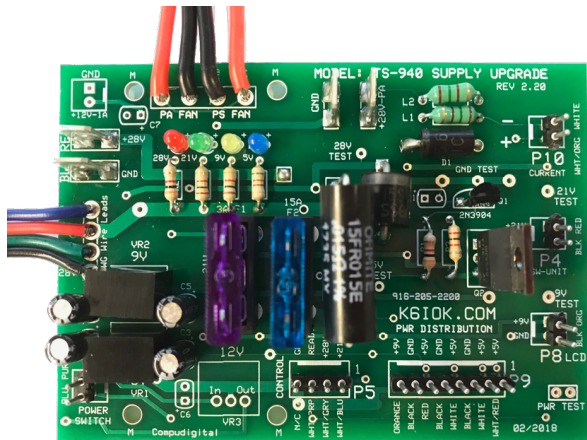
The TS-940S Power supply upgrade kit was designed to replace the original power supply. This kit is easy to install and should provide years of extended life to your TS-940S, in our opinion one of the best radios ever made by Kenwood.

Unpacking the kit:

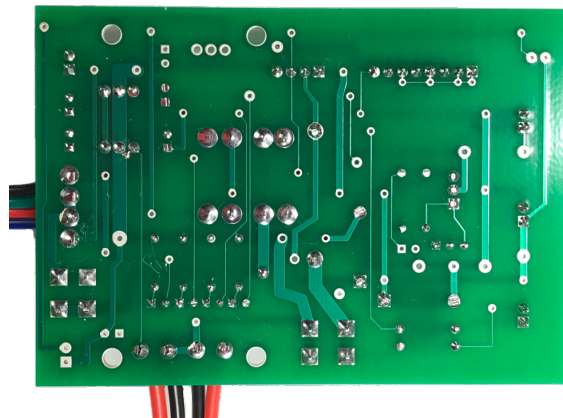
Unpack the kit and make sure that you have the following components:

- The TS-940S Upgrade Board with the attached 21V Buck Converter.
- Printed circuit board and parts
- External assembled Buck Converter board (+21V)
- 1 ea. Phoenix 24V @ 20A Power supply (if you purchased the full kit)
- 1 ea. 12V Cooling fan for the rear panel
- 1 ea. Red/Black 12AWG cable with spade lugs on one end to connect power supply to the board
- 2 sets – Red/Black fan extension cables with plugs
- 1 ea. Trimmed Snap Track section
- 4 ea. – Plastic standoffs with nuts and screws
- 2 pcs of Velcro Tape for power supply mounting (if you purchased the full kit)
- Instruction Manual and Theory of Operation
- Schematic Diagram & Board Layout document
- Parts List

Be sure to have the circuit board layout diagram and the parts list in front of you before you start building this board. The 12 V converter marked VR3 and the white LED are not used in the kit. Please refer to the picture below when determining where to put each component.



Component Locations and values



Solder Side of the board after soldering

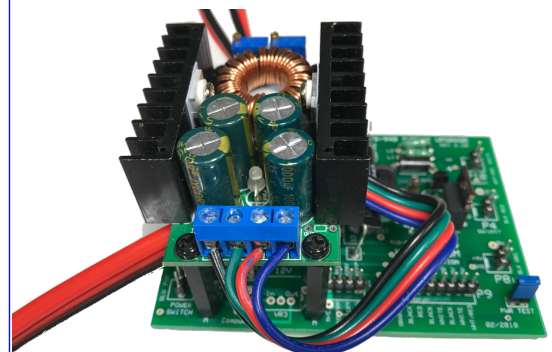
In the left hand picture the four wires to the left go to the Buck converter. Be sure to wire them as you see the picture. The four wires on the top go to the two different fans. On the left side the PA fan is the red and black wire and on the right side of that connector is the power supply fan. It is important to put the BLACK 1% .015 ohm resistor up off the board about 3/4 of an inch so that it can cool properly. Be careful when installing the two diodes and make sure that the cathode, the striped side is correct as you see in the picture.

Buck Converter Wiring

On the power switch and the other header connectors, use caution and do not heat them up anymore than you need to. They have a tendency to melt the plastic spacers if they get too hot.

The 21V Buck converter is wired as shown. Leave about 6" of cable between the 21V Buck Converter and the Supply Upgrade board. The Buck converter will be mounted with 4 plastic studs that are included with the kit.



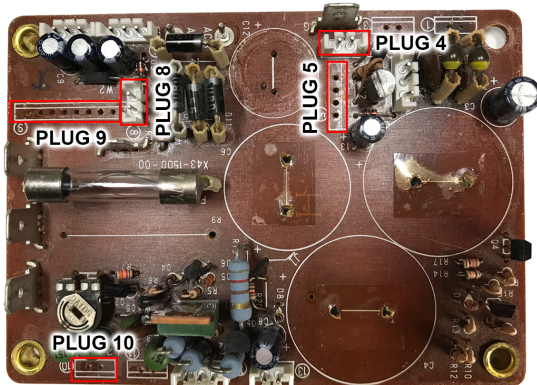


Theory of Operation

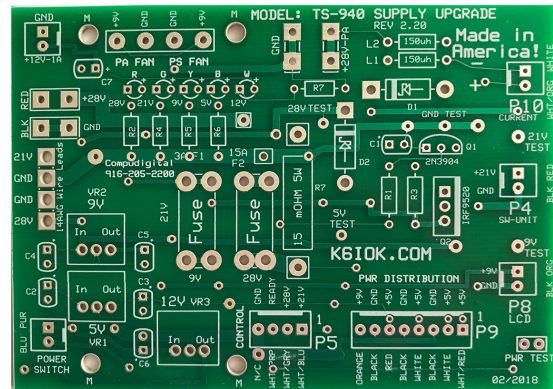
Check it in your radio first!

We always suggest that you check the board in then radio before you remove the original power supply components. The best way is to watch our video online at <https://vimeo.com/254540209> or, you can go to our website at k6iok.com, click on the link called "Videos" and select the video called "Testing the board in the TS-940 First". This video shows you how to unplug 5 connectors on the existing AVR board and 2 spade lugs that go to the PA assembly in the radio and move them over to the new upgrade board for testing. Use the diagrams above as a reference to make sure everything is connected correctly. It is a good idea at this point to check the receiver and transmitter for proper operation.

When you finish, the radio should fully function. When you have completed this step, you can then begin to remove the original supply from your radio. You can go to the following: Check it out online: URL: <https://vimeo.com/239675728> or, go to our site at k6iok.com and click on "Videos" then select the video Removing the Power Supply.



Original AVR Board



New Supply Upgrade Board

Construction of the Supply Upgrade Board

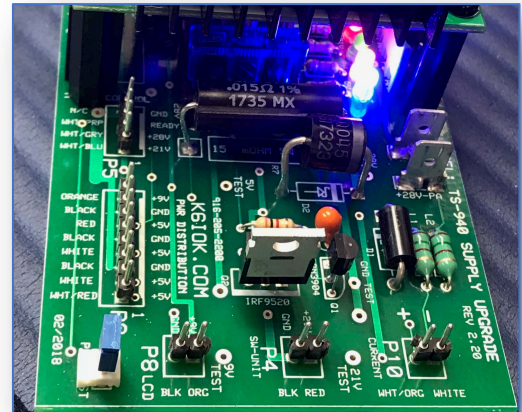
At Compudigital Industries, we take pride in delivering the highest quality product possible. This is why we have been through 5 revisions of this board before we released the first one for sale. The board is made using commercial quality FR4, .062" double sided circuit board material with solder mask and screen printing to indicate component locations, voltages, and cable colors. The board traces are silver plated to assure maximum current passing capability and the highest level of solderability. The high current through holes are filled with solder as well. The high current traces are wide and as short as possible to make sure that the voltage drops remain minimal during transmit conditions.

The original AVR board in the TS-940 served many functions. First, it controls the fans to make sure that they each come on as the radio requires them. These fans cooled the original power supply and the PA section. The fan controls and thermistors on the AVR are prone to failure, causing the fans to fail to come on when the components get hot. The new board provides 2 fan outputs, both operating at 9 volts and they run continuously. The Quint Power supply requires very little cooling but does need some air moving through it. The finals also do not require a full speed fan and so the 9V line has proven to work very well.

Another function of the original AVR board is to provide +21 volts, +9V, and +5V using the external pass transistors, regulators, heat sinks etc. Our new board has a +21V DC to DC 12 amp converter mounted on top of the board, and a 9V, 5V, and some models a 12V Switching Power supply mounted on the circuit board. These on board converters run with up to an amazing 98% efficiency and so they run cool, providing everything the TS-940 needs to run properly.

You will notice that the new board has a +28 volt input (spade lugs) and a +28 volt output (Marked +28V-PA) which serves the PA module. Referring to the schematic diagram you will notice that this 28V source goes through a 15A fuse, and then a .015 ohm (15 milli-ohm) 1% 5W resistor, used as a current sensor. This sense voltage provides and indication of the transmit current through PLUG 10 via the two 150uh chokes. This voltage is used to provide the meter reading for current during transmit, and to control the output power to make sure the driver and final stages remain safe. The original power resistor is subject to change which can throw off the readings to the control circuits of the radio. The maximum specified power output in all modes is 110 Watts and the radio uses this resistor to determine the output level.

LED Indicators We use 4-5 multi colored LEDs to indicate the different voltages within the upgrade board. The RED Led is used for 28V, Green is for 21V, Yellow for 9V, Blue for 5V, and on some models, White for 12V. These LEDs do not confirm that the voltages are correct, they just indicate that the voltages are there.



Radio Reverse Polarity Protection

We have installed 2 protection Schottkey diodes for reverse polarity protection. D1 is in place to protect the 21V line and D2 is used to protect the 28V line. If either of the voltages somehow get reversed, the diodes conduct and the respective fuse will blow.

Power-up Sequencing

On power-up, there is a specific sequence that is required to make sure the TS-940 processor starts properly and that the memory will be retained. The 28 volt line is normally in the ON condition all of the time. When you turn on the power switch, the 21V line is applied to PLUG 5, pin 1 and PLUG 4, pin 1. When these two voltages are applied, the associated circuitry comes online and then when ready sends a READY indication to PLUG 5, pin 3. This is an indication for our board to bring up the 9V and 5V power supplies. We use a high power MOSFET (Q2) to provide 21V to the inputs of the 9V and 5V switching power supplies when the READY signal has been received. And you will see the results on our power indication LEDs. When you press the power button, the RED is already on, indicating there is 28V power, the 21V line comes up (Green LED) and then after a very short delay, the 9V and 5V power supplies are enabled. Normally, while the radio is operational, all of the LEDs are lit up.

The TS-940 timer switch - prevent a real headache!

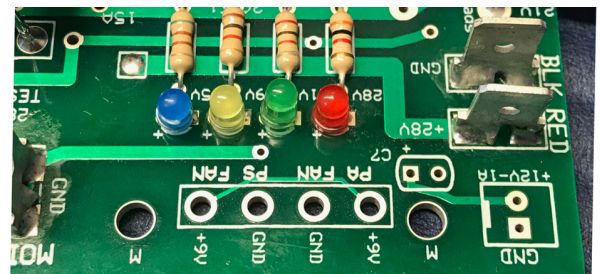
Many radios now days have a timer switch that is used to automatically turn the radio on and off automatically. The TS-940 was way ahead of its time and had the same. If the timer switch is pushed in, the radio checks with the timer module (behind the LCD display) to see if any timing function is scheduled. If not, the radio will just not come on. During development of this supply upgrade product the timer switch caused us many hours of frustration when it was inadvertently pressed in and we did not know it. The result, a completely dead radio. Make sure that the timer switch is not pressed in during your testing!

The 12V experimental output

We know that many of you are experimenters like I am and in this radio, 12 volts Just doesn't exist. So we added the option of a high efficiency 12V @ 1A switching power supply to the board and placed the output I the upper left corner of the board! If you have this option feel free to use this to provide power for your experiment or addition to the TS-940!

The Cooling Fan Outputs

We have provided 2 fan outputs so that you can hook your fans directly to the board. The fan included in the full kit is a 12V low current model used to put minimal air through the switching power supply. It runs perfectly at 9 volts. The fan that cools the TS-940 Final stages is a 12 volt fan that we also run at 9 volts. Running at a full 12 volts gets pretty noisy and is really not required.



Securing the power supply in the case

The Quint power supply is sized perfectly to fit within the TS-940 case. The best way we have found to secure it to the bottom of the case is using Velcro Tape (supplied). After you have completed all of the wiring and are ready to wrap the project up, you can secure the supply to the radio with the supplied VELCRO tape.

IMPORTANT NOTE: Internal batteries in the TS-940 are important!

There are 2 memory retention batteries in the TS-940 and both are critical. One is for the timer/clock module and the other is the memory retention battery located under the speaker. Most TS-940S radios have never had these batteries replaced. We recommend that you replace both as a part of this upgrade. You can purchase these batteries from our store at k6iok.com or through a retailer like Amazon. We will be providing a video outlining the steps to take in order to replace these batteries at our site at k6iok.com.

NOTE ABOUT KENWOOD CONNECTORS:



The connectors used in the Kenwood TS-940 are delicate and do not respond well to plugging and unplugging continuously. We recommend that you keep this repetitive action to a minimum to prevent damage to the plugs. The original pins on the AVR board and other parts of the radio are .037" and these header connectors are no longer available. We use a header with .035" pins, the only option we have been able to find anywhere. Many thanks to one of our partners PIEXX for their assistance in locating the headers we use!

If you have any questions about your installation, please contact us at 916-205-2200.