Quantar VHF Range 2 to Range 1 Amateur Band Modification
One quick approach (Rough Draft)
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The following information assumes the reader is already familiar with the Quantar and the Quantar Programming/Alignment Software

Note: Review this entire document before proceeding with any modifications.

Note: This document is a work in progress hence a Rough Draft as noted above. As more Quantars are modified, additional items of significance continue to surface and will be incorporated into this document.

The objective is to modify the Range 2 VHF Quantar to operate as low as possible in the 144-148 MHz range with the least amount of work involved. Note: This is not a procedure to convert a Range 2 unit to a fully functional Range 1 unit (132 -154 MHz). Results seem to vary from unit to unit. Some exciter modules will function reliably down to 144 MHz while others will not, however, good stable results have been achieved with all exciters with frequencies above 144.5000 MHz. All receiver modules modified so far seem to function well down to 144.0000 MHz.

IMPORTANT: First confirm the Quantar is fully functional as a Range 2 unit. If assembling a station from assorted modules it is suggested you perform the TX deviation alignment as a Range 2 unit before proceeding. In any case, whether you do a TX deviation alignment or not, record the four deviation values listed on the RSS Service folder Alignment Screen Tx Deviation tab as they may be needed in the workaround as detailed on the Workaround for the VHF R2 to R1 Exciter Tx Deviation Alignment Issue page of this document. If comfortable with the station setup as a Range 2 unit, proceed to the R2 to R1 modifications. For future reference, on the RSS Service folder Metering Screen, note how the Range 2 PA, Exciter and Receiver Module ID's are displayed.

R2 to R1 Modifications

Next step is to change and/or move a few chip resistors so that the PA, Exciter and Receiver Modules will report to the SCM as Range 1 Modules (see accompanying diagrams).

> **PA: Loosen the torx fasteners to remove the side cover. To have the PA to report to the SCM as a Range 1 Module, in the lower right shielded compartment a 20.5 kΩ resistor needs to be installed at R4162 (R2 operation has this spot open) and at R4163 a zero Ω resistor needs to be removed and a 10 kΩ installed in its place. 1206 SMD resistors are used for this application. Note: Be aware there are at least two or more PA versions that may or may not match the component locations as shown on the two accompanying PA diagrams.**

> **Note: To remove the covers on the Exciter and Receiver, a large slot head screwdriver held firmly perpendicular to the case while twisting at the retaining dimples seems to work well.**

> **Exciter: To have the Exciter report to the SCM as a Range 1 Module, in the shielded microprocessor compartment the 1 kΩ resistor at R3701 needs to be moved to R3700. A 1206 SMD resistor is used for this application.**

> **Receiver: To have the Receiver report to the SCM as a Range 1 Module, in the shielded PLL Synthesizer compartment the 3.3 kΩ resistor at R2415 needs to be replaced with a 0Ω resistor. A 0805 SMD resistor is used for this application.**

At this point it is suggested the modules be installed without covers and RF cables not connected. Allow the radio to boot up. Don't worry about any programming now. Launch the RSS and read the codeplug. In the Service folder Metering Screen, observe the Module ID's on the Exciter/PA and Receiver 1 tabs to insure the modules are now reporting to the Station Control Module (SCM) as Range 1 VHF Modules. If the modules report correctly, remove them from the chassis. Fasten the PA cover as the modifications to this module are complete.

Note: Initial PA testing showed no need to disturb the internal Range 2 circulator for Range 1 Amateur use, however, I would recommend the use of an external single or dual stage circulator once the modified Quantar is placed into service.

VCO Modifications

The next step is to modify the Exciter VCO and the Receiver OSC 1 to lock as low as possible. The results may vary from module to module. The following readings can be viewed in the Service folder Metering section of the RSS.

Ordinarily 1.0 VDC would be the lowest satisfactory level for reliable Exciter operation. The 1.0 VDC is based on those exciters that drop out of lock at about 0.8 VDC leaving roughly a 0.2 VDC cushion. I have experienced at least one exciter VCO that dropped out of lock at 1.059 VDC so later on it may be a good idea to check at what frequency the out of lock condition occurs and add an appropriate cushion for the reliable lowest frequency of operation.

2.00 is probably the lowest satisfactory level for reliable receiver operation. All of the receivers modified so far have had no issue exceeding the 2.00 value at 144.000 MHz.

Exciter VCO Modification (Microprocessor Compartment)

Remove the original lower and upper VCO cores from L3232 and L3202. Obtain four replacement cores from a Midland Low Band VHF or High Band VHF Syntech donor transceiver. Sometimes these Midland radios are known as Syntec one's In both L3232 and L3202, seat one Syntech core against the circuit board followed by seating the remaining two cores against the two cores just installed. This configuration allows the VCO to lock with a substantially higher voltage as opposed to the original Quantar cores thus extending the lower frequency range of the upper VCO without further circuit modification. (Side note: The Exciter change from upper to lower VCO occurs at 142.5000 MHz. Even though the lower VCO will not be used for amateur operation, I found it advantageous to double core both L3232 and L3202 for the purpose of doing the deviation alignment especially if the alignment workaround is necessary.)

Receiver OSC1 Steering Line Modification (Dual VCO Compartment)

Remove the original core from upper VCO L2232 and in a similar fashion to the Exciter VCO Modification, install two Midland cores in L2232. For the purpose of this modification found it unnecessary to disturb the lower VCO L2202. (Side note: The Receiver change from upper to lower VCO appears to occur at 143.0000 MHz.)

At this point if you're comfortable with your modifications, install the covers and install the modules in the chassis connecting all RF cables.

Boot up the radio and download the codeplug, Make the following changes to the codeplug:

- **Configuration Folder, Hardware Configuration: Change Rx Freq Band 1 and Tx Freq Band to VHF_R1. PA Power Rating: 125W. Don't attempt to Validate Configuration at this time.**

- **Configuration Folder, Access Code Table: Enter PL's to be used for testing.**

- **Configuration Folder, Channel Information, Basic tab: Select test frequencies at the lower end of the repeater band for Rx 1 and Tx.**

- **Configuration Folder, Channel Information, Advanced tab: Tx Power Normal 125 Watts**

Write this codeplug to the radio. Once written to the radio, this should be enough information to Validate Configuration in the Configuration Folder, Hardware Configuration screen.

You can now proceed to the alignment in the RSS Service folder along with any additional programming. If you encounter an alignment issue with Freq 3 on the Tx Deviation tab, Take a look at the Workaround for a VHF R2 to R1 Exciter Tx Deviation Alignment Issue page in this document.

As mentioned earlier, you may wish to load frequencies below 144.500 and view the resulting Exciter VCO Steering Line Voltage and Receiver Steering Line Level of OSC1 to determine the actual lowest satisfactory operating frequencies of the individual modules. Again, these values can be viewed in the Service folder Metering section of the RSS.

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A little background: A couple decades ago, I attended Quantar classes in Schaumburg. During lunch break I had a discussion with one of the class instructors, who was also a ham, about the possible use of the VHF Range 2 Quantar in the amateur band as eventually there would be a ton of these on the surplus market here in the United States. He had also given the subject some thought. In that type acceptance would not be a consideration in this situation; his thought was to simply change only the chip resistors that determine the range reported to the SCM by the receiver, exciter and PA. Although there are a number of component value differences between the R2 and R1 modules, his philosophy was if the all components involved were 20% tolerance rather than 5% almost if not all the values would overlap between the two ranges. Lunch was then over and that bit of info was shelved some 20+ years ago. Move ahead to 2022. Now I never had much interest in the Quantar for my own amateur radio use as most of my repeaters are located at solar powered sites, however, a Range 2 VHF transmitter / Range 1 VHF receiver Quantar showed up on my doorstep with a challenge to get the unit working in the lower portion of the 2 meter repeater band i.e. 144 to 146 area. My specific task was to achieve a method to raise the exciter VCO voltages to a reliable operational level for stable operation. Later on it was found that same technique worked for modifying Range 2 receivers to Range 1.

Miscellaneous Quantar Information

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VCO Modification Slugs

Tom K8TB passed along another source for the VCO modification slugs. I've placed an order; however, I have not had the opportunity to see how they compare to the Midland Syntech 1 slugs as mentioned in the modification documents.

https://www.ebay.com/itm/154941807643

Quantar Fasteners

If you need additional fasteners, they are M3.5-0.6. Common lengths for the Quantar are 8mm and 12mm.

Quantar Power Supply Notes

I had a couple bad 1048 supplies with good battery charger boards. I also had a few 1047 supplies that it would be nice to add the battery charging feature i.e. convert them to 1048 units. Discovered 1047G and 1047H units were not compatible with the charger board from a 1048F unit (physical interference between toroids on two of the boards). However, boards from a 1047F unit were compatible with the charger board from a 1048F unit.
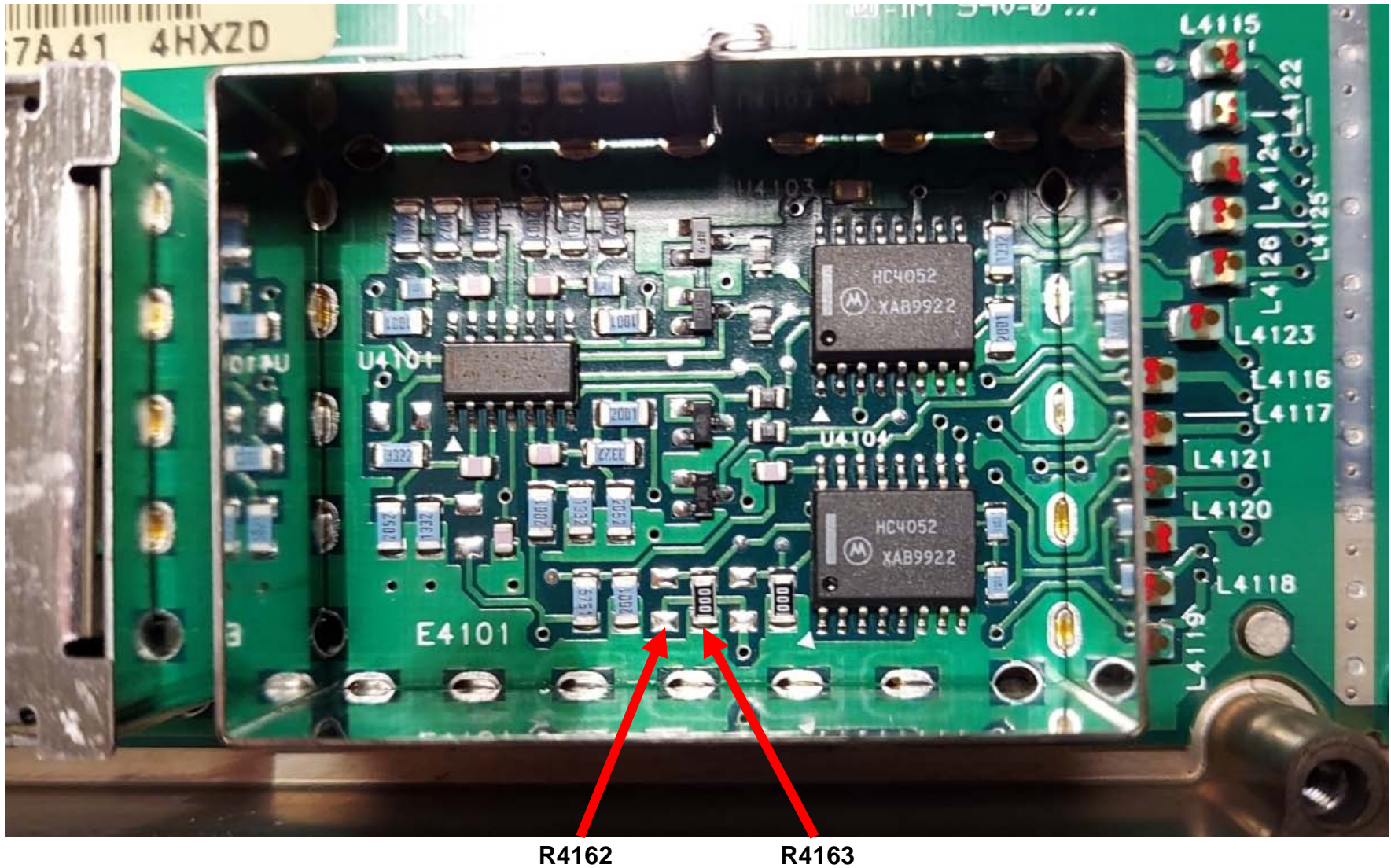
Quantar VHF PA Range Select Resistors

	R4162	R4163
125W Range 2	Open	0 Ω
125W Range 1	20.5 kΩ	10 kΩ
25W Range 1 & 2	12 kΩ	68 kΩ

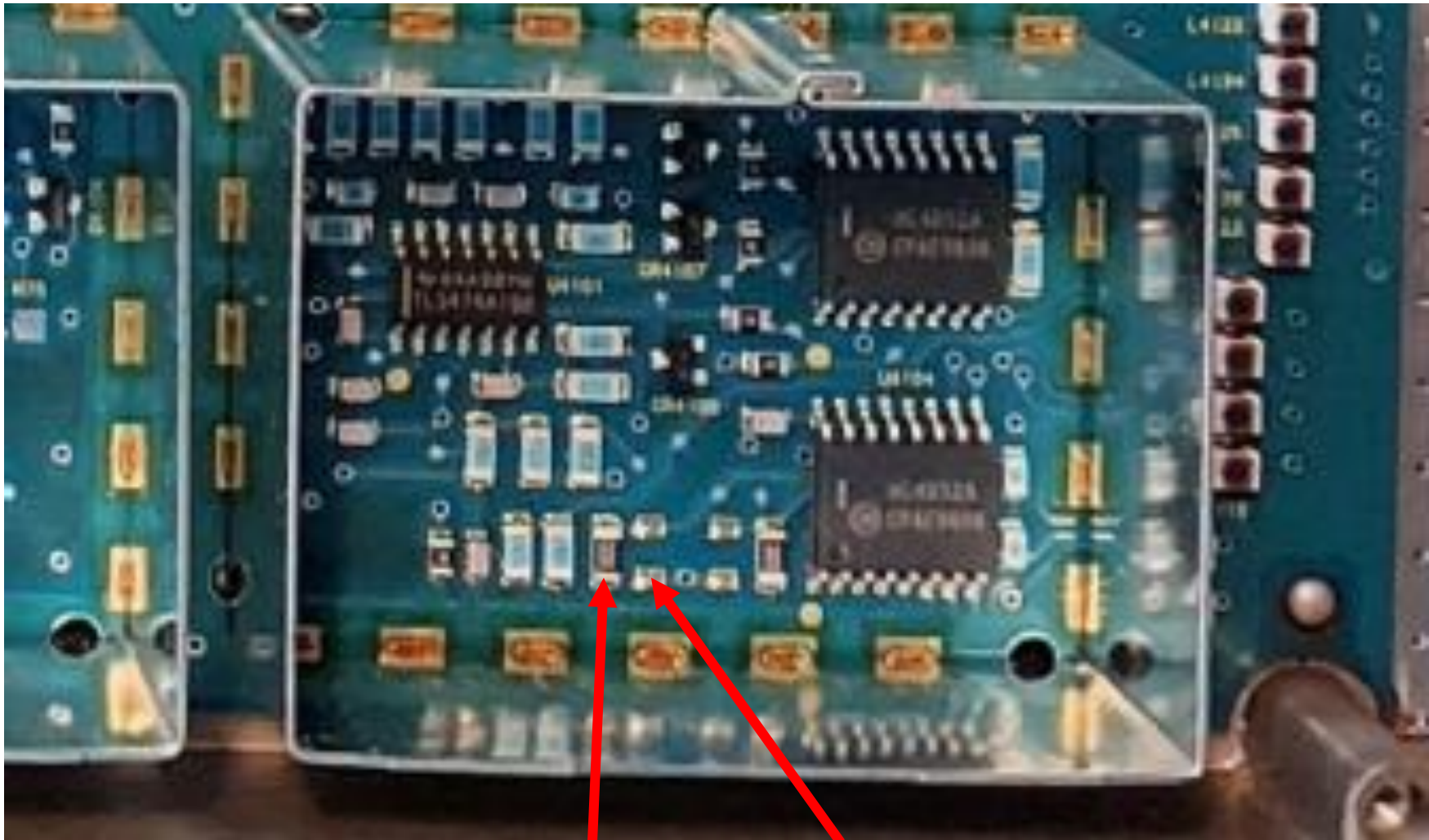# Quantar VHF PA Physical Layout
Rob Lee K7TGU – rob@k7tgu.com
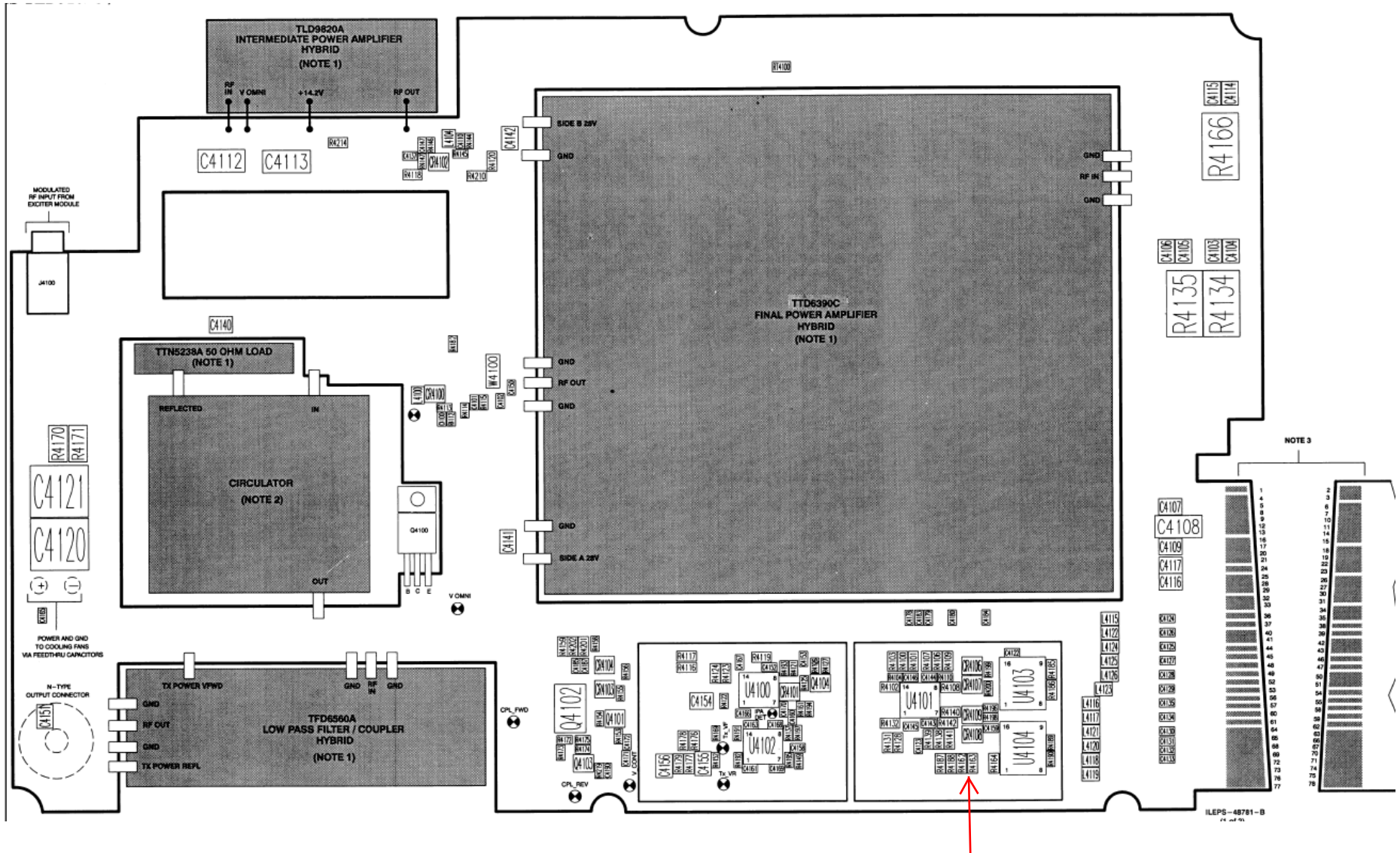
Quantar VHF PA Lower Right Shielded Enclosure
Range 2 to Range 1 Amateur Band (Range 2 configuration shown)
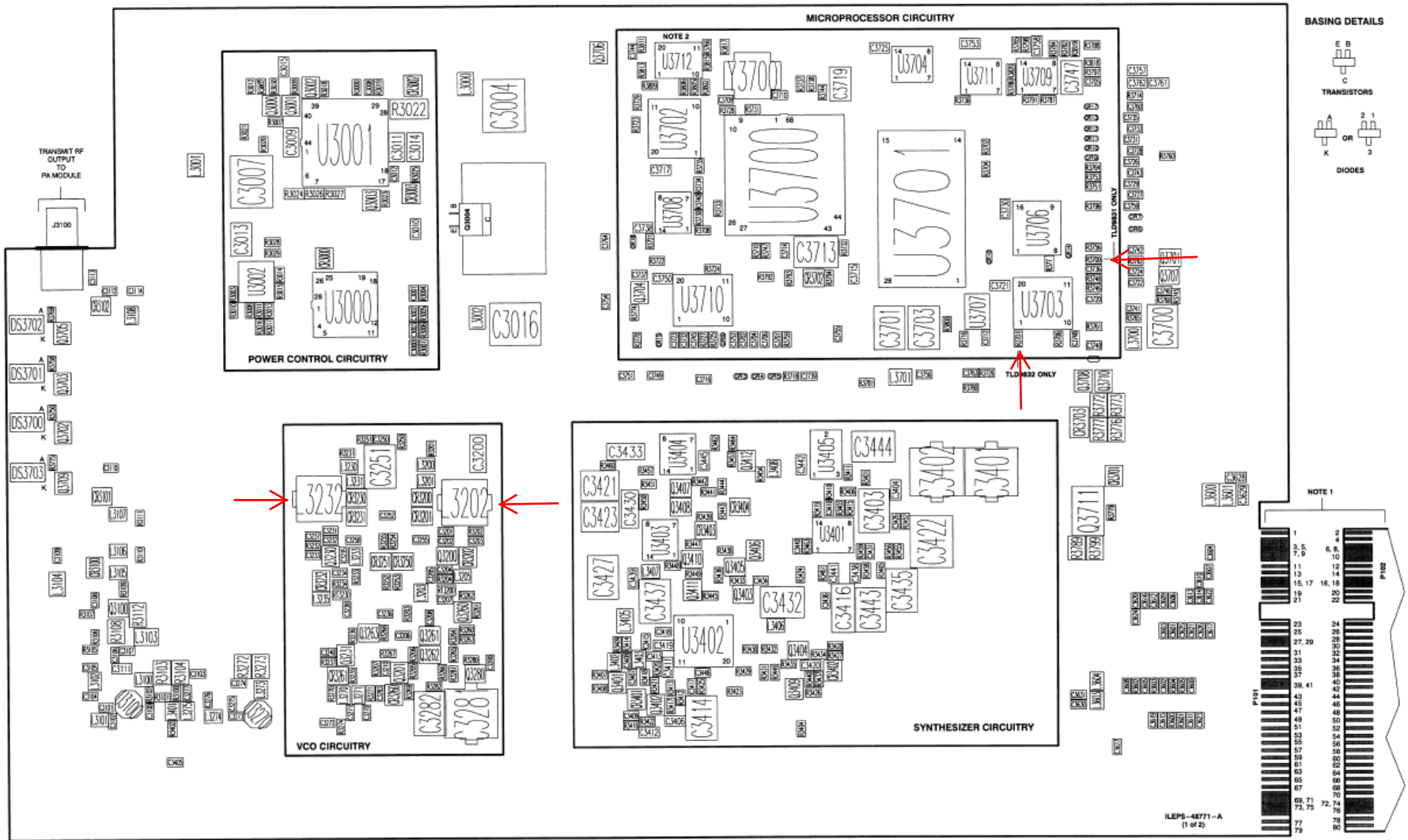### Rob Lee K7TGU – rob@k7tgu.com

R4162   R4163

This is one possible Range 2 configuration. Configurations will vary.

To have the PA report to the SCM as a Range 1 unit, a 20.5 kΩ resistor needs to be installed at R4162 (this location is empty for Range 2 operation as shown above) and at R4163 a 0 Ω resistor needs to be replaced with a 10 kΩ resistor.

Quantar VHF PA Lower Right Shielded Enclosure
Range 2 to Range 1 Amateur Band (Range 2 configuration shown)
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R4163   R4162

This is one possible Range 2 configuration. Configurations will vary.

To have the PA report to the SCM as a Range 1 unit, a 20.5 kΩ resistor needs to be installed at R4162 (this location is empty for Range 2 operation as shown above) and at R4163 a 0 Ω resistor needs to be replaced with a 10 kΩ resistor.

Quantar VHF Exciter Physical Layout

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Quantar VHF Exciter Microprocessor Compartment
Range 2 to Range 1 Amateur Band
Rob Lee K7TGU – rob@k7tgu.com

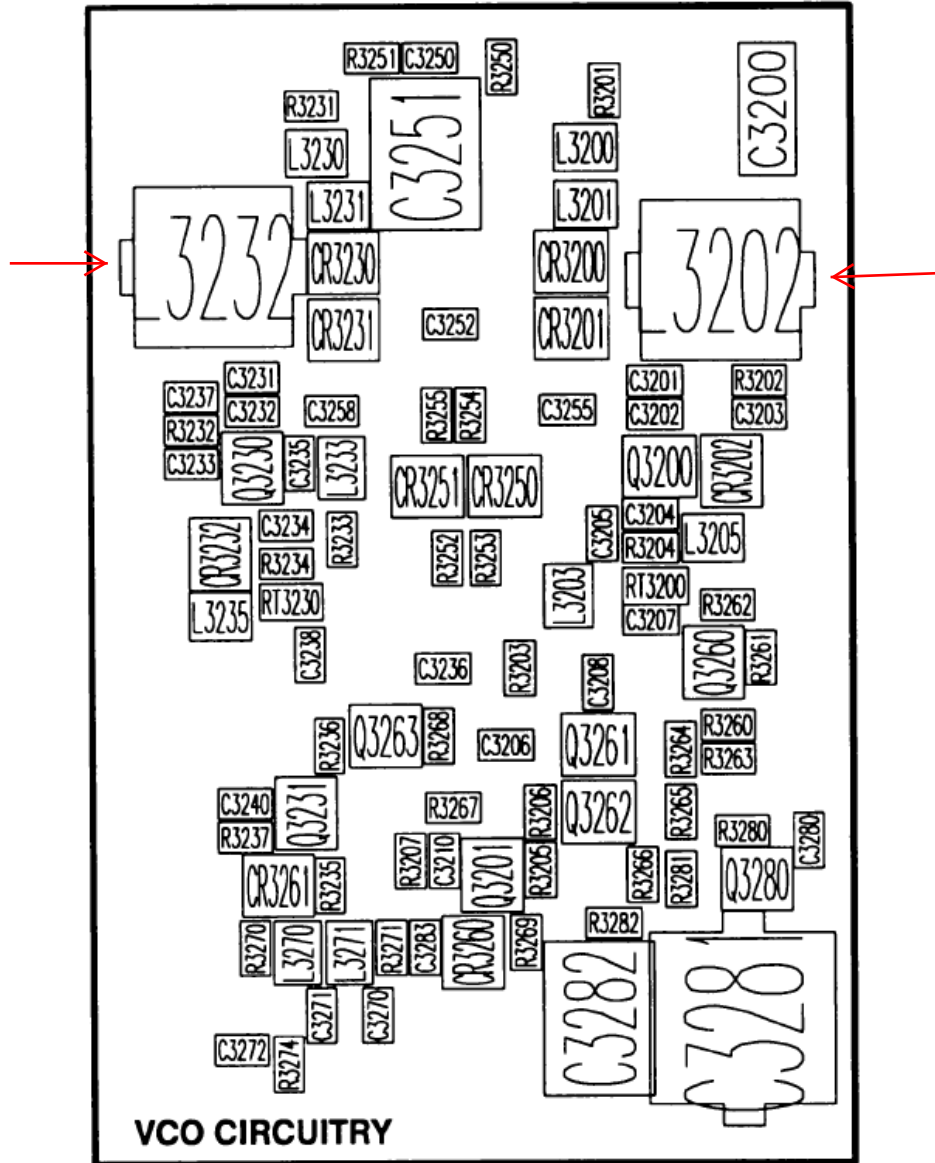**MICROPROCESSOR CIRCUITRY**
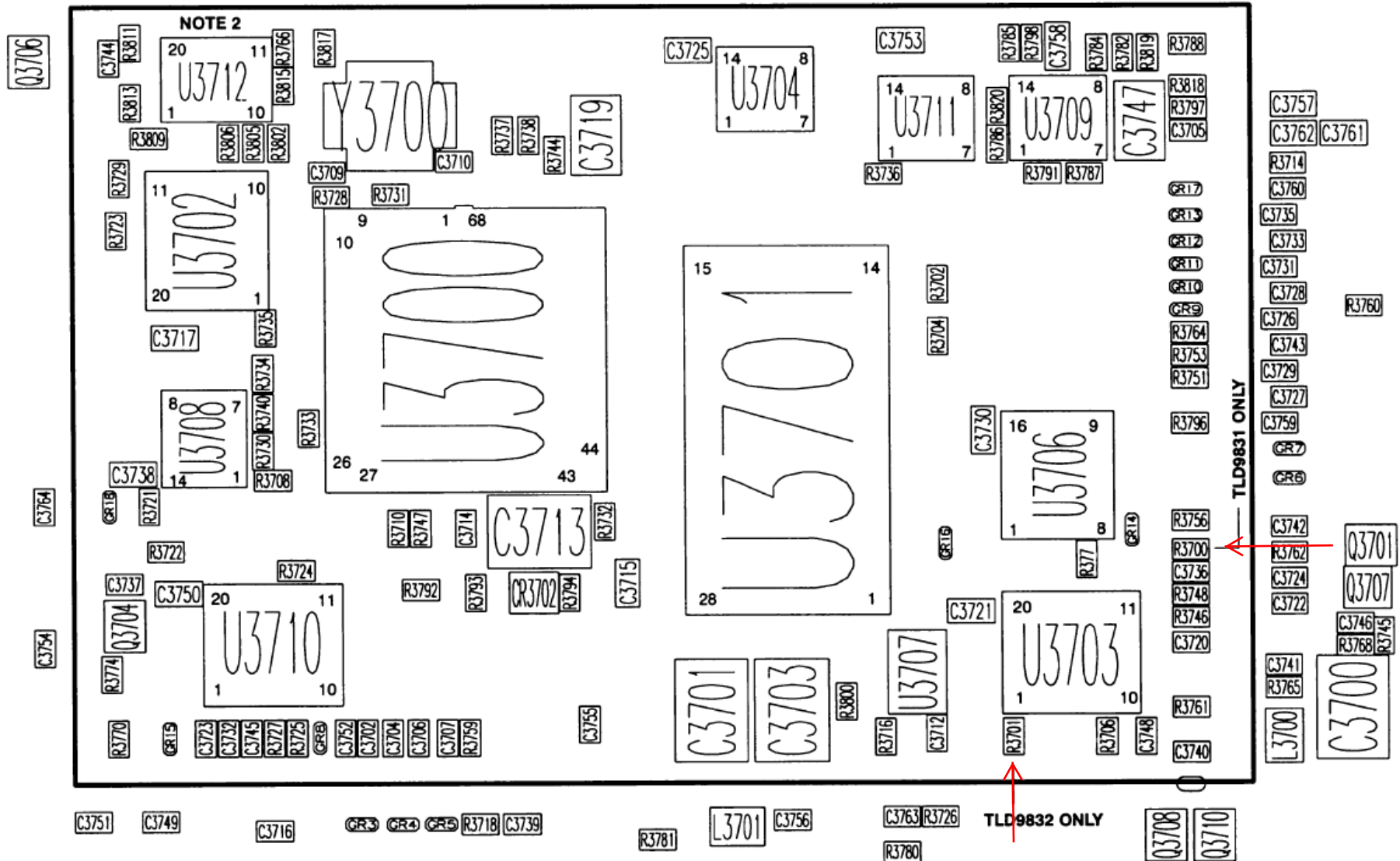
To have the exciter report to the SCM as a Range 1 unit move the 1 kΩ resistor from R3701 to R3700

Quantar VHF Exciter VCO Compartment
Range 2 to Range 1 Amateur Band

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VCO CIRCUITRY

The objective is to double core L3202 and L3232. I strongly suggest procuring slugs from a Midland Syntech VHF Low Band or VHF High Band radio as they provide wider VCO performance than the original Quantar slugs. These Midland radios are sometimes referred to as Syntech one units. Remove the original Quantar slugs and install the Midland slugs seating the first against the circuit board followed by seating the second slug against the first for both L3202 and L3232.

Quantar VHF Receiver Physical Layout

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1ST MIXER CIRCUITRY

T2071

C2302

1ST LO INJECTION
AMPLIFIER CIRCUITRY

C2281   C2282

DUAL VCO CIRCUITRY

+10 V REGULATOR

U2805

Y2101

1ST I-F CIRCUITRY

L2054

L2053

L2052

PLL SYNTHESIZER CIRCUITRY

U2401   U2402   C2418   C2424

U2403

C2407

C2824

C2828

PREAMPLIFIER CIRCUITRY

L2050

R2036   Q2031

RECEIVE RF
INPUT
FROM
RECEIVE
ANTENNA

Y2102

Y2103

U2701   C2701   U2702   C2708

ADDRESS DECODE
CIRCUITRY

U2600

C2425

C2823

U2801

U2800

U2804

U2803

U2802

U2500

M2501   M2502

C2542   C2522

C2532   C2533

U2503

CUSTOM RECEIVER IC CIRCUITRY

Quantar VHF Receiver PLL Synthesizer Compartment
Range 2 to Range 1 Amateur Band
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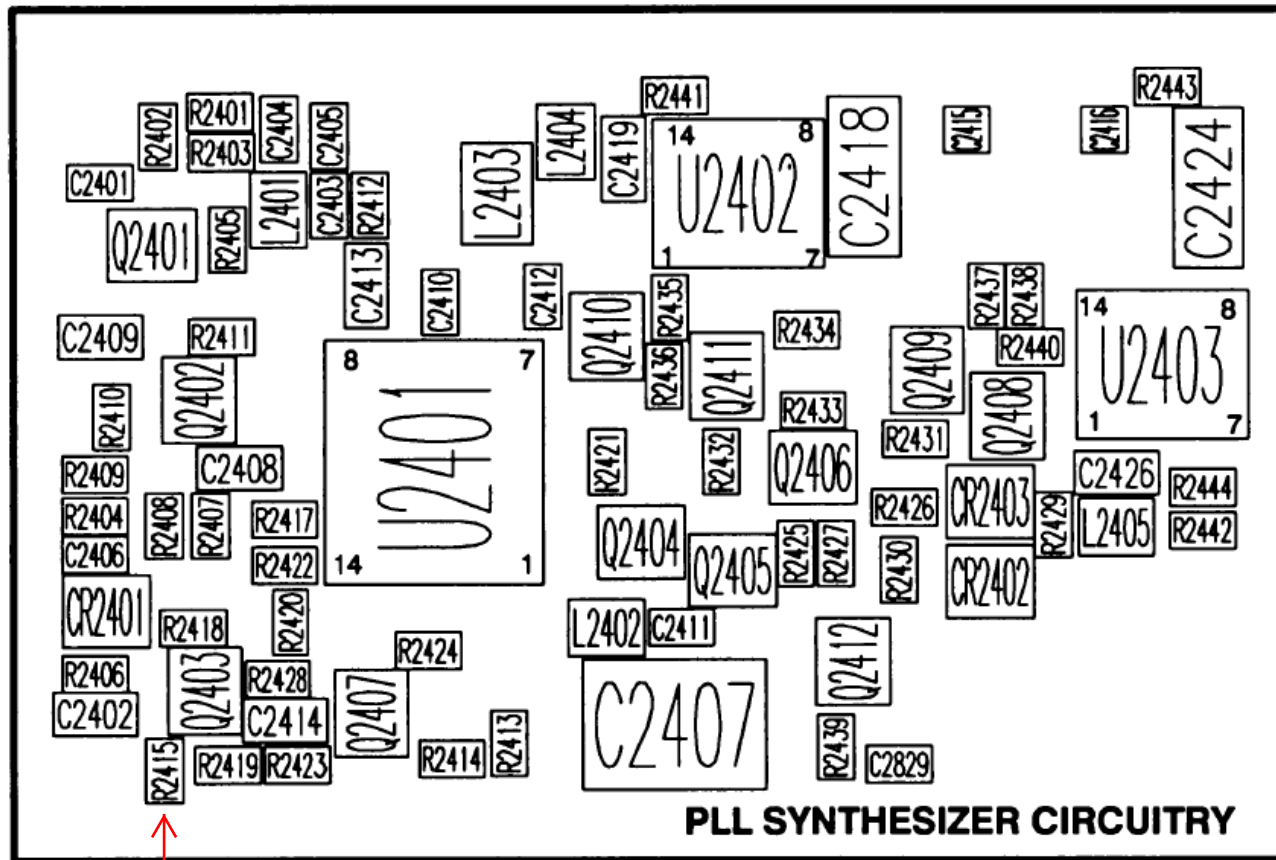
PLL SYNTHESIZER CIRCUITRY

To have the Receiver report to the SCM as a Range 1 unit change R2415 from 3300 Ω to 0 Ω

Quantar VHF Receiver Dual VCO Compartment
Range 2 to Range 1 Amateur Band

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DUAL VCO CIRCUITRY
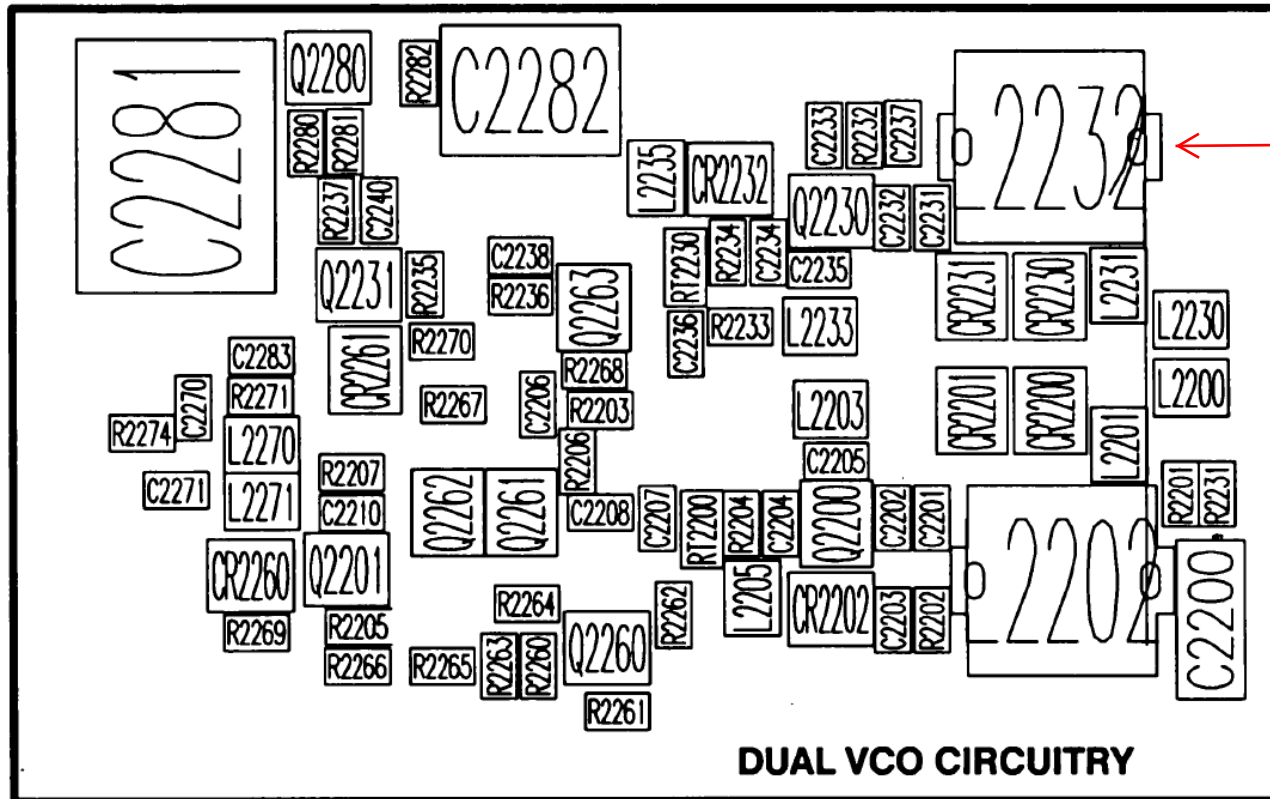
This modification is similar to that of the Exciter VCO with the exception of you are now dealing with just L2232. Remove the Quantar slug and double core L2232 with slugs from a donor Midland Syntech VHF Low Band or VHF High Band Transceiver.

Quantar 509CFK1475 Exciter/PA Metering Screen after R2 to R1 Modification @ 145.1300 MHz

| Exciter/PA | Receiver1 | Receiver2 | Power Supply | UHSO | Station Control / Wireline |

Item	Meter Value
Exciter Module ID	VHF R1 SL
PA Module ID	QA 125W VHF R1
Tx Reflected Voltage (Volts)	0.118
Tx Forward Voltage (Volts)	0.118
Power Control Voltage (Volts)	0.039
VCO Steeering Line Voltage (Volts)	1.137
10.2 V Exciter Voltage (Volts)	9.870
2.1 MHz Reference Level (Volts)	3.746
Internal Tx Forward Power (Watts)	0
Internal Tx Reflected Power (Watts)	0
Internal VSWR	1.0
External Tx Forward Power (Watts)	N/A
External Tx Reflected Power (Watts)	N/A
External VSWR	N/A
Final PA Side A Current (Amps)	0.000
Final PA Side B Current (Amps)	0.000
Intermediate PA Current (Amps)	0.000
Driver PA Current (Amps)	0.000
OMMI Control Voltage (Volts)	0.000
Thermistor Voltage (Volts)	3.590

Help   PA TEST ON   PA TEST OFF   KEY UP   DEKEY

Station Note:

Access Enable   Access Disable   Reset

Station Status: DeKeyed

Suggest keeping the VCO Steering Line Voltage above 1.000V to insure stable operation

Quantar 509CFK1475 Receiver Metering Screen after R2 to R1 Modification @ 144.5300 MHz

| Exciter/PA | Receiver1 | Receiver2 | Power Supply | UHSO | Station Control / Wireline |

Item	Meter Value
Module ID	VHF HB RANGE 1
Main Power Supply Voltage	14.15
Regulated 10 V Supply	9.80
Analog 5 V Supply	4.94
Steering Line Level Of OSC1	2.39
Steering Line Level Of OSC2	2.51
2.1 MHz Reference Level	2.13
Oscillator 1 Lock Indicator	4.92
Injection Level	0.61
Preamp Bias	7.18
A/D Self Check	2.51

Help

Station Note:

Access Enable   Access Disable   Reset

Station Status: DeKeyed

Suggest keeping the Steering Line Level of OSC1 above 2.00 to insure stable operation

Workaround for a VHF R2 to R1 Exciter Tx Deviation Alignment Issue

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The following information assumes the reader is already familiar with the Quantar and the Quantar Programming/Alignment Software.

The Range 2 to Range 1 Amateur Band modification may restrict the ability to perform the Service Folder/Alignment Screen/Tx Deviation Freq 3 alignment as there is a possibility the Exciter VCO may not lock at the 142.525 MHz test frequency. The following details a workaround for this situation.

If assembling a station from assorted modules it is suggested you perform the TX deviation alignment as a Range 2 unit before proceeding as those accurate values will be needed in the workaround.

On the Alignment Screen, record the existing Tx deviation alignment values for Freq 1, 2, 3 & 4*. Proceed through the alignment. <u>Note: These values can only be changed when the transmitter is keyed by the alignment program.</u> If the VCO is unlocked at Freq 3, continue to the Freq 4 alignment. To predict the approximate value needed for Freq 3 solve this simple proportion.

$$\frac{\text{Original Freq 3 value}}{\text{Original Freq 4 value}} = \frac{\text{Unknown Freq 3 value}}{\text{New Freq 4 value}}$$

Solving for the Unknown New Freq 3 value:

$$\text{Unknown New Freq 3 value} = \frac{(\text{Original Freq 3 value})\,(\text{New Freq 4 value})}{(\text{Original Freq 4 value})}$$

The alignment software may not allow you to enter the computed value for Freq 3 until you make a change to the new value you've entered for Freq 4. Record the value you entered for Freq 4 and make the change using the value requested by the software. Then enter the computed value for Freq 3. Finally perform the Freq 4 alignment again. The value obtained should be the same as was used in the formula above.

These deviation values don't appear to be particularly critical. The values provided by the formula seem suitable for amateur radio operation. Once this deviation alignment is completed for the frequency ranges of the upper and lower VCO no further adjustment should be needed for routine frequency changes unless a module replacement is required.

*I record all these original values on the backside of the blank panel between the SCM and Receiver for future reference if needed.

RSS Service Folder/Alignment Screen/Tx Deviation Tab

| RX Wireline (line 4) | ■ TX Wireline | Astro Simulcast Test Pattern | TDATA Calibration |

| ■ Battery Equalization | ■ Squelch Adjust | ■ RX Wireline (line 2) |

| ■ Reference Oscillator | ■ TX Deviation | ■ Power Output | ■ RSSI Calibration | ■ Reference Modulation Compensation |

Deviation (kHz): 5.3   Key On Freq1

Stored Deviation: 5.3

Deviation (kHz): 5.8   Key On Freq 2

Stored Deviation: 5.8

Deviation (kHz): 4.38   Key On Freq 3

Stored Deviation: 4.38

Deviation (kHz): 5.2   Key On Freq 4

Stored Deviation: 5.2

Current Frequency (MHz)   142.525

Key On Status

Save   Dekey

Help

Station Note: Station is Currently ACCESS DISABLED

Station Status: Not Keyed

If you can't achieve VCO lock on Freq 3, see the <u>Workaround for the VHF R2 to R1 Exciter Tx Deviation Alignment Issue</u> page of this document