

**Gibby Work Document 4/9-4/10 2021**  
**UHF Repeater Evaluation / Maintenance**

**12-VDC Powered Motorola Repeater Unit**

Indication: Unit suffered mechanical damage during a fall in a recent transport & was requested to test unit and duplexer

Test of Transmit / Receive Frequencies

Unit excited by UV82C handheld while terminated in a UHF dummy load with -35dB tap; 40dB additional pads to Siglent Spectrum Analyzer

Receiver channel	Tranmitter Channel	Squelch/Tone Squelch	Observed Frequency
P1	P1	123.0	output at 464.500 MHz - checks good
P2	P2	203.5	output at 464.550 MHz - checks good

Additional channels were not tested at this time.

Receiver was activating apparently normally from transmissions of UV82C suggesting adequate receiver tuning.

**Duplexer Tests**

LO PORT

Tracking Generator via 6dB pad, double shielded coax to LO freq duplexer port.

RF input of Spectrum Analyzer through 6 dB pad, double shielded coax to ANTENNA duplexer port  
50 ohm UHF load connected through double shielded coax to HI freq duplexer port.

PASS:

464.50 -1.88 dB Good transmit pass

464.55 -1.90 dB Good transmit pass

REJECT

469.50 -74 dB

469.55 -71 dB

Ultimate rejection noted -91dB at frequency 469.168. Implies HI port rejection is off by approximately 0.4 MHz.

HI PORT

Tracking Generator via 6dB pad, double shielded coax to HI freq duplexer port.

RF input of Spectrum Analyzer through 6 dB pad, double shielded coax to ANTENNA duplexer port  
50 ohm UHF load connected through double shielded coax to LO freq duplexer port.

PASS:

469.50 -1.52 dB Good transmit pass

469.55 -1.51 dB Good transmit pass

REJECT

464.50 -81 dB

464.55 -77 dB

Ultimate rejection noted -81 dB at frequency 464.44. Imples reasonably close to optimal tuning.

INTERVENTION:

Adjusted spectrum analyzer to get noise level down to -95 dB, by using very narrow bandwidth (1-3kHz), preamp, and readjusted LO port for notching:

469.5 approx -100 dB

469.55 approx -93 dB.

-80 dB points were at 469.24 and 46968 MHz, plenty wide enough.

Insertion losses were still in the -1.5 dB range.

SWR FROM TRANSMITTER (Antenna port terminated with 50 ohm load) measured approx 1.2:1 using inexpensive Workman 104 SWR meter. Poutput measured approximately 30+watts on both P1 and P2 frequencies.

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### **AC- Powered Motorola Repeater Unit**

Indication: Unit was reprogrammed by volunteers in Miami fire dept and unclear if duplexer was retuned; "scratchy" audio and low range noted.

Test of Transmit / Receive Frequencies

Unit excited by UV82C handheld while terminated in a UHF dummy load with -35dB tap; 40dB additional pads to Siglent Spectrum Analyzer

Receiver channel	Tranmitter Channel	Squelch/Tone Squelch	Observed Frequency
P1	P1	123	output at 464.500 MHz - checks good
P2	P2	203.5	output at 464.550667 MHz - checks good

Additional channels were not tested at this time.

Receiver was activating apparently normally from transmissions of UV82C suggesting adequate receiver tuning.

### **Duplexer Tests**

### **LO PORT**

Tracking Generator via 6dB pad, double shielded coax to LO freq duplexer port.  
RF input of Spectrum Analyzer through 6 dB pad, double shielded coax to ANTENNA duplexer port  
50 ohm UHF load connected through double shielded coax to HI freq duplexer port.

PASS:

464.50 -1.49 dB Good transmit pass  
464.55 -1.50 dB Good transmit pass

REJECT

469.50 -66 dB INDADEQUATE NOTCH

469.55 -67 dB INDADEQUATE NOTCH

Ultimate rejection noted at frequency 469.95. NEEDS READJUSTMENT Imples HI port rejection is off by considerable amount

HI PORT

Tracking Generator via 6dB pad, double shielded coax to HI freq duplexer port.

RF input of Spectrum Analyzer through 6 dB pad, double shielded coax to ANTENNA duplexer port  
50 ohm UHF load connected through double shielded coax to LO freq duplexer port.

PASS:

469.50 -1.91 dB Good transmit pass  
469.55 -1.88 dB Good transmit pass

REJECT

464.50 -69 dB INDADEQUATE NOTCH

464.55 -72 dB INDADEQUATE NOTCH

Ultimate rejection noted at frequency 465.03 . NEEDS READJUSTMENT.

INTERVENTION:

Adjusted spectrum analyzer to get noise level down to -95 dB, by using very narrow bandwidth (1-3kHz), preamp, and readjusted LO port for notching:

Retune HI

464.5 adjusted to -90 or better

464.55 adjusted to -90 approxmately

Insertion losses were approx -1.8 on 469.5 and 469.55 MHz

Retune LO

469.5 approx -87 dB

469.55 approx -85 - -88 dB.

Insertion losses were still in the -1.68- -1.70 dB Good

SWR FROM TRANSMITTER (Antenna port terminated with 50 ohm load) measured approx 1.8:1 using inexpensive Workman 104 SWR meter. Small adjustment of LO side tuning screws did not seem to improve this much. With little time remaining for futher optimization and no inline directional port (I didn't have time to set up the additional equipment to operate simultaneous return loss) I decided

to just leave this as it was. It isn't as good as I would like but my skill level and available instruments at time at that point, the best that I could do. Would need to put in directional coupler and 2nd spectrum analyzer to simultaneously measure return loss to get this better at same time as keeping low pass side of duplexer properly tuned for notch.

#### RANGE TESTS

Using HUM mast new antenna, measured an SWR of approximately 2:1 using Workman 104 SWR meter, at the transmitter end of approximately 50 feet of coax. This is a higher SWR than optimal, but we didn't have time to further investigate. Need to sweep this antenna and determine where it is resonant and move the resonance a bit to get the SWR lower at our end; using this much coax the SWR should have been better.

Range testing as difficult to do as we had a LARGE hill going out of town, and multiple smaller hills going into town. Using a 4-watt handtalkie to a roof mag mount, I found I could make comms to the base area work up to 2.5 - 3 miles when I was on hill tops. I did not study the hill valleys. The signal from the Repeater was still strong at that point but MY signal was not able to activate the repeater any further.

#### ODD CRACKLING

On BOTH repeaters, using the HUM mast antenna, we had a strange intermittent popping / crackling noise on top of otherwise excellent audio at close ranges (< 1 mile). This seemed actually less of a problem as I moved farther away from the repeater. Not able to repeat that further, other than to note that when we switched to a fold-up mast antenna on the PCC trailer with an SWR of 1.2 at the ground level cable end, the crackling seemed to go away! Unclear if the cause was the elevated SWR? This needs further investigation. We were much more satisfied with the operation of the repeater on the fold up mast at that point, than using the HUM antenna, but this can be fixed with some more time and work.