hy-range Ia, IIa
by hy-gain

MODELS 681 and 682
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 801266

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CHAPTER 1 — GENERAL INFORMATION

Introduction

This service manual contains all the information needed to service and repair the Hy-Gain, Hy-Range Ia and IIa transceivers (Models 681 and 682). 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-Range Ia and IIa are full 23-channel transceivers designed and type accepted 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 Lock Loop frequency synthesizer provides immediate operation on all 23 channels. Output jacks for an optional telephone-style handset and an external speaker are also included. 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 you ship a unit to us, contact the National Service Manager. Often a problem is field solvable with just a little extra help. This can save you lost time and shipping costs. Factory returns should be limited to the 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 for expeditious service.

When you request return authorization, you may also request notification of completion of repairs. The notification will include a copy of the bill. If you pay the bill before we return your unit, you can save yourself 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 your letter directly to it so this information is not overlooked. Wrap the unit and envelope in heavy paper or put then in a plastic bag. If the original carton is not available, place the unit in a strong carton that is 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 it with gummed paper, 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 very 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 to you.

All shipments to us 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 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

Channels.............................. all 23 channels in the Citizens Band (26.965 MHz - 27.255 MHz)
Antenna Impedance .... 50 ohms, nominal
Power Requirement.................... 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 — 5.965 MHz
2nd IF — 455 kHz
Audio output .... 3 watts maximum
Current drain, receive................. about 300 mA (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................ less than 1.2 amp. @ 12V DC nominal

CHAPTER 2 — THEORY OF OPERATION

General

The theory of operation of the Hy-Range Ia and IIa is divided into three sections: the Phase Lock 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.

Refer to the block diagram, Figure 2-1 for visual reference to the theory of operation.

Phase Lock Loop Frequency Synthesizer

The phase lock 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 generator function.

The 9.51 MHz Oscillator, Q105, has its output doubled and serves as a pre-scaler for the output of the Voltage Controlled Oscillator (VCO), Q101. The Offset Oscillator, Q109, operates at a frequency of 5.945 MHz, which mixes with the VCO output to provide the transmit frequency. The Reference Oscillator, Q117, serves as a reference for the PLL and as an injection frequency for the Second Receive Mixer.

The PLL circuit generates the operating frequencies needed for the transceiver by feeding the proper code from the channel selector switch to the programmable divider. Table A shows the following for each channel: the channel frequency, VCO frequency, BCD 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 21.020 MHz, the BCD code (N code) is 200. The channel selector switch programs the Programmable Divider for a division ratio of 200. The 6.4 MHz reference frequency is fed to the Integrated Circuit PLL Clip, IC101. It is divided by 640 within the chip, producing a 10 KHz reference signal. The output of the VCO is mixed in the PLL Mixer, Q102, with the doubled output of Q105. This produces a 2 MHz output. The Programmable Divider, which is set for 200, divides the 2 MHz output of Q105 down to 10 KHz.

The two KHz signals are phase compared in the phase detector within IC 101 producing a voltage that holds the VCO at 21.020 MHz. This is the DC voltage that controls the variactor diode, D102, to hold the oscillator to the output frequency of 21.020 MHz.

Assume that the channel selector is changed to channel 23. The channel selector now provides a code that will produce a division ratio of 229. At this instant the VCO frequency is at 21.020 MHz, which is mixed with the doubled output of Q105. Again, the PLL Mixer, Q102, produces an output of 2 MHz. The 2 MHz signal is divided by 229 to produce a frequency of 8.73 KHz.

The 8.73 KHz output, along with the 10 KHz reference 17, is fed to the phase detector. The comparison of the two frequencies in the phase detector produces an error output which is a 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 10 KHz. When the two frequencies are matched at 10 KHz, the error voltage output of the phase detector is zero.

When the error output voltage is zero, there is a new DC voltage set up to tune the varicap to the VCO frequency of 21.31 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 21.310 MHz VCO output is fed to the First Receive Mixer, Q115, and in the transmit mode it is mixed with the output of Q109 to produce a transmit frequency of 27.255 MHz.

N CODE — FREQUENCY CORRELATION CHART

Channel No.	***Channel Frequency***	***"N" Code***	***V.C.O. Frequency***	***Channel Switch Output (PLL Inputs)*** 1 A	2 B	4 C	8 D	10 A	20 B
1	26.965 MHz	200	21.020 MHz	0	0	0	0	0	0
2	26.975 MHz	201	21.030 MHz	1	0	0	0	0	0
3	26.985 MHz	202	21.040 MHz	0	1	0	0	0	0
4	27.005 MHz	204	21.060 MHz	0	0	1	0	0	0
5	27.015 MHz	205	21.070 MHz	1	0	1	0	0	0
6	27.025 MHz	206	21.080 MHz	0	1	1	0	0	0
7	27.035 MHz	207	21.090 MHz	1	1	1	0	0	0
8	27.055 MHz	209	21.110 MHz	1	0	0	1	0	0
9	27.065 MHz	210	21.120 MHz	0	0	0	0	1	0
10	27.075 MHz	211	21.130 MHz	1	0	0	0	1	0
11	27.085 MHz	212	21.140 MHz	0	1	0	0	1	0
12	27.105 MHz	214	21.160 MHz	0	0	1	0	1	0
13	27.115 MHz	215	21.170 MHz	1	0	1	0	1	0
14	27.125 MHz	216	21.180 MHz	0	1	1	0	1	0
15	27.135 MHz	217	21.190 MHz	1	1	1	0	1	0
16	27.155 MHz	219	21.210 MHz	1	0	0	1	1	0
17	27.165 MHz	220	21.220 MHz	0	0	0	0	0	1
18	27.175 MHz	221	21.230 MHz	1	0	0	0	0	1
19	27.185 MHz	222	21.240 MHz	0	1	0	0	0	1
20	27.205 MHz	224	21.260 MHz	0	0	1	0	0	1
21	27.215 MHz	225	21.270 MHz	1	0	1	0	0	1
22	27.225 MHz	226	21.280 MHz	0	1	1	0	0	1
23	27.255 MHz	229	21.310 MHz	1	0	0	1	0	1

Table A

Fundamental Block Diagram of PLL Circuitry

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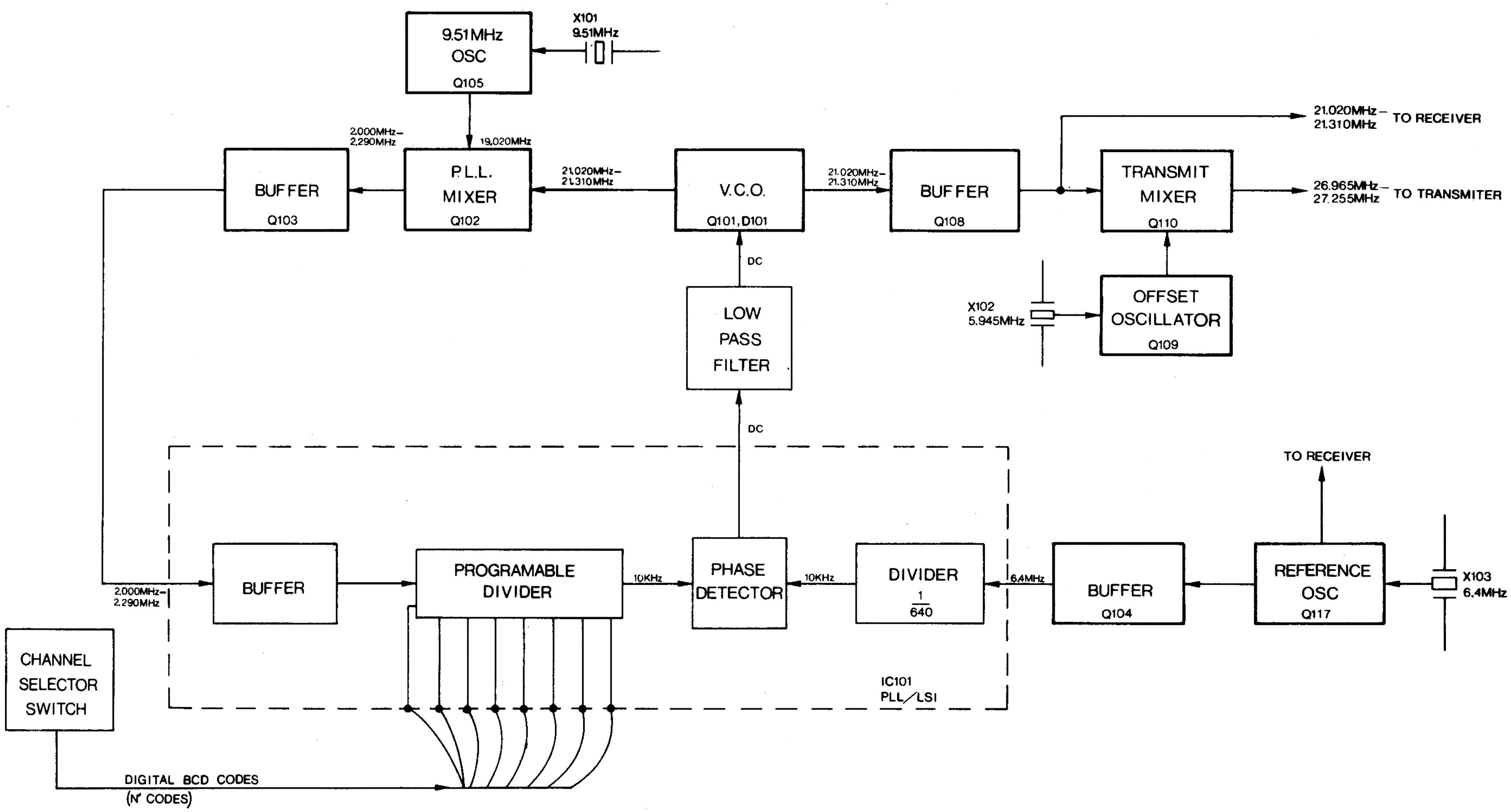


Figure 2-1

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 P.L.L. frequency synthesizer, which provides the first local oscillator frequency. A variable squelch circuit is included to quiet the receiver between transmissions.

In the receive mode, 13.8 VDC is supplied to IC102, 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.

AM signals are received by the antenna and enter the radio at the antenna jack. The filter formed by L109, L110, C152 and C1 of the rear panel matches the antenna impedance to the RF Amplifier, Q114. Signals in the 26.965 MHz - 27.255 MHz range are filtered out and amplified by the RF Amplifier and a tank circuit, C154/T104, that precedes it. (D107 is a signal overload protector.)

The output of the RF Amplifier and the synthesizer frequency, (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 for an output of 5.945 MHz, which is the first i-f.

The first i-f passes through the i-f tuned circuit, L112 and T106. It is then applied to the Second Receive Mixer, Q116, along with the output of the Reference Oscillator, Q117. The Reference Oscillator frequency is 6.400 MHz. The two signals are mixed in the Second Receive Mixer for an output of 455 kHz, which is the second i-f.

The second i-f is fed to the Crystal Filter, CF 101. It is then amplified by Q118 and Q119. They are the Second IF, First Stage and Second Stage Amplifiers, respectively. The amplified signal is then fed to the Detector, D110. The Detector recovers the audio from the modulated signal to yield an af output. The output is applied to the Automatic Noise Limiter (ANL), D108, and 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 VR2. In the absence of a signal, the base of Q120 is positive biased and it activates. This biases the squelch transistor inside IC102, which turns off the Audio Amplifier and squelches the receiver.

The output of the ANL goes through the volume control, VR1 and is RC-coupled to the Audio Amplifier, IC102. The amplified af output from IC102 passes through the audio transformer, T110, to be applied to the speaker jacks and the speaker.

Transmitter

The operating channel is determined by the P.L.L. frequency synthesizer. The synthesizer frequency is mixed with the offset oscillator output to yield the transmit signal. This frequency is then amplified by a three-stage power amplifier. T/R switching to the transmit mode is done in the following manner: when the PTT switch is closed, the base of the Transmit Switch, Q107, is grounded. This prevents biasing of Q107, which closes it. Regulated voltage from the Automatic Voltage Regulator (AVR), Q106, can then be supplied through Q107 to Q109, Q110, and Q111. With the PTT switch closed and rf applied to Q112 and Q113, the transceiver is in the transmit mode.

The synthesizer frequency is applied to the Transmit Mixer, Q110, along with the 5.945 MHz output of the Offset Oscillator, Q109. The synthesizer frequency is determined by the channel selector switch, S2, (as explained in the synthesizer section of this chapter). These two frequencies are mixed 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 third stage of amplification, 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, L109, L110, and C1 of the rear panel, and C152, and then to the antenna jack.

The transmit signal is modulated in the following manner: microphone output is applied to the Audio Amplifier, IC102. The output is applied to the collectors of Q112 and Q113 through the secondary coil of the audio output transformer, T110.

Control voltages for the Transmit Audio ALC, Q122, and the Range Boost, 121 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 rolls off af peaks so that a higher average af level is supplied to the Audio Amplifier. This gives the high average modulation desired at the output of Q113 without an overmodulation of the peaks.

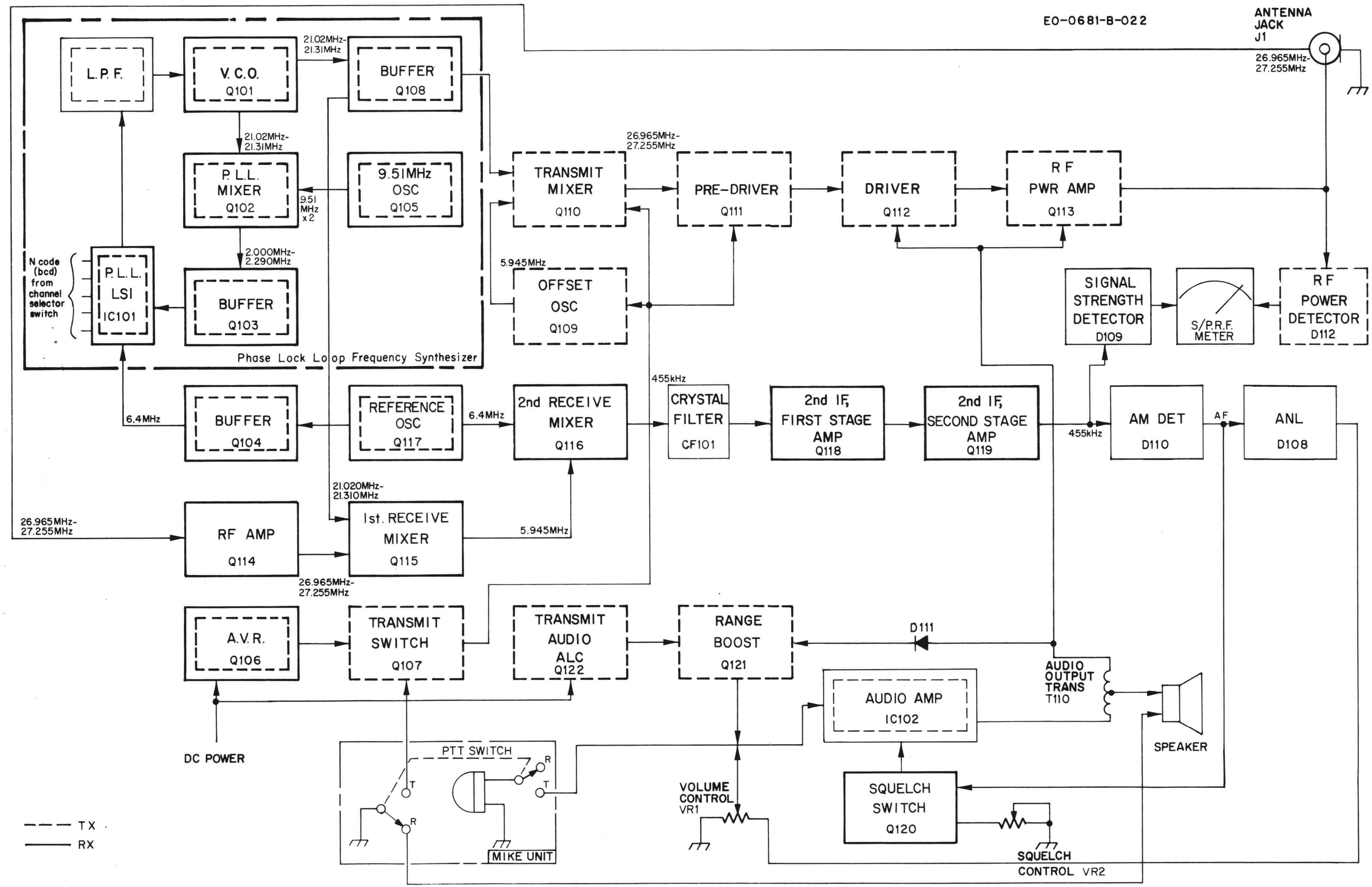


Figure 2-2. Block Diagram, Models 681 and 682

CHAPTER 3 — ALIGNMENT

General

These procedures must be followed to properly align the Hy-Range Ia and IIa transceivers (Models 681 and 682). 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 radiotelephone operator license," as stipulated in Part 95.97 (b) of the FCC Rules and Regulations.

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

These procedures assume that voltages are present at all points of the unit. If not, troubleshoot before continuing.

NOTE: The ferrite cores in the tuning coils are rather easily chipped or broken. Therefore, always use care when inserting an alignment tool in the tuning coil: insert it straight into the core.

Tools and Equipment

The following tools and equipment are recommended for use in aligning the Hy-Range Ia and IIa transceivers.

1. Audio signal generator, 10 Hz - 20 KHz
2. VTVM, 1 mV measurable
3. DC Ampere Meter, 2A
4. Regulated power supply, DC 0 to 20 V, 2A or higher
5. Frequency Counter, 0 to 40 MHz, high input impedance type
6. RF VTVM, Probe Type
7. Oscilloscope, 39 MHz, high input impedance
8. RF wattmeter, 50 ohm, 5W
9. Standard signal generator, 100 KHz - 50 MHz
10. Speaker dummy resistor, 8 ohm, 5W
11. VOM 20 K ohm/V

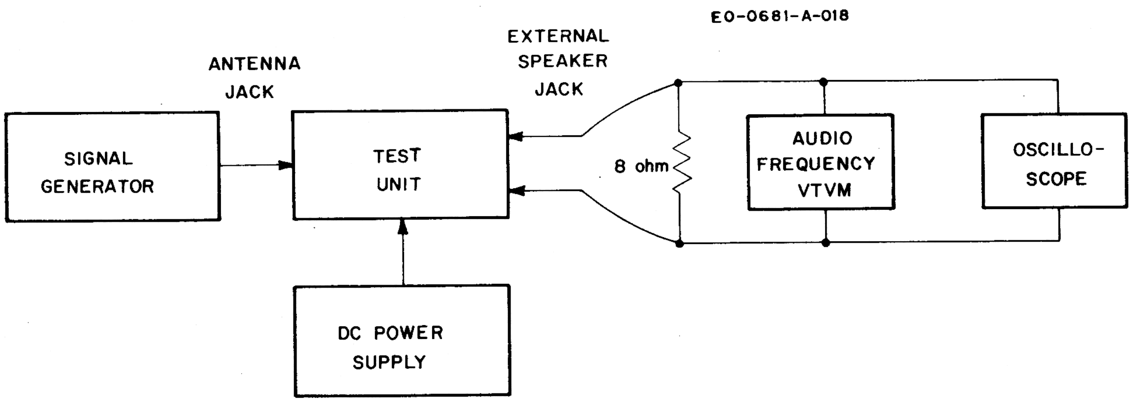
All test equipment should be properly calibrated.

NOTE: Test voltage is DC 13.8 V unless otherwise specified.

Receiver Alignment Procedure

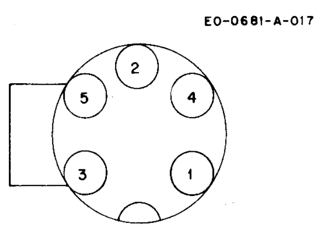
Refer to Figure 3-1 for the location of components to be adjusted for receiver alignment.

Equipment Set-up



NOTE: Place the ANL switch in the on position (682 only).

To put the transceiver in the receive mode, insert a 5-pin plug wired as shown below into the microphone jack on the front panel.



Receiver Alignment

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

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 L115, T104, T105, L112, T106, T107, T108 and T109 for maximum audio output on the oscilloscope, or use the S-meter on the unit.

Tight Squelch Adjustment

1. Set the signal generator to provide an rf input signal of 50uV, (1KHz, 30%, Mod.)

2. Rotate the squelch control fully clockwise.

3. Adjust RV101 so that tight squelch just breaks with the 50uV input.

S-Meter Adjustment

1. Set the signal generator to provide a 10 uV signal input.

2. Adjust RV-103 so the S-meter pointer reads 7 on the meter on the front panel.

Transmitter Alignment Procedures

Equipment Set-up

Refer to Figure 3-2 for the location of components to be adjusted for transmitter alignment.

Connect all test equipment as shown below.

***NOTE:** Refer to the figure on page 13 for connection of the dummy load.

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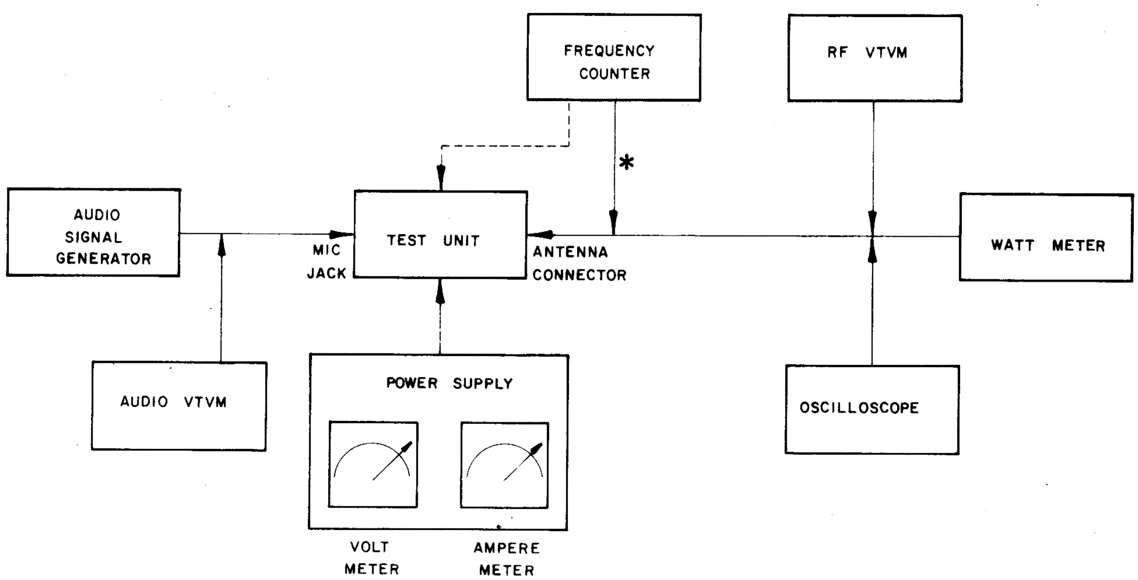

To set the transceiver to the transmit mode without the microphone, insert a 5-pin plug wired as shown below into the MIC jack on the transceiver. When applying an audio modulation signal to the microphone input circuit, use the same plug.

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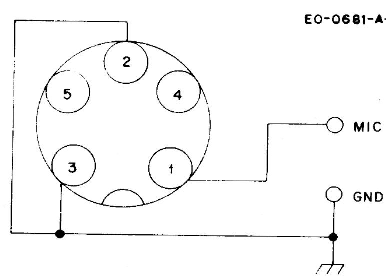

Pre-Alignment Frequency Check

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

Buffer, Q104, collector frequency should be 6400.5 MHz.

Buffer, Q108, base frequency should be 21.0195 MHz in the channel 2 position.

Offset Oscillator, Q109, emitter frequency should be 5945.300 MHz.

VCO Alignment

1. Place the channel selector in the channel 1 position.
2. Connect the VOM (DC 3V range) between ground and R114 (TP-8 side).
3. Adjust the T101 core clockwise to obtain *1.5V ± 0.1V* on the meter.
4. Place the channel selector in the open channel position. A voltage reading of 5.1 to 5.4 V is obtained.
5. Place the channel selector in the channel 23 position and read the value on the meter. It should be 2.7 ± 0.6 V.

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 at channel 13. Perform the following procedure at channel 13.
4. Key the transmitter.
5. Adjust the slugs of L103, L104, and T102 for a maximum reading of 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 of the VTVM.
8. Adjust L109 and L110 for maximum rf power output as indicated by the wattmeter.
9. Raise the power supply voltage to 13.8V.

10. Repeat steps 2 thru 8.

11. Repeat step 8 until no further improvement is noted.

12. Back off L110 (counterclockwise) for a reading of 4.0 watts maximum 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 must not exceed 1.3A.

Transmitter Frequency Check

1. Turn the transceiver off.

2. Connect the dummy load and frequency counter of the antenna jack as shown below.

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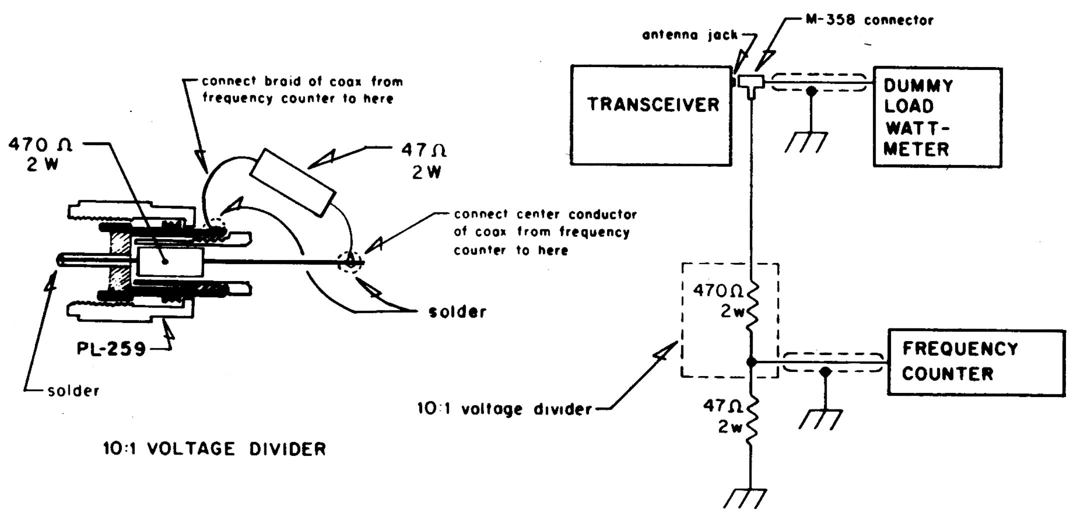


3. Key the transmitter with the microphone PTT button.

4. Check the frequency of each channel with the chart below:

CHANNEL FREQUENCY

Channel	MHz	Channel	MHz
1	26.965	13	27.115
2	26.975	14	27.125
3	26.985	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 Alignment

1. Set the unit in the transmit mode and apply a 20mV, 1 KHz signal to the microphone input circuit.

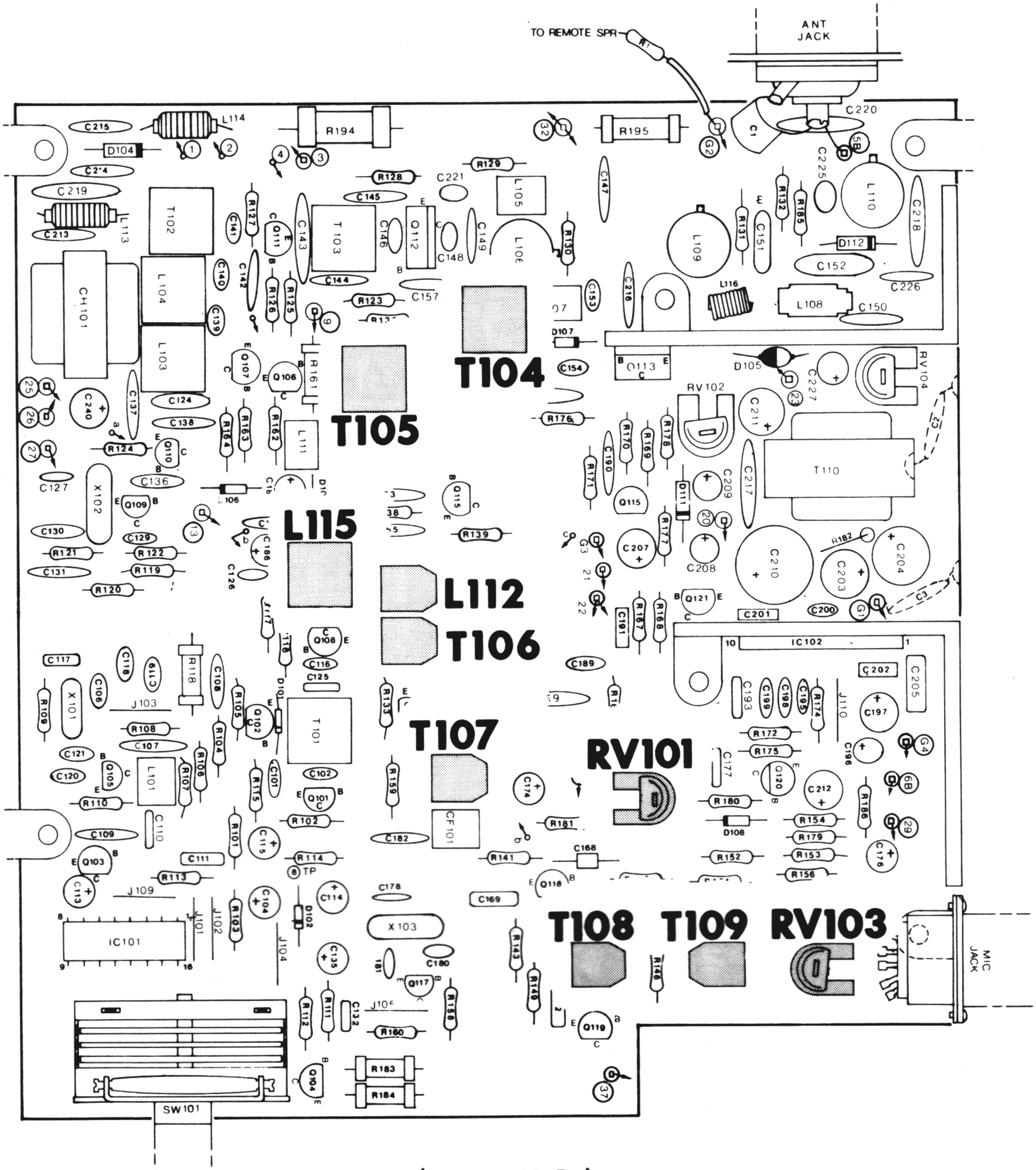
2. RV-102 should be adjusted to obtain 90% modulation in this condition.

3. Decrease the signal input to 6 mV and ensure that the modulation ratio is keeping a value higher than 80%.

RF Meter Alignment

Adjust RV-104 so that the meter pointer indicates the same wattage as the reading obtained on the wattmeter; or so that the meter pointer coincides with the center of the red zone on the meter scale.

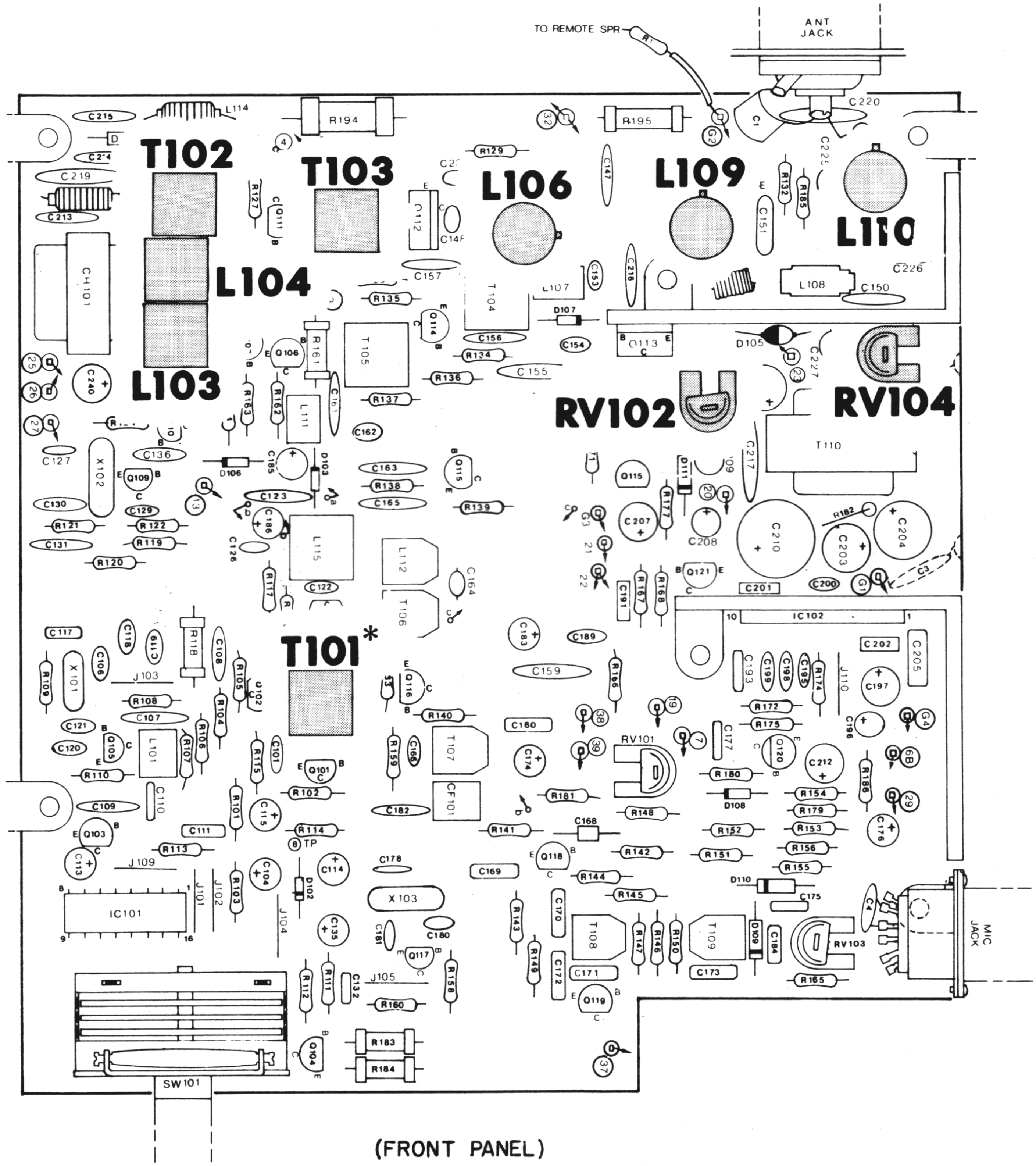
NOTE: (Refer to step 3 of the RF power alignment procedure to set the reference power level (3.8 W on the wattmeter).



(FRONT PANEL)

Figure 3-1

Components Adjusted for Receiver Alignment, Models 681 and 682



*T101 is adjusted for VCO alignment only.

Figure 3-2

Components Adjusted for Transmitter Alignment, Models 681 and 682

CHAPTER 4—CHARTS AND DRAWINGS

Voltage Readings Chart
Models 681 and 682

VOLTAGE READING CHART

Ref. Desig.		E	B	C
Q101	Rx	0	0	2.1
	Tx	0	0	2.1
Q102	Rx	0	0	2.3
	Tx	0	0	2.3
Q103	Rx	0	0	2.9
	Tx	0	0	2.9
Q104	Rx	0	0.6	2.7
	Tx	0	0.6	2.7
Q105	Rx	2.1	2.3	3.8
	Tx	2.1	2.3	3.8
Q106	Rx	8.0	8.2	13
	Tx	8.0	8.2	13
Q107	Rx	8.0	7.5	8
	Tx	8.0	7.5	7.8
Q108	Rx	0	0.6	6.0
	Tx	0	0.6	6.0
Q109	Rx	0	0.3	0.8
	Tx	2.2	2.5	5.0
Q110	Rx	0	0	0.4
	Tx	1.7	2.2	8.8
Q111	Rx	0	0.2	13.8
	Tx	1.1	1.75	13.8
Q112	Tx	0	-	11.5
Q113	Tx	0	-	12.5
Q114	Rx	1.8	2.2	13.0
Q115	Rx	1.8	2.2	12.7
Q116	Rx	0	0	0
Q117	Rx	1.7	2.0	3.5
	Tx	1.7	2.0	3.5
Q118	Rx	1.7	2.2	12.7
Q119	Rx	0.6	1.2	13.0
Q120				
squelched		0	0.5	0
unsquelched		0	0	6.5
Q121		0	0	0
Q122	Rx	0	0.6	0
	Tx	0	0.6	0

IC 102 (BA 521)

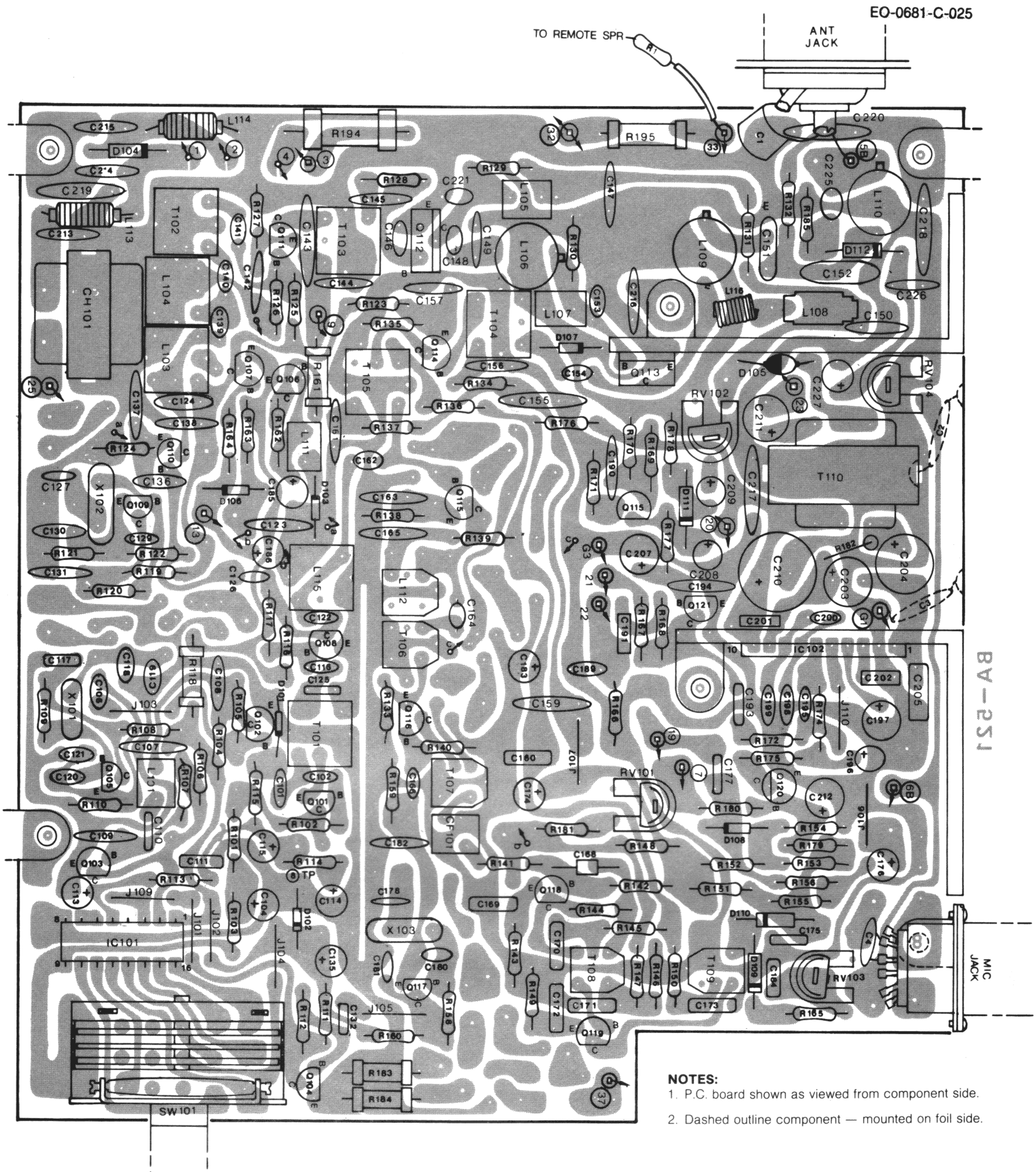
Pin No.	1	2	3	4	5	6	7	8	9	10
Voltage	6.8	0	1.1	6.6	6.2	6.3	1.0	8.0	8.0	13.8

IC 101 (P.L.L. 01A)

Pin No.	Voltage	Channels Selected
1	5.4	N/A
2	2.2	N/A
3	2.2	N/A
4	(not used)	N/A
5	1.8	N/A
6	2.3	N/A
7	2.3	N/A
8	0	N/A
9	4.9	All channels
10	0	All channels
11	4.9	17, 18, 19, 20, 21, 22, 23
12	4.9	9, 10, 11, 12, 13, 14, 15, 16
13	4.9	8, 16, 23
14	4.9	4, 5, 6, 7, 12, 13, 14, 15, 20, 21, 22
15	4.9	3, 6, 7, 11, 14, 15, 19, 22
16	4.9	2, 5, 7, 8, 10, 13, 15, 16, 18, 21, 23

NOTE: All voltage readings are taken with the power source set at exactly 13.8V.D.C.

Component Outline, Model 681



NOTES:

1. P.C. board shown as viewed from component side.
2. Dashed outline component — mounted on foil side.

Figure 4-1

Component Outline, Model 681

Component Outline, Model 682

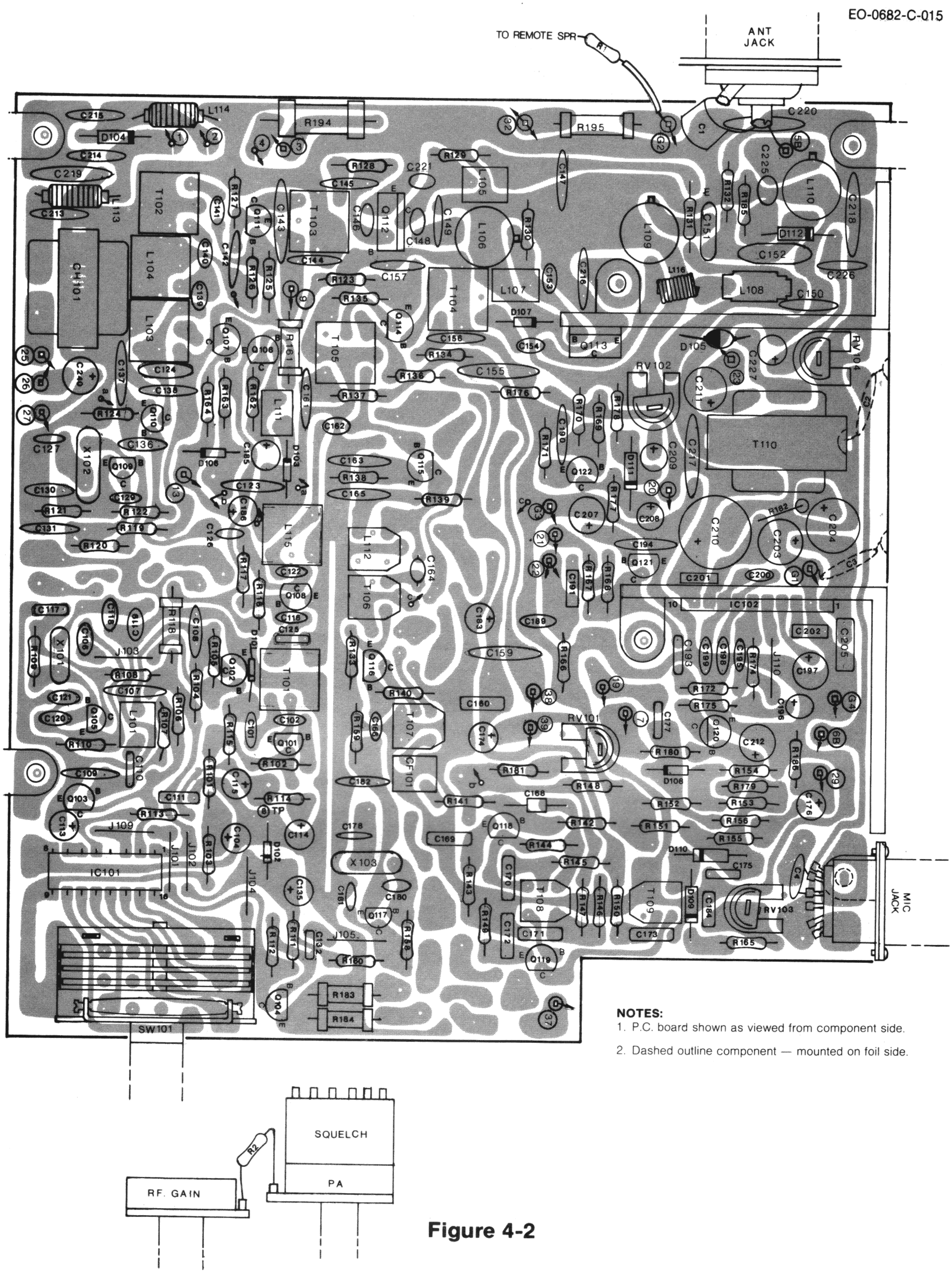


Figure 4-2

Component Outline, Model 682

NOTES:

1. P.C. board shown as viewed from component side.
2. Dashed outline component — mounted on foil side.

Parts List

MAIN P.C. BOARD

□—681 only
■—682 only

Unmarked components are common to both radios.

Reference Designator		Description	Part No.
	□	main p.c. board, complete	AP-TBM027BB
	■	main p.c. board, complete	AP-TBM027CB
		main p.c. board, plated and drilled	PT-BM027AOX
C101		.001uF, 50V, ceramic disc	CK-CB102KBM
C102		22pF, 50V, ceramic disc	CC-CB220KOM
C103		(not used)	
C104		10uF, 16V, electrolytic	CE-ED100ALN
C105		.01uF, 50V, mylar	CQ-MB103KCH
C106		22pF, 50V, ceramic disc	CC-CB220KOM
C107		.01uF, 50V, ceramic disc	CK-CB103PEM
C108		330pF, 50V, ceramic disc	CC-CB331KOM
C109		330pF, 50V, ceramic disc	CC-CB331KOM
C110		.001uF, 50V, mylar	CQ-MB102KCH
C111		.01uF, 50V, mylar	CQ-MB103KCH
C112		(not used)	
C113		.22uF, 50V, electrolytic	CE-EGR22ZMN
C114		10uF, 16V, electrolytic	CE-ED100ZMN
C115		4.7uF, 25V, electrolytic	CE-EE4R78MN
C116		10pF, 50V, ceramic disc	CC-CB100DOM
C117		.01uF, 50V, mylar	CQ-MB103KCH
C118		.47pF, 50V, ceramic disc	CC-CB470KPM
C119		10pF, 50V, ceramic disc	CC-CB100KPM
C120		100pF, 50V, mylar	CC-CB101KOM
C121		100pF, 50V, mylar	DD360-65SL101K50
C122		8pF, 50V, ceramic disc	CC-CB080DOM
C123		.01uF, 50V, ceramic disc	CK-CB103PEM
C124		100pF, 500V, mica	CM-SD101KCS
C125		1000pF, 50V, mylar	CQ-MB102KCH
C126		100pF, 50V, mylar	CC-CB101KOM
C127		33pF, 50V, mylar	CC-CB330KPM
C128		(not used)	
C129		560pF, 50V, mylar	CK-CB561KBM
C130		82pF, 50V, mylar	CC-CB820KPM
C131		.01uF, 50V, mylar	CK-CB103PEM
C132		560pF, 50V, mylar	CQ-MB561KCH
C133		(not used)	
C134		(not used)	
C135		10uF, 16V, electrolytic	CE-ED100ALN
C136		150pF, 50V, ceramic disc	CC-CB151KOM
C137		.01uF, 50V, ceramic disc	CK-CB103PEM
C138		.01uF, 50V, ceramic disc	CK-CB103PEM
C139		2pF, 50V, ceramic disc	CC-CB020COM
C140		2pF, 50V, ceramic disc	CC-CB020COM
C141		68pF, 50V, ceramic disc	CC-CB680KOM
C142		.01uF, 50V, ceramic disc	CK-CB103PEM
C143		100pF, 50V, ceramic disc	CC-CB101KPM
C144		.01uF, 50V, ceramic disc	CK-CB103PEM
C145		.01uF, 50V, ceramic disc	CK-CB103PEM
C146		470pF, 50V, ceramic disc	CK-CB471KBM
C147		.01uF, 50V, ceramic disc	CK-CB103PEM
C148		82pF, 50V, ceramic disc	CC-CB820KOM
C149		220pF, 50V, ceramic disc	CC-CB221KOM
C150		.01uF, 50V, ceramic disc	CK-CB103PEM
C151		100pF, 500V, mica	CM-SD101KCS
C152		270pF, 500V, mica	CM-SD271KCS
C153		82pF, 50V, ceramic disc	CC-CB820KOM

Reference Designator	Description	Part No.
C154	27pF, 50V, ceramic disc	CC-CB270KOM
C155	.047uF, 50V, ceramic disc	CK-CB473ZFM
C156	.01uF, 50V, ceramic disc	CK-CB103PEM
C157	.01uF, 50V, ceramic disc	CK-CB103PEM
C158	(not used)	
C159	.047uF, 50V, ceramic disc	CK-CB473ZFM
C160	.047uF, 50V, mylar	CQ-MB473KCH
C161	.01uF, 50V, ceramic disc	CK-CB103PEM
C162	10pF, 50V, ceramic disc	CC-CB100DOM
C163	.01uF, 50V, ceramic disc	CK-CB103PEM
C164	4pF, 50V, ceramic disc	CC-CB040COM
C165	.01uF, 50V, ceramic disc	CK-CB103PEM
C166	47pF, 50V, ceramic disc	CC-CB470KOM
C167	(not used)	
C168	2.2pF, 500V, ceramic disc	CG-2H2R2KNN
C169	.047uF, 50V, mylar	CQ-MB473KCH
C171	.047uF, 50V, mylar	CQ-MB473KCH
C172	.047uF, 50V, mylar	CQ-MB473KCH
C173	.047uF, 50V, mylar	CQ-MB473KCH
C174	3.3uF, 25V, electrolytic	CE-EE3R3ALN
C175	.0047uF, 50V, mylar	CQ-MB472KCH
C176	1uF, 50V, electrolytic	CE-EG010ALN
C177	.0022uF, 50V, mylar	CQ-MB222KCH
C178	39pF, 50V, ceramic disc	CC-CB390KPM
C179	(not used)	
C180	560pF, 50V, ceramic disc	CK-CB561KBM
C181	560pF, 50V, ceramic disc	CK-CB561KBM
C182	68pF, 50V, ceramic disc	CC-CB680KPM
C183	10uF, 16V, electrolytic	CE-ED100ALN
C184	.022uF, 50V, mylar	CQ-MB223KCH
C185	10uF, 16V, electrolytic	CE-ED100ALN
C186	.47uF, 50V, electrolytic	CE-EGR47ALN
C187	(not used)	
C188	(not used)	
C189	.0022uF, 50V, ceramic disc	CK-CB222KBM
C190	.01uF, 50V, ceramic disc	CK-CB103PEM
C191	.022uF, 50V, mylar	CQ-MB223KCH
C192	220pF, 50V, ceramic disc	CC-CB221KOM
C193	.01uF, 50V, mylar	CQ-MB103KCH
C194	.01uF, 50V, ceramic disc	CK-CB103PEM
C195	390pF, 50V, ceramic disc	CK-CB391KBM
C196	5.6uF, 25V, tantalum	CS-SE5R6MDN
C197	33uF, 6.3V, electrolytic	CE-EB330ALN
C198	68pF, 50V, ceramic disc	CC-CB680KOM
C199	68pF, 50V, ceramic disc	CC-CB680KOM
C200	390pF, 50V, ceramic disc	CK-CB391KBM
C201	.068uF, 50V, mylar	CQ-MB683KCH
C202	.022uF, 50V, mylar	CQ-MB223KCH
C203	47uF, 16V, electrolytic	CE-ED470ALN
C204	220uF, 16V, electrolytic	CE-AD221ZLS
C205	.068uF, 50V, mylar	CQ-MB683KCH
C206	(not used)	
C207	33uF, 6.3V, electrolytic	CE-EB330ALN
C208	10uF, 16V, electrolytic	CE-ED100ALN
C209	1uF, 50V, electrolytic	CE-EG010ALN
C210	1000uF, 16V, electrolytic	CE-ED102ZUN
C211	47uF, 25V, electrolytic	CE-AE470ZLS
C212	33uF, 6.3V, electrolytic	CE-EB330ALN
C213	.01uF, 50V, ceramic disc	CK-CB103PEM
C214	.01uF, 50V, ceramic disc	CK-CB103PEM
C215	.01uF, 50V, ceramic disc	CK-CB103PEM
C216	.01uF, 50V, ceramic disc	CK-CB103PEM
C217	.047uF, 50V, ceramic disc	CK-CB473ZFM
C218	.047uF, 50V, ceramic disc	CK-CB473ZFM
C219	.047uF, 50V, ceramic disc	CK-CB473ZFM
C220	.047uF, 50V, ceramic disc	CK-CB473ZFM
C221	27pF, 50V, ceramic disc	CC-CB270KOM
C222	(not used)	
C223	(not used)	
C224	(not used)	
C225	4pF, 500V, ceramic disc	CC-EE040COM

Reference Designator	Description	Part No.
C226	.0047uF, 50V, ceramic disc	CK-CB472PEM
C227	1uF, 50V, electrolytic	CE-EG010ALN
C228 through C239	(not used)	
C240	■ 33uF, 16V, electrolytic	CE-ED330ALN
CF101	ceramic filter	FB-R455A08M
CH101	choke coil	LJ-119H001Y
D101	ITT410, silicon	QD-CTT410XQ
D102	MZ205, zener	QD-ZMZ205XE
D103	RD9.1E, zener	QD-ZRD9EXAA
D104	1S1885, silicon	QD-SS1885XT
D105	V06C, silicon	QD-SVO6CXXB
D106	1S1555, silicon	QD-SS1555XT
D107	1S1555, silicon	QD-SS1555XT
D108	1S1555, silicon	QD-SS1555XT
D109	1N60, germanium	QD-G1N60XXT
D110	1N60, germanium	QD-G1N60XXT
D111	1N60, germanium	QD-G1N60XXT
D112	1N60, germanium	QD-G1N60XXT
D113	(not used)	
IC101	PLL01A	QQ-OPLL01AO
IC102	(TOYO) BA-521	QQ-MBA521AX
L101	rf coil	LF-220KD01N
L102	(not used)	
L103	rf coil	TR-10CD004S
L104	rf coil	TR-10CD005S
L105	rf coil	LF-2R2KD01N
L106	rf coil	TR-A5CZ001M
L107	rf coil	LF-680KD01N
L108	rf coil	LD-AX3825M
L109	rf coil	TR-A5CZ002M
L110	rf coil	TR-A5CZ003M
L111	rf coil	LF-680KD01N
L112	rf coil	TR-07MB007N
L113	rf coil	LD-ADB4024B
L114	rf coil	LD-ADB4024B
L115	rf coil	TR-10MD006S
L116	rf coil	LA-1KE1011A
Q101	(MITSUBISHI) 2SC710D	QT-CO710XBE
Q102	(NEC) 2SC829B	QT-CO829XAN
Q103	(NEC) 2SC829B	QT-CO829XAN
Q104	(NEC) 2SC829B	QT-CO829XAN
Q105	(MITSUBISHI) 2SC710D	QT-OO710XBE
Q106	(MATSUSHITA) 2SC1318(Q)	QT-C1318XAN
Q107	(MATSUSHITA) 2SA719(Q)	QT-AO719XAN
Q108	2SC1359B	QT-C1359XAN
Q109	(MITSUBISHI) 2SC710D	QT-CO710XBE
Q110	(MITSUBISHI) 2SC710D	QT-CO710XBE
Q111	2SC1687	QT-C1687XAN
Q112	(SONY) 2SC1760-3	QT-C1760XAS
Q113	(NEC) 2SC1306	QT-C1306XZA
Q114	2SC1047B	QT-C1047XAN
Q115	2SC1359B	QT-C1359XAN
Q116	2SC829C	QT-CO829XBN
Q117	(MITSUBISHI) 2SC710D	QT-CO710XBE
Q118	(NEC) 2SC829C	QT-CO829XBN
Q119	(NEC) 2SC829C	QT-CO829XBN
Q120	2SC372Y	QT-CO372XDN
Q121	2SC828PQ	QT-CO828XDN
Q122	2SC828P	QT-CO828XAN
R101	100, 10% ¼w, carbon film	RD25RJ101D
R102	100k, 10% ¼w, carbon film	RD25RJ104D
R103	1.5k, 10% ¼w, carbon film	RD25RJ152D

Reference Designator	Description	Part No.
R104	1.5k, 10% ¼w, carbon film	RD25RJ152D
R105	100k, 10% ¼w, carbon film	RD25RJ104D
R106	1.5k, 10% ¼w, carbon film	RD25RJ152D
R107	100k, 10% ¼w, carbon film	RD25RJ104D
R108	1.5k, 10% ¼w, carbon film	RD25RJ152D
R109	100k, 10% ¼w, carbon film	RD25RJ104D
R110	2.2k, 10% ¼w, carbon film	RD25RJ222D
R111	1.5k, 10% ¼w, carbon film	RD25RJ152D
R112	100k, 10% ¼w, carbon film	RD25RJ104D
R113	3.3k, 10%¼ w, carbon film	RD25RJ332D
R114	470, 10% ¼w, carbon film	RD25RJ471D
R115	22k, 10% ¼w, carbon film	RD25RJ223D
R116	470, 10%¼w, carbon film	RD25RJ471D
R117	100k, 10%¼w, carbon film	RD25RJ104D
R118	100, 10% ½w, metal oxide	RGHANJ101N
R119	1.5k, 10% ¼w, carbon film	RD25RJ152D
R120	100k, 10%, ¼w, carbon film	RD25RJ104D
R121	1K, 10%, ¼w, carbon film	RD25RJ102D
R122	2.7k, 10%, ¼w, carbon film	RD25RJ272D
R123	3.3.k, 10%, ¼w, carbon film	RD25RJ332D
R124	330, 10%, ¼w, carbon film	RD25RJ331D
R125	3.3k, 10%, ¼w, carbon film	RD25RJ332D
R126	1k, 10%, ¼w, carbon film	RD25RJ102D
R127	68, 10%, ¼w, carbon film	RD25RJ680D
R128	100, 10%¼w, carbon film	RD25RJ101D
R129	220, 10%, ¼w, carbon film	RD25RJ221D
R130	47, 10%, ¼w, carbon film	RD25RJ470D
R131	10, 10%, ½w, metal oxide	ERX-12ANJ100
R132	47k, 10%, ¼w, carbon film	RD25RJ473D
R133	220, 10%, ¼w, carbon film	RD25RJ221D
R134	680, 10%, ¼w, carbon film	RD25RJ681D
R135	1.5k, 10%, ¼w, carbon film	RD25RJ152D
R136	100, 10%, ¼w, carbon film	RD25RJ101D
R137	1.8k, 10%, ¼w, carbon film	RD25RJ182D
R138	1k, 10%, ¼w, carbon film	RD25RJ102D
R139	470, 10%, ¼w, carbon film	RD25RJ471D
R140	3.3k, 10%, ¼w, carbon film	RD25RJ332D
R141	1k, 10%, ¼w, carbon film	RD25RJ102D
R142	4.7k, 10%, ¼w, carbon film	RD25RJ472D
R143	470, 10%, ¼w, carbon film	RD25RJ471D
R144	47k, 10%, ¼w, carbon film	RD25RJ473D
R145	220, 10% ¼w, carbon film	RD25RJ221D
R146	3.3k, 10%, ¼w, carbon film	RD25RJ332D
R147	12k, 10%, ¼w, carbon film	RD25RJ123D
R148	27k, 10%, ¼w, carbon film	RD25RJ273D
R149	220, 10%, ¼w, carbon film	RD25RJ221D
R150	47, 10%, ¼w, carbon film	RD25RJ470D
R151	22k, 10%, ¼w, carbon film	RD25RJ223D
R152	390k, 10%, ¼w, carbon film	RD25RJ394D
R153	47k, 10%, ¼w, carbon film	RD25RJ473D
R154	68k, 10%, ¼w, carbon film	RD25RJ683D
R155	33k, 10%, ¼w, carbon film	RD25RJ333D
R156	47k, 10%, ¼w, carbon film	RD25RJ473D
R157	(not used)	
R158	100k, 10%, ¼w, carbon film	RD25RJ104D
R159	1.5k, 10%, ¼w, carbon film	RD25RJ152D
R160	1.5k, 10%, ¼w, carbon film	RD25RJ152D
R161	22, 10%, ½w, metal oxide	ERG-12ANJ220
R162	1k, 10%, ¼w, carbon film	RD25RJ102D
R163	390, 10%, ¼w, carbon film	RD25RJ391D
R164	10k, 10%, ¼w, carbon film	RD25RJ103D
R165	820, 10% ¼w, carbon film	RD25RJ821D
R166	3.3k, 10%, ¼w, carbon film	RD25RJ332D
R167	27k, 10%, ¼w, carbon film	RD25RJ273D
R168	3.3k, 10%, ¼w, carbon film	RD25RJ332D
R169	220k, 10%, ¼w, carbon film	RD25RJ224D
R170	22k, 10%, ¼w, carbon film	RD25RJ223D
R171	150, 10%, ¼w, carbon film	RD25RJ151D
R172	2.2k, 10%, ¼w, carbon film	RD25RJ222D
R173	(not used)	

Reference Designator	Description	Part No.
R174	10, 10%, ¼w, carbon film	RD25RJ100D
R175	10k, 10%, ¼w, carbon film	RD25RJ103D
R176	82, 10%, ¼w, carbon film	RD25RJ820D
R177	270, 10%, ¼w, carbon film	RD25RJ271D
R178	680, 10%, ¼w, carbon film	RD25RJ681D
R179	22k, 10%, ¼w, carbon film	RD25RJ223D
R180	1.8k, 10%, ¼w, carbon film	RD25RJ182D
R181	18k, 10%, ¼w, carbon film	RD25FJ183D
R182	100, 10%, ¼w, carbon film	ERD-14VJ101
R183	270, 10%, ½w, metal oxide	ERG-12ANJ271
R184	270, 10%, ½w, metal oxide	ERG-12ANJ271
R185	1k, 10%, ¼w, carbon film	RD25RJ102D
R186	10k, 10%, ¼w, carbon film	RD25RJ103D
R187 through R193	(not used)	
R194	15, 10%, 2w, metal oxide	ERX-2ANJ150
R195	150, 10%, 1w, metal oxide	ERG-1ANJ151
RV101	10k potentiometer	RP-GNB10301
RV102	2k, potentiometer	RP-GNB20201
RV103	20K, potentiometer	RP-GNB20301
RV104	20k, potentiometer	RP-GNB20301
SW101	rotary wafer switch	SR-0724301H
T101	rf coil	TR-10CA004S
T102	rf coil	TR-10CB001S
T103	rf coil	TR-10CP005S
T104	rf coil	TR-10MP003T
T105	rf coil	TR-10CA005S
T106	rf coil	TR-07MB007N
T107	i-f transformer	TR-07LA004N
T108	i-f transformer	TR-07LA005N
T109	i-f transformer	TR-07LA023N
T110	audio transformer	TB-G25B001W
VR1	50k, potentiometer (part of on/off switch)	ERV-0176
X101	9.50996 MHz, crystal	XA-S1B2001T
X102	9.94500 MHz, crystal	XG-S1A1001T
X103	6.40030 MHz, crystal	XG-S1A2001T

CHASSIS-MOUNTED COMPONENTS

Reference Designator		Description	Part No.
C1		200 pF, 500V, mica	FM11ZC221K5
C2		.01 uF, 50V, ceramic disc	DD310E103P50
C3		.01 uF, 50V, ceramic disc	DD310E103P50
C4		.01 uF, 50V, ceramic disc	DD310E103P50
J1		jack, antenna	YJCO2S007Z
J2		jack, microphone, 5 pin DIN	EZS-0084
J3		jack, phone, 3.5 mm	EZS-0056
J4	□	jack, phone, P.A.	EZS-0126
J5	■	jack, stereophone, remote speaker	EZS-0126
M		meter	EMM-0046
PL1		pilot lamp	EZP-0024E
PL2		pilot lamp	EZP-0024E
R1		8.2, 10%, ¼w, carbon film	ERD-14TJ8R2
R2	■	33K, 10%, ¼w, carbon film	RD25RJ333D
S1		switch, on/off power (part of volume control) (see main p.c. board)	ERV-0176
S2	■	switch, toggle, on/off	EST-0004
SP		speaker	EAS-0029
VR1		potentiometer, 50K, (volume control w/power switch)	ERV-0176
VR2	□	potentiometer, 10K, (squelch control)	ERV-0177
	■	potentiometer, 10K, (squelch control)	RVJE103B03
VR3	■	pontentiometer, 50K, (rf gain control)	ERV-0192
		fuse, 2A, 30mm	EZF-0005
		heat sink, —for IC102	ML-454AD002
		heat sink, —for Q113	ML-463AD001

MECHANICAL PARTS

Part No.		Description	Qty.
AM-681KD#01	□	escutcheon (front panel assembly)	1
AM-682KD#01	■	escutcheon (front panel assembly)	1
MU-667SZ019	□	chassis, main frame	1
MU-667SZ020	■	chassis, main frame	1
MB-762SZ016	□	panel, front, plastic	1
MB-762SZ017	■	panel, front, plastic	1
MCO88P003		case, upper	1
MCO88P004		case, lower	1
VE-90XVC014		channel selector dial plate	1
MCO46P010		bracket, meter	1
MWO-0345		holder, lamp (channel)	2
MWO-0346	■	holder, lamp (meter)	1
MTO-0003		knob, channel selector	1
MTO-0004		knob, squelch and volume	2
MYO-0142		bracket, speaker	1
EZS-0001		holder, fuse	1
ENO-0090		cord, power	1
EZZ-0025		bushing, power cord	1

ACCESSORY PARTS

Part No.	Description	Qty.
MCO46P006	bracket, mounting	1
MMO-0108A	handscrew	2
MYO-0025	holder, microphone	1
STPN401025Z	screw, self-tapping, M4x10	2
ZTU040000SX	washer, inside toothed, M4	2
STPT50132SN	screw, self-tapping, M5x13	4
ZTS050000SX	washer, outside toothed, M5	4
EAM-0032	microphone	1

Schematic Diagrams

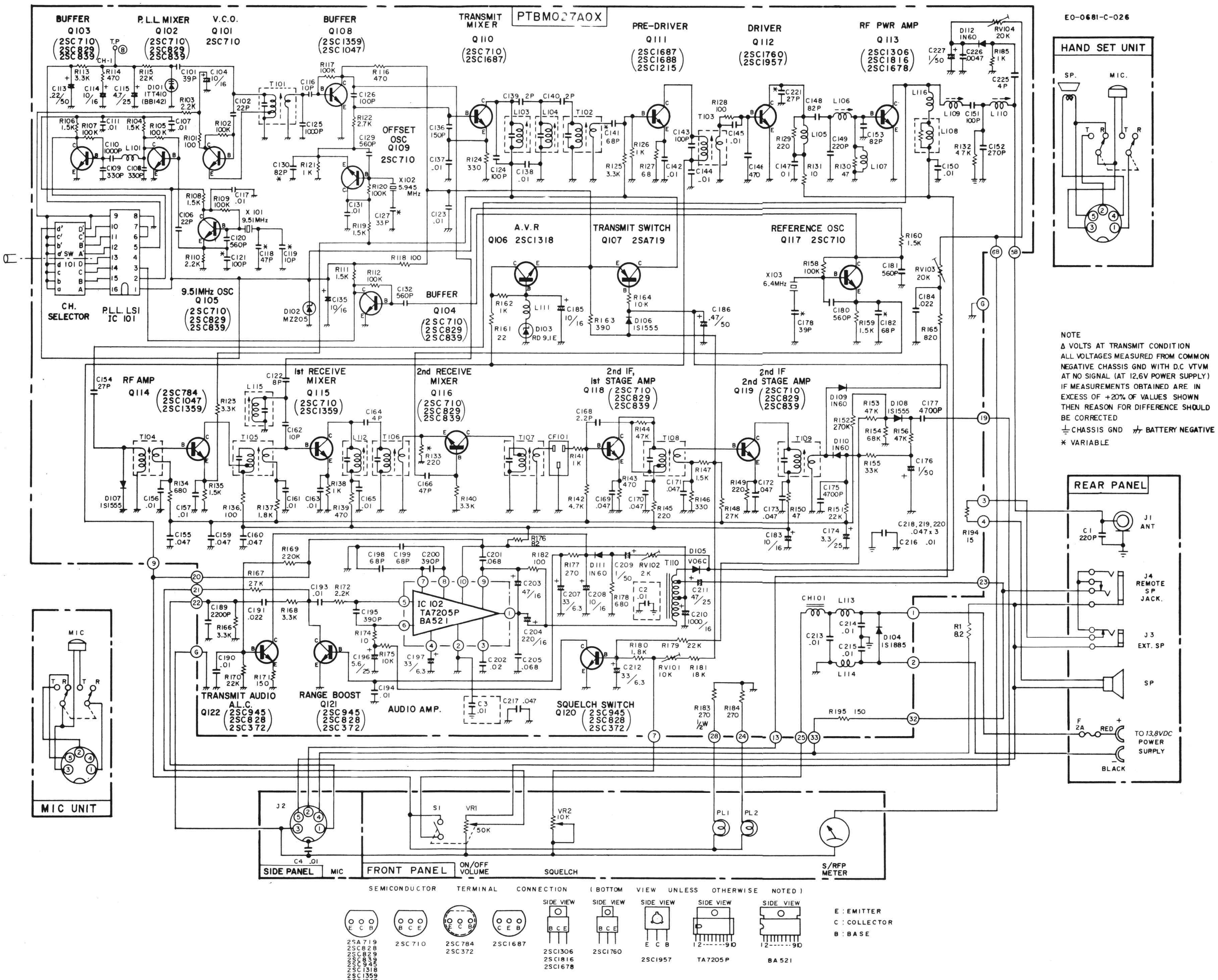


Figure 4-3. Schematic Diagram, Model 681

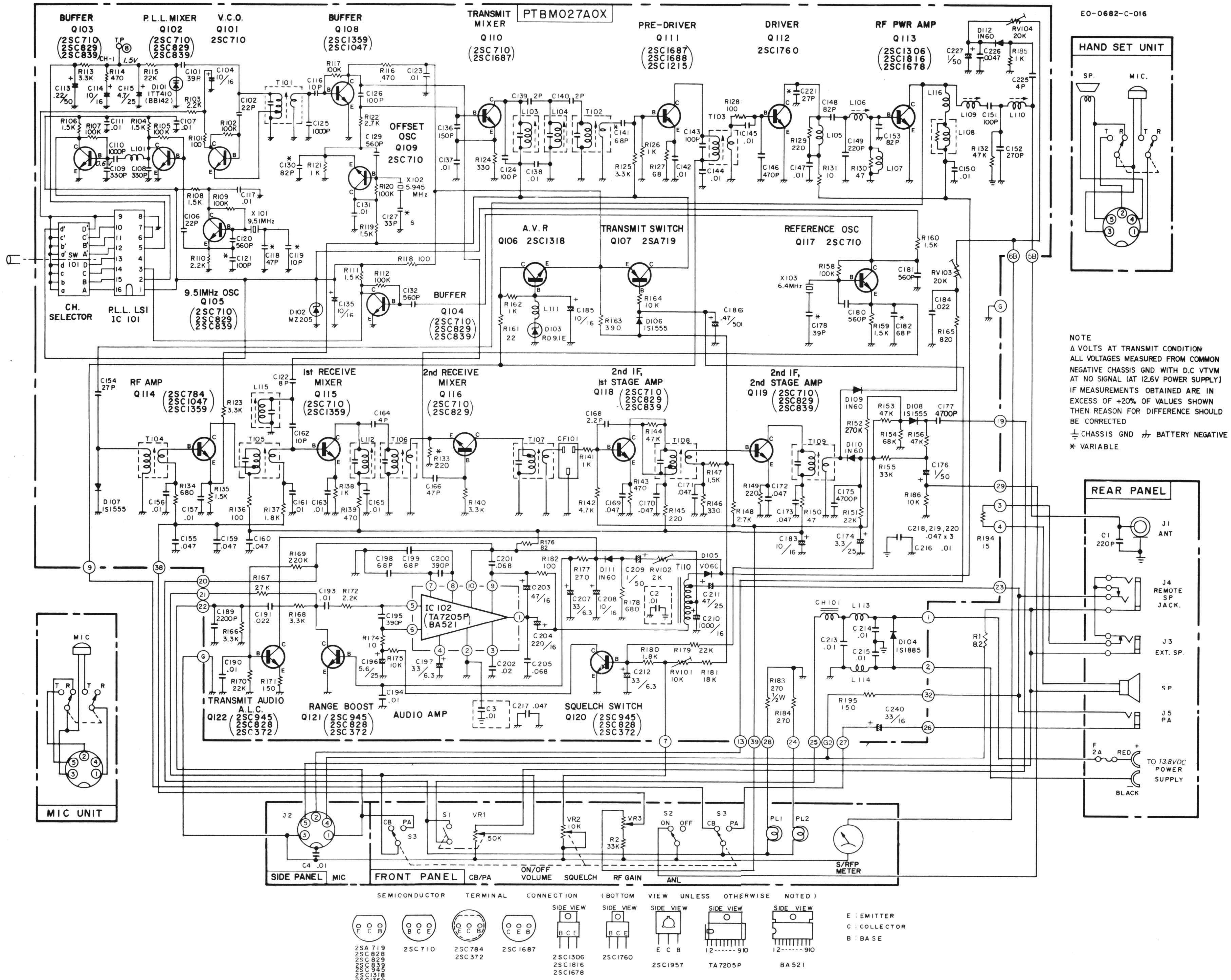


Figure 4-4. Schematic Diagram, Model 682

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