

# The W7RY QSK Board for the Kenwood TL-922 V 2.9

## **WARNING!**

**HIGH VOLTAGE WILL KILL YOU. PLEASE  
REMOVE ALL VOLTAGES BEFORE WORKING  
ON YOUR AMPLIFIER!**

### **General**

The W7RY QSK board is specifically designed to be installed into the Kenwood TL-922 linear amplifier. The QSK speed up circuit is designed to use the 80 volt AC winding on the filament transformer. This voltage is rectified and filtered for use as the voltage to switch the vacuum relay as well as the small reed relay.

The theory of operation for the speed up circuit can be found on Rich Measures so it won't be mentioned here. Please see: <http://www.somis.org/QSK922.html>

### **Relay Timing**

The board has been tested using an Icom IC-7200 IC-751A, IC-7600, IC-756 PRO II The internal amplifier keying relay was used in the 751A and it was plenty fast. The 751 uses a very fast reed relay for the amplifier switching and the 751A has more than 8 ms of relay close time before it generates RF. Much more time than needed for this circuit. The Icom IC-7200 and 756 line has 4-5 ms of T8 (transmit 8 volts) before it generates RF. The T-8 voltage (Transmit 8 Volts) is usually available at the transverter connector. T8 would be hooked to J1 pin 6 of the QSK board.

### **Mounting**

The board is mounted into the TL-922 where the existing zener diode and heat sink are located. The board is mounted on a ¼" long threaded standoff with 6-32 threads. I use a ¼" long stand-off that has a 6-32 threaded stud on one end and 6-32 female threads on the other. Mark the chassis before you

solder components onto the board. I use a drill with a 7/64" drill (or a #35) bit. Then I thread the hole with a 6-32 tap. This way you don't have to put a nut on the back side of the stud. Because of the height of C7, the mounting height is critical.

You MUST cut off the filament transformer mounting stud flush with the chassis. I remove the nut from the stud and then cut the stud off with a cutoff wheel in my Dremel tool. You can probably use a pair of heavy duty cutters to cut the stud off. Or score the stud with a tri-cornered file and then simply snap the stud off.

**When cutting, drilling and threading inside of the amplifier, please be aware of where your filings are going. I use a magnet stuck onto the chassis where I'm working. This catches most of the debris but be careful. You don't want anything shorting out ! I also use black tap or duct tape to clean up. You can also use duct tape with the sticky side out so it catches the debris.**

The mounting of Q7 is not critical. There is an existing hole in the chassis that I use for mounting it. Be sure to use an insulator under the transistor to insulate it from the chassis. I use the new ceramic or gray rubber style heat transfer insulator that does not require that pesky white heat sink compound.

Please check the mounting location of Q7 before you solder it to the board. I solder it very last.

You can elect to use or not use plugs for the wiring connections to the board. I used plugs and jacks in the amplifier that is shown in the pictures at:

<http://s900.photobucket.com/albums/ac206/w7ry/QSK%20Modifications%20to%20my%20TL-922/>

## Parts List

The parts list is on a separate document. Please double check the part numbers. Feel free to substitute any part you wish. Most parts are not critical; however the board layout is designed for the parts on the provided parts list.

If you use different LEDs than have been listed on the parts list, please be sure to check the current requirements for your LEDs and adjust the limiting resistors, R1 and R2 as required.

## Construction and alignment

Mount R-25 (1 Ohm) slightly above (3/16") the board so a voltmeter set on mV can be clipped onto it to measure the current in the circuit. (80 mili-volts is equivalent to 80 mA). 80 ma is the correct current for the relays specified on the parts list. If you substitute relays, re-calculate the values for R12, 13 and 14 as well as R19 across the coil of K1 (input relay).

## Bias

The circuit uses a TL-431 adjustable regulator along with Q7 as a pass transistor to control and switch the cathode bias. Q6 turns on and off the bias switching. D6 and D7, along with D8 and the MOV, keep

the bias circuit components safe during a high voltage arc in the 3-500s. Install Q6 after you have D8, D6 and D7 installed on the board. This will keep the gate of Q6 from being damaged by static during construction and installation.

The bias circuit was developed by Tony, W4ZT (SK), and also used by Paul, WD7S as well as Ian, GM3SEK on their respective Triode Boards. R16 is adjusted for the proper idling current on the 3-500Z tubes which is about 180 mA during transmit. Adjust the board from through the bottom of the TL-922 cabinet after the bottom is installed.

## Switching

With this QSK board, there is no need for a soft key module. The keying voltage on the PTT relay jack of the TL-922 is about 9 volts DC from R4 which is a pull-up resistor on the collector of Q1. The current is less than 5 mA. Any rig will key this QSK circuit. You can also put + voltage on J1 pin 6. It will take about 2 mA of current to supply this transistor from your rig. I use T8 (8 volts during transmit) from the Icom line of transceivers. Any voltage in the range of 4 to 14 volts will key the circuit. If your rig has a large slow PTT relay (like the Ten-Tec rigs have) use an alternate method of keying your amplifier such as a + keying voltage into pin 6 of J1. (See above).

## RF Relays

K1 is a reed relay with super fast switching time is less than 1ms with the speed up circuit. **When installing K1, please observe the polarity! The relay is marked on the bottom in hard to read markings. Pin 5 is - and pin 3 is +.** K2 is a high speed vacuum relay. I used a RJ1A-26N969 which is a silicone encapsulated relay available from Max Gain Systems; <http://www.mgs4u.com/RF-Microwave/vacuum-relays-SPDT.htm> The silicone encapsulated relay is best because it's a bit quieter than the non encapsulated version. It is also easier to mount. See the pictures for details. Any **RF rated** small vacuum relay made by Jennings, Gigavac, or Kilovac with a 26.5 Volt coil and a resistance of 335 Ohms will work fine. Alan at Max Gain Systems can help select the relay you need.

I install at 20 to 30 Pf capacitor (C11) across the bypass contacts so the SWR through the amplifier when in bypass mode (not keyed) is very low on 10 and 15 meters. Most amplifiers have SWR when you bypass the amplifier especially on 10 and meters even when you measure into a dummy load. This capacitor cancels out the inductive reactance caused by the relay wiring, interconnect cabling and the internal structure inside the relays.

I use narrow strips of copper to hook the coax cables to the vacuum relay terminals. You can use small braid from the shield of RG58 or similar. If you do use braid, be sure not to fill the braid with solder. If you do, you will lose the sound deadening that comes with using braid. You need to use some type of sound mitigation technique or vacuum relay can be quite loud. If you do use braid or small gauge copper strips, you will greatly reduce the sound that gets transferred and keep the amplifier relays nice and quiet.

## Removing the Old Relays and Other Components

Carefully remove the old relays and other parts. TL-922 part number D7 is actually connected to the zener diode anode D2. Both diodes should be removed along with C26 across the zener diode. Diode D8 on the QSK board takes the place of the TL-922 D7 diode. The Brown wire that you removed from anode of D2, and D7 is connected to J2 pin 4 of the QSK board.

## Step Start

A small step start board is available from W7RY for \$14.00 each. These are just the bare boards. You need to supply the 2 relays and the resistors. The board is designed to use 48 Volt DC relays. Mount the step start board inside of the TL-922. See the pictures for more detail of a completed Step Start Board mounted in the left rear corner. One of the dropping resistors are mounted the bottom of the board so it would clear the transformer windings. Simply use silicone sealant to mount the relay housings to the chassis. Remove the two large white wires from the fuse holders (remove the fuses first) and attach to the board. Then install #14 AWG leads from the fuse holders to the step start board. At turn on, there is a momentary (less than 200 ms) slight buzzing sound from RL-1 which is used in the fan circuit.

Because this is a universal step start circuit board, C1, C2, D1 and R1 (install a jumper in place of R1) are not required for the TL-922 if you use the W7RY QSK board. R15 on the QSK board is the only voltage dropping resistor needed for the step start board.

## LED Mounting

I start by filing down the tip of the LED with a small file. This makes the LED have a more defused output which makes for more even light output. Cut the bottom out of the grommets and bend the LEDs down so they “look” at the top of each meter. Point the LEDs slightly together. This will illuminate the meters best. Then mount the LEDs into the rubber grommets that Kenwood uses to mount the incandescent lamps. Use a small amount of silicone to secure the LEDs into the rubber grommet and set them aside to set up overnight before you mount the rubber grommets back into the amplifier. For the transmit and standby LEDs, I mount them just flush with the end of the grommet. See the photos for details. You can clean off all of the resistors and wiring from the terminal strip where the LEDs mount if you wish.

## Board Connections

### J1 connections are as follows:

#### **Pin 1, Meter LED:**

Connect to one of the meter LED strings. See the QSK Board schematic for details on how to connect the LEDs.

#### **Pin 2, Meter LED:**

Same as above,

#### **Pin 3&4, 8 VAC In:**

Connect these pins to each of the 8 volt winding of the filament transformer. You will have to remove one of the connections from chassis ground.

#### **Pin 5, PTT Low:**

This pin hooks to the wire that was hooked to the existing relays, which goes through switch S4 (linier standby/operate on the front panel) and also through TH1 and TH2 which is a thermal switch built into the plate transformer. This line needs to be grounded by the transmit relay in your radio. (See the notes in the **relay timing** section above).

#### **Pin 6, PTT High:**

Use this line if you want to key the TL-922 with a positive going voltage from your rig. I use the T8 (transmit 8 volts) from my Icom IC-7600 (I had to go inside of the rig and bring it out to the back of the rig) to key the TL-922.

#### **Pin 7, Stp Start:**

This pin provides ~110 Volts DC to the W7RY Step Start Board. If you use another brand of step start system, you may have to change the value of R15 on the QSK board to accommodate it.

#### **Pin8, ALC Circuit:**

This pin connects to R21 (22K Ohm) of the TL-922. This resistor did connect to the old TL-922 relays. This connection provides ~110 volts DC to the ALC circuit.

#### **Pin 9&10, 80 VAC In:**

Connect these pins to each of the 80 volt winding of the filament transformer. You will have to remove one of the connections from chassis ground.

**Pin 11, Standby LED:**

This pin connects to the Standby LED. See the QSK Board schematic for details on how to connect the LEDs.

**Pin 12, TX LED:**

This pin connects to the Transmit LED. See the QSK Board schematic for details on how to connect the LEDs.

**J2 connections are as follows:****Pin 1, Fil CT and L20**

This pin connects to the filament center tap on the filament transformer AND to L20, which is the cathode RF choke. Leave C63 and C78 (both .01 uF) in place. The center tap of the filament transformer may not currently be hooked to the filament winding center tap depending on how you removed the old T-R relays from the TL-922 and how your amplifier was wired.

**Pin 2, Chassis Ground**

This pin connects to chassis ground. Use a larger gauge (at least #20, #18 is better) of wire to connect this pin and keep it fairly short (less than 3 inches). Connect the other end to a convenient grounding location on the TL-922 chassis near the filament transformer.

**Pin 3, Chassis Ground**

This second connection is not necessary. Or, you can use 2 pieces of smaller wire for both pin 2 and 3.

**Pin 4, D7 Cathode and S4**

This pin connects to the brown wire that was removed from the zener diode. The brown wire is attached to S4 and also to the grid metering circuit and is routed to the front panel and to the circuit board on the top of the TL-922 behind the meters. D7, a medium sized white diode with a yellow band, was probably removed from the TL-922 when you removed the zener diode because it's soldered directly onto the zener. That is ok, because diode D8 on the QSK Board serves the same purpose as D7 in the TL-922. Go ahead and leave D7 out.

**J3 Connections are as follows:****Pin 1, T/R Relays –**

This pin connects to the – side of the TR relays. See the QSK Board schematic for details.

**Pin 2, 9.6 volts to LEDs**

This pin connects to the Transmit and Standby LED anodes. See the QSK Board schematic for details.

**Pin 3, No connection**

**Pin 4, T/R Relays +**

This pin connects to the + side of the TR relays. See the QSK Board schematic for details.

Thanks and 73!

Jim W7RY

Comments and questions to [w7ry@arrl.net](mailto:w7ry@arrl.net)

**A special thanks to Karin, K3UU for her assistance in the circuit board layout, and Rich Measures, AG6K for his idea of the relay speed up circuit.**

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