Motorola Mitrek frequency stability options
by Karl Shoemaker, AK2O

Introduction

This document is supplement to the main Mitrek repeater conversion project. The Mitrek radio, being a mobile, frequency stability should be good enough for most repeater projects. However, there are a couple items to keep in mind. You may note that new crystal will drift around during the first part of the aging process. Receiver elements run all the time; the transmitter does not during standby. Therefore, it will take much longer for the Tx frequency to settle down. To correct this may take a few (expensive) trips to the site over a year or two.

Solutions - modifications

To help "age" the transmit crystal it and the channel element can be left on full-time. This will require modifying the 9.5v lines for the early stages of the transmitter section. Stock has the first two multiplier stages "hot" (power applied) all the time, while the channel element (and crystal) is cold and only "hot" while the radio is keyed. You need to reverse these two section's operation. To do this, you need to make two PCB run cuts and install two jumpers. Two options were researched for your choice. The schematics later on in this document will also illustrate the differences.

The first run cut isolates the channel element from the "Tx 9.5v" line. Then install a jumper from the positive end of C747 to CE3, pin 3, which is a source of "Reg. 9.5" line. It's not necessary to install the jumper at the capacitor location mentioned; just that they are easy to locate since they are bypass caps. The second run cut isolates the first two multiplier stages from the "Reg. 9.5v" line. Then install a jumper from the positive end of C756 to the positive end of C907, which is a source of "Tx 9.5v" line. In case you're advanced in soldering there are alternate locations, described later on in this document. The following schematics will further clarify the modifications:

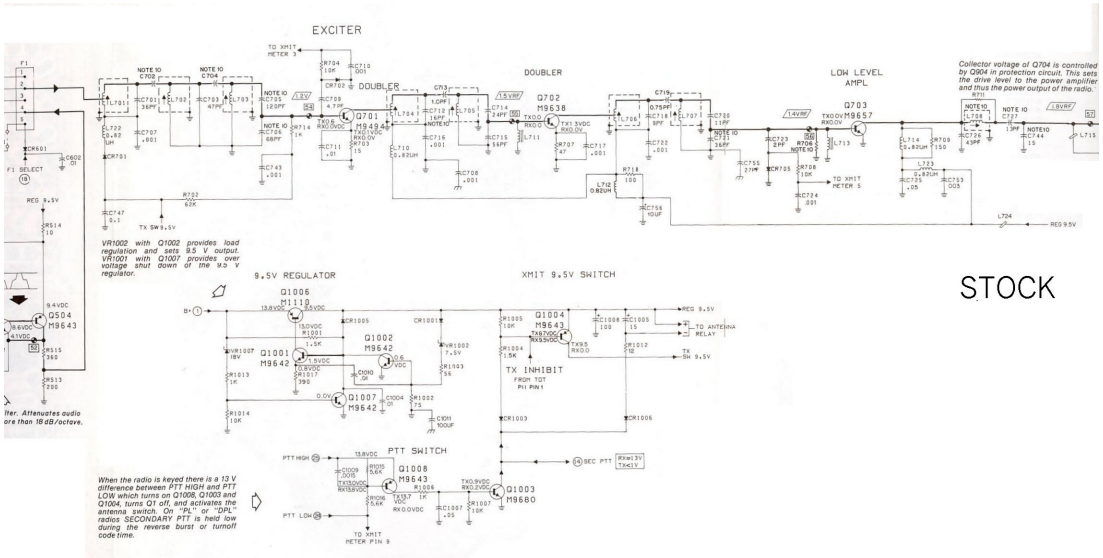
<u>Stability Options:</u>

- Stock is the channel element being cold as well as some the multiplier stages, while others sections are off during standby.

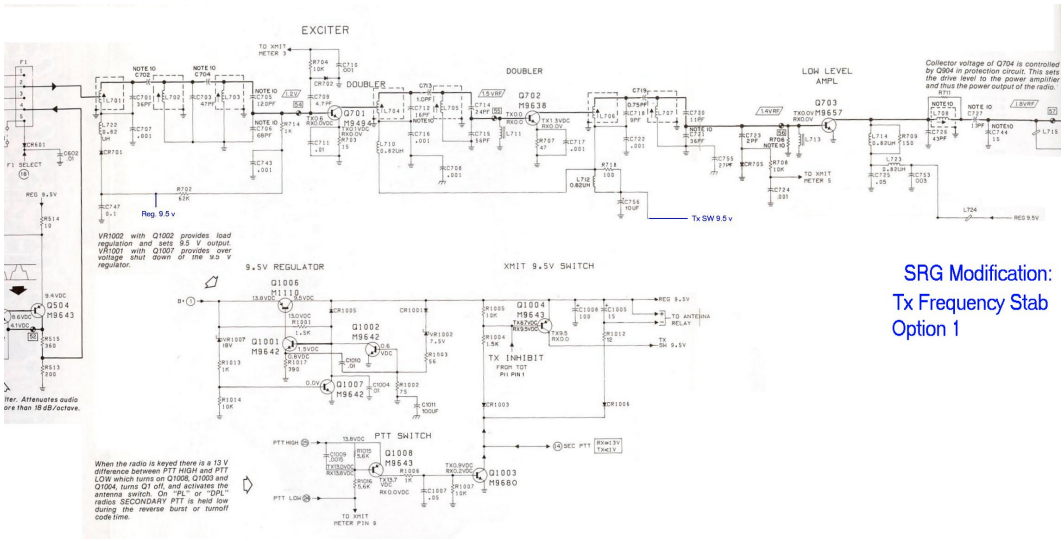
- Option 1 is to run the Tx channel element full-time, while the first two multiplier stages are switched on when the radio is keyed. As previously described, this requires two PCB run cuts and two jumpers.

- Option 2 is to run the Tx channel element and first multiplier stage full-time, while the second multiplier is switched on when the radio is keyed. This requires option 1 modifications, plus, moving a choke. There's a note about this choke near the end of this document.

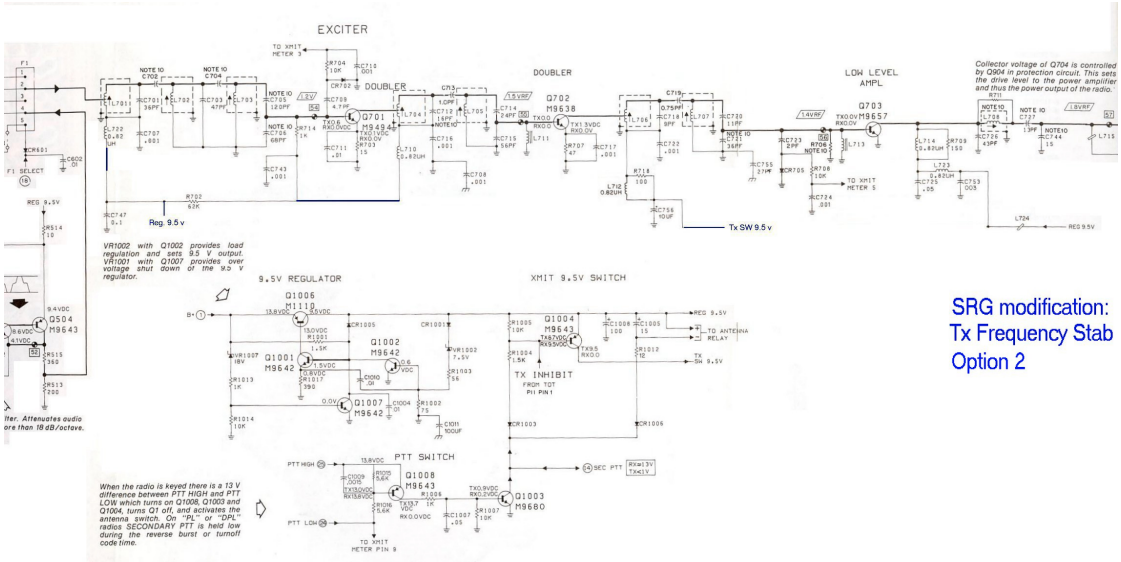
After checking out the schematics, the board layout modifications are on the next pages:



STOCK

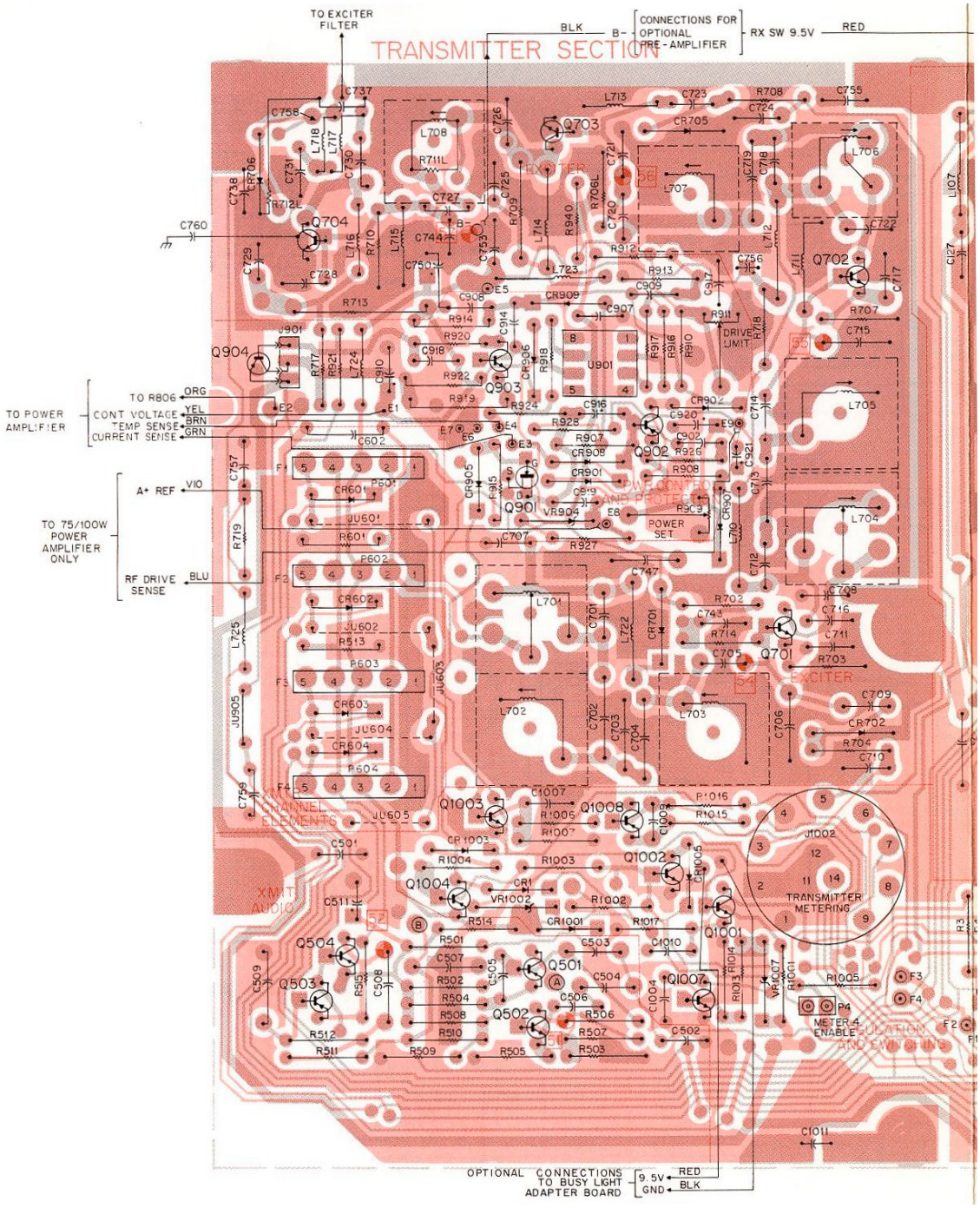


SRG Modification:
Tx Frequency Stab
Option 1



SRG modification:
Tx Frequency Stab
Option 2

Stock:


TRANSMITTER SECTION
TO EXCITER FILTER
BLK
B-
CONNECTIONS FOR OPTIONAL PRE-AMPLIFIER
RX SW 9.5V
RED
TO POWER AMPLIFIER
TO R806
ORG
CONT VOLTAGE
YEL
TEMP SENSE
BRN
CURRENT SENSE
GRN
TO 75/100W POWER AMPLIFIER ONLY
A+ REF
VIO
RF DRIVE SENSE
BLU
POWER CONTROL AND PROTECTION
POWER SET
DRIVE LIMIT
EXCITER
TRANSMITTER METERING
METER 4 ENABLE
OPTIONAL CONNECTIONS TO BUSY LIGHT ADAPTER BOARD
9.5V
RED
GND
BLK

Modification:

Tx Freq Stab:

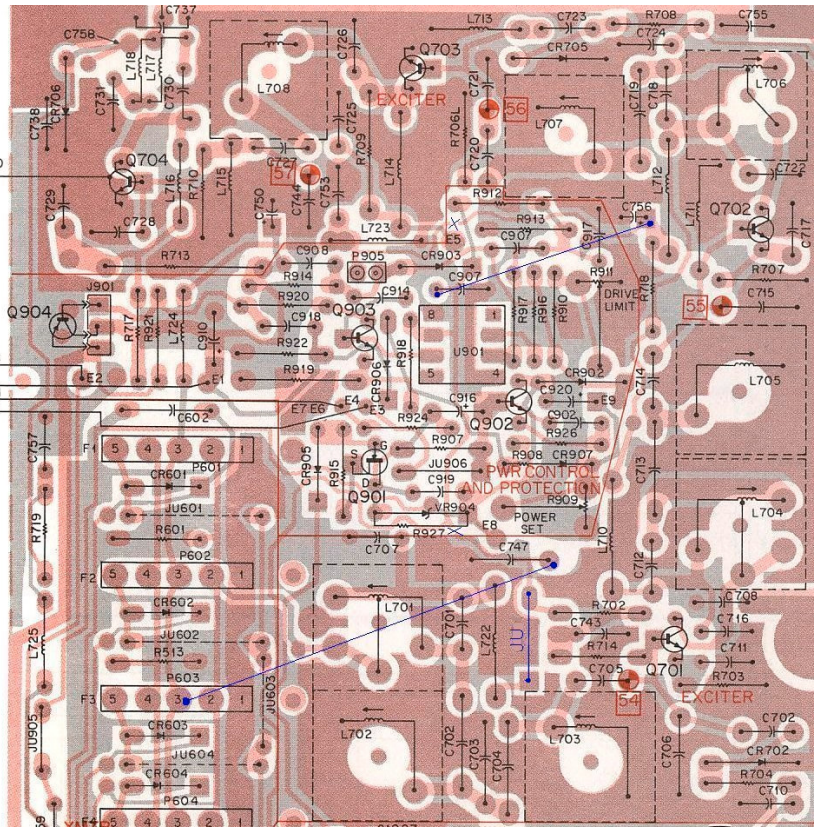
Option 1

Run cut near E5 → then a jumper to C756+
(Tx sw 9.5v)

Run cut near E8 → then jumper to C747+
(Reg 9.5v)

CR701 is jumpered
for a stock radio;
so just remove CR701

Early version radio



Modification:

Tx Freq Stab:

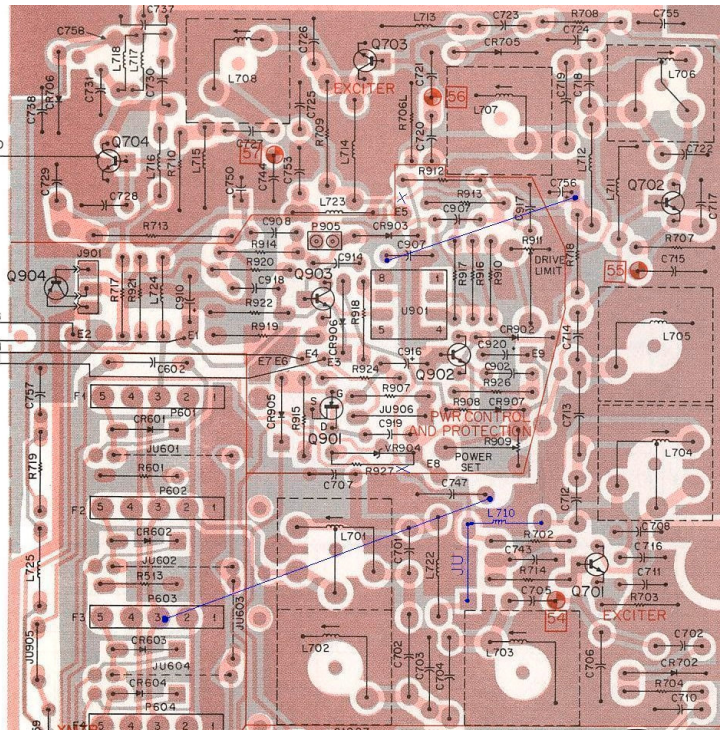
Option 2

Run cut near E5 → then a jumper to C756+
(Tx sw 9.5v)

Run cut near E8 → then jumper to C747+
(Reg 9.5v)
Also move L 710 →

CR701 is jumpered
for a stock radio
so just remove CR701

Early version radio



A word or two on the options. The PTT keyed 9.5 is controlled by Q1004, a PNP switching transistor, M9643, which crosses to a NTE159, which specs a maximum of 1 amp for collector current.

- Stock, this switches supplies 28.3 ma to the channel element circuitry only.
- Option 1 supplies 49.2 ma to Q701 and Q702 collector (but not Q701 base).
- Option 2 supplies 45.1 ma to Q702 only.

Either option is plenty below the limits of this device. Also, in any options (or stock) a very small amount goes to the power control circuitry involving U901.

After installing the new channel element and setting the frequency on, first drifting will typically occur in the next 5 hours; about 270 Hz up, then in 30 hours settling 340 Hz high. From that you can re-net on frequency for the operation. This was based on serial 44 with one of the options thus, running the channel element full time.

Alternate jumper location:

As previously mentioned, you may have advanced soldering skills. The second jumper (earlier described) can be greatly shortened (about 5mm). Make your run cut closer the Tx Reg 9.5 line). The images will clarify this choice: However, this increases the chance of a solder bridge, so check carefully with a magnifying glass after cleaning the rosin off the PCB in that area..

Frequency adjustment:

The frequency still may move around a bit due to loading on the channel element and its crystal. For example, if the element is running, by turning on Q701 will shift the operating frequency about 100 Hz. Q702 has less effect. Because of the option modification there will be some shift between keyed and unkeyed. Option 2 reduces this effect by half, being an advantage. Even by tuning (per OEM manual) the early stages change the reflected impedance (load to the crystal) thus, changes the operating frequency a little. Therefore, key the radio (with RF output) for the final (precise) netting.

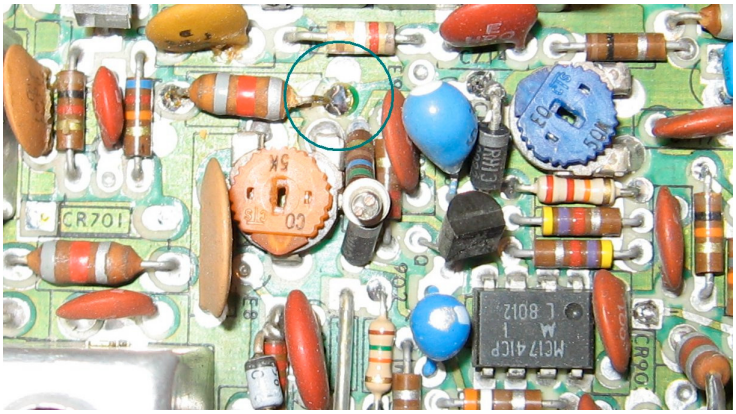
RF levels:

OEM supplies the “9.5” Tx voltage to the first stages of the transmitter via regulator Q1006 and switch Q1004. One OEM latter stage voltage is supplied only with switch. Reason the quotations are used because these are ***nominal*** voltages and not exact. There is a possibly of a little voltage drop through both of these transistors; each for some of the stages. Most likely OEM knows this and designed the circuits (and it’s RF drive levels) around this. Therefore, OEM works as planned.

Assuming this theory is correct, option 1 early circuits bypass the switch’s voltage drop (but not the regulator) but also one latter stage that is supplied with both the regulator and switch. Option 2 early circuits also bypass the switch however, not the regulator. Because of this, the exact operating voltages on the stages may vary from OEM design.

During construction and operational tests, it was observed (at least in one unit) that option 2 produced a stronger fundamental carrier (on CE/crystal frequency) plus, stronger harmonics of that fundamental. Harmonics are needed for the multiplier circuits so one can tune (select) the correct harmonic to result the correct operating frequency output to the PA stages while operating within OEM design parameters.

If this is a concern while operating at a populated site you may consider either option 1 or stock. In the case of serial 44, the Author restored the unit from option 2 to 1. L710 leads can be carefully (twisted) back to its original spot **once** without the threat of the lead breaking.



In some cases the leads may be not straight, plus one may be too short to come back into the eylet of the PCB. If its close you can flood the eyelet so it flows through the hole plus, add a little solder on the component side as shown here, with the teal circled area.

Some images may not be clear enough, therefore, seek the OEM manual for the drawings. Higher resolution pictures may be available in the future for a modest cost for S&H. Contact the web site for details.

 Most of the developments and corrections were made in June~August of 2004, with updates in Sept. 2005, October 2008, April 2014, October 2015, May 2016 and July 2018.

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