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MODEL 2679
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 801273

EO-2679-A-001

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CHAPTER 1 — GENERAL INFORMATION

Introduction

This service manual contains all the information needed to service and repair the Hy-Gain 9 transceiver (Model 2679). 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 unit is a full 23-channel transceiver designed and type accepted for Class D Citizens Radio Service, as designated by the Federal Communications Commission (FCC).

It is a compact mobile unit which operates by remote control. All the operator controls are built into one unit, the microphone, allowing the transceiver to be mounted out of sight in the vehicle.

The transceiver is completely solid-state, and highly reliable with low power consumption. Its PLL (Phase Locked Loop) synthesizer provides immediate operation on all 23 channels. A built-in automatic noise limiter (ANL) is included to help reduce atmospheric noise. Use the unit 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 your problem. Address your 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 your unit, contact the National Service Manager. Often a problem is field solvable with just a little extra help. This can save lost time and shipping costs. Limit factory returns to difficult problems.

How to Ship Returns

To return a unit, get a return authorization first. This is important. You will only delay the handling of your unit if you ship without it. If you must ship immediately, telephone or telex the National Service Manager to have him expedite the matter.

When you request return authorization, you may also request notification of completion of repairs. The notification will include a copy of the bill. Paying the bill before we return your 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. a 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 the information is not overlooked. Wrap the unit and envelope in heavy paper or put them 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 around the unit with resilient packing material (shredded paper, excelsior, bubble pack, etc.). Seal it 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 must be settled between you and the carrier and this can delay repair and return of the unit.

All shipments must be sent *PREPAID.* We **do not accept** collect shipments. After the unit has been repaired, we will send it back to you COD unless you have prepaid the bill. Unclaimed or refused COD shipments will not be reshipped until payment is received in full. 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

Channels ..... all 23 channels in the Citizens Band (26.965 MHz - 27.255 MHz)
Antenna impedance ..... 50 ohms, nominal
Power requirements ..... 11.5 VDC - 14.5 VDC, negative or positive ground
Compliance ..... type accepted under FCC rules, Part 95

Receiver Section

Circuitry ..... dual conversion superheterodyne with rf amplifier stage and 455 KHz ceramic filter
Sensitivity ..... 0.7 uV for 10 dB (S+N)/N ratio
Intermediate frequencies ..... 1st IF - 10.695 MHz
2nd IF - 455 KHz
Audio output ..... 3 watts, maximum
Current drain, receive ..... about 500 mA, standby (no signal)

Transmitter section

RF power output ..... 4 watts
Emission ..... AM, type 8A3
Spurious response rejection ..... all harmonic and spurious suppression better than FCC requirements
Modulation ..... AM, 90% typical
Current drain, transmit ..... about 1.3A @ 13.8 VDC unmodulated

CHAPTER 2 - THEORY OF OPERATION

General

The theory of operation of the radio is divided into four sections: the Phase Locked Loop Frequency Synthesizer, the Receiver, the Transmitter, and the Control and Logic Functions. 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.

Refer to the block diagram, Figure 2-2, for visual reference to the theory of operation.

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 three crystal oscillators to perform its frequency generating function.

The 11.8066 MHz Oscillator, Q105, has its output tripled and serves as a prescaler for the output of the Voltage Controlled Oscillator (VCO), Q101. The offset Oscillator, Q109, operates at a frequency of 10.695 MHz, which mixes with the VCO output to provide the transmit frequency. The 10.24 MHz Oscillator, Q117, provides a reference for the PLL and an injection frequency for the Second Receive Mixer.

The PLL circuit generates the operating frequenices needed for the transceiver in accordance with the code fed to the programmable divider, IC101, from the channel select logic board. Table A shows the following for each channel: the channel frequency, VCO frequency, binary code and the division ratio of the programmable divider.

For example, assume that channel 1 has been selected. The channel frequency is 26.965 MHz, the VCO frequency is 37.660 MHz, and the binary code ("N" code) is 224. The channel select logic board programs the Programmable Divider for a division ratio of 224. The 10.24 MHz reference frequency is fed to the Integrated Circuit PLL Chip, IC101. It is divided by 1024 within the chip, producing a 10 KHz reference signal. The output of the VCO is mixed in the PLL Mixer, Q102, with the tripled output of Q105, producing a 2.24 MHz signal. The signal is fed to the programmable divider, which divides it by 224 to produce 10 KHz.

The two 10 KHz signals are phase compared in the phase detector within IC101 producing a DC voltage. This DC voltage controls the varactor diode, D102, and holds the VCO frequency at 37.660 MHz.

Assume that the channel is changed to channel 23. The channel select logic board now provides a code that will produce a division ratio of 253. At this instance the VCO frequency is at 37.660 MHz, which is mixed with the tripled output of Q105. Again, the PLL Mixer, Q102, produces an output of 2.24 MHz. The 2.24 MHz signal is divided by 253 to produce a frequency of 8.73 KHz.

The 8.73 KHz output, along with the 10 KHz obtained from the reference oscillator, is fed to the phase detector. The comparison of the two frequencies in the phase detector produces an error output which is combined AC-DC voltage. The low pass filter removes the AC component and allows only the DC voltage to be fed to the VCO. The VCO frequency changes until the output of the programmable divider is again 10 KHz. When the two frequencies are matched at 10 KHz, the error voltage output of the phase detector is zero.

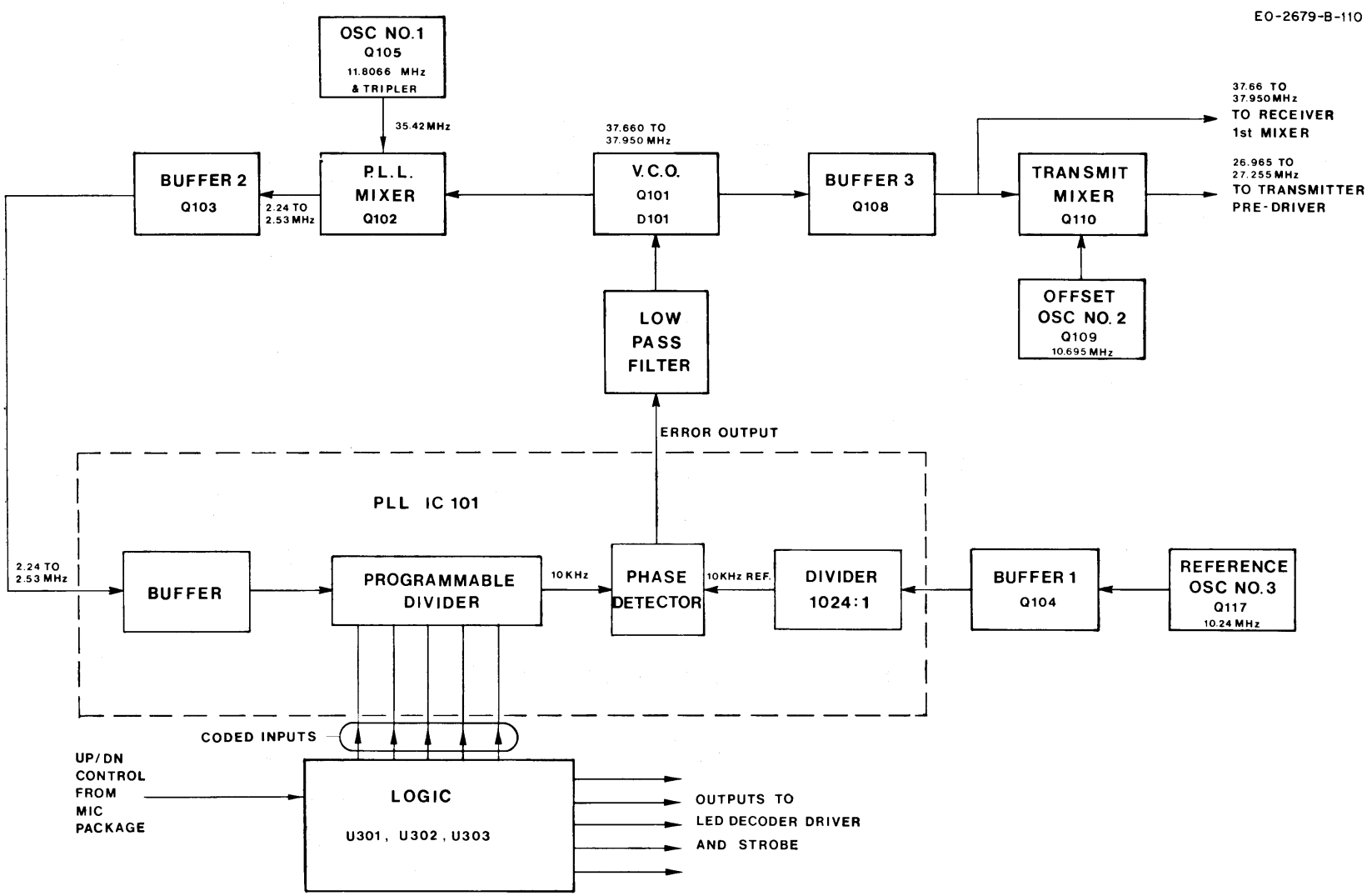


Figure 2-1. Block Diagram of PLL Circuitry

There is now a new DC voltage set up to tune the VCO frequency to 39.950 MHz. When this occurs the loop is considered locked. With the channel selector at 23, the following outputs of the PLL circuitry are produced: the 37.950 MHz VCO output is fed to the First Receiver Mixer and, in the transmit mode, is mixed with the 10.695 MHz output of Q109 to produce a transmit frequency of 27.255 MHz.

Receiver

The receiver is a dual-conversion superheterodyne, receiving AM signals from 26.965 MHz to 27.255 MHz. The operating channel is determined by the PLL frequency synthesizer, which provides the local oscillator frequency to the First Mixer. A variable squelch circuit is included to quiet the receiver between transmissions.

In the receive mode, 13.8 VDC is supplied to IC 102, Q114, Q115, Q118, Q119 and to Q106 (the AVR). The AVR supplies regulated voltage to the synthesizer stages and to the Reference Oscillator, Q117. A bias voltage is also applied to the base of the Transmit Switch, Q107. This bias holds the Transmit Switch open, so that the transceiver circuits remain in receive.

Radio signals are received by the antenna and enter the radio at the antenna jack. The filter formed by L109, L110, C153 and C1 matches the antenna impedance to the RF Amplifier. Signals in the 26.695 MHz to 27.555 MHz range are filtered out and amplified by the RF Amplifier, Q114, and its tuned circuits C154/T104 and T105. D107 is a signal overload protector.

The output of the RF Amplifier and buffered VCO signal (which in this case could be called the "first local oscillator frequency") are applied to the First Receive Mixer, Q115. These two signals are mixed in the First Receive Mixer and produce an output of 10.695 MHz, which is the first IF.

The first IF passes through tuned circuits L112 and T106. It is then applied to the Second Receive Mixer, Q116, along with 10.240 MHz from the Reference Oscillator, Q117. The two signals are mixed in the Second Receive Mixer and produce an output of 455 KHz, which is the second IF.

The second IF passes through the Ceramic Filter, CF101, and is amplified by Q118 and Q119. The amplified signal is then fed to the Detector, D110. The Detector establishes an automatic gain control (AGC) voltage and recovers the audio from the modulated signal. The AGC voltage maintains the output volume of the receiver constant under variations in input signal strength and also controls the Squelch Switch, Q120.

The squelch functions in the following manner: in the receive mode, a bias voltage from Q106 is applied to the base of Q120, as determined by RV101. In the absence of a signal, the base of Q120 is positively biased and is on. This biases the squelch transistor inside IC102, which turns off the Audio Amplifier and squelches the receiver. When a signal is received, the AGC voltage developed by D110 biases Q120 off. This biases the squelch transistor inside IC102 such that the audio amplifier is turned on and the signal is heard.

The recovered audio from the Detector passes through a series Automatic Noise Limiter (ANL), D108, to the Electronic Attenuator, U304. The Electronic Attenuator functions as a volume control. Its output is amplified by IC102 and is fed through transformer T110 to the external speaker jack and the microphone-speaker.

Transmitter

Switching to the transmit mode is accomplished in the following manner: when the PTT switch is closed, the base of the DC Switch, Q107, is grounded. This establishes forward bias which causes Q107 to conduct. Regulated voltage from the Automatic Voltage regulator (AVR), Q106, is then supplied through Q107 to Q109 and Q110. RF is now applied to Q111, Q112 and Q113.

The operating channel is determined by the PLL frequency synthesizer. The buffered VCO frequency is mixed in Q110 with the 10.965 MHz Offset Oscillaotr, Q109, output to yield the transmit frequency. The transmit frequency from Q110 passes through the filter circuit of L103, L104, and T102 and is applied to the Pre-driver, Q111. The filter circuit partially removes spurious signals from the transmit frequency.

The Pre-driver, Q111, and the Driver, Q112, form two stages of amplification leading to the final stage. The filter circuit of T103 follows Q111, and L106 follows Q112. These two circuits filter out the remaining spurious signals from the transmit frequency.

From the Driver the signal is applied to the final stage, the RF Power Amplifier, Q113. 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 L109, C152, L110 and C1, and then to the antenna jack.

The transmit signal is modulated in the following manner: Microphone output is applied through the mic transformer, T301, to the Audio Amplfier, IC102. The output of IC102 is applied to the collectors of Q112 and Q113 through the audio output transformer, T110. Control voltages for the transmit audio (ALC), Q122, and the Range Boost, Q121, come from detector diode D111. The transmit audio ALC boosts, or lowers, the amplifier gain in response to line voltage fluctuations. This insures full modulation of the carrier despite any changes in line voltage. The Range Boost reduces AF peaks so that a higher average AF level is supplied to the Audio Amplifier. This gives the desired high average modulation without overmodulation on peaks.

Control and Logic Functions

All operator controls, on/off switch, volume, push-to-talk switch, and channel selector up/down switch, are located in the microphone unit. The microphone also includes a speaker for receiver audio (which doubles as the microphone element) and LED radiants which indicate the channel selected.

Channel selection is accomplished with the use of a special logic chip, U301. The channel selector switch may be set to channel up or down. With the switch activated, a clock starts and a BCD counter cycles through the 23 channels. The binary-coded decimal (BCD) output is connected to read-only memory units (ROM), U302 and U303. The ROM units feed the correct binary code to the programmable divider of the PLL, IC101. Also fed out of the logic chip is multiplexed BCD data to the LED Decoder Driver, U401, in the microphone.

N CODE — FREQUENCY CORRELATION CHART

Channel No.	*Channel Frequency*	*"N" Code*	*V.C.O. Frequency*	*Channel Switch Output (PLL Inputs)*				
				A	B	C	D	A
1	26.965 MHz	224	37.660 MHz	0	0	0	0	0
2	26.975 MHz	225	37.670 MHz	1	0	0	0	0
3	26.985 MHz	226	37.680 MHz	0	1	0	0	0
4	27.005 MHz	228	37.700 MHz	0	0	1	0	0
5	27.015 MHz	229	37.710 MHz	1	0	1	0	0
6	27.025 MHz	230	37.720 MHz	0	1	1	0	0
7	27.035 MHz	231	37.730 MHz	1	1	1	0	0
8	27.055 MHz	233	37.750 MHz	1	0	0	1	0
9	27.065 MHz	234	37.760 MHz	0	1	0	1	0
10	27.075 MHz	235	37.770 MHz	1	1	0	1	0
11	27.085 MHz	236	37.780 MHz	0	1	1	1	0
12	27.105 MHz	238	37.800 MHz	0	0	1	1	0
13	27.115 MHz	239	37.810 MHz	1	1	1	1	0
14	27.125 MHz	240	37.820 MHz	0	0	0	0	1
15	27.135 MHz	241	37.830 MHz	1	0	0	0	1
16	27.155 MHz	243	37.850 MHz	1	1	0	0	1
17	27.165 MHz	244	37.860 MHz	0	0	1	0	1
18	27.175 MHz	245	37.870 MHz	1	0	1	0	1
19	27.185 MHz	246	37.880 MHz	0	1	1	0	1
20	27.205 MHz	248	37.900 MHz	0	0	0	1	1
21	27.215 MHz	249	37.910 MHz	1	0	0	1	1
22	27.225 MHz	250	37.920 MHz	0	1	0	1	1
23	27.255 MHz	253	37.950 MHz	1	0	1	1	1

General

CHAPTER 3 — ALIGNMENT

These procedures must be followed to align the transceiver. 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 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 tuning coils are easily chipped or broken. Therefore, always use care when inserting an alignment tool in the coil: insert it straight into the core.

Recommended Equipment

The following equipment is recommended for use in aligning the transceiver.

Audio Signal Generator, 1 KHz

AC VTCM, 1 mV measurable

DC Ampere Meter, 2A

Variable Regulated Power Supply, DC 8-15V, 2A or higher

Frequency Counter, 0 to 40 MHz, high input impedance type

VTVM with RF probe

Oscilloscope, 30 MHz, high input impedance

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 DC 13.8V unless otherwise specified.

Transmitter Alignment Procedure

Equipment Set-up

Refer to Figure 3-4 for the location of components to be adjusted for transmitter alignment.

Connect test equipment as shown below.

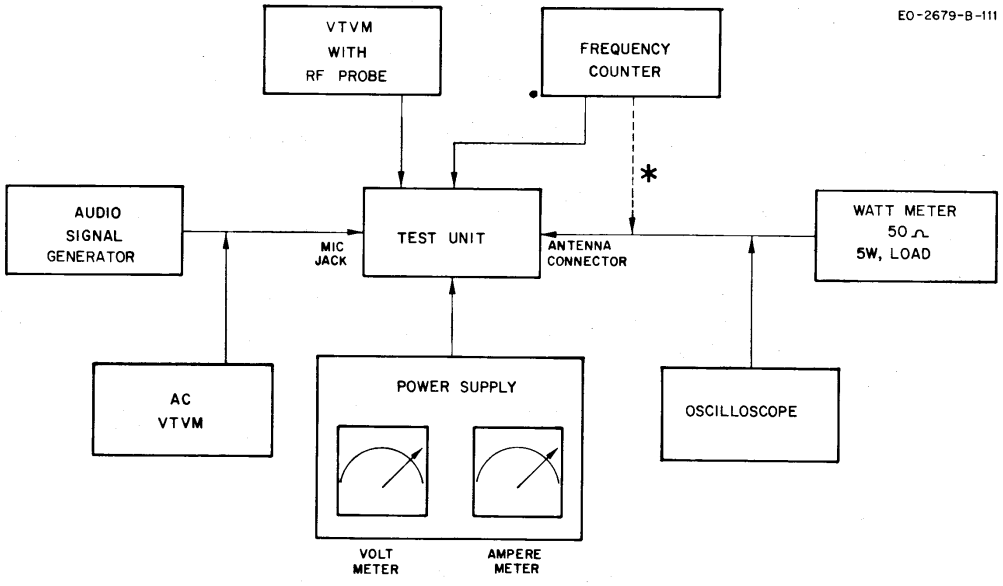


Figure 3-1

***NOTE:** See Figure 3-2 for connection of the frequency counter and the dummy load.

Pre-Alignment Frequency Check

Before alignment, use a high input impedence frequency counter through a 100 pF capacitor connected in series with the counter input probe to check the operating frequencies at the following points.

1. Pin 3 of IC101, reference input, check to read 10.24 MHz in accuracy.
2. Disconnect C103 from base of Q102. Check to read 11.8066 MHz at the base of Q102. If necessary, adjust C119 to obtain this frequency. Reconnect C103.
3. Q108 base, transceiver on Ch 1, check to read 37.66 MHz in accuracy.

VCO Alignment

1.Connect VOM (DC 10V ranged) across C135 and check to read 5.0V-5.5V.

2. Place the channel selector in the channel 1 position.

3. Connect the VOM between ground and R114 (TP-8 side).

4. Adjust T101 to obtain 1.5v ± .1V.

RF Output Adjustment

1. Adjust the power supply voltage to 8.0 volts.
2. Connect the VTVM RF probe between the base of Q111 and ground.
3. Set the transceiver channel selector to channel 13. Perform the following procedures on channel 13.
4. Key the transmitter.
5. Adjust the slugs of L103, L104, and T102 for a maximum reading on the VTVM.
6. Connect the VTVM RF probe between the base of Q112 and ground.
7. Adjust the slug of T103 for a maximum reading on the VTVM.
8. Adjust L106 for maximum RF output as indicated on the wattmeter.
9. Adjust L109, L110 for maximum RF power output as indicated on the wattmeter.
10. Raise the power supply voltage to 13.8V.
11. Repeat steps 2 through 7 only.
12. Back off L110 (counterclockwise) for a reading of 4.0 watts RF power output.
13. Readjust L109 for maximum power out.
14. Repeat steps 12 and 13 until the maximum power output is 4.0 watts with L109 peaked for maximum output.

Total transceiver current at this setting should not exceed 1.35A.

Transmitter Frequency Check

1. Turn the transceiver off.
2. Connect the dummy load and frequency count to the antenna jack as shown below.

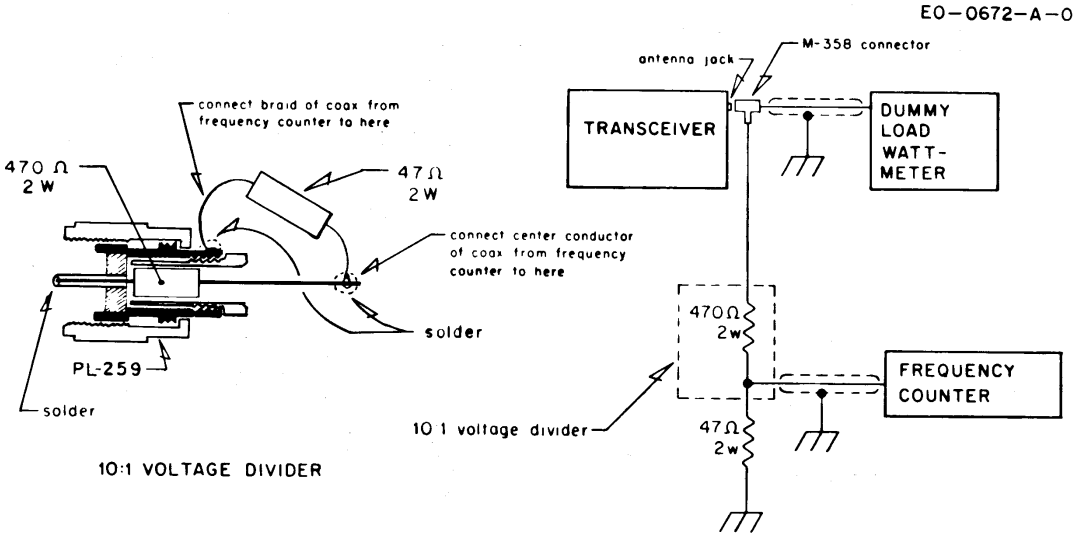


Figure 3-2

3. Key the transmitter with the microphone PTT button.

4. Check the frequency of each channel with the chart below. Frequencies should be within ±800 Hz at 25° C.

CHANNEL FREQUENCY

Channel	MHz	Channel	MHz
1	26.965	13	27.115
2	26.975	14	27.125
3	29.985	15	27.135
4	27.005	16	27.155
5	27.015	17	27.165
6	27.025	18	27.175
7	27.035	19	27.185
8	27.055	20	27.205
9	27.065	21	27.215
10	27.075	22	27.225
11	27.085	23	27.255
12	27.105		

Modulation Sensitivity Adjustment

1. Place the unit in the transmit mode and apply a 20 mV, 1 KHz signal to wire wrap pin 22 on the radio PC board.

2. Adjust RV-102 to obtain 90% modulation as observed on the oscilloscope.

3. Decrease the signal input to 6 mV. Modulation should not fall below 80%.

Receiver Alignment Procedure

Refer to Figure 3-5 for the location of components to be adjusted for receiver alignment.

Equipment Set-up

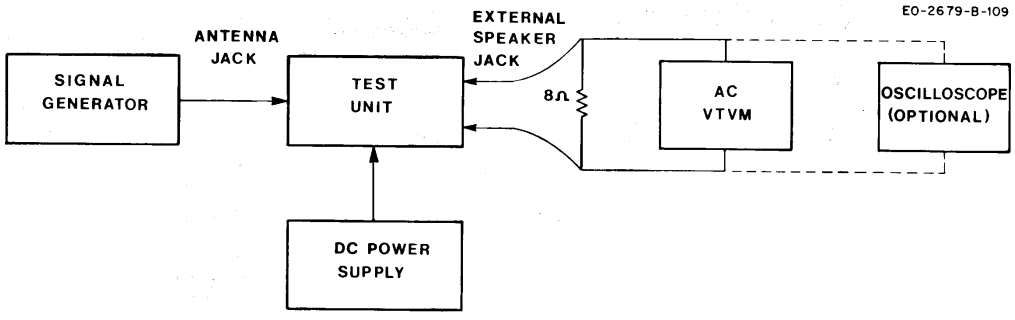


Figure 3-3

Receiver Alignment

1. Set the Signal Generator to 27.115 MHz, 30% 1 KHz, modulation and set the transceiver to channel 13.

NOTE: This alignment should be performed with an extremely small signal input from the signal generator to avoid inaccurate alignment due to AGC action.

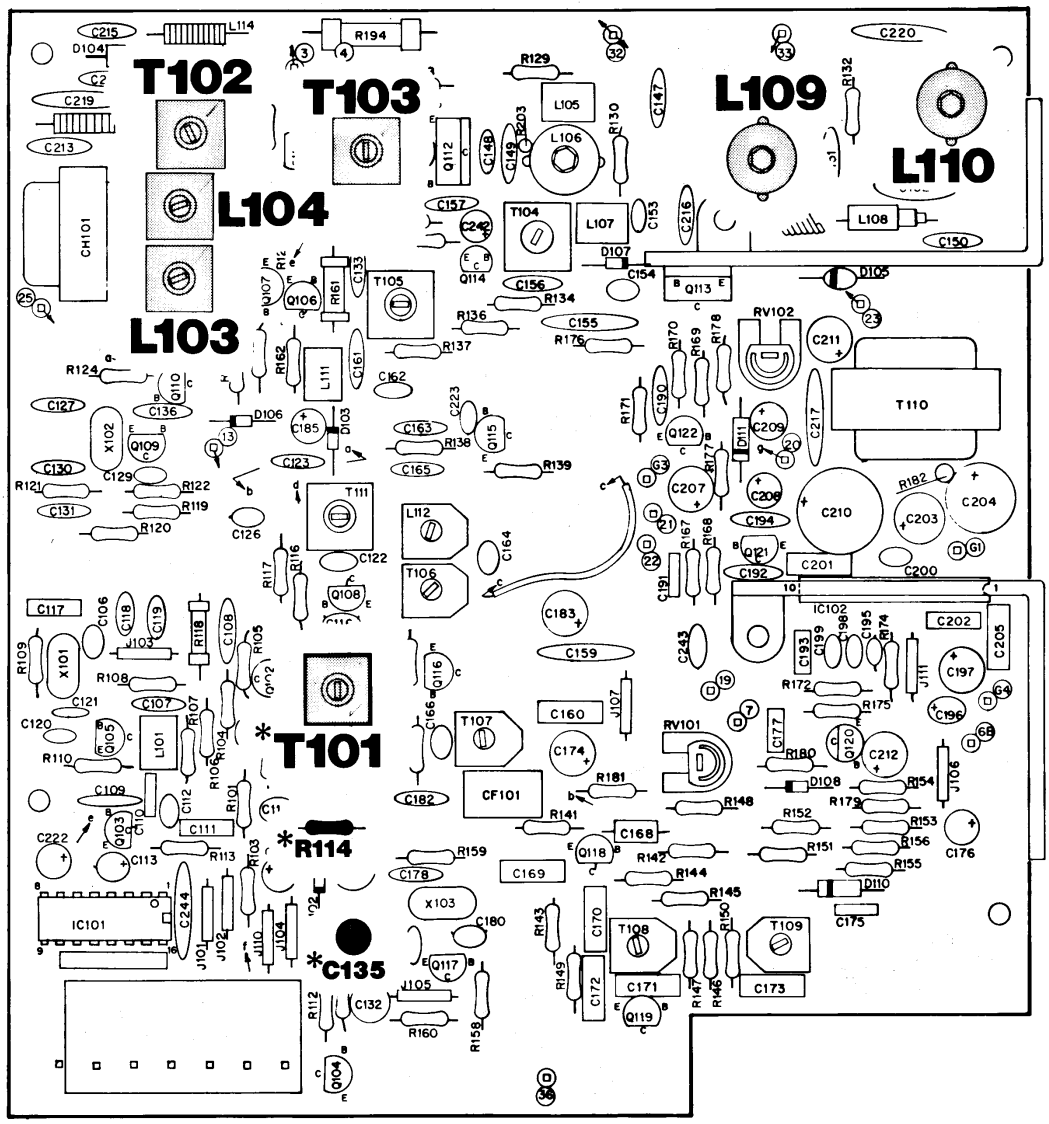
2. Adjust T104, T105, L112, T106, T107, T108 and T109 for maximum audio output as indicated on the AC VTVM (or oscilloscope if used).

Tight Squelch Adjustment

1. Set the signal generator to provide a RF input signal of 100 uV, (1 KHz, 30% mod.).

2. Rotate the squelch control fully clockwise.

3. Adjust RV-101 so that the squelch just breaks with the 100 uV signal input.



(FRONT PANEL)

Figure 3-4

Components Adjusted for Transmitter Alignment

CHAPTER 4 — CHARTS AND DRAWINGS

VOLTAGE MEASUREMENT CHARTS

Main P.C. Board

Reference Designator		E	B	C
Q101	RX	0.0	0.56	2.28
Q102	RX	0.0	0.55	2.55
Q103	RX	0.0	0.65	1.94
Q104	RX	0.0	0.64	2.36
Q105	RX	2.33	2.96	3.86
Q106	RX	8.50	9.17	12.52
Q107	RX	8.50	12.27	0.0
Q108	RX	0.0	0.74	3.78
Q109	RX	0.0	0.0	0.0
	TX	2.27	2.87	4.95
Q110	RX	0.0	0.0	0.0
	TX	1.62	2.22	8.43
Q111	RX	1.61	2.35	13.58
	TX	0.99	1.47	13.24
Q112	RX	0.0	0.0	13.28
	TX	0.0	-0.18	10.21
Q113	RX	0.0	0.0	13.28
	TX	0.0	-.008	11.43
Q114	RX	1.78	1.08	12.72
	TX	0.50	0.55	12.95
Q115	RX	1.81	2.49	11.98
	TX	0.05	0.54	12.95
Q116	RX	0.0	0.53	0.0
	TX	0.0	0.52	0.0
Q117	RX	1.92	2.49	3.63
	TX	1.92	2.49	3.63
Q118	RX	1.75	2.43	11.99
	TX	0.0	0.54	12.99
Q119	RX	0.56	1.24	12.69
	TX	0.0	0.22	13.01
Q120	squelched	0.0	0.65	0.01
	unsquelched	0.0	0.02	6.67
Q121	RX	0.0	0.01	0.0
Q122	RX	0.0	0.60	0.0

IC 102 (TA 7205P)

Pin No.	1	2	3	4	5	6	7	8	9	10
RX Voltage	6.76	0.0	1.24	6.72	6.63	6.66	0.94	8.0	13.25	13.58
TX Voltage	6.48	0.0	0.0	6.44	6.35	6.38	0.93	7.72	12.68	13.01

IC 101 (P.L.L. 02A)

Pin No.	Voltage	Channels Selected
1	5.43	N/A
2	1.92	N/A
3	2.36	N/A
4	(not used)	N/A
5	1.38 to 2.60	All channels
6	5.12	All channels
7	0.0	N/A
8	5.43	All channels
9	5.43	All channels
10	5.43	All channels
11 Low	.57	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
High	3.35	14, 15, 16, 17, 18, 19, 20, 21, 22, 23
12 Low	0.54	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19
High	3.90	20, 21, 22, 23
13 Low	0.11	1, 2, 3, 4, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22
High	3.71	5, 6, 7, 12, 13, 23
14 Low	0.12	1, 2, 3, 4, 5, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19,
High	3.84	20, 21, 23
15 Low	0.01	6, 7, 10, 22
High	3.92	1,2,3,4,5,6,8,9,10,11,12,14,16,17,18,19,20,21,22
16	Ground	7, 13, 15, 23

Channel Selector P.C. Board

U 304 (MC 334OP)

Pin No.	Voltage	Channels Selected
1	1.70	All channels
2	2.75	All channels
3	Ground	
4	(not used)	
5	(not used)	
6	7.70	All channels
7	7.00	All channels
8	12.4	All channels

U 301 (760109) (Channel Selector I.C.)

Pin No.	Voltage	Channels Selected
1	Low	1, 4, 5, 8, 9, 10, 11, 14, 15, 18, 19
	High	2, 3, 6, 7, 12, 13, 16, 17, 20, 21, 22, 23
2	Low	2, 4, 6, 8, 11, 20, 22
	High	1, 3, 5, 7, 9, 10, 12, 13, 14, 15, 16 17, 18, 19, 21, 23
3	12.0	All channels
4	Low	1, 2, 3, 8, 9, 10, 11, 12, 13, 18, 19 20, 21, 22, 23
	High	4, 5, 6, 7, 14, 15, 16, 17
5	Low	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22
	High	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23
6	Low	1, 4, 5, 8, 9, 10, 11, 14, 15, 18, 19, 20, 21
	High	2, 3, 6, 7, 12, 13, 16, 17, 22, 23
7	Low	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23
	High	8, 9, 18, 19
8	Low	All channels
	High	N/A
9	Low	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
	High	20, 21, 22, 23
10	(not used)	
11	Ground	
12 not channeling	8.1	N/A
down	13.0	N/A
up	1.2	N/A
13	Low	1, 2, 3, 4, 5, 6, 7, 8, 9, 20, 21, 22, 23
	High	10, 11, 12, 13, 14, 15, 16, 17, 18, 19
14	13.2	All channels
15	(not used)	
16 not channeling	Low	N/A
channeling	3.5	N/A
17 not channeling	12.0	N/A
channeling	8.0	N/A
18 not channeling	8.0	N/A
channeling	6.0	N/A
19	6.4	All channels
20	6.2	All channels
21	7.0	All channels
22	7.0	All channels
23	Low	10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23
	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 19
24	Low	10, 11, 12, 13, 18, 19, 20, 21, 22, 23
	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 14, 15, 16, 17

U 302 and U 303 (PROM No. 1 and No. 2)

Pin No.	Voltage	Channels Selected
1	Low	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 16, 17, 18, 19, 20, 21, 22
	High	7, 13, 15, 23
2	Low	1, 2, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 21, 23
	High	6, 10, 22
3	Low	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 20, 21, 22
	High	7, 23
4	Low	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
	High	20, 21, 22, 23
5	Low	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	High	14, 15, 16, 17, 18, 19, 20, 21, 22, 23
6	Low	8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
	High	1, 2, 3, 4, 5, 6, 7, 20, 21, 22, 23
7	Low	All channels
8	Ground	
9	Low	All channels
10	Low	2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22
	High	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23
11	Low	1, 4, 5, 8, 9, 10, 11, 14, 15, 18, 19, 20, 21
	High	2, 3, 6, 7, 12, 13, 16, 17, 22, 23
12	Low	1, 2, 3, 8, 9, 10, 11, 12, 13, 18, 19, 20, 21, 22, 23
	High	4, 5, 6, 7, 14, 15, 16, 17
13	Low	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23
	High	8, 9, 18, 19
14	Low	1, 2, 3, 4, 5, 6, 7, 8, 9, 20, 21, 22, 23
	High	10, 11, 12, 13, 14, 15, 16, 17, 18, 19
15 #1 PROM	Low	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
	High	20, 21, 22, 23
#2 PROM	Low	20, 21, 22, 23
	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
16	5.6	All channels

Microphone P.C. Board

U 401 (14511)

Pin No.	Voltage	Channels Selected
1	Low	1, 4, 5, 8, 9, 10, 11, 14, 15, 18, 19
	High	2, 3, 6, 7, 12, 13, 16, 17, 20, 21, 22, 23
2	Low	10, 11, 12, 13, 18, 19, 20, 21, 22, 23
	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 14, 15, 16, 17
3	13.5	All channels
4	13.5	All channels
5	Ground	
6	Low	10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23
	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 19
7	Low	2, 4, 6, 8, 11, 20, 22
	High	1, 3, 5, 7, 9, 10, 12, 19, 21, 23
8	Ground	
9	Low	1, 3, 4, 5, 7, 9, 11, 13, 14, 15, 17, 19
	High	2, 6, 8, 10, 12, 16, 18, 20, 21, 22, 23
10	Low	1, 4, 7, 9, 11, 14, 17, 19
	High	2, 3, 5, 6, 8, 10, 12, 13, 15, 16, 18, 20, 21, 22, 23
11	Low	2, 22
	High	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 23
12	Low	5, 6
	High	1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23
13	Low	1, 4, 6, 11, 14, 16
	High	2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18, 19, 20, 21, 22, 23
14	Low	1, 7, 10, 11, 17
	High	2, 3, 4, 5, 6, 8, 9, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23
15	Low	1, 2, 3, 7, 11, 12, 13, 17, 21, 22, 23
	High	4, 5, 6, 8, 9, 10, 15, 16, 18, 19, 20
16	13.5	All channels

Reference Designator	Channel	E	B	C
Q401	All channels	0.0	0.42	3.0
Q402	1 - 19	0.0	0.44	0.6
	20 - 23	0.0	0.0	1.2

NOTES:

1. All voltage measurements are taken with the power supply set at exactly 13.8 VDC.

2. All readings are taken in the receive mode unless otherwise specified.

3. Voltages designated high are approximately 7.5 to 8.0 V. Voltages designated low are approximately 0.0 V.

4. Voltages designated low on PLL 02A are approximately 0.0 to 0.50 V. Voltages designated high on PLL 02A are approximately 3.5 to 4.0 V.