Yaesu FT-817 ACC Jack Switched +13.8V mod

by VE3CZO ***Introduction***

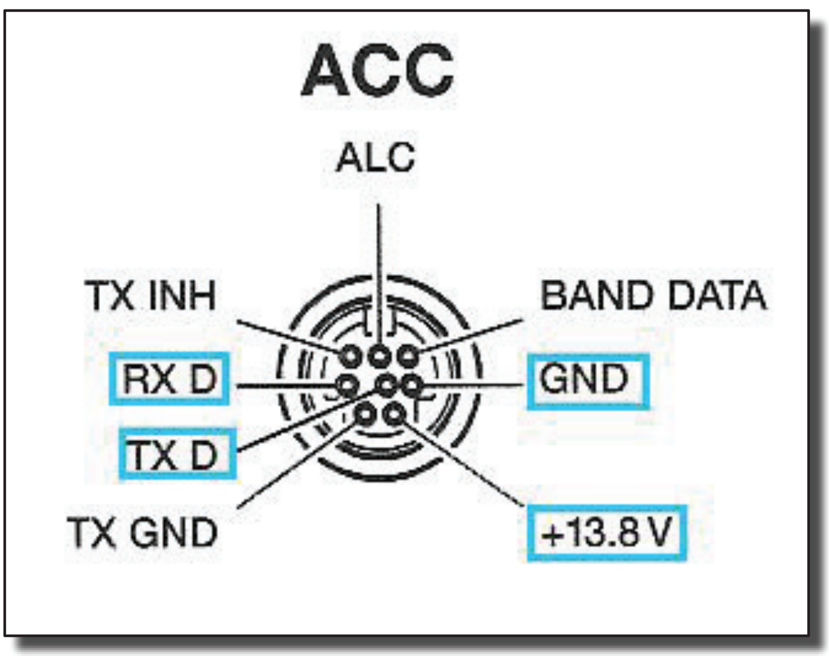
The FT-817ND provides a DC supply on the accessory (ACC) connector, pin 1, marked +13.8V to supply power to peripherals. Unfortunately this supply is not switched. It connects directly to the internal battery or an external power supply voltage if connected, and therefore is always on. This means even when you shut the rig off, if you leave a device that derives its DC power from the ACC socket connected to the transceiver it will drain the battery.

Additionally in the limited number of FT-817's tested, the output voltage on the +13.8V pin is not consistent over a range of load currents. The output resistance varied from about 15 to over 100 ohms (of course some of this variance could be the result of abuse).

This modification will connect the ACC +13.8V pin to an internal switched supply rail so that it is only on when the rig is turned on. Additionally the output resistance will be more consistent, able to drive up to about 150 mA and the output will also be protected against external short circuits.

ACC Connector

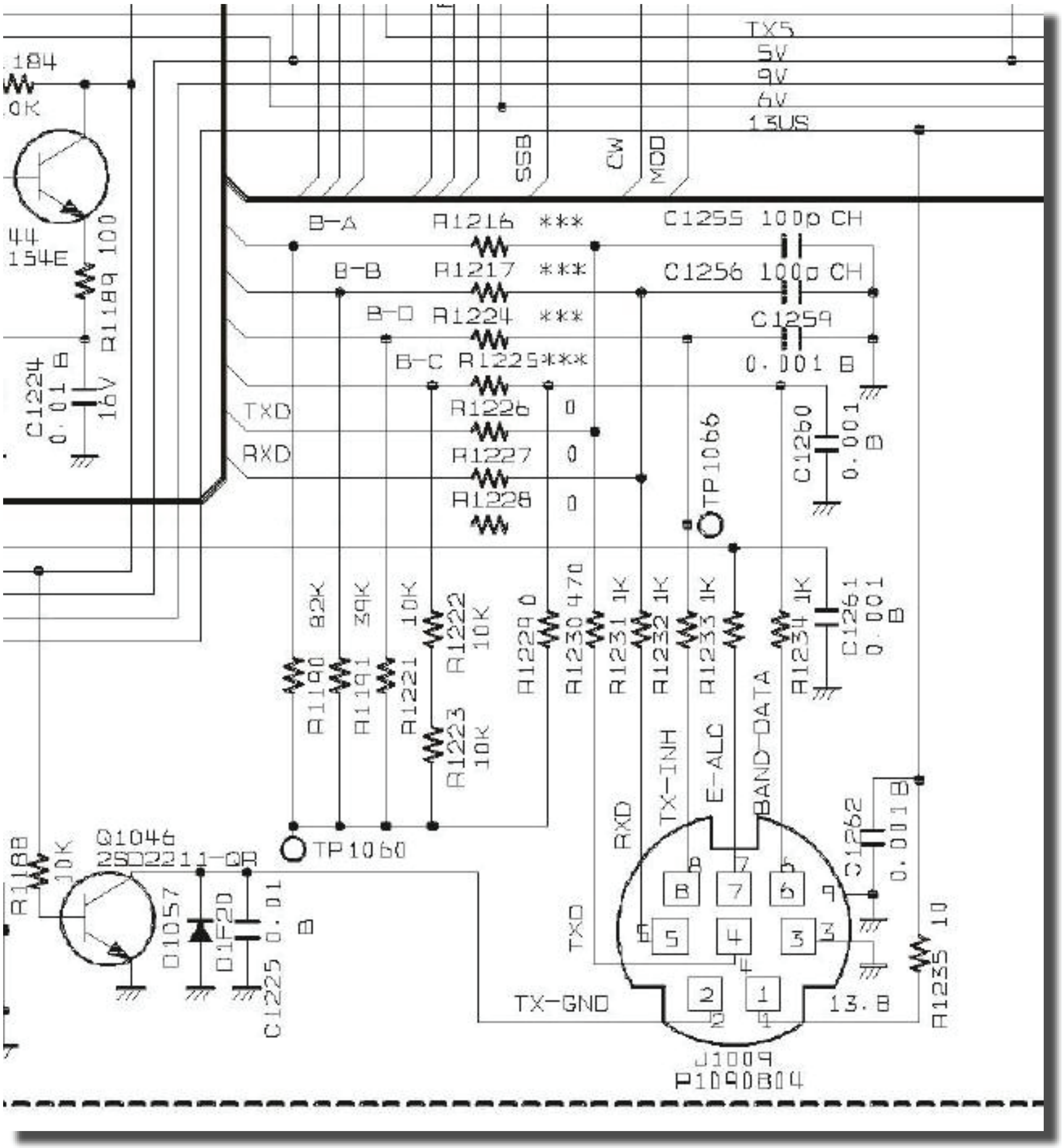
The ACC socket is an 8 pin Mini-DIN connector with +13.8V supply on pin 1 and ground (GND) on pin3



ACC jack as viewed from the rear of the transceiver

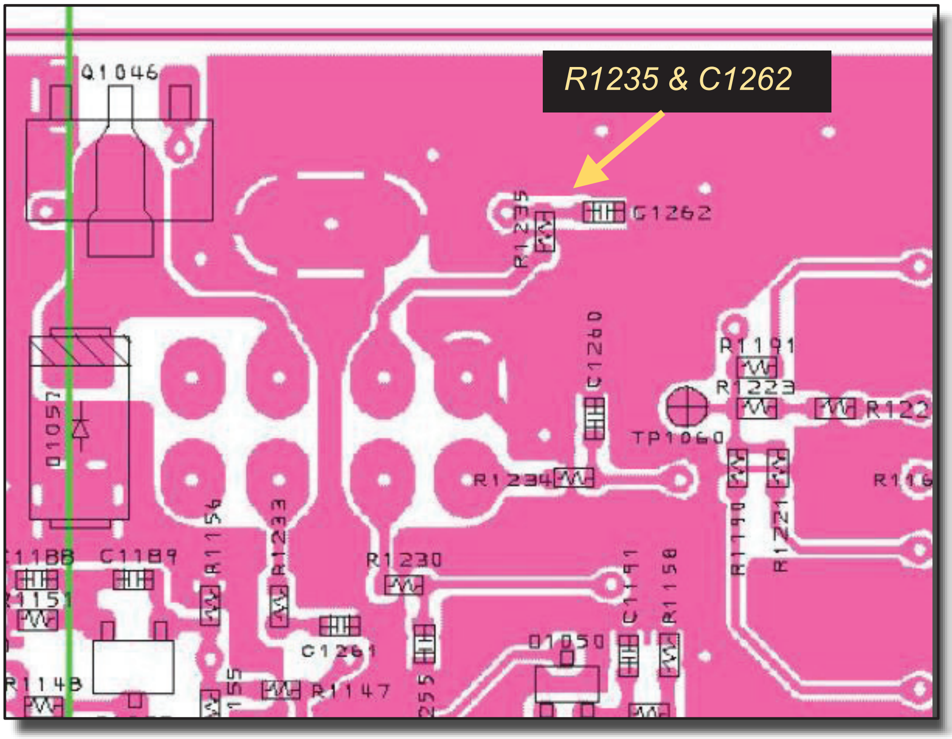
Pin	*Function*
1	13.8V
2	Tx-GND
3	Gnd
4	TxD
5	RxD
6	Band Data
7	ALC
8	TxInh

The circuit schematic from the most commonly available FT-817 service manual found on the internet shows the 13.8 pin connected to an unswitched internal buss named 13US. It is connected to this buss through a 10 ohm series resistor R1235 and C1262, a 1nF bypass capacitor.

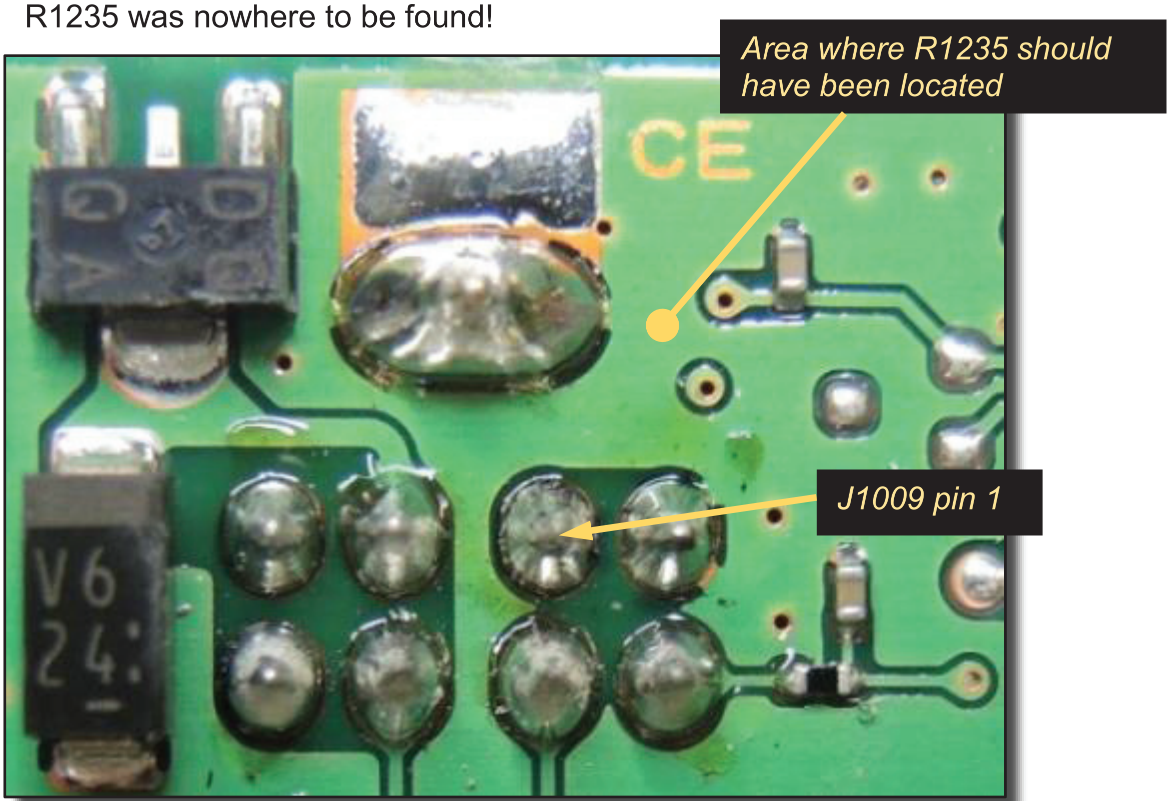


A 10 ohm R1235 resistor will provide a fairly stiff output to drive applications needing up to about 100 mA. However in measuring several transceivers it was found that the output resistance often changed with load current and varied from a high of just over 100 ohms to around 15 ohms. No method to

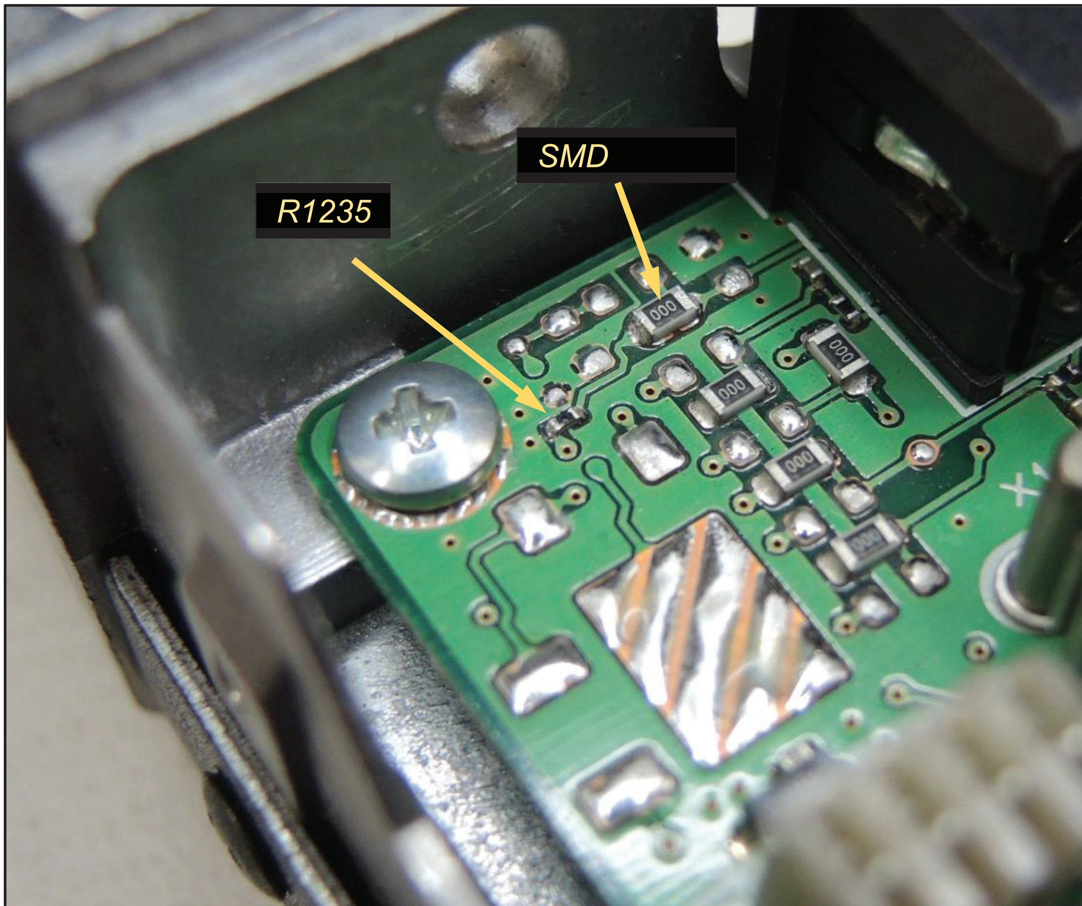
predict the voltage drop with current was found. But it was becoming evident that the circuit may not contain just a simple 10 ohm series resistor.
The PCB layout indicates that R1235 and C1262 should be on the bottom side of the Main-Unit PCB under J1009.



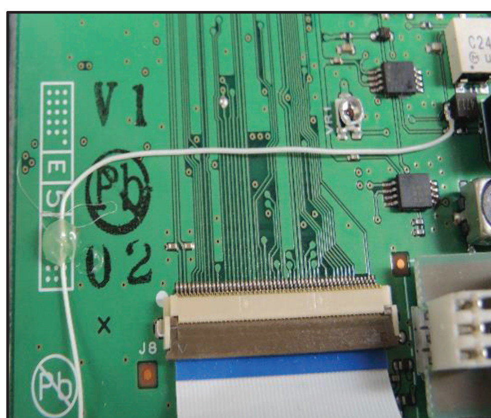
So with some trepidation the Main-Unit PCB was removed only to find that R1235 was nowhere to be found!



A search eventually found R1235. Yaesu had changed the printed circuit board so that the resistor is now on the top side and connects to J1009 pin 1 through a zero ohm 0805 jumper. And it's a tiny 0402 (read low power dissipation) part.



The PCB version is stamped on the board near the connector that leads to the front panel. The unit pictured here is V1 02. If your transceiver has a PCB with the same version or if the layout around J1009 is as shown in the picture above you can install this mod without removing the Main-Unit PCB. If not, you will have to locate the equivalent components for your PCB version of the transceiver. The white wire in the photo on the right has nothing to do with this modification. It is used with another mod, a small PCB for DC on transmit for the front BNC connector.



Circuit Description

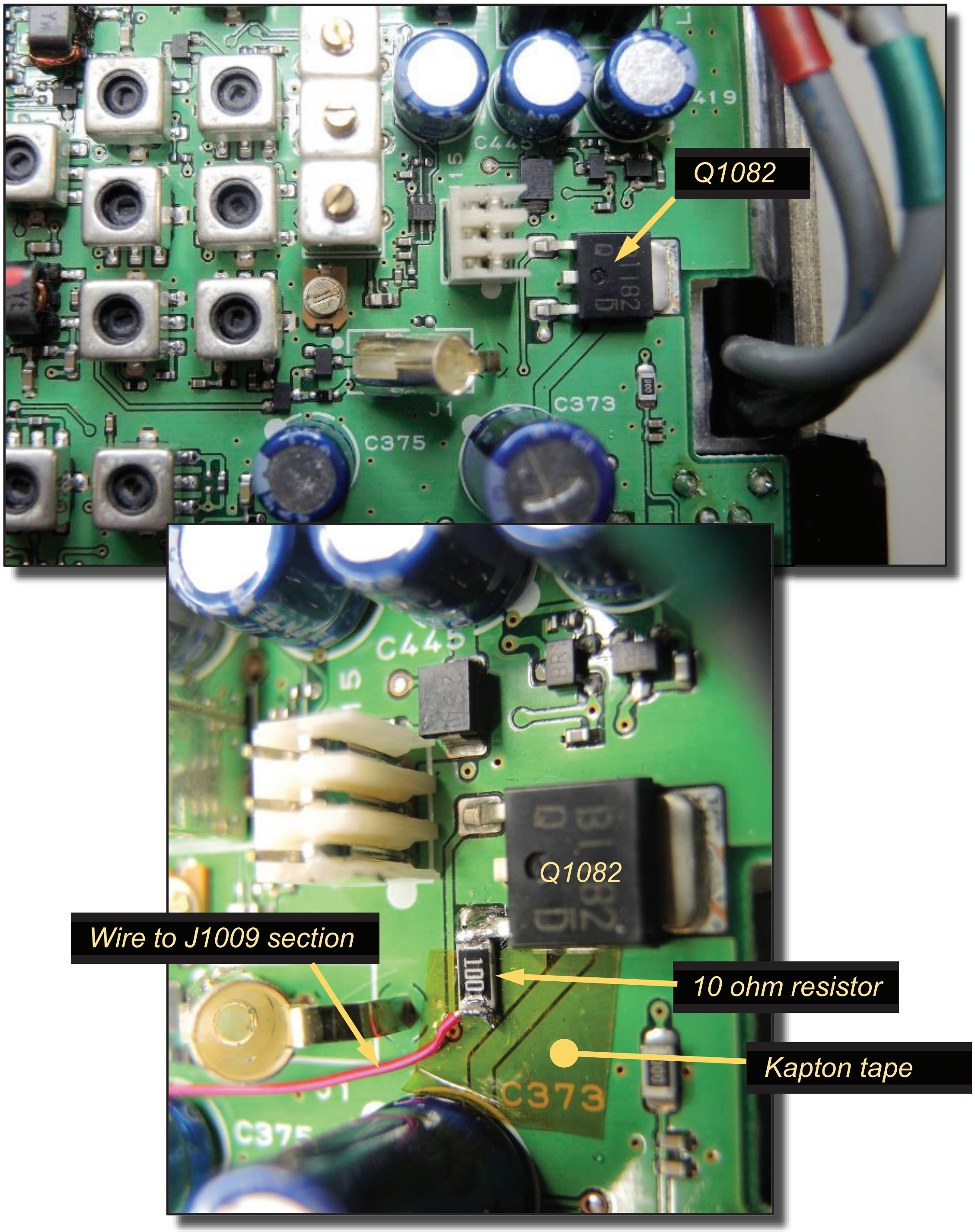
The circuit consists of a surge limiting resistor in series with a resettable PTC fuse that connects from an internal switched rail to pin 1 on the ACC connector. It is designed to provide a voltage supply for the ACC port for load currents of up to around 100 mA.

Q1104 a 2SJ355 30 volt 2 amp Pchannel FET switch located on the bottom of the Main-Unit PCB, is turned on and off with the transceiver's power switch. Q1104's drain provides power directly from the internal battery or an external supply to most of the radio's circuity. This switched supply can be found on the top of the Main-Board at the emitter or Q1082, and it's this point that is used to tap into the switched supply.

The PTC resettable fuse has a trip current of 250 mA and a low current resistance of typically 2 ohms with a specified minimum of 0.9 and maximum of 8 ohms. It's quite fast, taking only about 100 ms at 250 mA to rise to a tripped resistance of about 300 ohms. However for Q1104, the Pchannel FET, 100 ms is an eternity, and the FET could be permanently damaged by a short circuit at the +13.8V ACC port pin because of the low minimum resistance of the PTC fuse. To prevent damage to the PCB tracks and the FET, a 10 ohm resistor is placed in series with the PTC fuse. This limits the initial short circuit surge current to about 1.25 amps. Unfortunately this will raise the +13.8V supply output resistance. It's typically 15 to 16 ohms but at the PTC's maximum specified resistance of 8 ohms the output resistance may be as high as 20 ohms.
As there is also typically about a 300 mV drop across the Q1104 FET, with a 100 mA load the voltage at the +13.8V ACC pin will be 1.8 and 2.3 volts below the input supply voltage. While currents of up to a little over 200 mA can be drawn from the +13.8V pin before the PTC fuse trips, the voltage available at the pin will sag as determined by the output resistance.

Procedure Overview

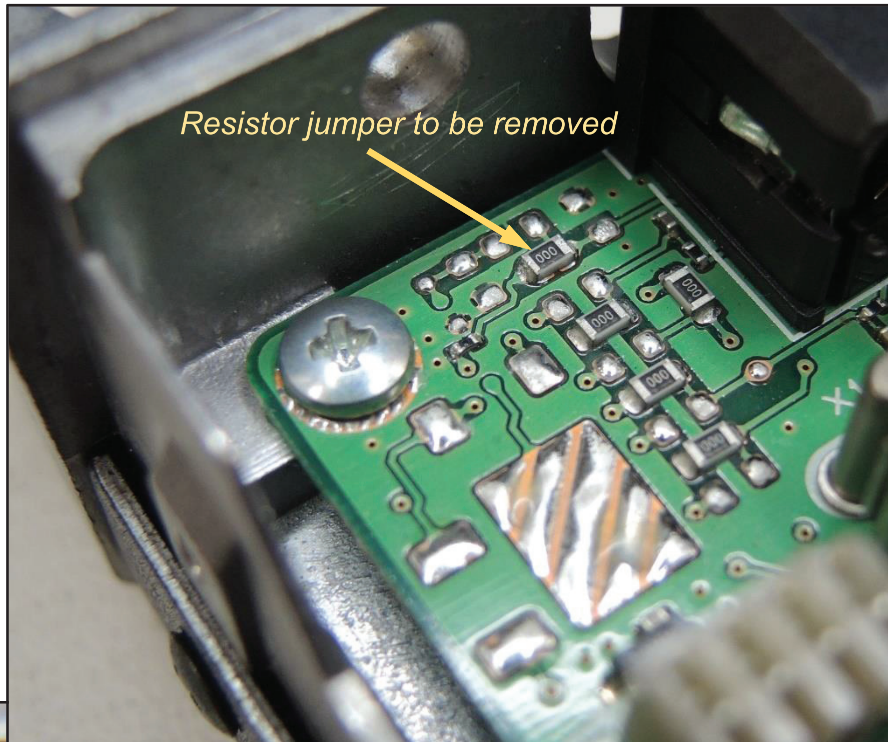
This procedure removes and installs SMD components.
An attachment point for the switched supply buss is found on the PCB top side at the emitter of Q1082. A 10 ohm resistor designed to limit current is then soldered to this node and a wire from the other end of the 10 ohm resistor is routed across the rig to a PCB land near J1009.

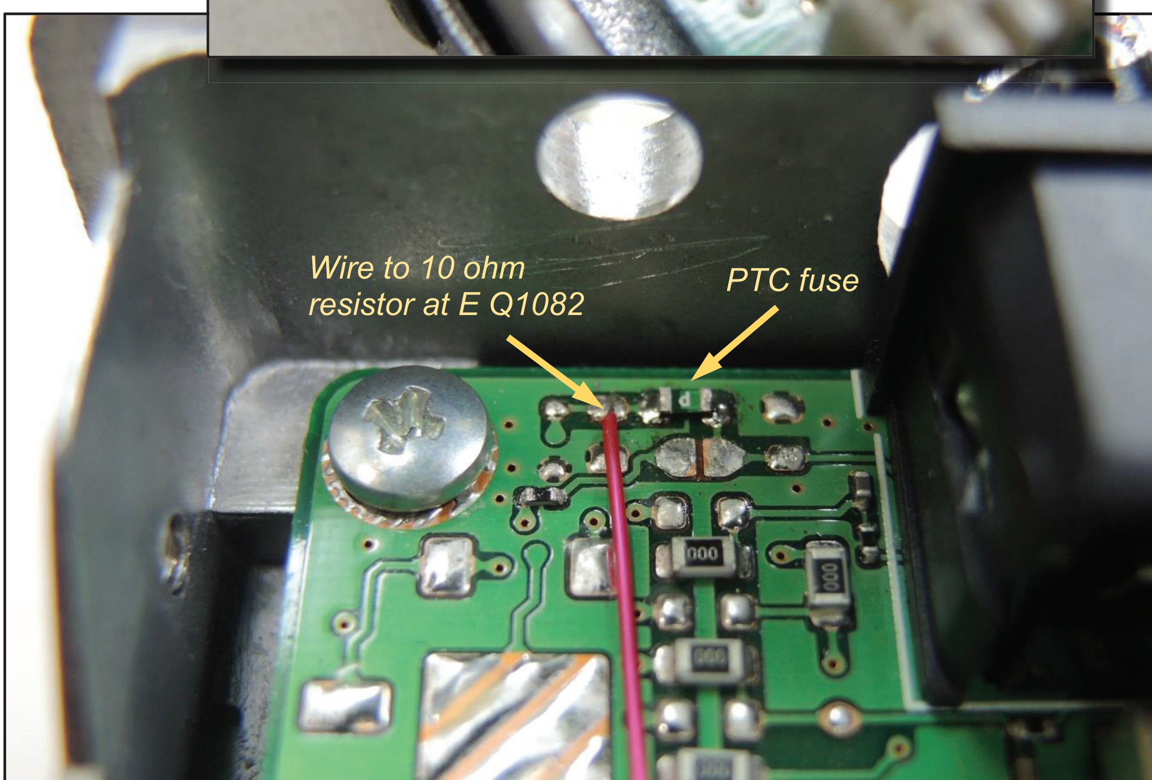


Q1082 before & after modification

The connection from R1235 to J1009 is severed by removing a connecting resistor jumper. A 100 mA PTC fuse is installed on an unused set of PCB lands located above the jumper. The wire leading to the 10 ohm resistor at the emitter of Q1082 is also soldered to a spare land on the left of the PTC.

The other end of the PTC connects to J1009 Pin1 though existing PCB tracks.





PCB around J1009 before & after modification

Note that the hole in the rear panel is not part of this modification, it was used for an MCX chassis bulkhead connector associated with a panadapter PCB interface modification. That connector was removed for these photos.

This modification should cost no more than a couple dollars even if the parts needed are bought in single unit quantities. The procedure will take a couple of hours including the verification testing.

Equipment & Supplies you'll need

- Surface Mount Device (SMD) soldering kit
  - Temperature controlled soldering iron with fine tip. Insure the tip is grounded!
  - SMD Tweezers
  - Fine solder for SMD work
  - Solder wick suitable for SMD work
- A second soldering iron
- Wire cutters
- Wire stripper
- 8 pin Mini-DIN plug
- A 3 ½ digit multimeter
- Variable regulated power supply to power the transceiver.
- Resistors for load testing - 100k ¼ watt, 1k ¼ watt, 100 ohm 2 watts, and 47 ohms 2 watts. The resistor values aren't critical but the resistance should be known so that accurate currents can be calculated
- Alligator clip test leads
- Small Philips screwdriver

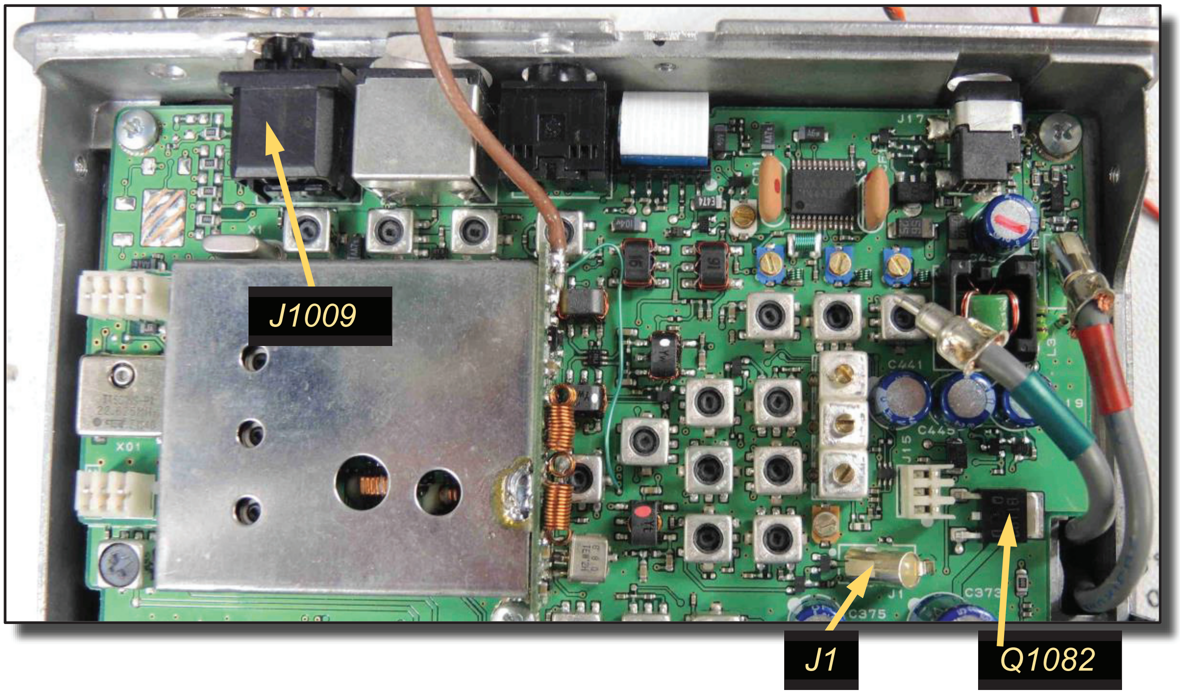
Parts List

Qty	Value	Device	Source	Part No. or Vendor ID
Resistor & PTC				
1	10R	RESISTOR 1206	Digi-Key	RNCP1206FTD10R0CT-ND
1	100mA resettable	PTC fuse 0603 Bel 0ZCM0010FF2G	Digi-Key	507-1818-1-ND
Other Parts				
1	piece kapton tape	about 7x7 mm from 10mm wide roll	eBay	lovesell2103
1	interconnect wire	20cm 30ga insulated wire		Kynar wire wrap wire

Detailed Procedure

1. Disconnect the internal battery. Remember the 13.8V ACC connection isn't switched so is wired directly to the transceiver's battery. The battery must be disconnected before proceeding. To do this place the radio on the workbench so that the battery cover is facing you. Push the cover latch toward the front panel to release the lid latch, then gently lift the battery cover. Disconnect the battery connector and remove the battery setting aside both the battery and its cover.

2. Locate Q1082 and J1009 on the MAIN-UNIT PCB.



3. For convenience unplug the coax cable from the connector marked J1, (J1001 in the service manual). This makes it easier to work around Q1082. In the picture above its shown removed from J1. It's the coax shown dangling in the air with the green tape around it.

Refer to the pictures in the Procedure Overview section above for the following steps

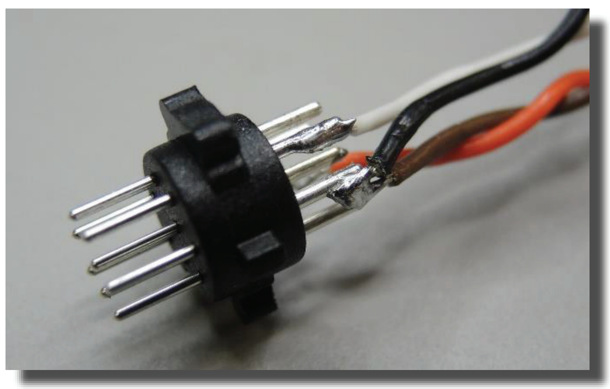
4. Place the 7 x 7 mm piece of Kapton tape on the PCB between the emitter of Q1082 and the adjacent capacitor. This will provide electrical isolation between the PCB and the 10 ohm resistor that is to be soldered onto the emitter of Q1082.
5. Place the 10 ohm 1206 SMD resistor against the emitter of Q1082 and solder it to the emitter.
6. Strip one end of the connecting wire and solder it to the unconnected end of the 10 ohm resistor.
7. Carefully route the interconnect wire across the rig and over to J1009.
8. Re-connect the Rx coax to J1.
9. In the area next to J1009 remove the zero ohm SMD resistor jumper connecting R1235 to J1009. The easiest way to do this is to use two soldering irons, one on each end of the jumper. When the solder melts at both ends remove the soldering iron tips from the PCB. The jumper will likely stick to one of the two irons and can be shaken off and discarded. Make sure the jumper doesn't end up 'lost' inside the rig.

10. Using solder wick remove the solder from the PCB lands where the jumper was located. Also remove the solder from the lands on the track just above the jumper lands.
11. Install the PTC fuse across the two lands just above where the jumper was located (refer to the picture in the Procedure Overview for location details).
12. Cut the interconnect wire to length, strip insulation from the end and solder it to the PCB land to the left of the PTC
13. Replace the battery, reconnect it, and re-fit the bottom battery cover
14. Optionally tack down the interconnect wire to the PCB in a couple place with a dab of hot glue.

This completes the modification. It would be a good time to check all solder joints for quality or bridging

Functional Verification Testing

The following tests insure the ACC jack +13.8V output pin is not shorted, verifies the supply voltage is off when the rig is turned off, and when the rig is turned on, tests the supply output resistance and short circuit protection.



These tests require voltage measurements on the ACC socket pin 1. The tests also require resistors of several values be attached from the +13.8V pin to ground. The easiest way to do this is to solder test leads to a Mini-DIN plug then use clip leads to attach resistors to the end of the test leads. In the adjacent picture there are two sets of wires, the white and black are attached to pins 1 (+13.8V) and 3 (ground), the brown and orange wires were used in a previous test to characterize the TxINH feature of the rig and are not used in this series of tests.

a. With the rig disconnected from an external power source measure the resistance between the +13.8V pin and ground. It should be greater than 2,000 ohms
   - ☐ Resistance _13.8V pin to ground __________ ohms.

b. Connect the rig to an external 14.0 volt power source. Connect a 100k ohm resistor from the +13.8V pin to ground and measure the voltage across this resistor with the rig off. It should be less than 10 mV.
   - ☐ Voltage +13.8V pin to ground __________ mV.

c. Turn the rig on and measure the voltage from the +13.8V pin to ground. The voltage should be greater than 13.7 volts. Note if a 14.0 volt power source isn't available any voltage above 12 volts will be ok. In this case the difference between the external voltage and the voltage at the +13.8V pin should be less than 350 mV. This voltage will be used as the reference for calculating the +13.8V supply's output resistance.
   - ☐ 100k voltage +13.8V pin to GND __________ volts.

d. Replace the 100k resistor with a 1k resistor and record the voltage at the +13.8V pin.
   - ☐ 1k voltage +13.8V pin to GND __________ volts.

   Calculate the output resistance. Subtract the voltage in test d from the reference voltage in test c and divide by the current in the 1k resistor (voltage at the +13.8V pin divided by 1k. The resistance should be less than 18 ohms.
   - ☐ Output resistance with 1k load __________ ohms.

e. Replace the 1k resistor with a 100 ohm resistor and record the voltage at the +13.8V pin.
   - ☐ 100 ohm voltage +13.8V pin to GND __________ volts.

   Calculate the output resistance. Subtract the voltage in test e from the reference voltage in test c and divide by the current in the 100 ohm resistor (voltage at the +13.8V pin divided by 100. The resistance should be less than 20 ohms.
   - ☐ Output resistance with 100 ohm load __________ ohms.

f. Replace the 100 ohm resistor with a 47 ohm resistor and record the voltage at the +13.8V pin. It should collapse to under 3 volts as the PTC's 200 mA trip current is exceeded.
   - ☐ 47 ohm voltage +13.8V pin to GND __________ volts.

   Disconnect the 47 ohm resistor. The voltage at the +13.8V pin should automatically recover as the PTC fuse cools down.
   - ☐ +13.8V pin voltage after 47 ohm load is removed __________ volts.

That's it. The modification has been completely verified and its characteristics recorded for future reference. Put the top cover on the rig and you're good to go.