Thank you for any support you can give.

hy-gain V

by hy-gain

# MODEL 2705
# CITIZENS TWO-WAY RADIO
## mobile

**Manufactured and Distributed by**
**Hy-Gain de Puerto Rico, Inc.**
**P.O. Box 68 State Hwy 31, KM. 4.0**
**Naguabo, Puerto Rico 00718**



PN 820265

EO-2705-A-001


First Printing, February, 1977
Original Edition, February, 1977

# TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS

# CHAPTER 1 — GENERAL INFORMATION

**Introduction**

This service manual contains all the information needed to service and repair the Hy-Gain V (Model 2705) transceiver. It includes an explanation of the theory of operation and alignment procedures. Revision, addendum, and errata sheets will be published as needed. Insert them as required in the manual.

The Hy-Gain V is a full 40 channel AM/SSB transceiver. It is transmitter type accepted and receiver certified for Class D Citizens Radio Service as designated by the Federal Communications Commission (FCC).

It is a compact mobile unit, completely solid-state and highly reliable with low power consumption. Its Phase Locked Loop (PLL) frequency synthesizer provides immediate operation on all 40 channels. A Clarifier Control allows fine tuning of stations that are slightly off frequency. A built-in switchable Noise Blanker reduces undesirable impulse noises. A Squelch circuit reduces receiver noise between transmissions. Output jacks for an optional telephone-style handset and an external speaker are also included. The unit can be used for public address with the addition of a PA speaker. The unit is used with 12 VDC (nominal), either negative or positive ground.

**Warranty Service Department**

For help with technical problems, for parts information, and information on local and factory repair facilities, contact the National Service Manager. When you write, please include all pertinent information that may be helpful in solving the problem. Address the letter to:

Hy-Gain Warranty Service Department
4900 Superior Street
Lincoln, Nebraska 68504
ATTN: National Service Manager

The Warranty Service Department can repair any unit. Before shipping the unit contact the National Service Manager. Often a problem is field solvable with a little extra help. This can save lost time and shipping costs. Limit factory returns to the difficult problems.

**How to Ship Returns**

To return a unit, get a return authorization. This is important. Handling of the unit may be delayed if shipped without it. If the unit must be shipped immediately, telephone or telex the National Service Manager for expeditious service.

When you request authorization, notification of repairs may also be requested. The notification will include a copy of the bill. Paying the bill before the return of the unit can save the cost of a COD fee.

For warranty repair, prepare a letter in duplicate containing the following information (for out-of-warranty repair delete items 2 and 3):

1. your name and address
2. purchaser's name and address
3. proof of purchase
4. serial number
5. complete description of the problem
6. the return authorization

Check the unit to see that all parts and screws are in place and attach an envelope containing a copy of the letter directly to it so this information is not overlooked. Wrap the unit and the envelope in heavy paper or put it in a plastic bag. If the original carton is not available, place the unit in a strong carton at least *six* inches larger in all three dimensions than the unit. Fill the carton equally around the unit with resilient packing material (shredded paper, excelsior, bubble pack, etc.). Seal the box with gummed paper tape, tie it with a strong cord, and ship it by prepaid express, United Parcel Service, or insured parcel post to the address given previously. Mail the original of the letter in a second envelope to that same address.

It is important that the shipment be well-packed and fully-insured. Damage claims can delay repair and return of the unit. All claims must be settled between you and the carrier.

All shipments must be sent PREPAID. We *do not* accept collect shipments. After the unit has been repaired we will send it back COD unless the bill has been prepaid. Unclaimed or refused COD shipments will not be reshipped until the payment in full is received. These items become the property of Hy-Gain 60 days after refusal or return and will be sold for payment of charges due.

**Units with unauthorized field modifications cannot be accepted for repair.**

**Purchase of Parts**

Parts can be purchased from any Hy-Gain Service Center or from the factory Warranty Service Department. When ordering, please supply the following information:

1. unit model number
2. unit serial number
3. part description
4. part number

**Specifications**

*General*

| | |
|---|---|
| Frequency | Phase Locked Loop Synthesizer (PLL) |
| Channels | 40 channels |
| Mode of operation | AM, LSB and USB |
| Power source voltage | 12 VDC, nominal |
| Speaker | Built-in, 3" dynamic type |
| Microphone | Dynamic type with PTT bar |

*Receiver*

| | |
|---|---|
| System | SSB: Single conversion superheterodyne<br>AM: Dual conversion superheterodyne |
| Sensitivity | SSB: 0.25 uV for 10 dB S/N ratio<br>AM: 1 uV for 10 dB S/N ratio |
| Selectivity | SSB: 2.4 kHz at 6 dB down<br>AM: 6 kHz at 6 dB down |
| Clarifier | ± 600Hz |
| Audio output | 3 watts to 8 ohms |
| Squelch range | SSB: 0.7 uV to 20 uV<br>AM: 1 uV to 500 uV |
| IF | SSB: 10.695 MHz<br>AM: 1st-10.695 MHz<br>2nd-455 kHz |

*Transmitter SSB*

| | |
|---|---|
| Generation | Double balanced modulator with crystal lattice filter |
| RF output power | 12 watts, (PEP FCC max.), at 13.8 VDC |
| Carrier suppression | 40 dB down |
| Unwanted sideband suppression | 60 dB down |
| Harmonic suppression | 60 dB down |

*Transmitter AM*

| | |
|---|---|
| Modulation | High level class B, power IC |
| RF output power | 4 watts (FCC max.), at 13.8 VDC |
| Harmonic suppression | 60 dB |

# CHAPTER 2 — THEORY OF OPERATION

## General

The theory of operation of the Hy-Gain V (Model 2705) transceiver is divided into three sections: the Phase Locked Loop Frequency Synthesizer, the Receiver, and the Transmitter. This material covers the functioning of the transceiver with a minimum of technical involvement. We have not attempted to explain the engineering techniques and approaches that arrived at these circuit designs.

## Phase Locked Loop Frequency Synthesizer

Refer to the block diagram, figure 2-1, for visual reference to the Phase Locked Loop Frequency Synthesizer.

The Phase Locked Loop (PLL) frequency synthesizer generates frequencies for use in both the transmitter and receiver sections. Its output determines the channel on which the transceiver is operating. The PLL circuitry incorporates two crystal oscillators to perform its frequency generating function.

The 10.240 MHz Oscillator, Q6, provides a reference for the PLL and an injection frequency for the Second Receiver Mixer, D22 and D23. The 10.0525 MHz Oscillator, Q3, provides a reference frequency for the VCO/Mixer, IC2.

The PLL circuit generates the operating frequencies needed for the transceiver in accordance with the code fed to the programmable divider, a portion of IC1, from the Channel Selector switch, SW-1a. Table A shows the following for each channel: the channel number, channel frequency, "N" digital code, VCO frequency (AM/USB,LSB), channel switch output, and the receiver first local oscillator frequency, (AM/USB, LSB).

For example, assume that channel 1 has been selected. The channel frequency is 26.965 MHz, the VCO frequency is 17.555 MHz (AM/USB), and the "N" code is 255. The Channel Selector switch programs the programmable divider for a division ratio of 255. The 10.24 MHz reference is fed to the PLL IC, IC1. It is divided internally by 1024, producing a 10 kHz reference signal. The output of the VCO Oscillator Block is mixed in the VCO/mixer portion of IC2 with the doubled output of the 10.0525 MHz Oscillator, Q3. The mixed and converted output difference frequency, 2.55 MHz, is then fed back to the PLL IC, IC1, through a buffer circuit located in the VCO/mixer IC, IC2. In the PLL IC, IC1, the output difference frequency goes through a buffer circuit to the programmable divider and is divided into a low frequency by the predetermined "N" code. In this case 2.55 MHz divided by 255 equals 10 kHz. The low frequency is fed to the phase detector and compared with the reference frequency.

The phase detector, which is internally located in the PLL IC, IC1, generates a DC output voltage corresponding to the phase difference between the two signals applied. The DC output is then applied to the VCO Oscillator Block through a low pass filter. The VCO frequency coincides with the reference frequency. In this case, the PLL IC output difference frequency divided by the "N" code 255 is 10 kHz and the divided reference frequency, 10.24 MHz, is 10 kHz, so there is no phase difference. The Phase Locked Loop circuitry will lock when the frequencies coincide with each other. When this happens, the VCO circuit provides stable frequencies over the band of 17.555 to 17.995 MHz (17.5535 to 17.9935 MHz for LSB) depending upon the "N" code or channel selected.

Assume that the channel is changed to channel 40. The Channel Selector switch now provides a code that will produce a division ratio of 211. At this instant the VCO frequency is at 17.555 MHz, which is mixed with the doubled output of the 10.0525 MHz Oscillator, Q3. Again the VCO/Mixer produces an output of 2.55 MHz. The 2.55 MHz signal is now divided by 211 to produce a frequency of 12.0853 kHz.

The 12.0853 kHz output, along with the 10 kHz obtained from the Reference Oscillator, Q6, is fed to the Phase Detector portion of IC1. The comparison of the two frequencies in the Phase Detector produces an error output which is a combined AC-DC voltage. The

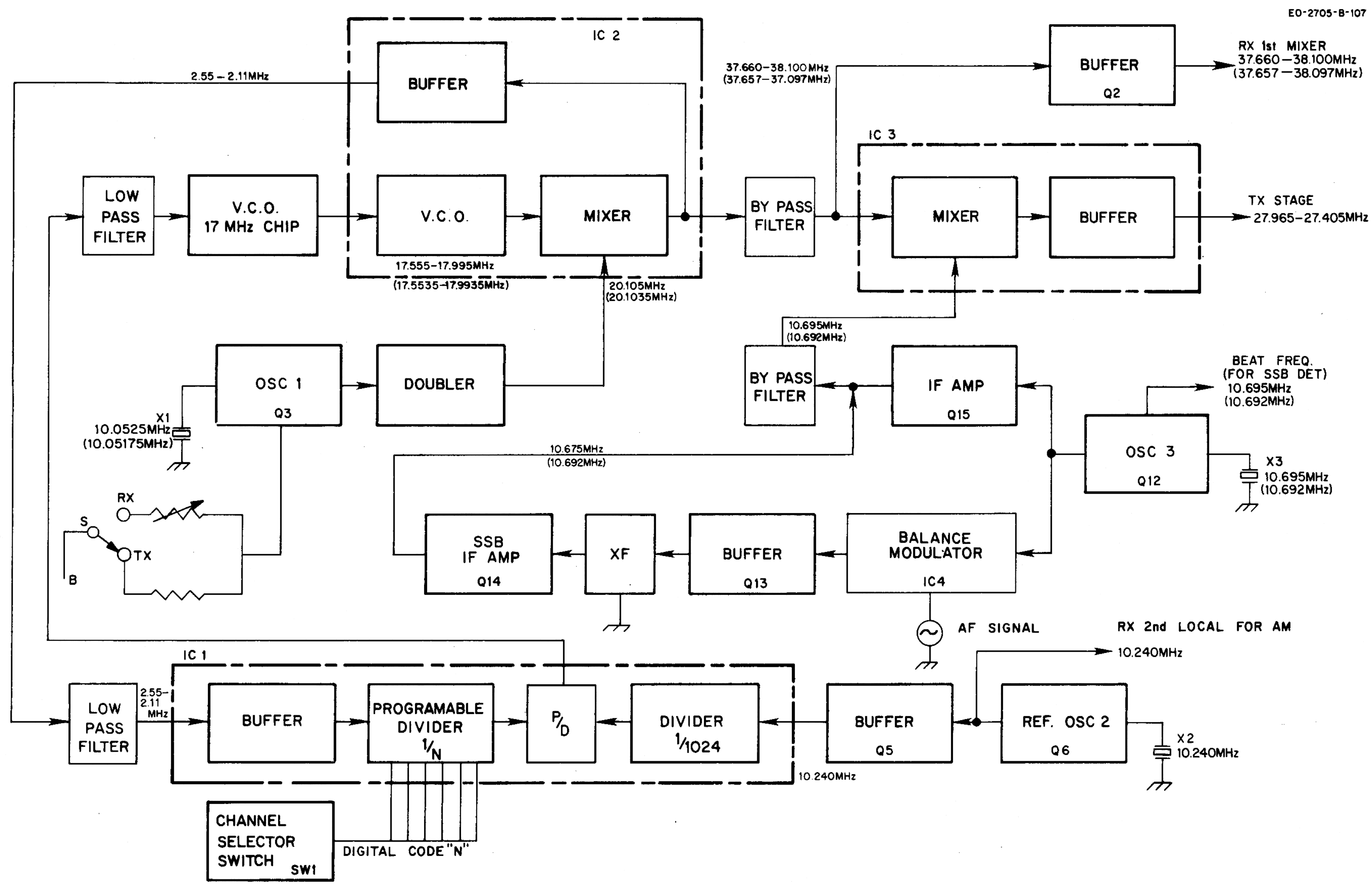



**Figure 2-1. Block Diagram of PLL Circuitry, Model 2705**

low pass filter removes the AC component and allows only the DC voltage to be fed to the VCO Oscillator Block.

The error voltage will change the VCO frequency until the output of the programmable divider is again 10 kHz (2.11 MHz divided by 211) and the error voltage output of the phase detector is zero.

There is now a new DC voltage set up to tune the VCO frequency to 17.995 MHz. When this occurs the loop is considered locked. With the channel selector at 40, the following outputs of the PLL circuitry are produced: the 17.995 MHz VCO output is mixed with 20.105 MHz doubled output from the 10.0525 MHz Oscillator, Q3, to produce 38.100 MHz which is fed to the First Receiver Mixer, Q22; and in the transmit mode, the 38.100 MHz is mixed with the 10.695 MHz output of Oscillator 3 in the Mixer IC, IC3, to produce a transmit frequency of 27.405 MHz.

## Receiver

*AM Receiver*

The receiver is a dual-conversion superheterodyne receiving AM signals from 26.965 MHz to 27.405 MHz. The operating channel is determined by the PLL frequency synthesizer which provides the local oscillator frequency to the First Receiver Mixer, Q22. A variable squelch circuit is included to quiet the receiver between transmissions. The squelch circuit is composed of Squelch Amplifier, Q32, First DC Amplifier, Q33, and the Second DC Amplifier, Q34.

Radio signals are received by the antenna and enter the radio at the antenna jack. The filter formed by C56, C57, L11, L12 and L13 matches the antenna impedance to the RF Amplifier, Q20, and its tuned circuit, C100 and T7. D18 and D19 are a signal overload protective circuit.

The output of the RF Amplifier, Q20, and the 37.660 to 38.100 MHz output from the VCO/Mixer, IC2, which was fed through Buffer, Q2, are applied to the First Receiver Mixer, Q22. The combined frequencies produce an output of 10.695 MHz which is the first IF.

The first IF passes through tuned circuits T10 and T13. It is then applied to the Second Receiver Mixer, D22 and D23, which has a second input of 10.240 MHz from the 10.240 MHz Oscillator, Q6. The output of the Second Receiver Mixer is 455 kHz, which is the second IF.

The second IF passes through the Ceramic Filter, CF1 and is amplified by the First, Second, and Third IF Amplifiers, Q27, Q28 and Q29. The amplified signal is then fed to the Detector, D25. The recovered audio signal is then applied to the AF Amplifier, IC5, through the Automatic Noise Limiter, D26.

Three stages of Automatic Gain Control loops are provided, one each at Q20, Q22 and Q27, to prevent signal overload distortion whenever the receiver is subjected to a strong signal.

The squelch functions in the following manner: in the receive mode, depending on where the Squelch Switch, VR2, is set, the Squelch Amplifier, Q32, will be turned on by low AGC voltage from Q27 applied to the base of Q32, and the voltage applied to the emitter of Q32 from VR2. Q34, the Second DC Amplifier, is on all the time supplying voltage to IC5 (Audio Amplifier, IC5). When Q32 turns on the First DC Amplifier, Q33, will turn on. With Q33 turned on, Q34 will be biased off, disabling the Audio Amplifier, IC5, and no signal will be heard.

The final amplified audio signal from the Audio Amplifier, IC5, passes through the Audio Transformer, T16, and is applied to the external speaker jacks and the speaker.

Q21 is a DC Switch which short circuits the primary of T9 during the transmit mode disabling the receiver circuit. With the transmitter on, a DC voltage is supplied to the base of DC Switch, Q21, from pin 6 of the Transmit Mixer, IC3.

*USB and LSB Receiver*

SSB radio signals are received by the antenna and enter the radio at the antenna jack. The filter formed by C56, C57, L11, L12 and L13 matches the antenna impedance to the RF Amplifier, Q20, and its tuned circuit, C100 and T7. D18 and D19 are a signal overload protective circuit.

The output of the RF Amplifier, Q20, and the 37.660 to 38.100 MHz (37.657 to 38.097 MHz for LSB) output for the VCO/Mixer, IC2, which was fed through the Buffer, Q2, are applied to the First Receiver Mixer, Q22. The combined frequencies produce an output of 10.695 MHz (10.692 MHz for LSB) which is the first IF.

The first IF passes through the tuned circuit, T10, and is applied to the Crystal Filter, XF. It is then applied to the First SSB IF Amplifier, Q14. The signal is further amplified by the Second SSB IF Amplifier, Q16, and the Third SSB IF Amplifier, Q17. The amplified signal is then fed to the base of the SSB Detector, Q19. Also applied to the emitter of Q19 is a 10.695 MHz signal (10.692 MHz for LSB). From Q19 the detected audio signal goes to the Audio Amplifier, IC5. The amplified audio signal is applied to the external speaker jack and the internal speaker.

The DC Switch, Q18, prevents undesirable noise that is generated by the microphone PTT switch from entering the SSB AGC circuit.

*SSB AGC Circuitry*

To prevent signal overload distortion whenever the receiver is subjected to a strong signal, a peak value AGC circuit is employed. The SSB IF signal goes from the secondary of T12 in the collector circuit of Q17 to the SSB AGC Circuit. The signal is applied to detectors D30, D31, D32 and D33. The detected signal from D32 and D33 is amplified and applied to the emitter of the SSB AGC Amplifier, Q30. The other detected signal from D30 and D31 is applied directly to the emitter of Q30. From Q30 the amplified voltage goes to two places: one side is used to drive the squelch circuit and is an input to the base of Q32. The other side is used as a bias voltage for the RF Amplifier, Q20, the First Receiver Mixer, Q22, and the First SSB IF Amplifier, Q14.

The Squelch circuit functions the same in SSB as the AM Receiver squelch circuit.

## Transmitter

*AM Transmitter*

The operating channel is determined by the PLL Frequency Synthesizer, IC1. The VCO frequency is mixed in IC2 with the 20.105 MHz signal from the doubled output of the 10.0525 MHz Oscillator, Q3, to yield a 37.660 to 38.100 MHz signal which is applied to RF Amplifier/Mixer, IC3. In IC3 the signal is mixed with a 10.695 MHz signal from the 10.695 Oscillator, Q12, applied through the AM IF Amplifier, Q15, to pin 1 of IC3. The difference frequency of 26.965 to 27.405 MHz is the transmit frequency. The transmit frequency from IC3 passes through the filter circuits of T4 and T5 and is applied to the base of RF Amplifier, Q7. The amplified signal is then applied to the base of RF Pre-driver, Q8. From Q8, the signal is passed through filter T6 and is applied to the RF Driver, Q9. The amplified RF signal is then applied to the final stage, the RF Power Amplifier, Q10. This is a current amplifier that raises the transmit signal to an output of four watts. Its output is applied to a filter, consisting of L11, C54, C55, L12, C57 and L13, and then to the antenna jack.

The transmit signal is modulated in the following manner: the microphone output is applied to the Audio Amplifier, IC5. From IC5, the amplified audio signal goes through transformer T6 and diode D43 to the collectors of Q9 and Q10 and modulates the transmit carrier frequency.

Control voltages for the Automatic Level Control circuit (ALC), composed of Q37 and Q35, come from the diode D43. Transistor Q35 is the Automatic Level Control provided to suppress the audio input level to IC5.To avoid overmodulation Q37, the AM AF ALC, obtains its input from the audio output circuit through D43. Q37's output controls Q35, thus keeping the modulation signal level at a relatively constant level.

During transmit, when the PLL circuit is locked on frequency, a voltage from pin 6 of the PLL IC, IC1, will turn on Q7 and allow the RF drive sequence to operate. During receive Q1 keeps the RF drive turned off. This prevents feedback through the receiver circuits.

*USB and LSB Transmitter*

Switching to the SSB transmit mode is accomplished in the following manner: when the Mode Selector switch, S2, is placed in the U or L (USB or LSB) position, and the PTT switch is closed, the operating channel is determined by the PLL frequency synthesizer, IC1. The VCO frequency is mixed in IC2 with the 20.105 MHz signal from the doubled output of the 10.0525 MHz Oscillator, Q3, to yield a 37.660 to 38.100 MHz (37.657 to 38.097 MHz LSB) signal which is applied to RF Amplifier/Mixer, IC3. At the same time, a 10.695 MHz, (10.692 MHz LSB) generated by the 10.695 MHz Oscillator, Q12, is fed to the Balanced Modulator, IC4. IC4 also has as another input, the amplified audio signal from IC5 whenever there is an audio input from the microphone. The output from IC4 with both inputs is a carrier suppressed double side band signal. The double side band signal then goes through Buffer, Q13, to Crystal Filter, XF. At the crystal filter the desired sideband is separated from the double sideband signal. The sideband signal then goes to the SSB IF Amplifier, Q14, is amplified, then fed to pin 1 of IC3. Mixer. At the Mixer, IC3, the 10.695 MHz (10.692 MHz LSB) SSB signal is mixed with the 37.660 to 38.100 MHz signal (37.657 to 38.097 MHz LSB) from the VCO/Mixer, IC3, to produce the 26.965 to 27.405 MHz transmit signal. The 26.965 to 27.405 MHz SSB signal is then fed to the base of RF Amplifier, Q7. The amplified signal is then applied to the base of RF Pre-driver, Q8. From Q8, the signal is passed through filter T6 and is applied to the RF Driver, Q9. The amplified RF signal is then applied to the final stage RF Power Amplifier, Q10. The signal then goes through the filter comprised of L11, C54, C55, L12, C57 and L13, then to the antenna jack.

To avoid over-modulaton, an ALC circuit, consisting of Automatic Level Control, Q35, and SSB AF ALC, Q38, is provided in the SSB microphone amplifier circuit. The SSB AF ALC, Q38, obtains its input from the audio output circuit of IC5. Q38's output controls the Automatic Level Control, Q35, thus keeping the modulation signal level at a relatively constant level.

Another ALC circuit is employed in the RF circuit to reduce the distortion in the RF stages. A feedback loop is provided from the RF Power Amplifier, Q10, through the RF ALC Detector, D8, to the SSB IF Amplifier, Q14.

Transistors Q36 and Q39 are DC switching circuits that operate the Audio Amplifier, IC5, as a SSB microphone amplifier. Q36 and Q39 are turned on, enabling IC5, when power switch S1 is turned on and either Upper or Lower sideband operation is selected by S2.

**Noise Blanker**

Any impulse signal (noise) along with received RF signals will be amplified by RF Amplifier, Q23, and applied to the Noise Blanker Detector, D21. The rectified positive portion of the impulse is then applied to Voltage Amplifiers, Q24 and Q25. Q24 and Q25 amplify the positive pulse to a high enough level to gate DC Switch, Q26, on for the duration of the impulse. When this occurs, the primary of T10 is grounded to the chassis through C121 and the emitter collector of Q26, preventing a mixer output during the pulse period.

Detector, D20, controls the bias voltage of Q24, keeping it turned off during the reception of normal received signals.

**Regulated Power Supply (AVR)**

The Automatic Voltage Regulator circuit consists of Q44 and D50. D50 is a zener diode and will break down when any voltage spikes occur. This circuit supplies the regulated voltage through switching transistors Q40, Q41, Q42 and Q43. The various switching transistors operate depending on the mode of operation selected by S2.

## N CODE — FREQUENCY CORRELATION CHART

| CHANNEL NO. | CHANNEL FREQ. (MHz) | "N" CODES | VCO FREQUENCY | | CHANNEL SWITCH OUTPUT (PLL Inputs) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | AM/USB | LSB | P0 | P1 | P2 | P3 | P4 | P5 |
| 1 | 26.965 | 255 | 17.555 | 17.5535 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 26.975 | 254 | 17.575 | 17.5735 | 0 | 1 | 1 | 1 | 1 | 1 |
| 3 | 26.985 | 253 | 17.575 | 15.5735 | 1 | 0 | 1 | 1 | 1 | 1 |
| 4 | 27.005 | 251 | 17.595 | 17.5935 | 1 | 1 | 0 | 1 | 1 | 1 |
| 5 | 27.015 | 250 | 17.605 | 17.6035 | 0 | 1 | 0 | 1 | 1 | 1 |
| 6 | 27.025 | 249 | 17.615 | 17.6135 | 1 | 0 | 0 | 1 | 1 | 1 |
| 7 | 27.035 | 248 | 17.625 | 17.6235 | 0 | 0 | 0 | 1 | 1 | 1 |
| 8 | 27.055 | 246 | 17.645 | 17.6435 | 0 | 1 | 1 | 0 | 1 | 1 |
| 9 | 27.065 | 245 | 17.655 | 17.6535 | 1 | 0 | 1 | 0 | 1 | 1 |
| 10 | 27.075 | 244 | 17.665 | 17.6635 | 0 | 0 | 1 | 0 | 1 | 1 |
| 11 | 27.085 | 243 | 17.675 | 17.6735 | 1 | 1 | 0 | 0 | 1 | 1 |
| 12 | 27.105 | 241 | 17.695 | 17.6935 | 1 | 0 | 0 | 0 | 1 | 1 |
| 13 | 27.115 | 240 | 17.705 | 17.7035 | 0 | 0 | 0 | 0 | 1 | 1 |
| 14 | 27.125 | 239 | 17.715 | 17.7135 | 1 | 1 | 1 | 1 | 0 | 1 |
| 15 | 27.135 | 238 | 17.725 | 17.7235 | 0 | 1 | 1 | 1 | 0 | 1 |
| 16 | 27.155 | 236 | 17.745 | 17.7435 | 0 | 0 | 1 | 1 | 0 | 1 |
| 17 | 27.165 | 235 | 17.755 | 17.7535 | 1 | 1 | 0 | 1 | 0 | 1 |
| 18 | 27.175 | 234 | 17.765 | 17.7635 | 0 | 1 | 0 | 1 | 0 | 1 |
| 19 | 27.185 | 233 | 17.775 | 17.7735 | 1 | 0 | 0 | 1 | 0 | 1 |
| 20 | 27.205 | 231 | 17.795 | 17.7935 | 1 | 1 | 1 | 0 | 0 | 1 |
| 21 | 27.215 | 230 | 17.805 | 17.8035 | 0 | 1 | 1 | 0 | 0 | 1 |
| 22 | 27.225 | 229 | 17.815 | 17.8135 | 1 | 0 | 1 | 0 | 0 | 1 |
| 23 | 27.255 | 226 | 17.845 | 17.8435 | 0 | 1 | 0 | 0 | 0 | 1 |
| 24 | 27.235 | 228 | 17.825 | 17.8235 | 0 | 0 | 1 | 0 | 0 | 1 |
| 25 | 27.245 | 227 | 17.835 | 17.8335 | 1 | 1 | 0 | 0 | 0 | 1 |
| 26 | 27.265 | 225 | 17.855 | 17.8535 | 1 | 0 | 0 | 0 | 0 | 1 |
| 27 | 27.275 | 224 | 17.865 | 17.8635 | 0 | 0 | 0 | 0 | 0 | 1 |
| 28 | 27.285 | 223 | 17.875 | 17.8735 | 1 | 1 | 1 | 1 | 1 | 0 |
| 29 | 27.295 | 222 | 17.885 | 17.8835 | 0 | 1 | 1 | 1 | 1 | 0 |
| 30 | 27.305 | 221 | 17.895 | 17.8935 | 1 | 0 | 1 | 1 | 1 | 0 |
| 31 | 27.315 | 220 | 17.905 | 17.9035 | 0 | 0 | 1 | 1 | 1 | 0 |
| 32 | 27.325 | 219 | 17.915 | 17.9135 | 1 | 1 | 0 | 1 | 1 | 0 |
| 33 | 27.335 | 218 | 17.925 | 17.9235 | 0 | 1 | 0 | 1 | 1 | 0 |
| 34 | 27.345 | 217 | 17.935 | 17.9335 | 1 | 0 | 0 | 1 | 1 | 0 |
| 35 | 27.355 | 216 | 17.945 | 17.9435 | 0 | 0 | 0 | 1 | 1 | 0 |
| 36 | 27.365 | 215 | 17.955 | 17.9535 | 1 | 1 | 1 | 0 | 1 | 0 |
| 37 | 27.375 | 214 | 17.965 | 17.9635 | 0 | 1 | 1 | 0 | 1 | 0 |
| 38 | 27.385 | 213 | 17.975 | 17.9735 | 1 | 0 | 1 | 0 | 1 | 0 |
| 39 | 27.395 | 212 | 17.995 | 17.9935 | 0 | 0 | 1 | 0 | 1 | 0 |
| 40 | 27.405 | 211 | 17.995 | 17.9935 | 1 | 1 | 0 | 0 | 1 | 0 |

# CHAPTER 3 — ALIGNMENT

## General

These procedures must be followed to align the Hy-Gain V transceiver (Model 2705). Alignment should not be undertaken unless the technician has adequate test equipment and a full understanding of the circuitry of the transceiver.

**IMPORTANT:** Tuning adjustment of this transceiver "shall be made by or under the immediate supervision and responsibility of a person holding a first or second-class commercial radio operator's license", as stipulated in Part 95.97 (b) of the FCC Rules and Regulations.

The procedures are divided into two main sections: Transmitter Alignment and Receiver Alignment. See *Equipment* below for a complete list of recommended equipment.

These procedures assume that proper voltages are present at all points in the unit, if not, troubleshoot before continuing.

**NOTE:** The ferrite cores in the tuned coils are easily chipped or broken. Always use care when inserting an alignment tool in the coil: insert it straight into the core.

## Recommended Tools and Equipment

The following equipment is recommended for use in aligning the Hy-Gain V transceiver.

Audio Signal Generator, 20Hz to 20 kHz
AC VTVM, 1 mV measurable
DC Ampere Meter, 2A
Variable Regulated Power Supply, 8-15 VDC, 2A
Frequency Counter, 0 to 40 MHz, high input impedance type
VTVM with RF probe
Oscilloscope, 30 MHz, high input impedance
Low capacitance RF probe, capacitance not to exceed 7 pF.
RF wattmeter and 50 ohm, 5W dummy load
Standard RF signal generator, 27 MHz CB band
Speaker dummy resistor, 8 ohm, 5W
VOM 20k ohm/V
All test equipment should be properly calibrated.

**NOTE:** Test voltage is 13.8 VDC unless otherwise specified.

## Transmitter Alignment Procedure

***Equipment Set-up***

Refer to figure 3-1 for the test equipment set-up. Refer to figure 3-6 for location of components to be adjusted for transmitter alignment.

***Pre-Alignment Frequency Check***

Before alignment, use the frequency counter through a 1000 pF coupling capacitor connected in series with the counter input probe to check the operating frequencies at the following points.

1. Place the Mode switch, S2, in the USB position; the Channel Selector to channel 19. Connect the frequency counter to TP2 and adjust the Trimmer Capacitor, CT3, for a reading of 10.24000 MHz.

2. Connect both an RF VTVM with an RF probe and the frequency counter to TP3. Adjust the core of T3 for a maximum indication on the RF VTVM. Adjust Trimmer Capacitor, CT1, for a reading of 20.105 MHz ± 40Hz.

3. Return the Mode Switch, S2, to the USB position. Connect the frequency counter to TP5 and adjust CT5 for a reading of 10.695 MHZ ± 50Hz. Place the Mode Switch, S2, in the LSB position and adjust CT4 to read 10.692 MHz ± 50Hz.

Connect all test equipment as shown below:

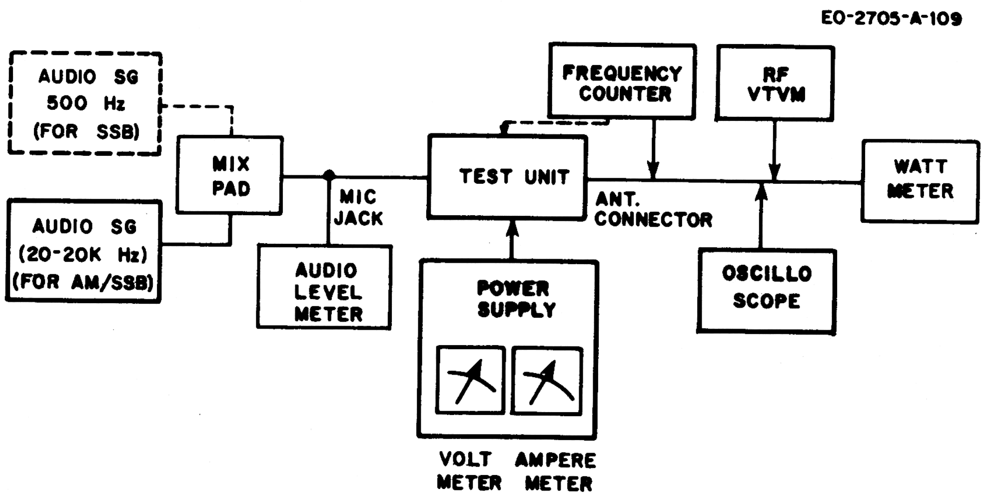



**Figure 3-1. Equipment Set-up, Transmitter Alignment**

***VCO Circuit Alignment***

1. Place the Channel Selector in the channel 1 position.

2. Connect the VOM (12 VDC range) between ground and TP4.

3. Adjust the core provided in the VCO Block to obtain a reading of 3.6V ± 0.1V, starting from top to bottom when turning the core.

4. Place the Channel Selector to the channel 40 position. The reading should be within 1.4 to 2.3V.

***Driver Stage Alignment***

1. Apply a 2.4 kHz, 2.5 mV audio signal to the MIC input.

2. Place the Channel Selector in the channel 40 position and the Mode Switch, S2, in the USB position.

3. Connect an oscilloscope and 50 ohm dummy load across the ANT connector.

4. Adjust T1 for maximum amplitude on the oscilloscope display.

5. Place the Channel Selector in the channel 1 position and adjust T2 for maximum amplitude.

6. Connect an ampere meter between the emitter of Q10 and chassis ground. Adjust RV1 to obtain a bias current of 35 mA ± 10 mA.

7. Place the Channel Selector in the channel 40 position and adjust T4 for maximum amplitude.

8. Place the Channel Selector in the channel 1 position and adjust T5 for maximum amplitude.

***SSB RF Power Amplifier Stage Alignment***

1. Place the Channel Selector in the channel 19 position and the Mode switch in the USB position.

2. Feed a 2.4 kHz, 25 mV audio signal to the microphone input.

3. Connect an oscilloscope to the emitter of Q7 and adjust T11 for a maximum amplitude display on the oscilloscope.

4. Turn T6 core fully upward, then adjust RV11 to obtain a reading of 150 mV (peak to peak) on the oscilloscope.

5. Connect the oscilloscope to the ANT connector in parallel with the wattmeter.

6. Temporarily adjust RV2 fully counterclockwise and adjust the core of L13 so that the core top is flush with the top of the coil bobbin.

7. Adjust T6, T11, L7 and L11 for maximum power output.

8. Decrease the audio signal to the microphone input to zero and adjust RV4 and RV5 for minimum amplitude of carrier leakage on the oscilloscope display.

9. Feed two signals, 500Hz to 2400Hz, of 25 mV to the microphone input and adjust RV2 to obtain 10 watts of PEP power. Make sure the PEP power output at each channel is within 9 to 11 watts. The waveshape displayed on the oscilloscope should conform to the waveshape shown in figure 3-2.

10. Place the Mode switch in the LSB position. Check to see that the AM/USB alignments are not affected, and that similar results are obtained in this mode of operation.

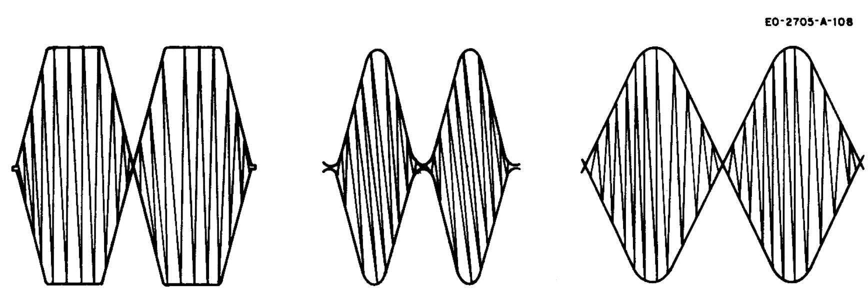



**Figure 3-2. Waveforms**

***AM RF Power Stage Alignment***

1. Place the Mode switch in the AM position and the Channel Selector in channel 19 position.

2. Adjust VR5 for an RF power output of 3.7 watts as indicated on the wattmeter.

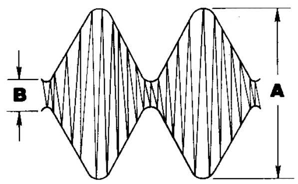
***AM Modulation Alignment***

1. Apply a 2.5 kHz, 25 mV audio input signal to the MIC circuit.

2. Adjust RV12 so that the modulation depth is 80% to 95%.

3. Decrease the signal input to 2.5 mV and check that the modulation depth is 30% or higher.

**NOTE:** To figure modulation percentage use the formula in figure 3-3.




$$\text{Modulation ratio} = \frac{A - B}{A + B} \times 100\ [\%]$$

**Figure 3-3. Modulation Waveform**

***RF Power Meter Alignment***

Adjust RV3 so that the P-RF meter provided on the front panel of the equipment indicates the same wattage as the wattmeter.

***Lock-Out Circuit Check***

Place the Channel Selector in the open channel (detent) position. Check the voltage at the base of Q1 using a VOM. The voltage should be within 0.05 to 0.4V.

***Transmit Frequency Check***

1. Place the transceiver into transmit AM mode with no modulation.

2. Connect the frequency counter to the antenna connector as shown in figure 3-4. Read the frequency at each channel. The frequency should be within ±800Hz from each center channel frequency as tabulated in the frequency table.

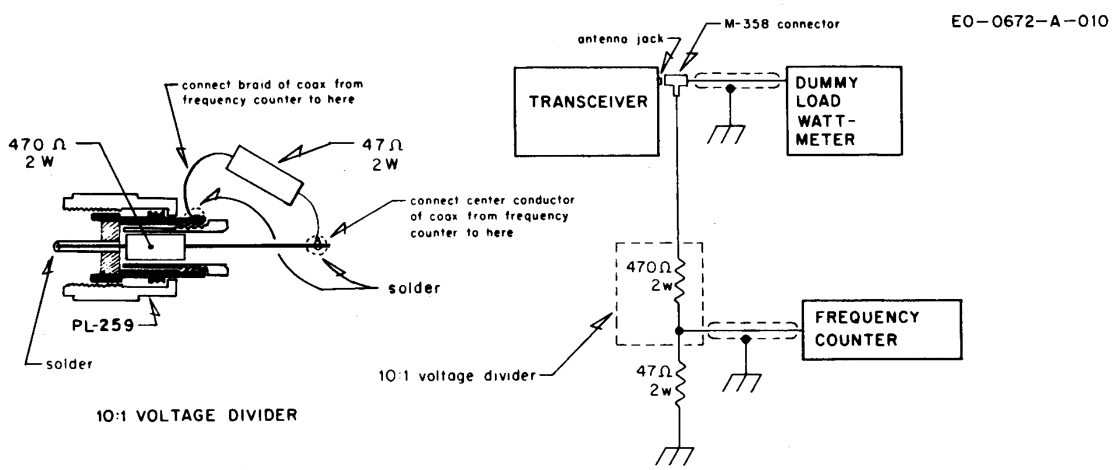



**Figure 3-4. Connection of Frequency Counter and Dummy Load**

**CHANNEL FREQUENCY**

| Channel | MHz | Channel | MHz | Channel | MHz | Channel | MHz |
|---|---|---|---|---|---|---|---|
| 1 | 26.965 | 11 | 27.085 | 21 | 27.215 | 31 | 27.315 |
| 2 | 26.975 | 12 | 27.105 | 22 | 27.225 | 32 | 27.325 |
| 3 | 26.985 | 13 | 27.115 | 23 | 27.255 | 33 | 27.335 |
| 4 | 27.005 | 14 | 27.125 | 24 | 27.235 | 34 | 27.345 |
| 5 | 27.015 | 15 | 27.135 | 25 | 27.245 | 35 | 27.355 |
| 6 | 27.025 | 16 | 27.155 | 26 | 27.265 | 36 | 27.365 |
| 7 | 27.035 | 17 | 27.165 | 27 | 27.275 | 37 | 27.375 |
| 8 | 27.055 | 18 | 27.175 | 28 | 27.285 | 38 | 27.385 |
| 9 | 27.065 | 19 | 27.185 | 29 | 27.295 | 39 | 27.395 |
| 10 | 27.075 | 20 | 27.205 | 30 | 27.305 | 40 | 27.405 |

## Receiver Alignment

### *Equipment Set-up*

Refer to figure 3-5 for the test equipment set-up. Refer to figure 3-7 for the location of components to be adjusted for transmitter alignment.

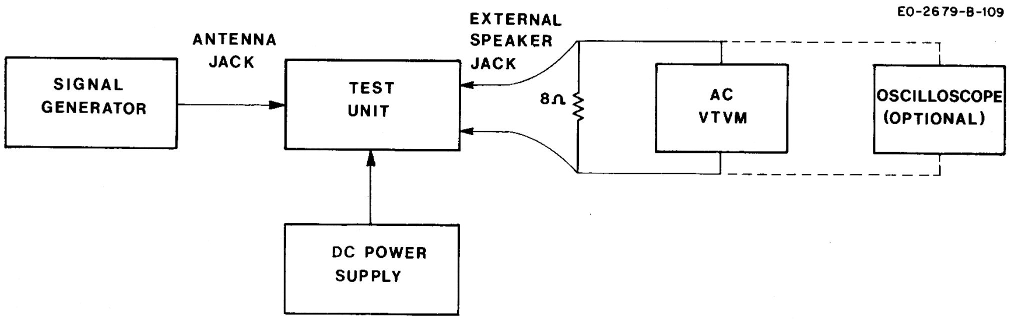



**Figure 3-5. Test Equipment Set-Up, Receiver Alignment**

### *AGC Alignment*

1. Connect the VOM to terminal number 15 on the main p.c. board and chassis ground.

2. Place the Mode switch in the AM position.

3. Adjust RV8 to obtain a reading of 2V.

### *Receiver Sensitivity Alignment*

To put the transceiver into the receive mode, short pins 3 and 5 of the MIC jack on the front panel together.

1. Set the signal generator to 27.185 MHz, 1 kHz, 30% modulation and set the transceiver to channel 19. **NOTE:** This alignment should be performed with an extremely small signal input from the signal generator to avoid inaccurate alignment due to AGC action.

2. Adjust T7, T8, T9, T10, T13, T14 and T15 for maximum audio output as indicated on the AC VTVM (or oscilloscope, if used).

3. Turn the core of T7 one turn clockwise.

### *Squelch Circuit Alignment*

1. Place the Mode switch in the AM position.

2. Set the signal generator to provide an RF input signal of 50 uV, 1 kHz, 30% modulation.

3. Rotate the squelch control fully clockwise.

4. Adjust RV9 so that the squelch just breaks with the 50 uV signal input.

5. Place the Mode switch in the USB position and adjust RV10 so that the squelch just breaks with the 50 uV signal input.

### *S-Meter Adjustment*

1. Set the signal generator to provide a 30 uV signal input and place the Mode switch in the USB position.

2. Adjust RV7 so that the S-meter indicates "9".

3. Place the Mode switch in the AM position and retune the signal generator slightly to obtain maximum audio output.

4. Adjust RV6 so that the S-meter indicates "9".

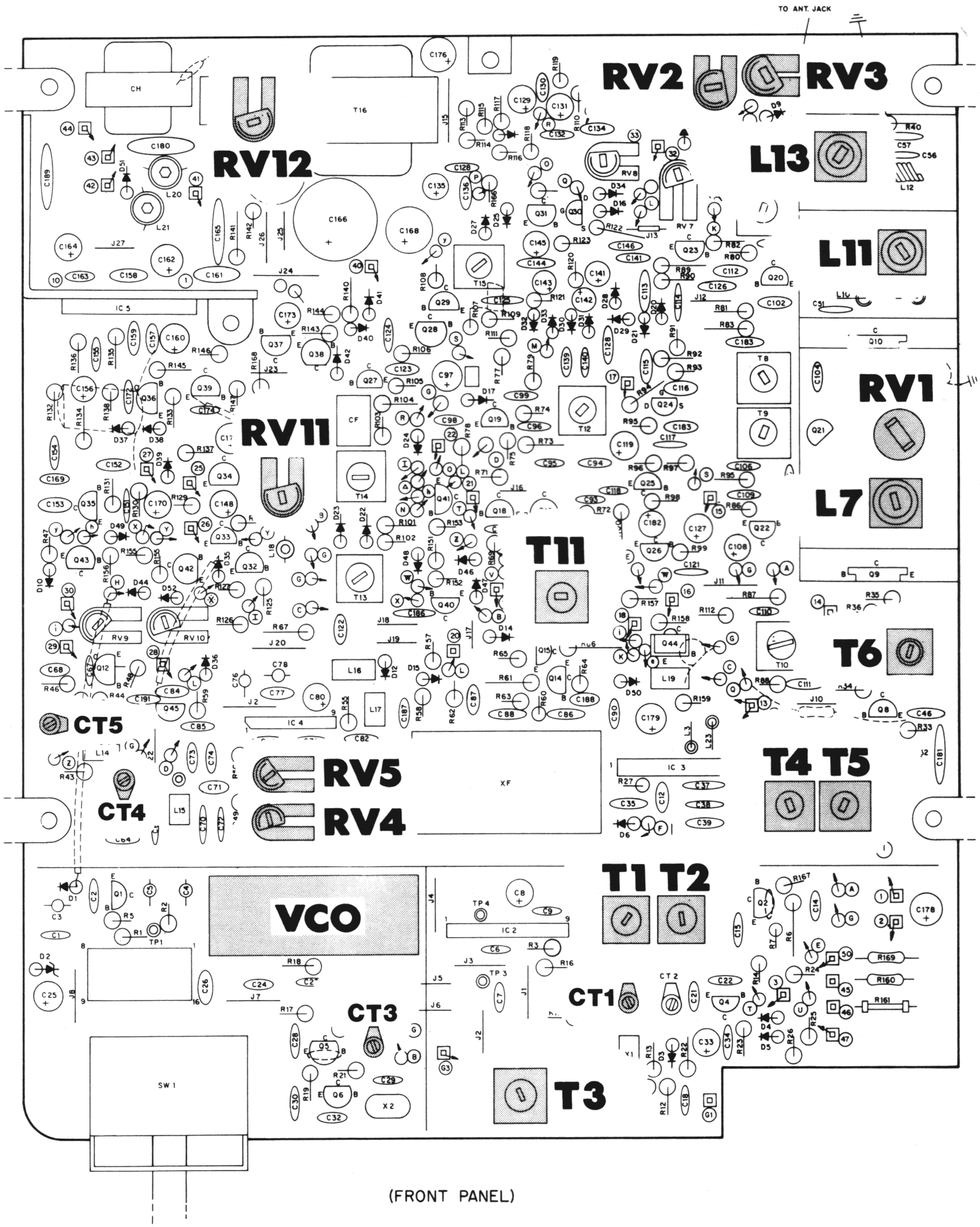



**Figure 3-6. Components Adjusted for Transmitter Alignment**

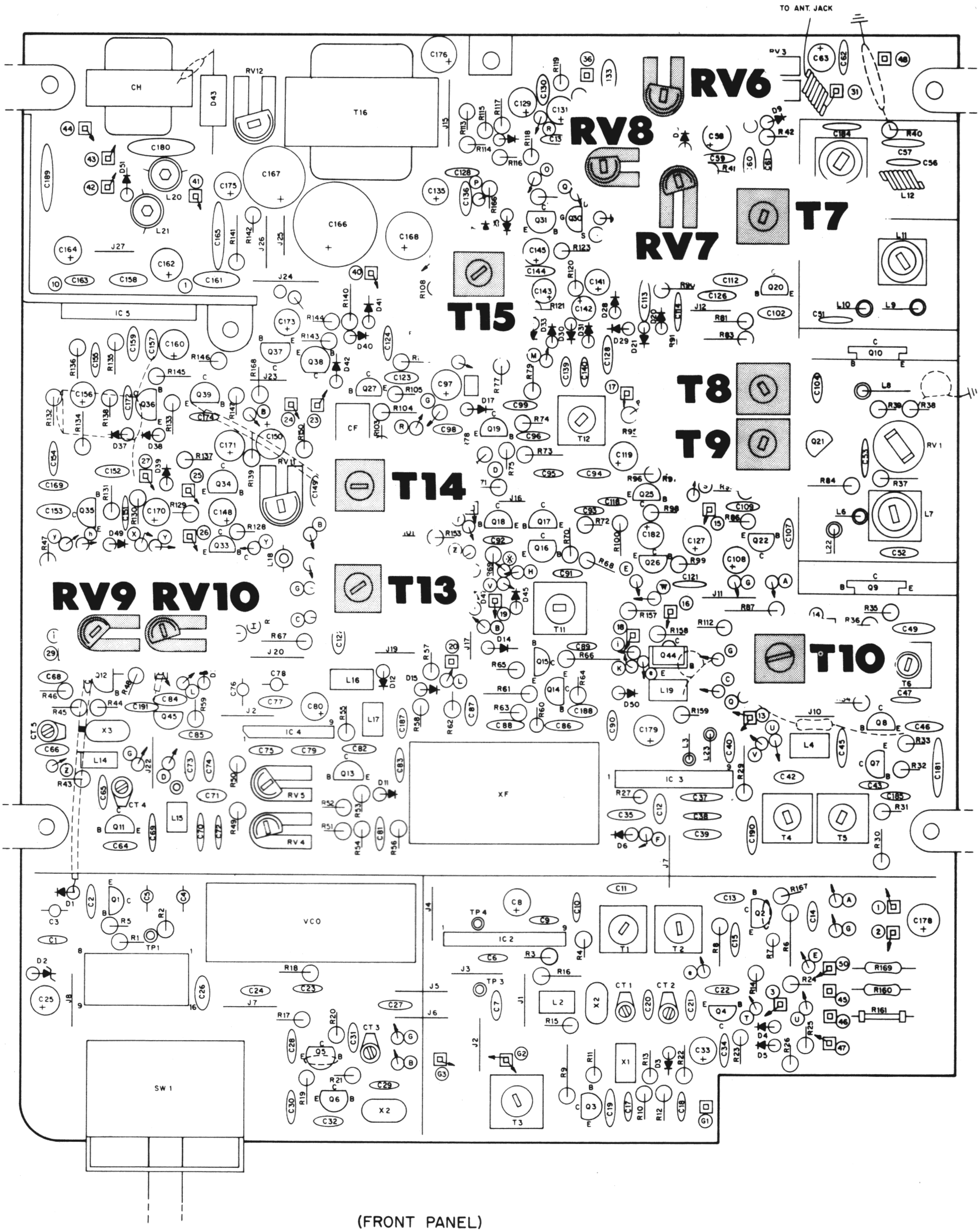



**Figure 3-7. Components Adjusted for Receiver Alignment**

# CHAPTER 4 — CHARTS AND DRAWINGS

# VOLTAGE MEASUREMENT CHARTS

**(AM Receive-Transmit)**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q1 | Rx | 3.8 | .25 | 5.6 |
| | Tx | 3.8 | .25 | 5.6 |
| Q2 | Rx | 1 | 1.5 | 9.3 |
| | Tx | 0 | 0 | 9.3 |
| Q3 | Rx | 1.08 | 1.5 | 9.2 |
| | Tx | 1.08 | 1.5 | 9.2 |
| Q4 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q5 | Rx | .5 | .82 | 5.6 |
| | Tx | .5 | .82 | 5.6 |
| Q6 | Rx | 0 | .6 | .82 |
| | Tx | 0 | .6 | .82 |
| Q7 | Rx | 0 | .7 | 0 |
| | Tx | 1.5 | .7 | 7.2 |
| Q8 | Rx | 0 | 0 | 13.8 |
| | Tx | .76 | 1.55 | 13 |
| Q9 | Rx | 0 | 0 | 13.8 |
| | Tx | 0 | .7 | 5.6 |
| Q10 | Rx | 0 | 0 | 13.8 |
| | Tx | 0 | .6 | 5.4 |
| Q11 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q12 | Rx | 2.8 | 3.2 | 9.4 |
| | Tx | 2.5 | 3.0 | 8.0 |
| Q13 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q14 | Rx | 0 | 0 | 9.4 |
| | Tx | 1.05 | 0 | 3.2 |
| Q15 | Rx | 0 | 0 | 9.4 |
| | Tx | 1.05 | 1.63 | 3.2 |
| Q16 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |

**AM Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q17 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q18 | Rx | 0 | 0 | 0 |
| | Tx | 0 | .75 | 0 |
| Q19 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q20 | Rx | 1.45 | 1.85 | 10.8 |
| | Tx | .4 | .45 | 10.8 |
| Q21 | Rx | 0 | 0 | 0 |
| | Tx | 0 | .75 | 0 |
| Q22 | Rx | 1.5 | 1.75 | 12.2 |
| | Tx | .2 | .4 | 13 |
| Q23 | Rx | 0 | 4.7 | 13 |
| | Tx | 0 | 4.7 | 13 |
| Q24 | Rx | 0 | .65 | 7.8 |
| | Tx | 0 | 0 | 0 |
| Q25 | Rx | 8.6 | 7.6 | 3.4 |
| | Tx | 0 | 0 | 0 |
| Q26 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q27 | Rx | .6 | .87 | 8 |
| | Tx | 0 | 0 | 13 |
| Q28 | Rx | 0 | .65 | 2 |
| | Tx | 0 | 0 | .25 |
| Q29 | Rx | 1.35 | 2 | 11 |
| | Tx | 0 | .25 | 13 |
| Q30 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q31 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q32 Squelched | Rx | 1.7 | 1.7 | 0 |
| | Tx | .9 | .2 | .7 |

**AM Receive-Transmit**

| Ref. Desig | | E | B | C |
|---|---|---|---|---|
| Q32 Unsquelched | Rx | 2.7 | 1.8 | .7 |
| | Tx | 1.6 | .5 | .7 |
| Q33 Unsquelched | Rx | 0 | .7 | 0 |
| | Tx | 0 | .7 | 0 |
| Q33 Squelched | Rx | 0 | 0 | .7 |
| | Tx | 0 | .7 | 0 |
| Q34 Unsquelched | Rx | 0 | 0 | 3.3 |
| | Tx | 0 | 0 | 3.3 |
| Q34 Squelched | Rx | 0 | .65 | 0 |
| | Tx | 0 | 0 | 3.3 |
| Q35 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q36 | Rx | 0 | .7 | 0 |
| | Tx | 0 | .7 | 0 |
| Q37 | Rx | 1.5 | 4.4 | 0 |
| | Tx | 1.5 | 4.3 | 0 |
| Q38 | Rx | 1.5 | 6.9 | 0 |
| | Tx | 1.5 | 6.6 | 0 |
| Q39 | Rx | 0 | 0 | 7.6 |
| | Tx | 0 | 0 | 7.3 |
| Q40 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q41 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q42 | Rx | 9.2 | 9.1 | 0 |
| | Tx | 9.1 | 8.4 | 9 |
| Q43 | Rx | 8.6 | 9.2 | 9.4 |
| | Tx | .35 | .8 | 9.3 |

**USB Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q1 | Rx | 3.8 | .25 | 5.6 |
| | Tx | 3.8 | .25 | 5.6 |

**USB Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q2 | Rx | 1 | 1.5 | 9.3 |
| | Tx | 0 | 0 | 9.3 |
| Q3 | Rx | 1.08 | 1.5 | 9.2 |
| | Tx | 1.08 | 1.5 | 9.2 |
| Q4 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q5 | Rx | .5 | .82 | 5.6 |
| | Tx | .5 | .82 | 5.6 |
| Q6 | Rx | 0 | .6 | .82 |
| | Tx | 0 | .6 | .82 |
| Q7 | Rx | 0 | .7 | 0 |
| | Tx | 1.65 | .7 | 7.2 |
| Q8 | Rx | 0 | 0 | 13.8 |
| | Tx | .76 | 1.7 | 13.5 |
| Q9 | Rx | 0 | 0 | 13.8 |
| | Tx | 0 | .7 | 13.8 |
| Q10 | Rx | 0 | 0 | 13.8 |
| | Tx | 0 | .6 | 13.8 |
| Q11 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q12 | Rx | 2.5 | 3 | 8 |
| | Tx | 2.5 | 3 | 8 |
| Q13 | Rx | 0 | 0 | 0 |
| | Tx | 4 | 4.7 | 6.8 |
| Q14 | Rx | .97 | .83 | 8.2 |
| | Tx | .6 | 1.1 | 8.6 |
| Q15 | Rx | .97 | 0 | 8.2 |
| | Tx | .6 | 0 | 8.6 |
| Q16 | Rx | 0 | .7 | 1.9 |
| | Tx | 0 | 0 | 0 |
| Q17 | Rx | 1.1 | 1.9 | 6 |
| | Tx | 0 | 0 | .2 |
| Q18 | Rx | 0 | 0 | 1.9 |
| | Tx | 0 | .75 | 0 |

**USB Receive-Transmit**

| Reg. Desig. | | E | B | C |
|---|---|---|---|---|
| Q19 | Rx | 0 | .5 | 5.6 |
| | Tx | 0 | 0 | 0 |
| Q20 | Rx | 1.25 | 1.85 | 13.2 |
| | Tx | .5 | .45 | 13.2 |
| Q21 | Rx | 0 | 0 | 0 |
| | Tx | 0 | .75 | 0 |
| Q22 | Rx | 1.3 | 1.75 | 12.8 |
| | Tx | .2 | .45 | 13.5 |
| Q23 | Rx | 0 | 4.9 | 13.5 |
| | Tx | 0 | 4.9 | 13.5 |
| Q24 | Rx | 0 | .65 | 7.8 |
| | Tx | 0 | 0 | 0 |
| Q25 | Rx | 8.6 | 7.6 | 3.4 |
| | Tx | 0 | 0 | 0 |
| Q26 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q27 | Rx | 0 | 0 | 13.5 |
| | Tx | 0 | 0 | 13.5 |
| Q28 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q29 | Rx | 0 | 0 | 13.5 |
| | Tx | 0 | 0 | 13.5 |
| Q30 | Tx | 1.5 | 2.2 | 7.7 |
| | Tx | 0 | 0 | 0 |
| Q31 | Rx | .1 | 1.5 | 2.05 |
| | Tx | 0 | 0 | 0 |
| Q32 Unsquelched | Rx | 2.7 | 1.8 | .7 |
| | Tx | 1.6 | .5 | .7 |
| Q32 Squelched | Rx | 1.7 | 1.7 | 0 |
| | Tx | .9 | .2 | .7 |
| Q33 Unsquelched | Rx | 0 | .7 | 0 |
| | Tx | 0 | .7 | 0 |
| Q33 Squelched | Rx | 0 | 0 | .7 |
| | Tx | 0 | .7 | 0 |

**USB Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q34 Unsquelched | Rx | 0 | 0 | 3.3 |
| | Tx | 0 | 0 | 3.3 |
| Q34 Squelched | Rx | 0 | .65 | 0 |
| | Tx | 0 | 0 | 3.3 |
| Q35 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q36 | Rx | 0 | .7 | 0 |
| | Tx | 0 | 0 | 0 |
| Q37 | Rx | 1.5 | 4.4 | 0 |
| | Tx | 1.5 | 4.4 | 0 |
| Q38 | Rx | 1.5 | 6.9 | 0 |
| | Tx | 1.5 | 1.5 | 0 |
| Q39 | Rx | 0 | 0 | 7.6 |
| | Tx | 0 | .75 | 0 |
| Q40 | Rx | 8.4 | 8.2 | 0 |
| | Tx | 8.2 | 7.4 | 8 |
| Q41 | Rx | 7.5 | 8.1 | 8.4 |
| | Tx | .2 | .7 | 8.2 |
| Q42 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q43 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |

**LSB Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q1 | Rx | 3.8 | .25 | 5.6 |
| | Tx | 3.8 | .25 | 5.6 |
| Q2 | Rx | 1 | 1.5 | 9.3 |
| | Tx | 0 | 0 | 9.3 |
| Q3 | Rx | 1.08 | 1.5 | 9.2 |
| | Tx | 1.08 | 1.5 | 9.2 |
| Q4 | Rx | 0 | .77 | 0 |
| | Tx | 0 | .77 | 0 |

**LSB Receive-Transmit**

| Ref. Desig | | E | B | C |
|---|---|---|---|---|
| Q5 | Rx | .5 | .82 | 5.6 |
| | Tx | .5 | .82 | 5.6 |
| Q6 | Rx | 0 | .6 | .82 |
| | Tx | 0 | .6 | .82 |
| Q7 | Rx | 0 | .7 | 0 |
| | Tx | 1.65 | .7 | 7.2 |
| Q8 | Rx | 0 | 0 | 13.8 |
| | Tx | .76 | 1.7 | 13.5 |
| Q9 | Rx | 0 | 0 | 13.8 |
| | Tx | 0 | .7 | 13.8 |
| Q10 | Rx | 0 | 0 | 13.8 |
| | Tx | 0 | .6 | 13.8 |
| Q11 | Rx | 0 | .7 | 0 |
| | Tx | 0 | .7 | 0 |
| Q12 | Rx | 2.5 | 3 | 8 |
| | Tx | 2.5 | 3 | 8 |
| Q13 | Rx | 0 | 0 | 0 |
| | Tx | 4 | 4.7 | 6.8 |
| Q14 | Rx | .97 | .95 | 8.2 |
| | Tx | .6 | 1.1 | 8.2 |
| Q15 | Rx | .97 | 0 | 8.2 |
| | Tx | .6 | 0 | 8.2 |
| Q16 | Rx | 0 | .7 | 1.9 |
| | Tx | 0 | 0 | 0 |
| Q17 | Tx | 1.1 | 1.9 | 6 |
| | Tx | 0 | 0 | .2 |
| Q18 | Rx | 0 | 0 | 1.9 |
| | Tx | 0 | .75 | 0 |
| Q19 | Rx | 0 | .5 | 5.6 |
| | Tx | 0 | 0 | 0 |
| Q20 | Rx | 1.25 | 1.85 | 13.2 |
| | Tx | .5 | .45 | 13.2 |
| Q21 | Rx | 0 | 0 | 0 |
| | Tx | 0 | .75 | 0 |

**LSB Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q22 | Rx | 1.3 | 1.75 | 12.8 |
| | Tx | .2 | .45 | 13.5 |
| Q23 | Rx | 0 | 4.9 | 13.5 |
| | Tx | 0 | 4.9 | 13.5 |
| Q24 | Rx | 0 | .65 | 7.8 |
| | Tx | 0 | 0 | 0 |
| Q25 | Rx | 8.6 | 7.6 | 3.4 |
| | Tx | 0 | 0 | 0 |
| Q26 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q27 | Rx | 0 | 0 | 13.5 |
| | Tx | 0 | 0 | 13.5 |
| Q28 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q29 | Rx | 0 | 0 | 13.5 |
| | Tx | 0 | 0 | 13.5 |
| Q30 | Rx | 1.5 | 2.2 | 7.7 |
| | Tx | 0 | 0 | 0 |
| Q31 | Rx | .1 | 1.5 | 2.05 |
| | Tx | 0 | 0 | 0 |
| Q32 Unsquelched | Rx | 2.7 | 1.8 | .7 |
| | Tx | 1.6 | .5 | .7 |
| Q32 Squelched | Rx | 1.7 | 1.7 | 0 |
| | Tx | .9 | .2 | .7 |
| Q33 Unsquelched | Rx | 0 | .7 | 0 |
| | Tx | 0 | .7 | 0 |
| Q33 Squelched | Rx | 0 | 0 | .7 |
| | Tx | 0 | .7 | 0 |
| Q34 Unsquelched | Rx | 0 | 0 | 3.3 |
| | Tx | 0 | 0 | 3.3 |
| Q34 Squelched | Rx | 0 | .65 | 0 |
| | Tx | 0 | 0 | 3.3 |
| Q35 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |

**LSB Receive-Transmit**

| Ref. Desig. | | E | B | C |
|---|---|---|---|---|
| Q36 | Rx | 0 | .7 | 0 |
| | Tx | 0 | 0 | 0 |
| Q37 | Rx | 1.5 | 4.4 | 0 |
| | Tx | 1.5 | 4.4 | 0 |
| Q38 | Rx | 1.5 | 6.9 | 0 |
| | Tx | 1.5 | 1.5 | 0 |
| Q39 | Rx | 0 | 0 | 7.6 |
| | Tx | 0 | .75 | 0 |
| Q40 | Rx | 8.4 | 8.2 | 0 |
| | Tx | 8.2 | 7.4 | 8 |
| Q41 | Rx | 7.5 | 8.1 | 8.4 |
| | Tx | .2 | .7 | 8.2 |
| Q42 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |
| Q43 | Rx | 0 | 0 | 0 |
| | Tx | 0 | 0 | 0 |

## IC 1 (P.L.L. 02)

| Pin No. | Voltage | Channels Selected |
|---|---|---|
| 1 | 5.6 | N/A |
| 2 | 1.8 | N/A |
| 3 | .15 | N/A |
| 4 | 5.3 | N/A |
| 5 | No Pin | |
| 6 | 1.5 - 3.5 | 40 - 1 |
| 7 | 0 | N/A |
| 8 | 5.6 | N/A |
| 9 | 5.6 | N/A |
| 10 | 5.6 | 1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22,23,24,25, 26,27 |
| 11 | 5.6 | 1,2,3,4,5,6,7,8,9,10,11,12,13,25, 29,30,31,32,33,34,35,36,37,38,39,40 |
| 12 | 5.6 | 1,2,3,4,5,6,7,14,15,16,17,18,19,28, 29,30,31,32,33,34,35 |
| 13 | 5.6 | 1,2,3,8,9,10,14,15,16,20,21,22, 24,28,29,30,31,36,37,38,39 |
| 14 | 5.6 | 1,2,4,5,8,11,14,15,17,18,20,21,23, 25,28,29,32,33,36,37,40 |
| 15 | 5.6 | 1,3,4,6,9,11,12,14,17,19,20,22,25, 26,28,30,32,34,36,38,40 |
| 16 | 0 | N/A |

**NOTE:** All voltage readings are taken with the power source set at exactly 13.8 VDC.

## IC 2

| Pin No. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | Rx | 2.5 | 2 | 1.3 | 2.3 | 0 | 8.4 | 2.1 | 4.4 | 5.5 |
| | Tx | 2.5 | 2 | 1.3 | 2.3 | 0 | 8.4 | 2.1 | 4.4 | 5.5 |

## IC 3

| Pin No. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | Rx | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Tx | 2.6 | 2 | 1.3 | 2.7 | 0 | 7.2 | 2 | 7.3 | 6.8 |

## IC 4

| Pin No. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Voltage | Rx | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Tx | 3.1 | 3.4 | 3.5 | 0 | 6.3 | 8.3 | 4.7 |

## IC 5

| Pin No. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Voltage squelched | | 13.8 | 12.5 | 2.5 | 12 | .4 | 1.6 | 1.5 | 0 | 0 | 11 |
| Voltage unsquelched | | 13.8 | 12.5 | 4 | 8.4 | 1.3 | 3.8 | 3.5 | 1.3 | 0 | 7.1 |

**NOTE:** All voltage measurements are taken with the power supply set at exactly 13.8 VDC.