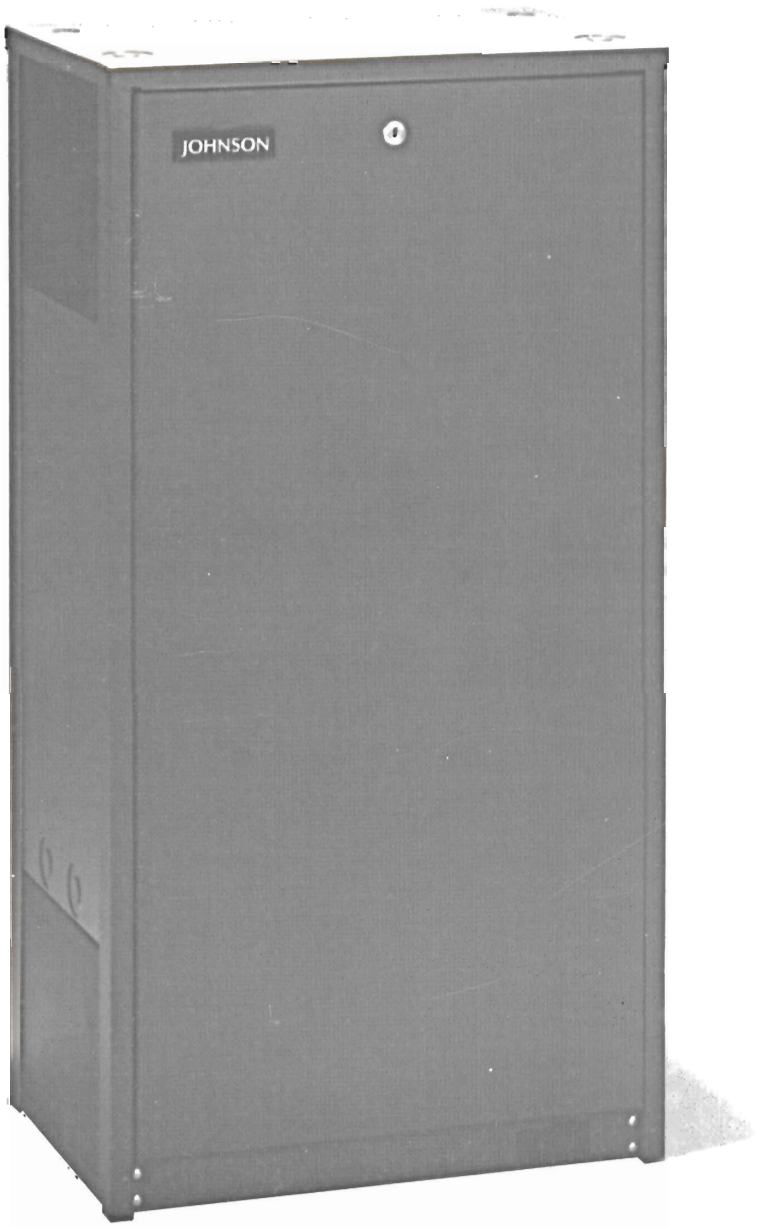
EFJohnson®

Service Manual

1100 SERIES REPEATER

150-174 MHz

115/230 VAC 25–100 Watts
Part No.: 242-1100-xxx



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JOHNSON 1100
150-174 MHz REPEATER
SERVICE MANUAL

115/230V AC OPERATION
25-100 WATT RF OUTPUT
PART NO. 242-1100-xxx

The E.F. Johnson Company designs and manufactures two-way radio equipment to serve a wide variety of communications needs. E.F. Johnson produces equipment for the mobile telephone and land mobile radio services which include business, industrial, government, public safety, and personal users.

LAND MOBILE PRODUCT WARRANTY

The manufacturer's warranty statement for this product is available from your product supplier or from the E.F. Johnson Company, 299 Johnson Avenue, Box 1249, Waseca, MN 56093-0514. Phone (507) 835-6222.

WARNING

This device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference. In addition, changes or modification to this equipment not expressly approved by the E.F. Johnson Company could void the user's authority to operate this equipment (FCC rules, 47CFR Part 15.19).

DO NOT allow the antenna to come close to or touch, the eyes, face, or any exposed body parts while the radio is transmitting.

DO NOT operate the radio near electrical blasting caps or in an explosive atmosphere.

DO NOT operate the radio unless all the radio frequency connectors are secure and any open connectors are properly terminated.

DO NOT allow children to operate transmitter equipped radio equipment.

SAFETY INFORMATION

Proper operation of this radio will result in user exposure below the Occupational Safety and Health Act and Federal Communication Commission limits.

The information in this document is subject to change without notice. E.F. Johnson Company will not be liable for any misunderstanding due to misinformation or errors found in this document.

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SECTION 1 GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual includes installation, circuit description, servicing, and alignment information for the Johnson 1100 VHF repeater, Part No. 242-1100-xxx.

1.2 DESCRIPTION

The Johnson 1100 is a VHF FM repeater which operates on a single channel in the 150-174 MHz range. It is completely solid state and the transmitter is rated at 100 watts RF power output continuous duty. The output from the duplexer (if equipped) is approximately 70 watts.

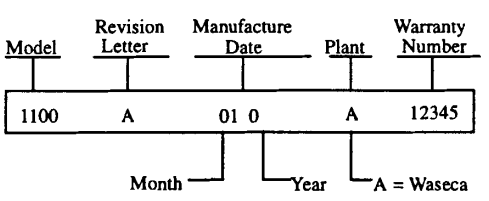
The 1100 can be ordered as a single-user or a community repeater. When used in a single-user configuration, the repeater is activated by the receiver's squelch circuitry or by a tone if the unit is equipped with the Retransmit Call Guard® card.

The tone remote console (Part No. 250-45xx-xxx) functions as a control point or base station when used with the repeater.

When used in the community repeater configuration, the repeater is activated by any one of 16 possible Call Guard tones. Each Call Guard card contains four tunable Call Guards (see Table 1-1).

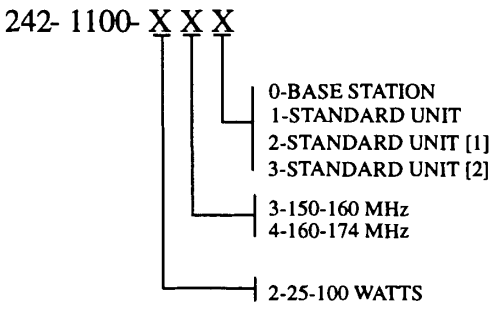
1.3 REPEATER IDENTIFICATION

The serial number is printed on an adhesive backed cloth attached to the inside of the cabinet. The following table shows a breakdown of an identification number.



1.4 JOHNSON CR1100 MODELS

The following breakdown shows the part number scheme used for the Johnson CR1100 models.



[1] WITH DUPLEXER
[2] WITH TONE REMOTE

1.5 ACCESSORIES

Refer to Table 1-1 for a listing of CR1100 repeater accessories/options and their part numbers.

1.5.1 EXTERNAL CW IDENTIFIER

The CWID is a separate PC board option that provides automatic international Morse Code station call sign identification by superimposing coded audio onto the transmit modulation. If voice communication is in process, the ID is not transmitted until the repeater unkeys. If the ID is being transmitted, the repeater can be accessed and the voice communication will be heard over the ID.

U701 is included in the kit to upgrade the software if necessary. Revision 208 or later software is required with the CWID.

The PROM can be factory programmed or programmed with the PROM Programmer II, Part No. 250-3020-200.

Table 1-1 ACCESSORIES/OPTIONS

Description	Part Number
Transmit 2.5 PPM TCXO [1]	522-0xxx-xxx
Receive 2.5 PPM TCXO [1]	522-1xxx-xxx
Transmit 5 PPM TCXO [1]	521-0xxx-xxx
Receive 5 PPM TCXO [1]	521-6xxx-xxx
Receiver Shield Kit	023-3823-080
Test Panel	023-3823-340
4-Tone Call Guard Squelch	023-3823-050
Type-A Call Guard Squelch	023-3823-056
Power Failure Alarm	023-3988-001
CW Identifier Card	023-3823-330
Heavy Duty Microphone	250-0740-200
60" Indoor Cabinet	023-3824-003
43" Outdoor Cabinet	023-4061-001
60" Outdoor Cabinet	023-4061-002
Duplexer	
150-162 MHz	532-4001-006
162-174 MHz	532-4001-013
[1] The last six digits are determined by the frequency in MHz.	

1.5.2 REPEATER CABINETS

The standard 30-inch cabinet does not have additional room for accessories. The 43" or 60" cabinets are used when accessories, such as a duplexer are installed. The outdoor cabinet consists of three panels which install around the indoor cabinet to make it weather resistant.

1.5.3 MICROPHONE

This is a high-impedance microphone used for repeater testing.

1.6 PRODUCT WARRANTY

The warranty statement for this transceiver is available from your product supplier or from the

Warranty Department
Transcrypt International, Inc.
299 Johnson Avenue,
Box 1249,
Waseca, MN 56093- 0514

This information may also be requested by phone from the Warranty Department as described in Section 1.7. The Warranty Department may also be contacted for Warranty Service Reports, claim forms, or any questions concerning warranties or warranty service by dialing (507) 835-6222.

1.7 FACTORY CUSTOMER SERVICE

The Customer Service Department of the E.F. Johnson Company provides customer assistance on technical problems and the availability of local and factory repair facilities. Regular Customer Service hours are 7:30 a.m. - 5:30 p.m. Central Time, Monday - Friday. The Customer Service Department can be reached using one of the following telephone numbers:

Toll-Free: (800) 328-3911
(From within continental United States only)

International: (507) 835-6911

FAX: (507) 835-6969

E-Mail: First Initial/Last Name@transcrypt.com
(You need to know the name of the person you want to reach. Example: dthompson@transcrypt.com)

NOTE: Emergency 24-hour technical support is also available at the 800 and preceding numbers during off hours, holidays, and weekends.

When your call is answered at E.F. Johnson Company, you will hear a brief message informing you of numbers that can be entered to reach various departments. This number may be entered during or after the message using a tone-type telephone. If you have a pulse-type telephone, wait until the message is finished and an operator will come on the line to assist you. When you enter some numbers, another number is requested to further categorize the type of information you need.

You may also contact the Customer Service Department by mail. Please include all information that may be helpful in solving your problem. The mailing address is as follows:

Transcrypt International, Inc.
Customer Service Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.8 FACTORY RETURNS

Repair service is normally available through local authorized E.F. Johnson Land Mobile Radio Service Centers. If local service is not available, the equipment can be returned to the factory for repair. However, it is recommended that you contact the Customer Service Department before returning equipment because a service representative may be able to suggest a solution to the problem so that return of the equipment would not be necessary.

Be sure to fill out a Factory Repair Request Form #271 for each unit to be repaired, whether it is in or out of warranty. These forms are available free of charge by calling the repair lab (see Section 1.7) or by requesting them when you send a unit in for repair. Clearly describe the difficulty experienced in the space provided and also note any prior physical damage to the equipment. Then include a form in the shipping container with each unit. Your telephone number and contact name are important because there are times when the technicians have specific questions that need to be answered in order to completely identify and repair a problem.

When returning equipment for repair, use a PO number or some other reference number on your paperwork in case you need to call the repair lab about your unit. These numbers are referenced on the repair order and it makes it easier and faster to locate your unit in the lab.

Return Authorization (RA) numbers are not necessary unless you have been given one by the Field Service Department. RA numbers are required for exchange units or if the Field Service Department wants to be aware of a specific problem. If you have been given an RA number, reference this number on the Factory Repair Request Form sent with the unit. The repair lab will then contact the Field Service Department when the unit arrives.

1.9 REPLACEMENT PARTS

E.F. Johnson replacement parts can be ordered directly from the Service Parts Department. To order parts by phone, dial the toll-free number as described in Section 1.7. When ordering, please supply the part number and quantity of each part ordered. E.F. Johnson dealers also need to give their account number. If there is uncertainty about the part number, include the designator (C112, for example) and the model number of the equipment the part is from.

You may also send your order by mail or FAX. The mailing address is as follows and the FAX number is shown in Section 1.7.

E.F. Johnson Company
Service Parts Department
299 Johnson Avenue
P.O. Box 1249
Waseca, MN 56093-0514

1.10 INTERNET HOME PAGE

The E.F. Johnson Company has a home page on the World Wide Web that can be accessed for information on such things as products, systems, and regulations. The address is http://www.transcrypt.com.

SECTION 2 INSTALLATION

2.1 INTRODUCTION

Although this equipment is carefully aligned at the factory, shipment can upset some of the adjustments so pre-installation testing is recommended. Complete the tests listed in the "Performance Tests", Sections 5.4 and 5.5.

Site preparation and antenna installation is not within the scope of this manual. Refer to the "Dealer Guide To Site Preparation", Part No. 004-8000-100, for preliminary installation requirements. Factory installation of repeaters is available. Contact your sales representative for more information.

2.2 115/230V AC OPERATION

CAUTION

Do not connect the power supply to AC power until an antenna or dummy load has been connected to the antenna jack. The transmitter may momentarily key and damage to the power amplifier could result.

The same power supply can be used for 115 or 230V AC power sources. If the power supply needs to be converted to operate on the other power source, rewire the transformer and change fuse F1 as shown on the schematic and wiring diagrams in the back of this manual. However, if a change between 50 and 60 Hz power sources is necessary, a different transformer is required.

2.3 INSTALLATION

1. Install the antenna coaxial cable through the access holes in the front or back baseplates of the repeater cabinet. Connect the cable to the duplexer or to the transmitter and receiver, depending on the type of installation. Connect the power supply to AC power.

NOTE: Because most repeater installations require several hundred feet of coaxial cable, it is very important that the cable be a high quality product. Failure to use a high quality cable may result in large power losses and poor repeater performance.

2.4 REPEATER START-UP

Connect the AC power cord and set the various controls on the cards as follows:

- Call Guard Card

Set the Encode switch to OFF and the switches on the PC board to ON if the respective Call Guard squelch is being used.

- Control Card

Set Repeat switch to ON and the Access switch to TONE.

- Level Card

The Call Guard Level control and Transmit Audio Level control are factory set or are adjusted during repeater alignment. Adjust the Local audio control as desired and adjust the Squelch Adjust control so the squelch opens and the transmitter keys when the desired signal level is received.

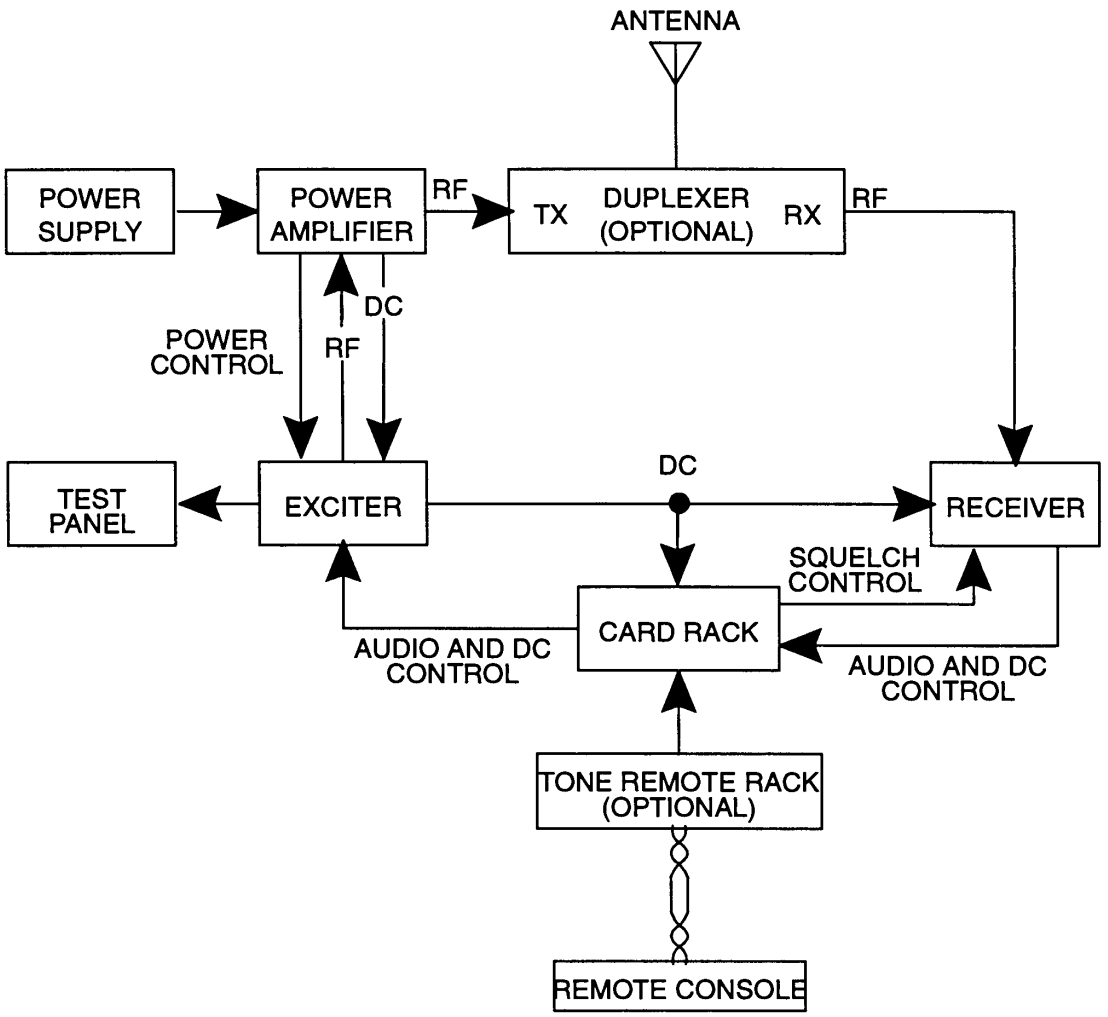


Figure 2-1 REPEATER BLOCK DIAGRAM

Table 2-1 CALL GUARD FREQUENCIES

FREQ	FREQ	FREQ	FREQ	FREQ
0.0	88.5	114.8	151.4	203.5
67.0	91.5	118.8	156.7	210.7
71.9	94.8	123.0	162.2	218.1
74.4	97.4	127.3	167.9	225.7
77.0	100.0	131.8	173.8	233.6
79.7	103.5	136.5	179.9	241.8
82.5	107.2	141.3	186.2	250.3
85.4	110.9	146.2	192.8	

CR1100 SPECIFICATIONS

The following are general specifications intended for use in testing and servicing this repeater. For current advertised specifications, refer to the Marketing Specifications sheet. Specifications are subject to change without notice.

GENERAL

Frequency Range	150-174 MHz
Channels	1
Transmit/Receive Separation	5 MHz
Dimensions	43"H x 22"W x 15"D
Microphone	Optional HD for local operation and test
Power Source	115V AC/230V AC
FCC Compliance	Parts 15, 21, 74, 90 and 16F3
Duty Cycle	Continuous
Circuit Protection	25A fuse

RECEIVER

Sensitivity	0.35 mV (12 dB SINAD)
Selectivity	-90 dB
Squelch Sensitivity	0.25 mV
Spurious	-100 dB
Image Rejection	-100 dB
Intermodulation	-80 dB
Audio Power Output	0.5 Watt (local)
Hum and Noise	-60 dB (squelched)
Frequency Stability	±5 PPM -22°F to +140°F
Optional	±2.5 PPM -22°F to +140°F
Input Impedance	50 Ohms (nominal)
Speaker Impedance	8 Ohms

TRANSMITTER

RF Power Output	100 Watts
Duty Cycle	Continuous
Spurious and Harmonic Emissions	-70 dB
Modulation	16K0F3E: ±5 kHz at 77°F/100% at 1 kHz
FM Hum and Noise	-50 dB minimum
Frequency Stability	±5 PPM -20°F to +140°F
Optional	±2.5 PPM -20°F to +140°F
Audio distortion	5% at 1 kHz (±3 kHz deviation)
Load Impedance	50 Ohms

SECTION 3 CIRCUIT DESCRIPTION

3.1 GENERAL

The Johnson 1100 is a VHF full duplex multitone repeater (see Figure 2-1). The unit is powered by a 115/230V AC power supply. The incoming signal is fed from the receive section of the duplexer to the receiver. The audio output of the receiver is then fed to the card rack. A portion of the Card Rack processes the audio and turns on the exciter. The RF output of the exciter is coupled to the power amplifier and to the optional duplexer and the antenna. The repeater can also be controlled by the optional tone remote console. Refer to the appropriate schematic diagram or block diagram while following the circuit description.

3.2 RECEIVER

3.2.1 DC POWER SUPPLY

DC power is applied to the receiver 15.7V DC line at J200, pin 35. This line supplies power to the audio output stages, 9.1V regulator, first mixer, 10.7 MHz IF amplifier, and the audio output stages. Filtering is provided by C1, C2, C260, L206, C296, L212, C297, L213 and C299. A regulated 9.1V is supplied to the remainder of the receiver by zener diode CR209.

3.2.2 HELICAL FILTER, FIRST MIXER

The incoming on-channel signal is coupled through a 5-section helical resonator and L106 to the gate of first mixer Q101. The individual cavities are tuned by C101-C105. These variable capacitors represent the variable spacing between the ends of their respective coils and ground. The size and shape of the aperture between cavities determine the degree of coupling and bandpass characteristics.

An impedance match between the helical resonators and the gate of Q101 is provided by L106 and C106. First mixer Q101 mixes the incoming signal with the output of injection amplifier Q102.

3.2.3 OSCILLATOR TRIPLER, SECOND TRIPLER, INJECTION AMPLIFIER

Parts are included on the circuit board for two channel operation, however, only channel 1 is operational. This has been done by hard wiring the emitter circuit of Q211 to ground.

The oscillator tripler is a modified Colpitts circuit with the collector of Q211 tuned to the third harmonic of the crystal frequency. The oscillator output frequency is tuned by R208 and T209. A passive temperature compensation scheme is used with thermistor RT201 controlling the effective capacitance of C291 which establishes the temperature compensation of the oscillator.

NOTE: Crystal compensating capacitor C291 is a factory selected part and is shipped with the crystal.

Frequency adjustment is provided at C269 and the range of adjustment can be extended by changing C271 (see Section 5.2.2).

The first oscillator crystal frequency can be determined by the following formula:

Crystal Freq. = (Chnl Freq ± 10.7 MHz) ÷ 9

The oscillator output circuit is coupled by T208 and T209 to the base of second tripler Q213 through capacitor C281. The tripler output signal is then coupled through transformer T210 and capacitor C286 to the base of injection amplifier Q102. A tripler test voltage is rectified by CR212 and coupled to TP204. The tripler output is tuned by T210.

The signal from injection amplifier Q102 is coupled to the source of first mixer Q101. The output of Q102 is tuned by C108 and C109. A test voltage is rectified by CR101 and coupled to TP205.

3.2.4 10.7 MHZ CRYSTAL FILTER AND 10.7 MHZ AMPLIFIER

The output of Q101 is tuned to 10.7 MHz, the difference of the incoming signal frequency and the output frequency of injection amplifier Q102. This difference frequency is fed through a length of coax, L202 and C201 to the input of 2-pole crystal filter Z202. The crystal filter has a bandwidth of ±5 kHz at the 3 dB points. The output of Z202 is coupled through C202, T201 and C298 to the base of 10.7 MHz IF amplifier Q215.

The output of Q215 is taken off the collector and coupled through R295 to crystal filter Z201. An impedance match between Q215 and Z201 is provided by R295. This crystal filter has a bandwidth of 15 kHz at the 6 dB points.

3.2.5 SECOND OSCILLATOR, SECOND MIXER

Second oscillator Q214 is a modified Colpitts oscillator with the feedback controlled by C263 and C264. Crystal Y203 functions as a parallel resonant element and oscillates at either 11.155 MHz (high side injection) or 10.245 MHz (low side injection). High side injection is used in most units, low side injection is optional. The signal from the second oscillator is coupled to the base of second mixer Q202 through C209 and C206.

The output of second mixer Q202 is tuned to 455 kHz, the difference of the two signals on the base. The output is coupled from T207 through C215 to the base of IF amplifier Q203.

3.2.6 FIRST IF AMPLIFIER, SECOND IF AMPLIFIER

The output of first IF amplifier Q203 is coupled to the base of second IF amplifier Q204 through T203 and C221. The output of Q204 is coupled to limiter/ discriminator U201 by T204. An IF test voltage is rectified by CR201 and coupled to TP203.

3.2.7 LIMITER/DISCRIMINATOR

The IF amplifier, limiter, detector and audio pre-amplifier circuitry are contained in U201. The detector operates as a quadrature type which means that a 90° phase shift audio recovery process is used. Inductor T205 adjusts the detector and is tuned for maximum undistorted audio output.

3.2.8 AUDIO PRE-AMPLIFIER, CALL GUARD FILTER

Detected audio from U202 is coupled through C235 to the de-emphasis network C230, C255, C237, R233, R234 and R232. This network provides a 6 dB per octave de-emphasis from 300-3000 Hz. The gain of U202A is determined by the ratio of the feedback resistance and its input resistance. The feedback path contains C247, used to roll off amplification of frequency over 3 kHz.

The output of U202A is coupled by C252 and C254 to the inverting input of Call Guard filter U202B. The components make U202A act as a high-pass filter with a low frequency roll-off of approximately 300 Hz to remove Call Guard tones. The audio output from U202A, pin 10 is coupled through C246 to J200, pin 11. This pin goes to the transmit audio circuit and to local volume control on the Level Adjust card in the card rack.

3.2.9 AUDIO DRIVER, AUDIO OUTPUT

The output of the local volume control is fed to J200, pin 12 and coupled by C250 and R247 to the base of audio amplifier Q206. Base bias for Q206 is developed across R262 and fed through R252 to the base of Q206. Negative feedback capacitor C259 helps high frequency roll-off response. The audio is directly coupled from Q206 to the base of audio driver, Q207. The output of Q207 is taken off the collector of Q207 and applied to the primary of T206, the input transformer to a Class B push-pull audio amplifier. A 180° shift of the audio signal applied to Q210 and Q209 is accomplished by putting the base circuits of the two transistors in the opposite portions of the secondary. The transistors are biased slightly by a biasing network made up of R256, R255, R254 and R253 to prevent crossover distortion. To provide temperature stabilization, R261 and R257 are in the emitter circuits of Q210 and Q209 respectively. Negative feedback is provided by C258 and R259 to further decrease distortion and shape the audio response. R249 and C274 in series dampen oscillations caused by the inductive effects of the speaker.

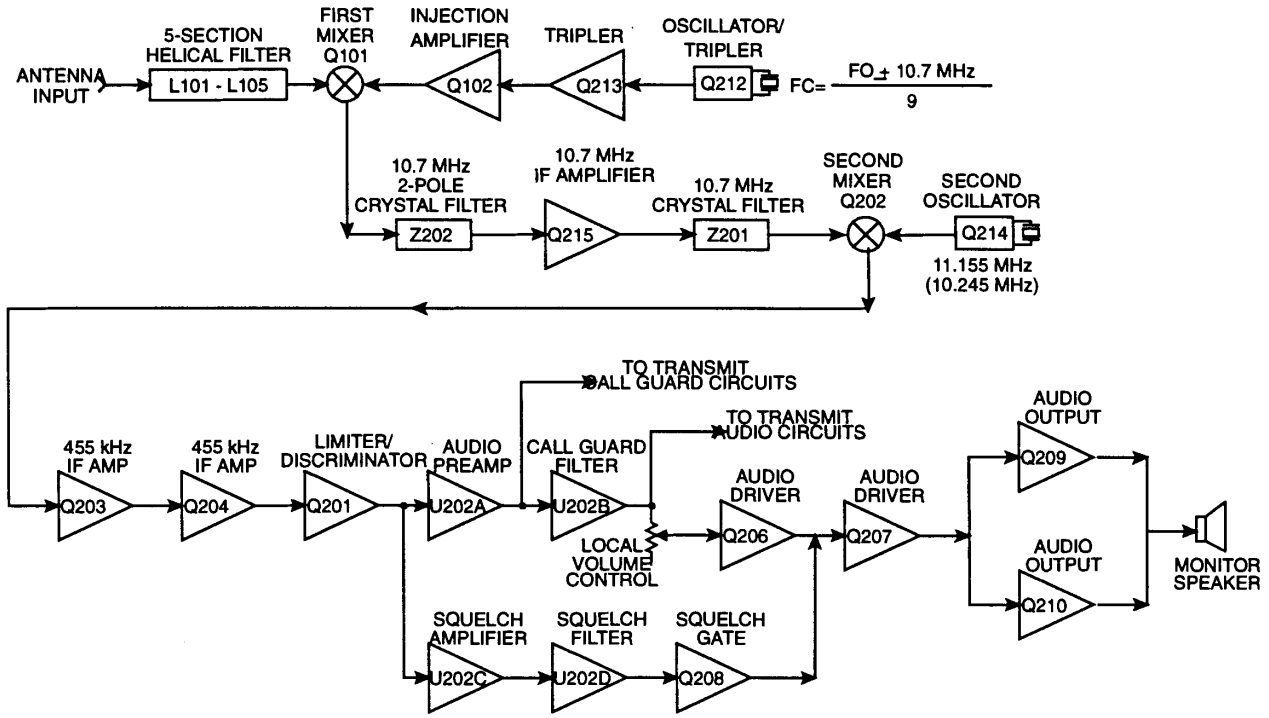


Figure 3-1 RECEIVER BLOCK DIAGRAM

3.2.10 SQUELCH AMPLIFIER, SQUELCH FILTER, SQUELCH GATE

The operation of the squelch circuit depends upon the presence or absence of an on-frequency RF carrier. Without an on-frequency signal input to the receiver, high frequency noise is fed from the limiter/discriminator to squelch amplifier U202C through R240. The level of noise is raised approximately 20 dB and fed to squelch filter U202D. The squelch filter has a sharp roll off below 3 kHz. The noise output is fed to a voltage divider network consisting of R237/R238. This network establishes the input level to squelch filter U202D. The feedback circuit consists of C241, C242 and R235. These components allow U202D to act as a highpass filter. The output is fed through C244 to a voltage rectifier/doubler circuit made up of CR204, CR203 and C248.

In this model receiver, CR205 and C295 perform no function. The positive DC voltage from the rectifier/doubler is fed through R250 to the base of squelch gate Q208, turning it on. The collector of Q208 goes low, disabling local audio amplifiers Q206 and Q207. This low is also fed to the squelch circuits on the level adjust card. The squelch potentiometer on the Level Adjust card sets the point at which Q208 conducts.

When an on-channel signal is received there is no noise fed to the squelch amplifier, the squelch filter, or the rectifier/doubler. The base of the squelch gate goes to 0V and Q208 turns off. The collector voltage on Q208 rises and allows Q206 and Q207 to operate normally.

To prevent intermittent squelching when receiving a weak/fading signal, a hysteresis circuit made up of CR208/R242 is used. In the unsquelched mode CR208 is forward biased. This provides a shunt path to ground through R242, CR208 and C236 for some of the noise. This effectively reduces the sensitivity of the squelch circuit to minor fades. A greater change in the received noise is now required to squelch the radio. To prevent the receiver from being unsquelched during short fades, C245 is in the emitter-base circuit of Q208.

3.3 TRANSMITTER

3.3.1 DC POWER SUPPLY, TRANSMIT SWITCH

B+ from the power supply is applied to the power amplifier assembly through P904. Transient voltage protection is provided by 17V zener diode CR902. Polarity protection is provided by CR901. If a negative potential is applied to the radio, CR901 conducts and blows the power supply fuse.

A DC power cable containing a 5A fuse carries B+ from the power amplifier to the exciter. Inside the exciter B+ is applied directly to the collector of Q376 and to L206 in the transmit switching circuit.

In the receive mode, transmit switch Q348 is turned off by a positive voltage on the base provided by R374/R360. This prevents the 13.8V transmit switch line from becoming activated.

In the transmit mode, J1, pin 10 becomes grounded and Q348 turns on. This supplies B+ voltage to the exciter circuitry except for Q375/Q376. The receive switch is inactive as the receiver is on all the time.

3.3.2 TRANSMIT AUDIO STAGES

Transmit audio from the level adjust card is applied through C302 and R301 to first audio amplifier U301A, pin 6.

The amplified audio goes from U301A, pin 5 through C303 and R304 to U301B, pin 3. The series RC network C303 and R304 forms a pre-emphasis network. This network gives the audio signal part of the required 6 dB per octave pre-emphasis. A high level of modulation is maintained by a logarithmic compression amplifier U301B, CR301, CR302, R305 and C304. This is accomplished by effectively varying the resistance of the feedback path from U301B, pin 4 to U301B, pin 3. The gain of U301B is initially set by R305.

With a low level of audio fed back to U301B, pin 3, CR301 and CR302 do not conduct. This effectively increases gain. With a high level of audio fed back to U301B, pin 3, CR301/CR302 conduct. This effectively decreases the feedback loop resistance, decreasing the gain of U301B. The result is a constant audio output level regardless of input audio level. Capacitor C304 helps to roll off the high frequency response.

The amplified and compressed audio goes from U301B, pin 4 through C305 to limiter circuit R307, CR303, CR304, R308 and R309. Diodes CR303 and CR304 limit the audio to prevent overmodulation. This is done by partially forward biasing CR303 and CR304 to approximately 0.5V with voltage divider R307, R308 and R309. When the positive peak audio level exceeds 0.5V, CR303 becomes reverse biased and limits the audio signal. When the negative audio peaks exceed 0.5V, CR304 becomes reverse biased and limits the audio.

The audio is coupled from the limiter through C306/R310 to U301C, pin 11. U301C performs splatter filtering and audio amplification.

The amplified and filtered audio is coupled from U301C, pin 10 through C307/R313, that provide additional pre-emphasis, and R314 to U301D, pin 8. U301D performs additional splatter filtering and audio amplification.

3.3.3 TRANSMIT OSCILLATOR/DOUBLER

Channel one of the transmitter is used for the repeater, however, channel two can be used by grounding the emitter of Q321.

Processed audio is taken from U301D, pin 9 and coupled through C310, R320, R324, C321 and L321 to varactor diode CR321. Varying the amount of reverse bias applied to this type of diode, the internal capacity is varied. This varies the frequency of the varactor's associated crystal.

The varactor is reverse biased by the +6.2V regulated line. When audio is applied to the varactor, the reverse bias voltage varies at an audio rate and this direct FM modulates the oscillator. Deviation is adjusted by R324 on the TCXO circuit board and by R714 on the level adjust card. Temperature compensation is accomplished in the same manner as in the receiver. The approximate frequency on which Y301 operates is determined by C327 and is peaked to the center range of C325. The transmitter oscillator/doubler can be set exactly on frequency by adjusting C325.

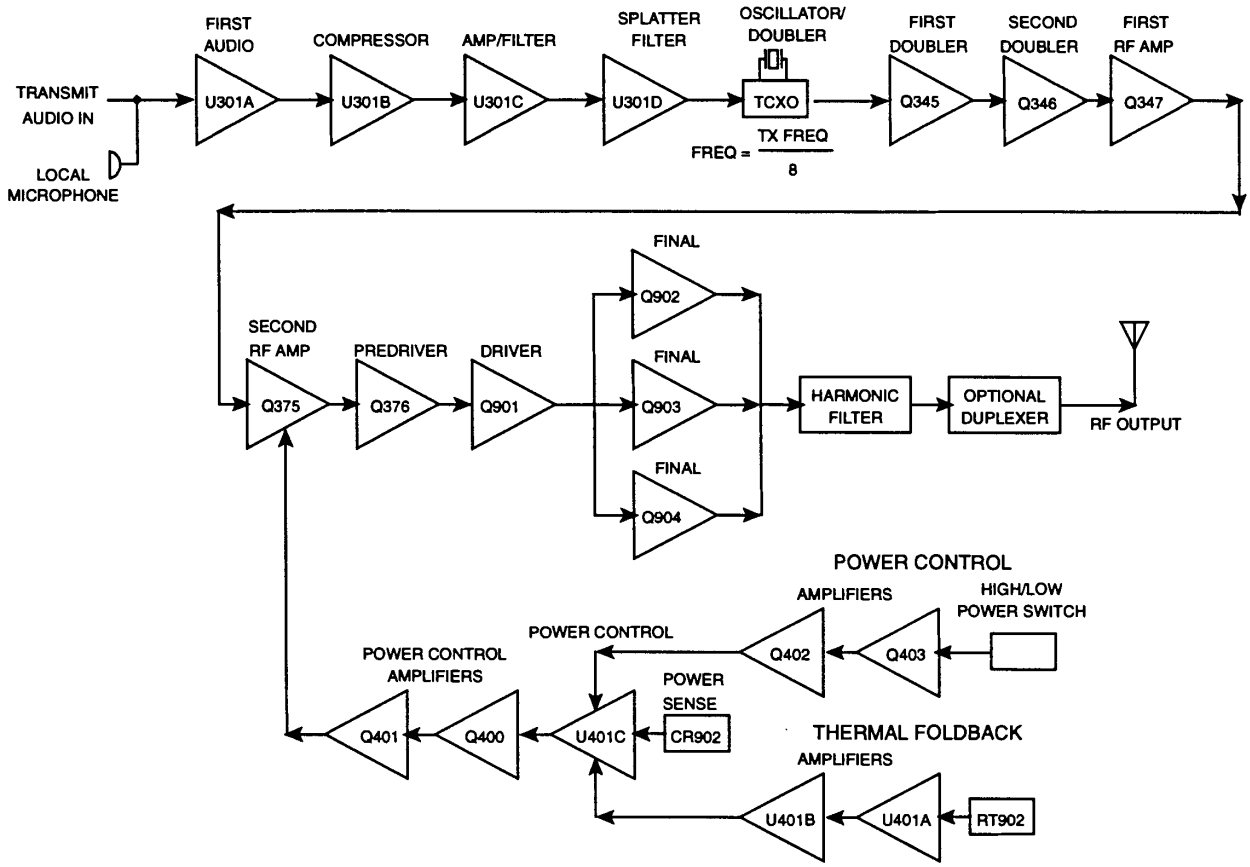


Figure 3-2 TRANSMITTER BLOCK DIAGRAM

The transmitter oscillator is a modified Colpitts using a fundamental crystal operating in the 18.7 - 21.8 MHz range. Crystal frequency can be determined by the following formula:

Crystal Freq. = Channel Freq. ÷ 8

The collector circuit of W320 is tuned to twice the crystal frequency by L320/L345. An oscillator test voltage is rectified by CR345 and filtered by R345/C363.

3.3.4 FIRST DOUBLER, SECOND DOUBLER

The output of Q320 is coupled by C345/C347 to the base of first doubler Q345. The collector circuit of Q345 is tuned to twice the frequency of the signal on the base. The output of Q345 is taken off the collector and coupled by C352/C353 to the base of second doubler Q346. The collector circuit of Q346 is also tuned to twice its input frequency. A test voltage is rectified by CR346 and filtered by R358/C366.

3.3.5 FIRST RF AMPLIFIER, SECOND RF AMPLIFIER

The output of Q346 is coupled by C358/C359 to the base of first RF amplifier Q347. A test point voltage is rectified by CR347 and filtered by R359/C368. The amplified output is taken off the collector of Q347 and coupled through C361, L351 and a section of microstrip to the base of second RF amplifier Q375. The collector current of Q375 is controlled by the power control circuit. This regulates the transmitter's RF power output.

3.3.6 PREDRIVER, DRIVER, FINALS

The output of Q375 is taken off the collector and coupled through a section of microstrip, C383, and another section of microstrip to the base of predriver Q376. The output is taken off the collector and fed through a section of microstrip, C397 and a coaxial cable to the PA assembly.

The power amplifier assembly contains the driver, finals, power sense, thermal sense circuitry and the lowpass filter. The signal from the exciter is fed through microstrip to the base of driver Q901. The output of Q901 is taken off the collector and fed to three paralleled finals, Q902, Q903 and Q904. The output of the finals is fed through microstrip, C931, a length of coax, and a lowpass filter to either a duplexer or an antenna.

3.3.7 POWER CONTROL

The power control circuit processes two separate inputs to control the transmitter RF power output. One input is a sample of the output power taken from the output circuit just ahead of the lowpass filter. The other input is a temperature indication produced by a thermistor located near the finals. Under normal operating conditions only the RF power level input has an effect on the power output. If the ambient temperature of the finals exceeds a certain level, the power is cut back to protect the finals from damage.

A sample of the RF power output is coupled by C954 from the input to the lowpass filter and rectifier/ filter circuit CR903, R910 and C957. The DC voltage is applied through a voltage divider network to U401C, pin 6. Thermistor RT400 is used to keep the reference voltage level on U401C, pin 6 constant over temperature.

The thermal foldback circuit is controlled by the voltage drop across thermistor RT902. As the power amplifier temperature increases, the resistance of RT902 decreases. This results in a drop in the voltage level on U401A, pin 13. The voltage level on U401A, pin 14 increases since the input is on the inverting input. When the output on U401A, pin 14 is about 5.6V, zener diode CR400 conducts and a voltage is added to the reference voltage on U401B, pin 2. Since this is the inverting input, the output of U401B, pin 1 decreases causing the voltage level on U401C, pin 5 to decrease. The voltage level on U401C, pin 7 also decreases which turns off Q400. The collector voltage on Q400 increases and turns off Q401. This leaves less current available for Q375 and the RF output power decreases until the power amplifier cools to a safe temperature.

If the power amplifier section gets extremely hot, the resistance of RT902 decreases even more. This causes the voltage on U401A, pin 14 to go even higher. When this DC level gets to approximately 6.8V, CR402 conducts. This applies a positive DC voltage to the inverting input of U401C. This also results in the power output decreasing but since both inputs to U401C are involved the amount of power decrease is even more. This is done to ensure that the power output decreases, especially if R412 or R420 are turned up to a high level.

When the high/low power switch is not used, no voltage is applied to the junction of R426 and C420. This allows Q403 to turn on which turns on Q402. With the collector of Q402 essentially at ground potential, a voltage divider consisting of R420 and R421 is placed in the input circuit of U401C. The high power adjustment is made with R420.

When the high/low power switch is used (with the power fail beep alarm installed), normally no voltage is applied to the junction of R426 and C420 as previously discussed. When the AC power fails and the battery takes over, approximately 12V is applied to the junction of R426 and C420. This turns off Q403 which turns off Q402. With Q402 shut off, the high power adjustment voltage divider is removed from the inverting input circuit of U401C. This causes the input voltage on the inverting input of U401 to increase. The output on U401C, pin 7 decreases and tends to turn off Q400. The collector voltage on Q400 increases causing Q401 to conduct less. This reduces the conduction of Q375 and reduces the RF power output. The low power adjustment is made with R412.

3.4 POWER SUPPLY

This supply consists basically of a ferroresonant transformer, bridge rectifier, and voltage regulator. The ferroresonant power transformer is designed to accept a nominal input of 110/220V AC ±15% and

provide a constant output of the secondary of 16V AC. The output of the secondary is rectified by CR3 and CR4. The output of the rectifier is then fed to a shunt regulator circuit.

The initial load on the power supply is established by R1. The base of Q1 is held at a constant 14V by zener diode CR1 and CR2. This places the emitter of Q1 at approximately 14.7V. If the power supply output voltage tends to rise, the conduction of Q1 increases. This increases the current flow in the secondary of T1 which increases the voltage drop. This increase in voltage drop opposes the output voltage increase. If the output voltage tries to decrease, the conduction of Q1 decreases. There is now less of a voltage drop on the secondary of T1. This decrease in voltage drop offsets the decrease in output voltage. To increase the regulation of Q1, CR7 is placed between the base and emitter.

3.5 CONTROL CARD

3.5.1 GENERAL

Refer to Figures 3-3 and 7-2 for block diagram layouts of the card rack and control card.

The repeater control card contains circuitry that can be put into two categories:

- Transmit Control circuits
- Call Guard circuits

While going through the circuit description refer to the control card schematic Figure 7-18.

3.5.2 TRANSMIT CONTROL CIRCUITS

NOTE: While going through the transmit control circuits, initially assume the receiver is receiving an on-channel signal with the proper Call Guard tone. The circuitry that causes various voltages on the input pins to the control card are discussed in the appropriate sections of this service manual.

When a properly encoded signal is received, pins 15 and 16 go low. This places a low through repeater switch S601 and R601 to the base of Q600. With S601 in the OPEN position, a Call Guard tone is not needed to operate the repeater. A Call Guard tone is needed in the TONE position. A low is also applied from pin 15 through R652 to NOR gate U602A, pin 9. A low is not on U602A, pins 9, 10 and 11. In order to key the transmitter, a low is also needed on U602A, pin 12. With S600 in the OFF position, U602A, pin 11 will always be high and the transmitter cannot be keyed. The base station control line (Control Card, pin 21) is not used in the repeater.

When a low is applied to the base of Q600, it turns off. This causes a positive pulse to be coupled through C602 and CR600 to the base of Q603. C603 is charged to approximately 9V and this voltage is applied to the base of Q603 and the collector goes low. This places the positive end of C603 and U602A, pin 12 near ground potential. The capacitor cannot discharge through the base- emitter junction of Q601, therefore the base of Q601 goes to approximately -8V. This turns off Q601 and the collector goes high. The base of Q603 also goes high to ensure it stays turned on. C603 then begins discharging through R607.

With all of the inputs to U602A low, the output on U602A, pin 13 goes high. This high is applied through R613 to the base of Q604 and it turns on. The emitter of Q604 also goes high charging C605. This high is passed through a resistor network to the base of Q605 and it turns on. A low appears on the collector of Q605 and is applied to the inputs of NOR gate U602B. This portion of U602 acts as an inverter and a high appears on the base of Q606. A low appears on the collector of Q606 that turns on CR603 and places a low on the transmit switch line on Control Card, pin 19 to key the transmitter.

After approximately three minutes, C603 in the time-out timer circuit discharges through R607 to a point where Q601 turns on. This places a low on the collector of Q601 and the base of Q603. The collector voltage on Q603 rises and places a high on U602A, pin 12. The output of U602A, pin 13 goes low to turn off Q604. This allows C605 to discharge through R615, R655 and the base-emitter junction of Q605. After approximately three seconds Q605 turns off. The collector voltage on Q605 increases and places a high on the inputs to U602B. The output on U602B, pin 1 goes low and turns off Q606. The collector voltage of Q606 rises and unkeys the transmitter and turns off CR603. The low on U602B, pin 1 is also applied

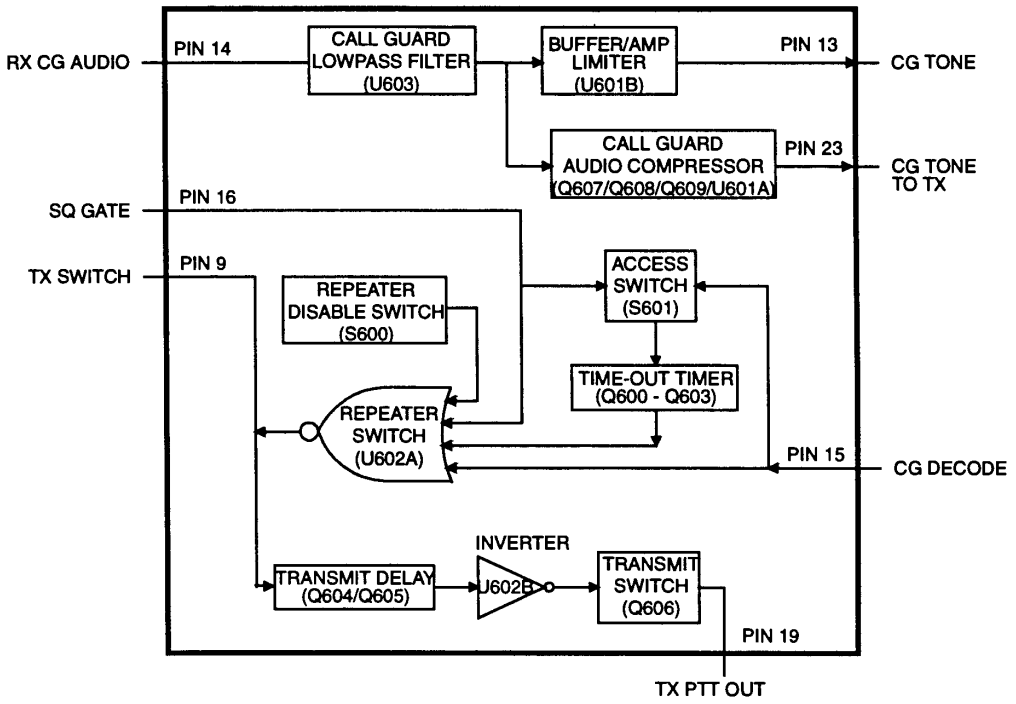


Figure 3-3 CONTROL CARD BLOCK DIAGRAM

through R606 to the base of Q602. Q602 turns on and places a high positive voltage on the base of Q601. This holds Q601 on and the transmitter stays unkeyed. In order to bring the repeater up again, the remote operator must unkey the microphone that turns Q600 on.

The next signal (with appropriate Call Guard tone) that the repeater receives brings it up again. The three minute transmit cycle can also be started again by using TIMER RESET switch S602, located on the front of the repeater control card. This is a momentary contact normally open switch. When the switch is depressed, C602 discharges through R609. When the switch is released, C602 charges and passes a positive pulse through CR600 to the base of Q603 to reset the timing cycle.

The purpose of the delay selector is to keep the repeater up for a short period of time (usually three seconds) after a transmission. This eliminates one of the squelch tails and prevents loss of signal between operators. If the repeater has to come up between conversation exchanges, the first part of each message could be missed. Any one of three resistors can be chosen for the desired time delay. In addition, a provision has been made on the PC board for mounting a potentiometer.

3.5.3 CALL GUARD SQUELCH CIRCUITS

The audio output containing the Call Guard squelch frequencies from the receiver is fed from the level card to pin 14 on the control card. The audio is then coupled by C606, R620 and C632 to the input of low pass filter U603. This filter is a quad operational amplifier which removes all frequencies above 300 Hz. This leaves only the Call Guard tones at the output on pin 14. The output of the limiter is coupled by C624 to Control Card, pin 13 and goes to the Call Guard card.

The output of low pass filter U603D, pin 14 is also fed to the Call Guard audio compressor through C618 and R637. This circuit ensures that the level of the Call Guard tone fed to the Level Adjust card is constant.

The input to the compressor is on the gate of amplifier Q608. The source output is coupled by C619 and R638 to U601A, pin 6. A portion of the output is taken off U601A, pin 5 and coupled by C620 to the anode of CR605 and the base of Q609. When a received tone is of too great an amplitude, the negative peaks cause Q609 to conduct. Filtering is provided by C261 and the gate of Q607 goes in a negative direction. This turns on Q607 and shorts the excess signal to ground.

The processed Call Guard audio output is taken off U601A, pin 5 and coupled through C607 to pin 22 on the Control Card. This pin goes to the Call Guard level adjustment circuitry on the Level Adjust card.

3.6 LEVEL ADJUST CARD

3.6.1 GENERAL

Refer to Figures 3-4 and 7-2 for block diagram layouts of the Card Rack and Level Adjust card.

The Level Adjust card contains the 9.6V regulator, a portion of the transmit and audio Call Guard circuitry, a portion of the transmitter control circuitry, and the local audio and keying circuitry. This card also contains various transmit audio and Call Guard audio level adjustments along with the receiver squelch adjustment.

3.6.2 9.6V REGULATOR

The regulator supplies 9.6V regulated DC to the cards in the repeater card rack. An unregulated 15.7V is applied to pin 21. The base of Q701 is held at a constant 11V by CR700. The emitter- base junction of Q701 is forward biased which forward biases the emitter-base junction of Q700. The emitter of Q700 is approximately 1.4V less than the base of Q701 because of the two pin junctions.

If the 9.6V regulated line tends to decrease, both Q701 and Q700 turn on. The emitter to collector resistance of Q700 decreases and it drops less voltage. This compensates for the decrease in voltage of the regulated line.

If the regulated line tries to increase in voltage, both Q701 and Q700 tend to turn off. The emitter to collector resistance of Q700 increases and Q700 drops more voltage. This increased voltage drop counteracts the increase in voltage on the regulated line.

3.6.3 TRANSMIT AUDIO CIRCUITS (REMOTE KEYING)

When the transmitter is brought up, the output of U602A on the Control Card goes high. This puts a high on pin 9 of the Level Adjust card and on bilateral switch U701A, pin 6. When U701A, pin 6 goes high, the switch closes and allows signals to pass.

The audio from the receiver is applied to pin 8 on the Level Adjust card through a resistor network and C720 to U701A, pin 8. Local audio control, R710 adjusts the received audio volume at the repeater site. Level adjust pot R714 sets the amount of audio to the transmit audio circuitry.

The output on U701A, pin 9 is coupled through R724, C710 and C711 to Call Guard filter Q705 and Q706. These two transistors, along with their associated components, make up a highpass filter that removes signals of under 300 Hz. The output is taken off the emitter of Q706 and coupled through C716 to pin 18 of the Level Adjust card.

3.6.4 RECEIVE CALL GUARD AUDIO CIRCUITS

Level Adjust card pin 12 is connected to the collector of squelch gate Q208. When an on- channel signal is received, the collector of Q208 goes high. This places a high on the base of Q703. The collector of Q703 goes low which places a low on Level Adjust card pin 16 and Control Card pin 10.

A low is also placed on the base of Q702. The collector of Q702 rises and U701B, pin 12 goes to 9.6V. This closes U701B and the Call guard audio from the receiver is coupled through R742, C721, U701B and C722 to Level Adjust card pin 15. This pin goes to the Call Guard lowpass filter on the Control Card.

The Control Card processes Call Guard audio and feeds it to Call Guard card pin 13 and Level Adjust card pin 23. From pin 23, the Call Guard audio is coupled through U701D (normally closed by a high on U701D, pin 5) to Call Guard level adjust R705. From R705 the audio is coupled to level amplifier Q704. The output on the collector is coupled through C709 to Level Adjust card pin 22.

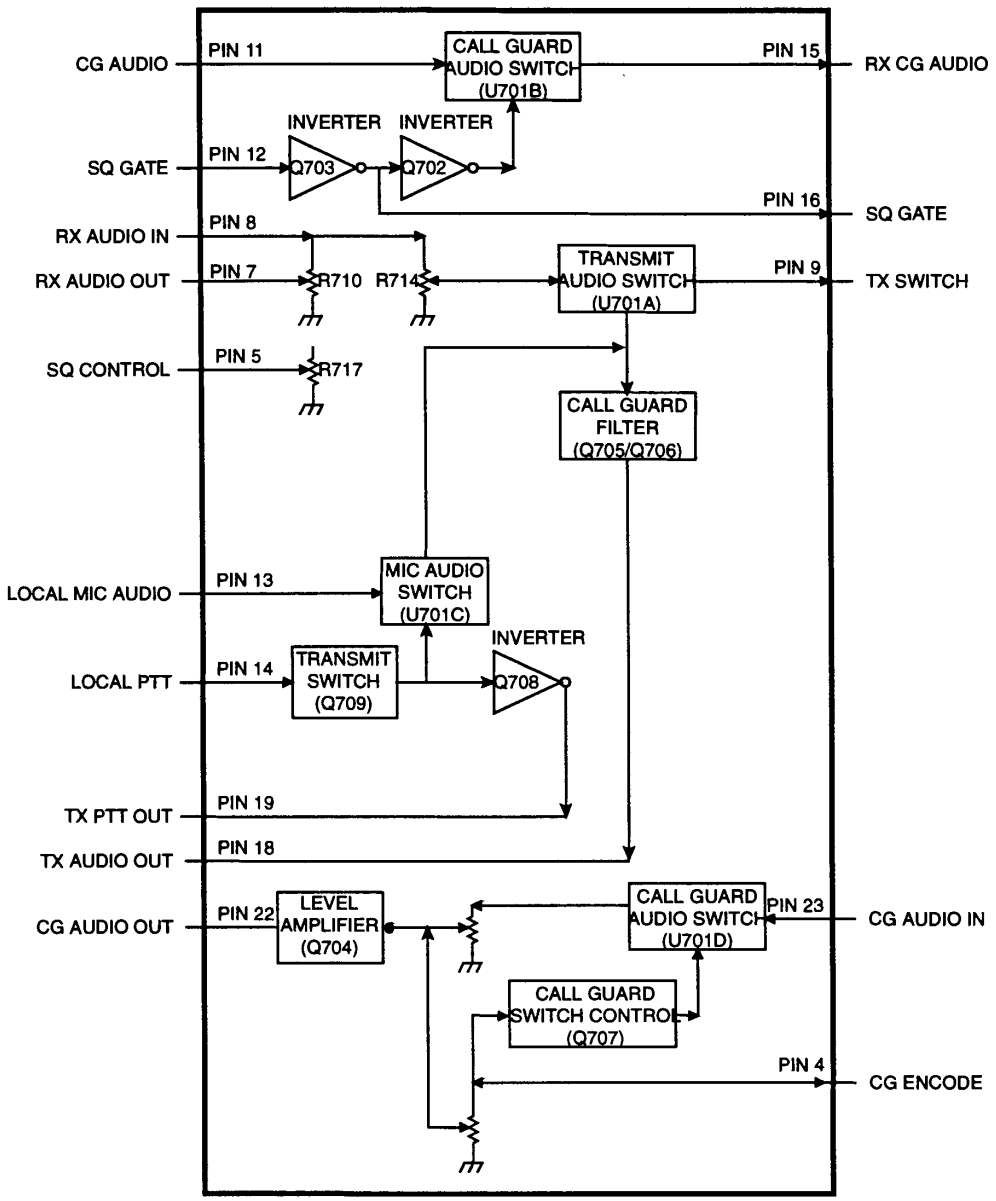


Figure 3-4 LEVEL ADJUST CARD BLOCK DIAGRAM

3.6.5 ENCODED CALL GUARD AUDIO

When the Call Guard card is placed in the ENCODE mode, encoded Call Guard audio is coupled to Level Adjust card pin 4. The Call Guard audio is then coupled by C700 to encode level adjust R700, through R701/C706 to the base of level amplifier Q704. Collector output is coupled through C709 to Level Adjust card pin 22.

When the Call Guard card is in the ENCODE mode, it is necessary to make sure that a received Call Guard tone is not simultaneously retransmitted with the encoded tone. A portion of the encoded Call Guard audio is coupled from Level Adjust card pin 4 through C717 and R738 to a voltage doubler consisting of CR701 and CR702. The output of the voltage doubler is a positive voltage that is applied to the base of Q707. This causes the collector of Q707 and U701D, pin 5 to go low to disabled and no received Call Guard audio is retransmitted.

3.6.6 TRANSMIT AUDIO CIRCUITS (LOCAL KEYING)

The repeater can be brought up at the site by keying the local microphone. Level Adjust card pin 14 goes to ground and the base of Q709 goes to 0V to place a high on the collector, the base of Q708, and U701C, pin 13. The microphone audio switch closes to allow the local microphone audio to be coupled to the Call Guard filter.

U602 on the Control card contains two 4-input NOR gates. The output from both U602A and U602B is high only when all inputs are low. When one or more of the inputs on each NOR gate is high, the output is low.

The transmitter is keyed if all four inputs to U602A are low. This means the squelch, time-out timer, Call Guard (if used), and repeater disable signals must be low to key the transmitter.

The inputs to U603B must all be low for the output to go high and turn on Q606 that keys the transmitter. To unkey the transmitter, an input to U602B goes high, the output goes low and Q606 turns off.

When the local microphone keys, a high is on the base of Q708 and the collector goes low to Level Adjust card pin 19 to key the transmitter.

3.6.7 SQUELCH ADJUSTMENT

The middle contact on squelch adjust pot R717 is connected to CR206 in the receiver squelch circuit. The lower the resistance of R717, more noise is required to turn on the squelch gate. The higher the resistance of R717, less noise is required to turn on the squelch gate.

3.7 CALL GUARD SQUELCH CARD

3.7.1 GENERAL

Each Call Guard card contains four separate decode/encode Call Guard circuits. Each Call Guard circuit can be tuned to any subaudible tone squelch frequency and produce a low output when the correct tone is decoded. These Call Guard circuits generate an encoded tone for test and alignment purposes.

A rotary switch on the front panel of the Call Guard card is used to switch each Call Guard to the encode or tone generating mode so the correct frequency can be set. During normal repeater operation, this switch is set to the "OFF" position so all four Call Guard circuits are in the decode mode. An ON/OFF switch for each Call Guard circuit is located on the PC board to allow a Call Guard circuit to be disabled.

3.7.2 DECODE AUDIO INPUT

The Call Guard audio signal is from the receiver audio preamplifier stage on J211. The receive audio and subaudible Call Guard tone is fed from the receiver on J200, pin 20 to Level Adjust card pin 11 in the card rack. In the Level Adjust card the signal passes through audio switch U701B to Level Adjust card pin 15 and on to Control card pin 14. The signal is then passed through lowpass filter U603. This filter attenuates frequencies above 300 Hz and passes the Call Guard tone frequencies. From the lowpass filter the signal is fed to buffer/ amplifier U601B and a diode limiter circuit that changes the Call Guard signal from a sine wave to a square wave. The square wave Call Guard signal is then fed to Call Guard card pin 13.

NOTE: The following circuit description applies to all four Call Guard circuits. Call Guard circuit number three is used for discussion purposes.

3.7.3 DECODE BUFFER/AMPLIFIER (U503A), BANDPASS FILTER (U503B/U503C)

The Call Guard audio input signal on pin 13 is coupled by C514 to buffer/amplifier U503A, pin 2. The buffer/amplifier provides isolation between the bandpass filter and the receiver audio preamplifier.

From U503A the signal is fed to the bandpass filter formed by U503B, U503C and their associated components. This is an adjustable active filter formed from operational amplifiers and has a bandpass of 2.5 Hz at Call Guard frequencies. The bandpass frequency is set by R548 and jumper wires A, B, C and D. The location of the jumper wires is shown in Table 5-4. The ENCODE switch is used to set the Call Guard frequency.

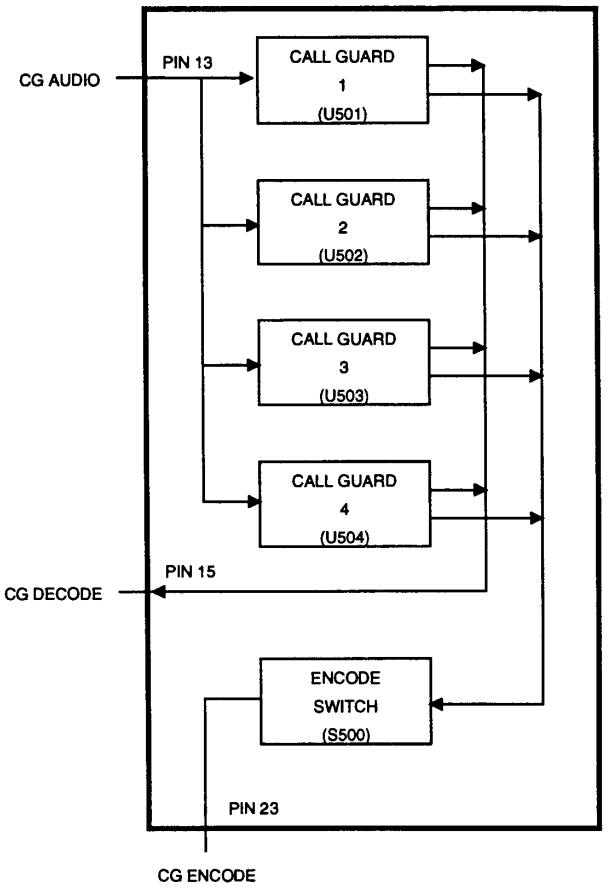


Figure 3-5 CALL GUARD CARD BLOCK DIAGRAM

3.7.4 THRESHOLD DETECTOR (U503D), BANDPASS FILTER (U503B/U503C)

The output of the bandpass filter is on U503D, pin 7 and fed to threshold detector U503C, pin 13. The threshold level of the operational amplifier is set by the voltage divider consisting of R559/R560.

With no signal input to the threshold detector, U503C, pin 13 is approximately 4.6V and pin 12 is approximately 4V. Since the inverting input is at a higher level, the output on U503C, pin 14 is 0V. When the bandpass filter decodes a signal, a sine wave input on U503C, pin 13 is produced. When the negative going alternation drops below the level on U503C, pin 12, a positive pulse is provided on the output. These pulses cause C520 to charge through CR502 and turn on Call Guard switch Q505. The collector drops to near ground potential and current flows through LED CR506 and R584. The Call Guard switch line output on Call Guard card pin 15 is the voltage drop across Q505 and CR506, approximately 2.2V.

3.7.5 ENCODE SWITCH (Q504) AND AUDIO SWITCH (S500)

Encode switch Q504 is turned on in the decode mode by removing the base voltage through S500B. This effectively shorts the feedback path of the Call Guard to AC ground which prevents the Call Guard from oscillating.

3.7.6 ENCODE MODE

When the Call Guard circuit is in the encode mode, S500A connects contacts 6 and 4 placing the output of the Call Guard circuit to pin 4. In S500B, contacts 12 and 10 are connected placing a high positive voltage on the base of Q504 and it turns off. A portion of the Call Guard output is now fed back through R558/R557 to U503A, pin 3. This positive feedback causes the Call Guard to oscillate at the bandpass frequency.

The amplitude of the oscillations is controlled by a voltage divider and limiter circuit made up of R591, R592, CR512 and CR513. The diodes are connected on one side to the DC input line which presents a ground for AC signals. The output of the oscillator is from U503B, pin 7 and fed through S500, pins 4 and 6 to the encoded Call Guard output line on Call Guard card, pin 4. The oscillator frequency is measured at TP503 or encoded on the transmit signal and measured from the RF output.

The encode audio switch, Q508 is turned on in the encode mode. This shorts the Call Guard audio input line to ground. This prevents any signals on the Call Guard audio input line from interfering with the oscillator's operation.

SECTION 4 SERVICING

4.1 GENERAL

4.1.1 PERIODIC CHECKS

Heavy duty cycles and the number of users that depend on the repeater make it especially important that regular preventive maintenance be performed. Checks should include; receiver sensitivity, SINAD, and transmitter frequency, deviation and power output. The repeater should be checked monthly during the first six months of operation and quarterly thereafter.

4.1.2 VISUAL INSPECTION

Always give the repeater a visual inspection before attempting to isolate a problem. Check for; loose, broken or pinched wires, overheated or discolored components and cold solder joints. A defective solder joint may have excess solder, too little solder or a dull, uneven coloring.

4.1.3 SCHEMATICS AND COMPONENT LAYOUTS

Schematic diagrams and component layouts for all PC boards are located in Section 7. The component layouts allow quick location and identification of components and test points.

4.1.4 REPLACEMENT PARTS

A replacement parts list with component part numbers is located in Section 6. Parts are listed alphabetically according to designator, starting with the lowest number, and are separated into sections identified by headings in boldface type.

Semiconductor devices used in the repeater are selected to meet specific parameters and are listed with E. F. Johnson part numbers. To obtain maximum repeater performance, always replace defective semiconductors with the same type parts.

4.1.5 SERVICE AND ALIGNMENT TOOLS

Only common service and alignment tools are required to service the repeater. Use a low power soldering iron (60 watts or less) to prevent component damage from overheating and use rosin core solder containing 60% tin and 40% lead. To remove solder when replacing a defective component, use a desoldering aid such as braided solder wick, bulb or plunger type suction tool.

Common straight, pointed and hex tipped alignment tools are used for adjustments. A kit containing all the alignment tools needed to adjust Johnson equipment is available from the Johnson Customer Service Department. This kit (Part No. 115-0410-001) contains seven alignment tools plus two ceramic replacement tips (Replacement Parts Price Book).

4.1.6 DRAWER REMOVAL

The drawers used in this repeater can be pulled out and tilted down for servicing or they can be easily removed. Before removing a drawer or other subassemblies, turn off power and unplug all cables (note where each is attached). To remove the drawer, slide it out until the guide pins line up with the holes in the side rails and then lift it up and out of the cabinet. Each drawer has a top and bottom cover that can be removed for servicing. To remove the power amplifier or power supply, remove the mounting screws from the back of the cabinet mounting rail.

4.2 INTEGRATED CIRCUIT SERVICING

4.2.1 CMOS HANDLING PRECAUTIONS

Some of the integrated circuits used in this repeater are CMOS devices. CMOS integrated circuits can be identified by a part number of 544-3x1x-xxx. Since these devices have very high open circuit

impedance, they are particularly susceptible to damage from static discharges. Damaging static charges may be present even if static arcs are not observed. When handling these devices, observe the following precautions:

1. Before touching the equipment or a CMOS device, discharge any built-up static charge on your body by touching a good earth ground.

2. Ground all test equipment and make sure the soldering iron tip is grounded. Connect ground leads before connecting test probes.

3. Leave the CMOS device in its conductive shipping packaging until it is inserted in the PC board.

Once the device is installed in the PC board, it is protected by internal diode protection circuits, so the chance of static damage is somewhat reduced. A service bench protection kit, Part No. 299-0026-001, can be ordered from the Service Parts Department. This kit eliminates static build-up on the body and includes a conductive mat, wrist strap, and a grounding strap with a 1M ohm resistor.

4.2.2 SERVICING TECHNIQUES

A good starting point when servicing integrated circuits is to measure steady state DC voltages. Operational amplifiers which function as buffers or amplifiers usually have a DC voltage on the input and output that is half the supply voltage. Others which function as comparators may have an output voltage that is near the supply voltage or 0 volts, depending on which input is higher.

The steady state DC voltages of logic gates such as AND or OR gates can also be measured with a voltmeter. Check the output level produced by each input combination. Troubleshooting operating digital circuits, i.e. microprocessors, is difficult because of the dynamic operation of these devices.

Table 4-1 shows the approximate logic levels for CMOS and TTL integrated circuits.

4.3 TRANSISTOR SERVICING

4.3.1 REPLACING TRANSISTORS SOLDERED TO MICROSTRIP

Use the following procedure to replace transistors that are soldered directly to PC board micro- strip such as those on the power amplifier board.

Removal

Remove the defective transistor and all excess solder on the microstrip. Clean the mounting surface with alcohol or another solvent that does not leave a residue. Do not apply solvent to Under- wood capacitors because it may cause dielectric breakdown and affect the value.

Tinning

Lightly tin the underside of each transistor lead with solder. Do not allow a thick build-up of solder since this could cause case separation when the transistor is tightened (when applicable).

Table 4-1 APPROXIMATE LOGIC LEVELS

	Input Level		Output Level	
Device	**Logic Low (Max)**	**Logic High (Min)**	**Logic Low (Max)**	**Logic High (Min)**
CMOS				
5V Supply	1.5V	3.5V	0.05V	4.95V
10V Supply	3.0V	7.0V	0.05V	9.95V
ECL	3.5V	3.9V	3.4V	4.0V

Mounting

Check to make sure that the transistor mount- ing surface is clean and then apply a thin coat of silicon heatsink compound. Insert the transistor and tighten it securely (when applicable).
Solder the transistor using a generous amount of solder to provide good contact between the entire transistor tab and the microstrip. Check that no solder bridges are present.

4.4 LOCALIZING PROBLEM TO A DEFECTIVE ASSEMBLY

4.4.1 INTRODUCTION

A problem with the repeater can usually be isolated fairly quickly to a main subassembly such as the receiver or exciter drawer. The following checks can be used to verify operation of the receiver and transmitter. Before proceeding with these checks, make sure all the cables on the rear panel connectors are in place and that the power supply output voltage is approximately 14V.

Refer to the troubleshooting flowchart Figure 4-3 or to the following information to determine if the receiver is working properly.

4.5 RECEIVE TROUBLESHOOTING

The receiver can be removed from its mount for servicing by loosening the two screws holding it in place. The receiver can now be removed from its mounting, the covers removed, and turned over for easier servicing. (Refer to Figure 5-1 for a suggested test setup.)

For troubleshooting purposes, receiver troubles can be quickly isolated to the defective stage by following the receiver troubleshooting flow chart (see Figure 4-3) or by proceeding as follows.

4.5.1 DC SUPPLY VOLTAGES

1. Measure the DC voltage on the cathode of CR208 and the positive lead of C260. They should be within ±5% of those listed below.

   Positive lead of C260 15.7V DC
   Cathode of CR209 9.0V DC

4.5.2 SQUELCH

1. With no signal into the transceiver, measure the DC voltage on the collector of Q208 (J209) while rotating squelch control R717. (The squelch control can be adjusted through a hole on the level adjust card in the card rack.)

   Counterclockwise 6.6V DC
   Clockwise .1V DC

2. With no signal into the receiver, measure the noise on U201, pin 6 with an oscilloscope. (Typically 500 mV P-P of noise.)

3. Measure and compare the voltages in the squelch section with those in Table 4-2.

Table 4-2 SQUELCH VOLTAGES

Measured At	Volts P-P	V DC Squelched	V DC Unsquelched
U202C,			
pin 1		0.5V	0.5V
pin 5	8.0V	4.5V	4.5V
pin 6	20 mV	0.5V	0.5V
U202D,			
pin 2		0.5V	0.5V
pin 3	100 mV	0.5V	0.5V
pin 4	2.0V	4.2V	4.2V
Q208,			
base		0.7V	0.2V
collector		0.6V	6.7V

Test Conditions: No RF into receiver. Squelch control set as indicated.

4.5.3 AUDIO

1. With the receiver unsquelched, measure the voltage at the base of Q207.
   (Typically 2.1V DC.)

2. Inject a 1 kHz signal at 400 mV on U201, pin 6.

3. With the Local Audio volume control on the Level Adjust card set for maximum unclipped audio output across the speaker load.
   (Typically 11V P-P or 4V RMS minimum.)

4. Measure and compare the DC voltages in the audio circuit with those in Table 4-3.

Table 4-3 RECEIVER AUDIO SIGNAL TRACING

Measured At	Volts RMS	Volts P-P	V DC
U202A,			
pin 8		6.2V	0.5V
pin 9	2.3V		4.2V
U202B,			
pin 11			0.5V
pin 10	2.45V	6.8V	4.4V
R710/R723*	2.2V	6.1V	
Q206			
Base			0.6V
Collector	45mV	125mV	2.1V
Q207			
Base	45mV	125mV	2.4V
Collector	1.1V	3.0V	14.6V
Q209			
Base	34mV	104mV	0.7V
Collector	4.15V	11.6V	7.3V
Q210			
Base	4.15V	11.6V	2.1V
Collector	24.5mV	70mV	15.7V
J212	0.41V	1.12V	

Test Conditions: No RF into receiver. Squelch control set fully CCW.

Table 4-4 IF AND LIMITER/DISCRIMINATOR VOLTAGES

Measured At	Volts DC	Volts P-P (Noise)
U201,		
pin 1	2.1V	1.0V
pin 2	2.1V	
pin 3	2.1V	
pin 6	4.7V	1.0V
pin 7	0.4V	100mV
pin 8	5.4V	200mV*
pin 9	5.6V	80mV*
pin 10	5.6V	
pin 11	8.7V	150mV
Q204		
Emitter	1.1V	
Base	1.8V	15mV
Collector	7.2V	3.0V
Q203		
Emitter	1.1V	
Base	1.7V	
Collector	7.2V	100mV

* At 455 kHz.
Test Conditions: No RF input to the receiver.

4.5.4 LIMITER-DISCRIMINATOR, FIRST AND SECOND IF

1. Inject an unmodulated 455 kHz signal at a level of 70 µV into TP202 using a 6800 pF coupling capacitor. 20 dB of quieting should be measured.

2. Measure and compare the voltages on Q203, Q204 and U201 with those listed in Table 4-4.

4.5.5 SECOND MIXER/SECOND OSCILLATOR / 10.7 MHZ AMPLIFIER

1. Inject unmodulated 10.7 MHz and 455 kHz signals at the points indicated in Table 4-5 and compare readings.

2. Measure and compare the DC voltages on Q202, Q214 and Q215 with those listed in Table 4-6.

Table 4-5 10.7 MHz UNMODULATED INJECTION POINTS

Injected At	Level (µV)	Quieting (dB)
Q202		
Base	10	20 (455 kHz)
Collector	25	20 (455 kHz)
Q215		
Base	5	20 (10.7 MHz)
Collector	1.5	20 (10.7 MHz)
Q101		
Drain	7	20 (10.7 MHz)

Table 4-6 2nd MIXER/2nd OSC/10.7 MHz AMP

Measured At	Volts DC	Volts RMS
Q202		
Emitter	1V	
Base	1.6V	0.06V
Collector	8.6V	
Q214		
Emitter	4.7V	0.32V
Base	5.2V	0.83V
Collector	5.3V	
Q215		
Emitter	2.7V	
Base	3.4V	
Collector	15.6V	
Test Conditions: No RF into receiver.		

4.5.6 OSCILLATOR-TRIPLER/TRIPLER/INJECTION AMPLIFIER/FIRST MIXER

1. Measure and compare voltages on Q211, Q213, Q102 and Q101 with those listed in Table 4-7.

Table 4-7 INJECTION STRIP AND FIRST MIXER

		Crystal	
	IN		OUT
Measured At	RF Volts (RMS)	V DC	V DC
Q211			
Emitter	0.5V	2.1V	2.0V
Base	1.8V	2.2V	2.3V
Collector	1.4V	8.7V	8.7V
Q213			
Emitter		1.9V	0.5V
Base	0.87V	1.1V	1.2V
Collector	0.92V	9.3V	9.4V
TP204		0.5V	
Q102			
Emitter		2.2V	1.3V
Base	0.51V	2.0V	2.1V
Collector		9.3V	9.3V
TP205		0.2V	
Q101			
Source	0.52V	3.2V	2.2V
Drain	0.07V	15.6V	15.6V
Test Conditions: No RF into the receiver.			

4.6 TRANSMIT TROUBLESHOOTING

4.6.1 GENERAL

The exciter can be removed from its mount for servicing by loosening the two screws holding it in place. The exciter can now be removed from its mount, the covers removed, and turned over for easier servicing. Refer to Figure 5-2 for suggested test setup.

For troubleshooting purposes, exciter troubles can be quickly isolated to the defective stage by following the exciter troubleshooting flow chart (see Figure 4-4), or by proceeding as follows.

4.6.2 DC SUPPLY VOLTAGE

1. Measure the voltage on the cathode of CR350. A reading of 14V DC ±5% should be read.

2. Key the exciter and measure the DC voltage at the cathode of CR307. A reading of 9V DC ±5% should be measured.

4.6.3 AUDIO

Remove the transmit crystal and proceed as follows.

1. Inject a 1 kHz audio signal at a level of 0.1V RMS at microphone pin 1 on the card rack assembly. A microphone substitution fixture (see Figure 4-1) can be used.

2. Using an oscilloscope, measure and compare the audio level with those listed in Table 4-8.

4.6.4 OSCILLATOR/DOUBLER, FIRST-SECOND DOUBLER

1. With the transmit crystal inserted, measure and compare the voltage readings on Q320, Q345 and Q346 with those listed in Table 4-10.

2. With the transmit crystal removed, measure and compare the voltage readings with those in Table 4-10.

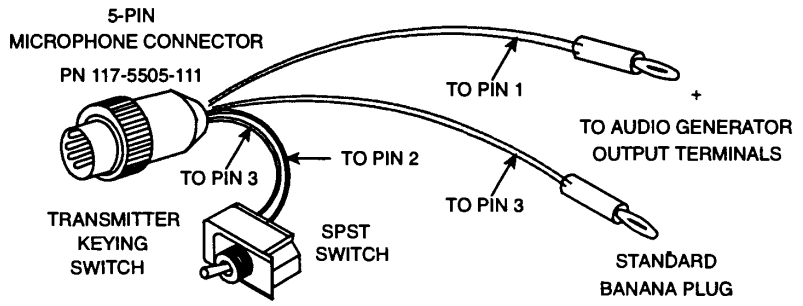


Figure 4-1 MICROPHONE SUBSTITUTE

Table 4-8 TRANSMITTER AUDIO SIGNAL TRACING

Measured AT	Signal Voltage Volts (RMS)	Volts (P-P)
U301,		
pin 4	390mV	0.8V
pin 5	87mV	250mV
pin 9	0.9V	5.2V
pin 10	2.1V	4.3V
CR303/CR304	200mV	0.5V
C306/R310	24mV	40mV
R320/R324	0.9V	5.2V
R324/C321	480mV	2.6V

Test Conditions: Inject a 1 kHz audio signal at ±4.5 kHz deviation on J2, pin 1. Transmitter keyed and transmit crystal was removed.

4.6.5 FIRST-SECOND RF AMPLIFIERS, PRE-DRIVER

1. With the transmit crystal inserted, measure and compare the voltage readings on Q347, Q375 and Q376 with those listed in Table 4-10.

2. With the transmit crystal removed, measure and compare the voltage reading with those listed in Table 4-10.

4.6.6 POWER CONTROL

1. Measure and compare the voltages in Table 4-9 with those in the power control section.

Table 4-9 POWER CONTROL VOLTAGES

Measured At	Crystal IN Volts DC	Crystal OUT Volts DC
Q402		
Base	0.8V	0.8V
Q403		
Emitter	1.2V	1.2V
Base	0.5V	0.5V
Collector	0.8V	0.8V
Q400		
Base	0.6V	0.7V
Collector	12.7V	0.5V
Q401		
Emitter	14.1V	15.7V
Base	13.4V	15.0V
Collector	3.7V	15.7V
U401		
pin 2	0.9V	0.8V
pin 3	0.9V	0.8V
pin 4	9.5V	9.5V
pin 5	0.9V	0.8V
pin 6	0.9V	0.8V
pin 7	0.7V	5.0V
pin 12	4.7V	4.7V
pin 13	4.7V	4.7V
pin 14	2.2V	2.3V

Table 4-10 EXCITER VOLTAGE READINGS

	Crystal		
	IN		OUT
Measure At	V RMS	V DC	V DC
Q320			
Base	0.68V	1.9V	2.4V
Emitter	0.21V	2.2V	2.1V
Collector	1.9V	8.2V	8.3V
TP301		1.5V	
Q345			
Base	0.47V	1.0V	2.2V
Emitter		2.0V	1.5V
Collector	3.0V	14.9V	15.1V
TP302		1.1V	
Q346			
Base	1.6V	0.6V	1.0V
Emitter	0.06V	2.3V	0.3V
Collector	2.2V	13.1V	15.3V
TP303		0.2V	
Q347			
Base	0.3V	0.5V	0.6V
Collector	3.0V	11.6V	15.2V
Q375			
Base Collector	0.47V 1.5V	15.7V	15.7V
Q376			
Base	1.0V		
Collector	4.6V	13.6V	15.7V
Power at J313	17 Watts		

Test Conditions: Voltage readings are with reference to 17W output.

4.7 POWER AMPLIFIER TROUBLESHOOTING

4.7.1 COMPONENT REPLACEMENT

When a component needs replacing, it can be accessed from the component side of the power amplifier board.

When replacing components on certain areas of the board, care must be taken to prevent leads from touching the heat sink under the PC board. An insulator is installed between the PC board and the heat sink, but it covers only a portion of the board. The remainder of the board is mounted by electrically conductive standoffs which keep the component leads from becoming grounded. The standoffs also provide a path to ground for the PC board.

Transistors Q901 through Q904 may be removed by first removing each transistor's two mounting screws. The transistor's flanges may now be unsoldered and the transistor can be removed.

NOTE: When reinstalling Q901 through Q904, make sure there is adequate heat sink compound on the mounting base of the transistor. This can be done by applying heat sink compound to the transistor's mounting base and installing the transistor using the two mounting holes. DO NOT SOLDER AT THIS TIME. Remove the transistor and inspect the "footprint" on the heat sink. Look for any air pockets and be sure there are no bare spots. Do the same for the transistor's mounting base.

NOTE: Power amplifier transistors Q901 through Q904 must be of the same type and manufacturer.

4.7.2 POWER AMPLIFIER PC BOARD REMOVAL

The power amplifier PC board can be removed by first removing the PA cover.

1. Unscrew the six screws holding the cover in place and remove the cover.
2. Unsolder the coaxial input and output lines along with the DC input line on C976.
3. Remove the eight mounting screws attaching Q901 through Q904.
4. Remove the three screws holding the PC board in place and remove the board.

NOTE: When reinstalling the PC board, make sure there is adequate heat sink compound on the transistor bases and that the insulator between the PC board and heat sink is in place. Also, make sure that no component leads touch the heat sink.

4.7.3 CIRCUIT PROTECTION

If a transistor is shorted in the power amplifier, the 25A fuse in the power cable will open. The fuse provides short circuit protection for the power amplifier and must not be defeated since severe component or microstrip damage could result.

4.7.4 TESTING Q901

1. Confirm the Exciter is putting out approximately 17W RF.

2. Measure the DC voltage on the collector of Q901 with the transmitter unkeyed. (Typically 15.7V DC)

3. Unsolder the supply side of L901.

4. Connect a DC ammeter between L901 and the removal point.

5. The DC current should be about 3-3.5A with 100W RF output.

4.7.5 TESTING Q902, Q903 AND Q904

Any one or a combination of the following may be used to check Q902, Q903 and Q904. Be sure the Exciter is delivering approximately 17W to the PA.

WARNING

DO NOT TOUCH POWER AMPLIFIER COMPONENTS WHILE TRANSMITTING BECAUSE RF BURNS MAY RESULT.

1. Temperature Method

a. Key the transmitter for a short time to allow the transistors to heat.

b. Unkey the transmitter and briefly touch the transistor cases.

c. If one is cold it probably is not conducting and may be defective.

4. Power Change Method

a. Key the transmitter.

b. Briefly short the suspected transistor's base and emitter with the blade of a screwdriver.

c. If the power output drops significantly, the transistor is probably operating properly.

d. If the power output does not drop, the transistor is probably bad and must be replaced.

5. Isolation Method

a. Unsolder the final's base legs and their associated equalizing resistors.

b. Temporarily reconnect each transistor's base individually.

c. Each transistor should have about 33W RF output power.

4.8 LEVEL ADJUST, CONTROL AND CALL GUARD SQUELCH CARDS

4.8.1 GENERAL

To isolate a problem to a specific stage on one of these cards, refer to the card rack block diagram (see Figure 7-2) and the appropriate schematic diagram. Determine the signal path from the block diagram and then measure the DC and AC voltages as shown on the schematic.

4.8.2 CONTROL CARD NOR GATE (U602) OPERATION

On the Control card, U602 contains two, 4-input NOR gates. The output from both U602A and U602B is high only when all the inputs are low. When one or more of the inputs on each NOR gate is high, its output is low.

The transmitter is keyed if all four inputs at U602A are low. This means that the squelch, time-out timer, Call Guard squelch (if used), and the repeater disable signals must be low to key the transmitter.

The inputs to U602B must all be low to key the transmitter. This puts a high on the output and turns on Q606. To unkey the transmitter, the input to U602B goes high. This produces a low on the output of U602B and Q606 turns off.

4.9 CHECKING RECEIVE DESENSITIZATION

4.9.1 INTRODUCTION

Receiver desensitization is the loss of receiver sensitivity caused by high level off-frequency signals that are applied to the receiver. Some possible causes of desensitization are improperly tuned combining equipment or a transmitter generating excessive spurious radiation. The following test measures desensitization and helps locate its source.

4.9.2 CAPACITIVE COUPLER

A capacitive coupler can be used to connect a signal generator to the antenna cable. This coupler should provide 50-60 dB of isolation to adequately protect the generator from high-level RF present on the cable.

Use a coupler such as a Bird Model 4275 or fabricate one from a coaxial "T" connector. To do this, remove the pin from one of the side terminals of the connector and shorten it until the required isolation is obtained.

4.9.3 TEST PROCEDURE

1. Connect the test setup shown in Figure 4-2. The coupler should be inserted in the cable between the receive antenna and repeater or combining equipment.

2. Switch the REPEAT switch to "OFF".

3. Set the signal generator to the receive channel frequency with an unmodulated output.

4. Connect the generator and the antenna to the capacitive coupler. The repeater transmitter should be unkeyed.

5. Set the unmodulated generator output to obtain 15 dB of quieting.

6. Switch the REPEAT switch to "ON".

7. Less than 2 dB quieting degradation should result.

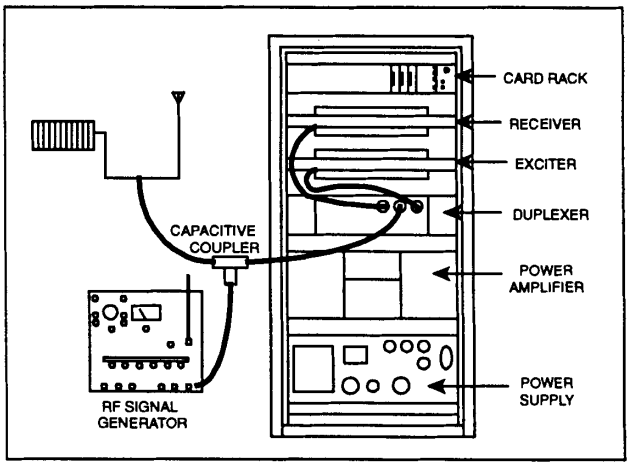


Figure 4-2 RECEIVER DESENSE TEST SET-UP

4.9.4 LOCALIZING CAUSE OF DESENSITIZATION

ANTENNA

Substitute a 50 ohm dummy load for the transmit antenna and repeat the test. If the result is normal, the antenna or feedline may be defective.

DUPLEXER OR COMBINING EQUIPMENT

Connect the signal generator to the receiver antenna jack and connect a 50 ohm dummy load to the RF output jack of the transmitter. Repeat the test and if the result is normal, the duplexer or combining equipment may be improperly tuned or defective.

TRANSMITTER

If the preceding test still resulted in abnormal desensitization, the transmitter may be emitting excessive spurious radiation.

4.10 DETERMINING EFFECTIVE SENSITIVITY

If the repeater is operating in a congested area where many high-level RF signals are present, the effective sensitivity may be less than that obtained using the standard bench check procedure. To determine the effective sensitivity of the repeater, perform the following test.

1. Check the quieting sensitivity of the receiver using the standard bench check procedure detailed in the "Performance Tests" in Section 5.4. Perform the test with the antenna combining equipment (if used) and record the results.

2. Connect the test setup shown in Figure 4-2 using the capacitive coupler as described in Sections 4.9.2 and 4.9.3. Check the sensitivity using a 50 ohm dummy load connected to the capacitive coupler and record the results (transmitter may be keyed or unkeyed).

3. Connect the antenna to the coupler and check the sensitivity with no on-channel signal present. Record the results.

4. Determine the effective sensitivity using the following formula:

   Eff. Sens. = Bench X (Antenna ÷ 50Ω load)

EXAMPLE:

Bench Check Sensitivity = 0.4 µV (20 dB Quieting)
Sensitivity with 50Ω load = 400 µV (20 dB Quieting)
Antenna Sensitivity = 4000 µV (20 dB Quieting)
Effective Sensitivity = 0.4 X (4000 ÷ 400)

Effective Sensitivity = 4 µV

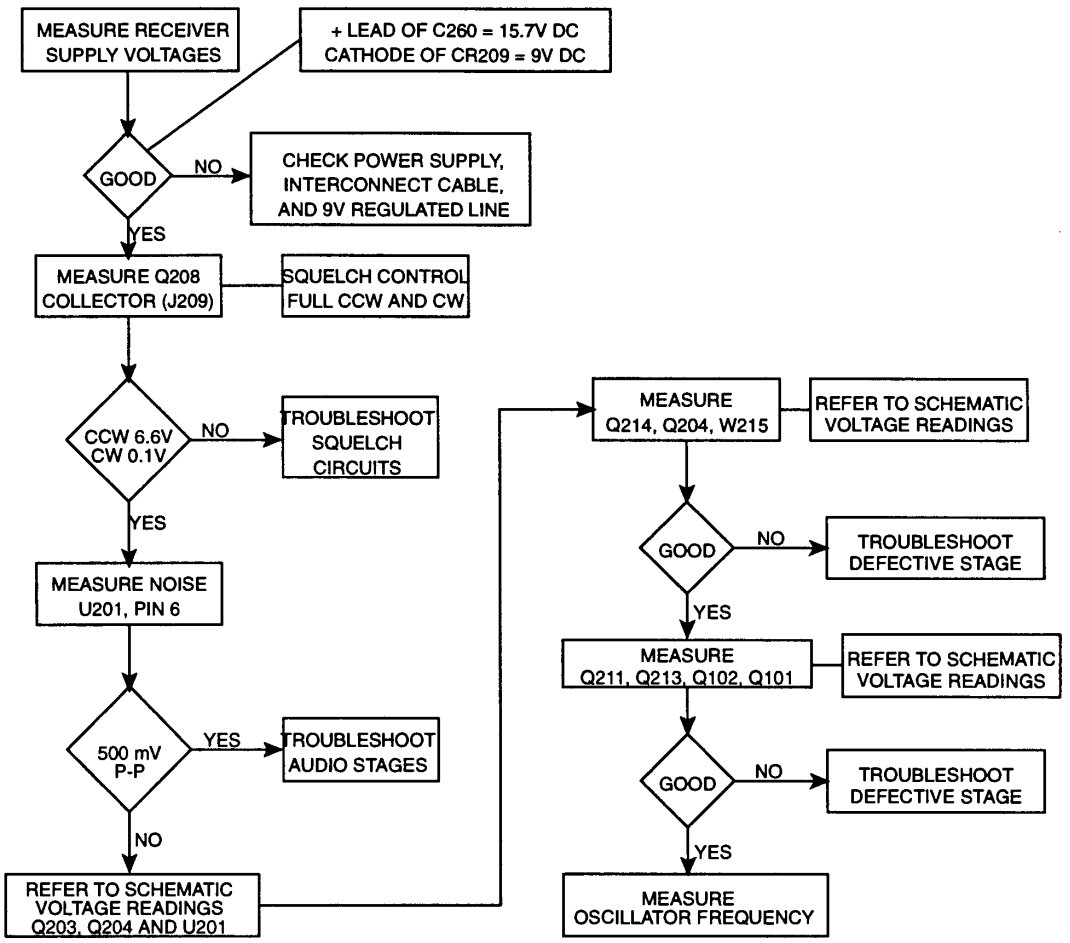


Figure 4-3 RECEIVER TROUBLESHOOTING FLOWCHART

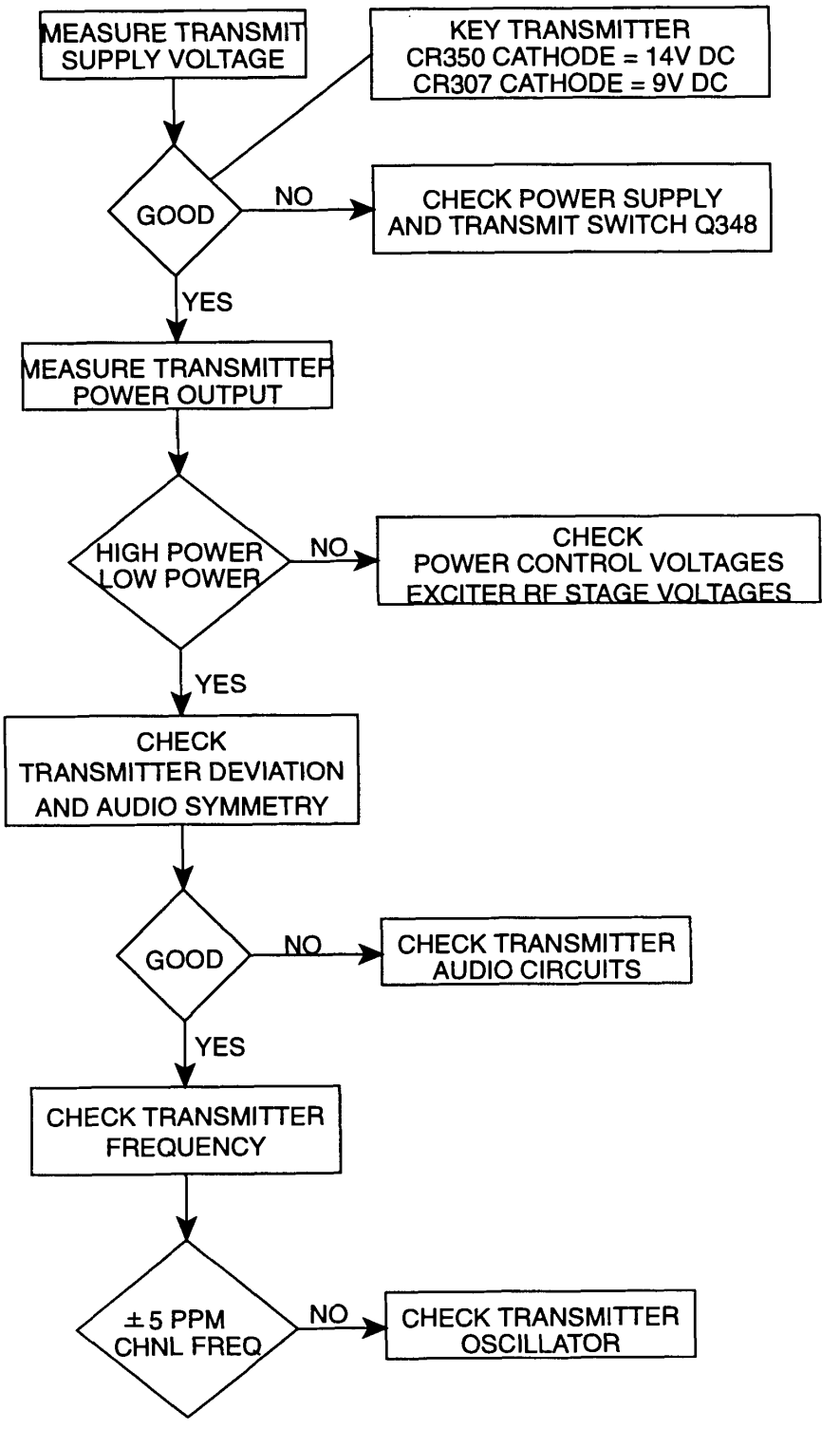


Figure 4-4 TRANSMITTER TROUBLESHOOTING FLOWCHART

SECTION 5 ALIGNMENT AND PERFORMANCE TESTS

5.1 GENERAL

A test panel is located on the card rack to provide a convenient location for measuring test point voltages during alignment. Plug a high impedance voltmeter into the jacks provided and select the desired test point with the selector knob as shown in Table 5-1.

Table 5-1 TEST PANEL SWITCH POSITIONS

Position	Test Points
1	TP204 Receiver osc/triple TP302 Transmit 2nd doubler
2	TP301 Transmit 1st doubler
3	TP203 Receiver IF TP302 Transmit 1st RF amp
4	TP205 Receiver injection amp
5	J308 13.8V DC
6	J304 15.7V DC (RX) 13.7V DC (TX)

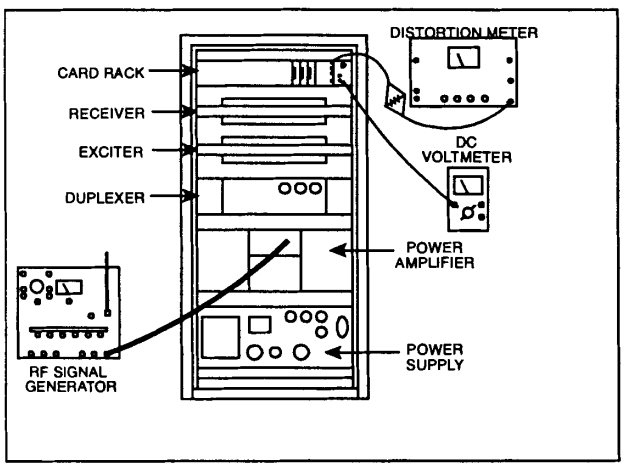


Figure 5-1 RECEIVER TEST SETUP

5.2 RECEIVER ALIGNMENT

1. Loosen the two screws holding the receiver and its mounting bracket in place.

2. Pull the assembly toward you and remove the top cover.

3. Set the Control card access switch to OPEN and the REPEAT switch to OFF.

4. Connect the test equipment as shown in Figure 5-1.

5.2.1 FIRST OSCILLATOR/TRIPLER, INJECTION AMPLIFIER

1. Set the test panel switch to position 1 (TP204).

2. Adjust T208, T209 and T210 for a maximum voltage.

3. Set the test panel switch to position 4 (TP205).

4. Adjust C108 and C109 for maximum voltage.

5. Repeat the preceding steps.

5.2.2 FIRST OSCILLATOR FREQUENCY ADJUSTMENT

1. Place a frequency monitor pickup loop near T210 and monitor the oscillator frequency.

2. Adjust C269 to the channel frequency minus 10.7 MHz.

NOTE: The value of C217 can be changed to set the oscillator frequency to within the tuning range of C269 (see Table 5-2).

Table 5-2 C271 VALUES

Description	Part Number
27 pF ±5% N220	510-3017-270
33 pF ±5% N220	510-3017-330
39 pF ±5% N220	510-3017-390

5.2.3 FRONT END AND IF AMPLIFIERS

1. Connect a signal generator set to the channel frequency, modulated with a 1 kHz tone at ±5 kHz deviation to the antenna jack.

2. Set the test panel switch to position 3 (TP203).

3. Adjust C101 through C105, L106, T211, L204, L205 and T201 through T204 for maximum voltage while decreasing the generator output.

4. Retune C101 - C105 for maximum quieting.

5. Retune T211, T201, T203 and T204 for best SINAD.

NOTE: DO NOT retune L204 and L205.

5.2.4 DISCRIMINATOR

1. Connect an AC VTVM across a 3 ohm dummy load plugged into the external speaker jack on the card rack or connect an AC VTVM to the audio output jacks.

2. Adjust T205 for a maximum meter indication (signal generator output on channel, modulated with 1 kHz tone at ±5 kHz deviation).

5.3 TRANSMITTER ALIGNMENT

1. Loosen the two screws holding the transmitter and its mounting bracket in place.

2. Place the assembly toward you and remove the top cover.

3. Connect the test equipment as shown in Figure 5-2.

5.3.1 OSCILLATOR-DOUBLER, MULTIPLIERS

1. Disconnect the Exciter coax from the PA input and connect a wattmeter with a 25W VHF element and terminate with a 50 ohm dummy load.

2. Set the test panel switch to position 2 (TP301).

3. Key the transmitter and tune L320 and L345 for maximum voltage.

4. Set the test switch to position 1 (TP302).

5. Key the transmitter and tune T346 and L347 for a maximum voltage reading.

6. Set the test switch to position 3 (TP303).

7. Key the transmitter and tune T348 and L349 for a maximum voltage reading.

8. Tune L351 for maximum power output (typically 17W).

9. Place the frequency monitor's pickup loop near the load and put the transmitter on frequency by adjusting C325.

NOTE: C327 is a factory selected component and can be replaced to bring the frequency within range of C325 (see Table 5-3).

Table 5-3 C325 VALUES

Description	Part Number
22 pF ±5% 100V 1DM15	510-0001-220
27 pF ±5% 100V 1DM15	510-0001-270
33 pF ±5% 100V 1DM15	510-0001-330
39 pF ±5% 100V 1DM15	510-0001-390
43 pF ±5% 100V 1DM15	510-0001-430
47 pF ±5% 100V 1DM15	510-0001-470
56 pF ±5% 100V 1DM15	510-0001-560
68 pF ±5% 100V 1DM15	510-0001-680

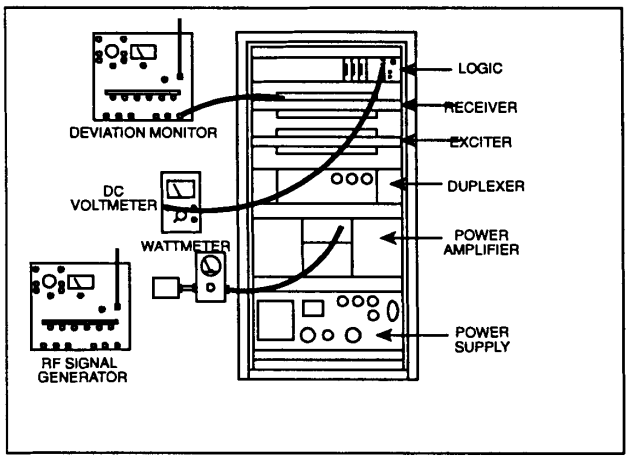


Figure 5-2 TRANSMIT TEST SETUP

5.3.2 SECOND RF AMPLIFIER

1. Turn off the transmitter, disconnect the wattmeter and connect the Exciter output to the power amplifier input.

2. Connect the wattmeter with a 250W VHF range to the power amplifier output. DO NOT use the duplexer.

3. Power Switch-Over Option NOT Used

a. Preset R412 and R420 on the power control board fully counterclockwise.

b. Adjust R420 for 100W output power. DO NOT re-adjust R412.

3. Power Switch-Over Option is used.

a. Preset R412 and R420 on the power control board fully counterclockwise.

b. Apply 9V DC to the junction of C420 and R426 by soldering a jumper wire from that junction to the cathode of CR401.

c. Adjust R412 for 25W output power.

d. Remove the jumper wire and adjust R420 for 100W output power. DO NOT re-adjust R412.

5.3.3 PRELIMINARY DEVIATION ADJUSTMENT

1. On the Control card, set the REPEAT switch to ON and the ACCESS switch to OPEN.

2. On the Level Adjust card, set XMIT AUDIO LEVEL control R714 to maximum (fully clockwise).

3. Set CALL GUARD LEVEL control R705 to minimum (fully counterclockwise).

4. Set SQUELCH ADJUST control R717 fully counterclockwise. The squelch should open and the transmitter should key up.

5. Set LOCAL AUDIO control R710 for background noise, then re-adjust R717 for threshold squelch. The transmitter should unkey.

5.3.4 TRANSMIT DEVIATION

1. Connect an RF signal generator to the receiver antenna jack.

2. Set the generator for a 100 µV output on the receiver channel frequency modulated with a 1 kHz tone at ±5 kHz deviation.

3. Monitor the transmitter output with a deviation meter and adjust deviation control R324 on the Exciter TCXO for ±5 kHz transmit deviation.

4. Reset the signal generator deviation level to ±4 kHz.

5. Adjust XMIT AUDIO LEVEL R714 on the Level Adjust card for ±4 kHz transmit deviation.

5.3.5 CALL GUARD DEVIATION

1. Connect an RF signal generator to the receiver antenna jack.

2. Set the generator for 100 µV output on the receive channel frequency modulated with 150 Hz audio at ±600 Hz deviation.

3. Monitor the transmitter output with a deviation meter and adjust Call Guard level control R705 on the Level Adjust card for ±600 Hz transmit deviation.

4. Turn off the signal generator modulation.

5. Remove the Level Adjust card and reinsert with an extender card.

6. Turn the ENCODE switch on the Call Guard card to any encode position with a Call Guard frequency of 60-250 Hz.

7. Monitor the transmitter output and adjust R700 on the Level Card for ±600 Hz.

5.3.6 CALL GUARD TONE FREQUENCY ADJUSTMENT

Refer to Figure 5-3 for Call Guard card alignment locations.

1. Remove the Call Guard card from the card rack and reinsert with an extender card.

2. Cut the frequency range jumpers as shown in Table 5-4.

3. Check that the Call Guard switch on the PC board for each active Call Guard circuit is ON.

4. Refer to Figure 5-3 for the ENCODE switch position, the frequency test point and the frequency adjustment pot for each of the four Call Guard circuits.

5. Use one of the following procedures to set the frequency to the required ±0.5% tolerance.

Method 1

Connect a period counter to the proper test point and set it for the proper period count.

Period = 1 ÷ Frequency in Hz.

Method 2

Compare the Call Guard frequency at the test point to a preset frequency from an audio generator by using a Lissajous pattern. A digitally set generator is preferred over an analog generator because it can be more accurately set on frequency. Connect the vertical input of an oscilloscope to the test point and the horizontal input to the audio generator. With the audio generator set to the Call Guard frequency, adjust the proper frequency adjust pot to stop the rotation of the circular Lissajous figure. Distortion of the circular pattern is caused by differences in amplitude and not frequency.

6. Return the ENCODE switches to the OFF position. The switches on the PC board should be in the ON position unless that particular Call Guard is not being used.

Table 5-4 CALL GUARD RANGE JUMPERS

Frequency Range	JA	JB	JC	JD
65-73 Hz	OUT	OUT	OUT	OUT
73-90 Hz	OUT	OUT	IN	OUT
90-125 Hz	OUT	IN	OUT	OUT
125-187 Hz	OUT	IN	IN	OUT
187-251 Hz	IN	IN	IN	IN

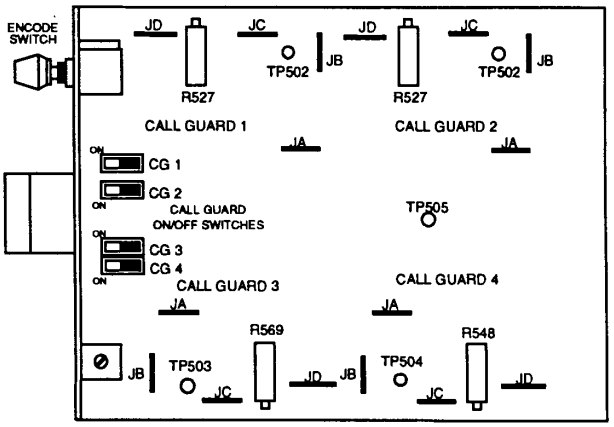


Figure 5-3 CALL GUARD CARD ALIGNMENT POINTS

5.4 RECEIVER PERFORMANCE TEST

Set the repeat switch to "off" and the access switch to "open" on the Control card. Connect an RF signal generator and set the receive channel frequency (no output) to the receiver subassembly antenna jack.

5.4.1 QUIETING SENSITIVITY

1. Connect an AC VTVM across a 3 ohm dummy load plugged into the external speaker jack or to the audio output jacks on the card rack panel.

2. Set the squelch adjust control on the Level Adjust card fully counterclockwise.

3. Set the local audio control for 0 dB indication on the AC VTVM.

4. Increase the RF signal generator output (unmodulated) to 0.5 µV. The AC VTVM indication should drop 20 dB or more.

5.4.2 SINAD SENSITIVITY

1. Connect a distortion meter across a 3 ohm dummy load or to the audio output jacks.

2. Set the RF signal generator for an output of 0.35 µV on the receiver channel frequency, modulated with 1 kHz tone at ±3 kHz deviation.

3. Adjust the local audio control for an output level of 0.77V RMS (200 mW).

4. Adjust distortion meter for a 0 dB reference and null out the 1 kHz signal (should occur at least 12 dB below the reference reading).

$$(S + N + D) \div (N + D) = \geq 12 \text{ dB}$$

S = Signal
N = Noise
D = Distortion

5.4.3 SQUELCH SENSITIVITY

1. With no signal input, adjust the SQUELCH ADJ control on the Level Adjust card for threshold squelch (just quieted).

2. Set the signal generator to the receive channel frequency, modulated with 1 kHz tone at ±3 kHz deviation.

3. Increase the signal generator output until the squelch opens which should open ≤ 0.25 µV.

5.4.4 CALL GUARD SQUELCH

1. Set the squelch adjust control on the Level Adjust card for threshold squelch and the access switch to "tone".

2. Set the RF signal generator on the receiver channel frequency modulated with the Call Guard tone (67-250 Hz) at ±600 Hz deviation.

3. Increase the generator output to 0.5 µV and the squelch should open.

4. Repeat this procedure for each of the Call Guard tones.

5.5 TRANSMIT PERFORMANCE TEST

Set the repeat switch to "off" and the access switch to "open" on the Control card. The encode switch on the Call Guard card should be "off".

5.5.1 TRANSMIT FREQUENCY

1. Set the communications monitor to the transmitter frequency and key the transmitter.

2. The transmitter frequency should be within ±5 PPM (±0.0005%).

5.5.2 TRANSMIT POWER OUTPUT

Key the transmitter. Power output should be 100W (without duplexer) after one minute of continuous transmission.

NOTE: If the optional duplexer is used, there is normally up to 1 dB power loss or up to 30W with an input of 100W, not including any power reflected from the duplexer input.

5.5.3 TRANSMIT DEVIATION

1. Set the repeat switch to "on" and the squelch adjust control for threshold squelch.

2. Set an RF signal generator to the receive channel frequency modulated with a 1 kHz tone at ±5 kHz deviation at an output level of 100 µV.

3. Connect the signal generator to the receiver subassembly antenna jack.

4. Monitor the transmitter deviation meter. Deviation should be ±4.5 - 5 kHz.

5. Decrease the signal generator to ±4 kHz and the transmitter deviation should drop to ±4 kHz. To reset deviation see Section 5.3.4.

5.5.4 CALL GUARD SQUELCH

1. Set the encode switch on the Call Guard card to position 1, 2, 3 or 4 and key the transmitter.

2. Deviation should be ±600 Hz on the Call Guard frequency. Refer to Section 5.3.6.

3. Repeat for each Call Guard tone.

4. System deviation with Call Guard deviation should be ±4.5 kHz, ±500 Hz.

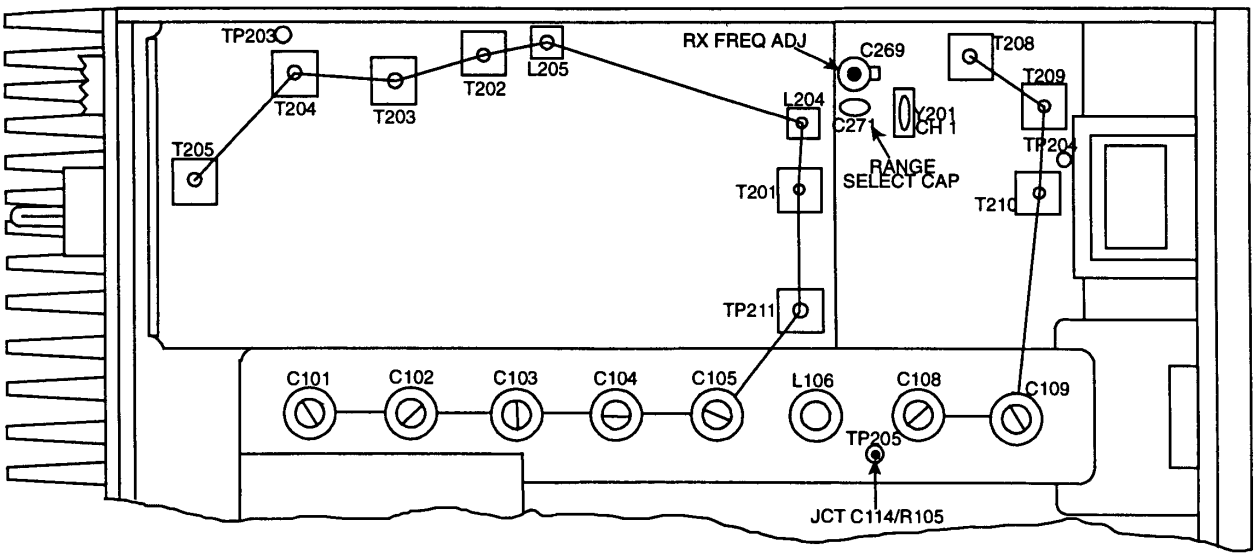


Figure 5-4 RECEIVER ALIGNMENT POINTS

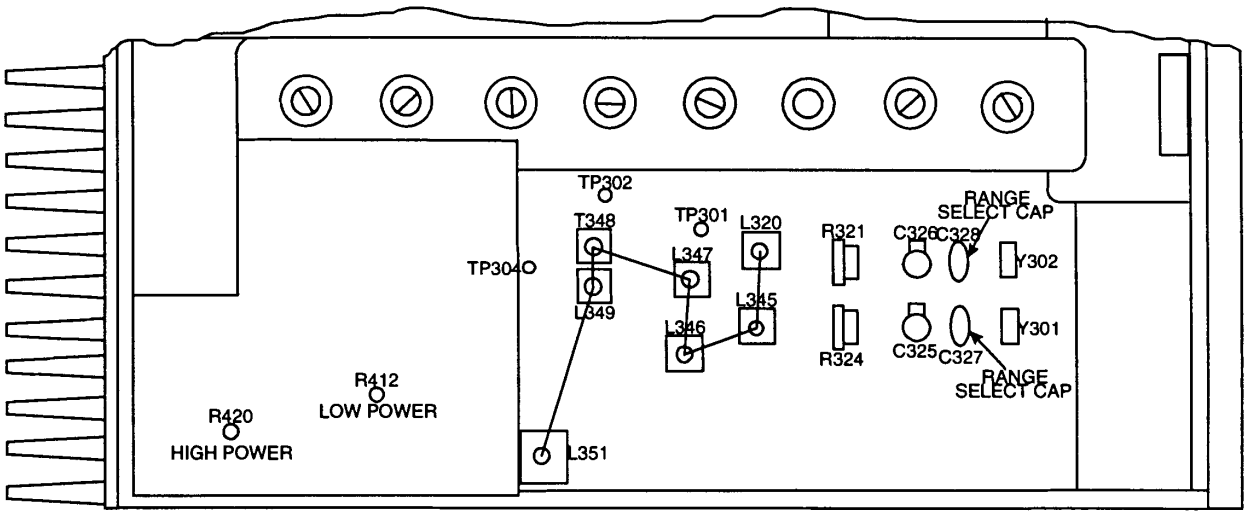


Figure 5-5 TRANSMITTER ALIGNMENT POINTS

SECTION 6 PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	1100 REPEATER 150-160 MHz PART NO. 242-1100-231	
A 000	25A power supply 110V 60Hz	023-3341-012
A 000	Card rack assembly	023-3823-020
A 000	Test card	023-3823-022
A 000	Control card assembly	023-3823-030
A 000	Level adjust card assembly	023-3823-040
A 000	Receiver 150-174 MHz assem	023-4111-101
A 000	Exciter 150-160 MHz assem	023-4111-210
A 000	PA 150-160 MHz assembly	023-4111-260
C 977	100 pF ±5% 50V N750 disc	510-3020-101
CH000	Cover	017-1626-030
CH000	43" repeater cabinet assembly	023-3824-001
HW000	#10 U-type ZPS speed nut	560-1810-002
HW000	1/4-20 HH flange ZPS screw	575-1914-012
HW000	1/4-20 HH flange ZPS screw	575-1914-016
HW000	#10 TF pan head philips CPS	575-3610-032
HW000	Backing plate	013-1479-001
NP000	FCC name plate	559-0009-179
NP000	VHF repeater 1100 label	559-0009-195
NP000	VHF 1100 repeater label	559-0009-196
NP000	Exciter label	559-3056-001
W 000	Harness	023-3823-070
W 000	RG-400 3 ft N-PL-259	597-3004-001
Y 000	Crystal comp	023-4245-001
Y 000	Crystal comp kit	023-4246-001
Y 000	Transmit crystal	521-0000-000
Y 000	Receive crystal	521-6000-000
	1100 REPEATER 160-174 MHz PART NO. 242-1100-241	
A 000	25A power supply 110V 60Hz	023-3341-012
A 000	Card rack assembly	023-3823-020
A 000	Test card	023-3823-022
A 000	Control card assembly	023-3823-030
A 000	Level adjust card assembly	023-3823-040
A 000	Receiver 160-174 MHz assem	023-4111-101
A 000	Exciter 160-174 MHz assem	023-4111-310
A 000	PA 160-174 MHz assembly	023-4111-360
C 977	100 pF ±5% 50V N750 disc	510-3020-101
CH000	Cover	017-1626-030
CH000	43" repeater cabinet assembly	023-3824-001
HW000	#10 U-type ZPS speed nut	560-1810-002
HW000	1/4-20 HH flange ZPS screw	575-1914-012
HW000	1/4-20 HH flange ZPS screw	575-1914-016
HW000	#10 TF pan head philips CPS	575-3610-032
HW000	Backing plate	013-1479-001
NP000	FCC name plate	559-0009-179
NP000	VHF repeater 1100 label	559-0009-195
NP000	VHF 1100 repeater label	559-0009-196
NP000	Exciter label	559-3056-001
W 000	Harness	023-3823-070
W 000	RG-400 3 ft N-PL-259	597-3004-001
Y 000	Crystal comp	023-4245-001
Y 000	Crystal comp kit	023-4246-001
Y 000	Transmit crystal	521-0000-000
Y 000	Receive crystal	521-6000-000
	RECEIVER 150-174 MHz PART NO. 023-4111-101	
A 100	Front end assembly	023-4091-001
A 200	Receiver board assembly	023-3706-021
A 201	Receiver harness assembly	023-3823-002
BK101	Bracket (front end)	017-1641-001
C 001	33 pF ±5% 50V NPO disc	510-3013-330
C 002	33 pF ±5% 50V NPO disc	510-3013-330
C 106	15 pF ±5% 50V N150 disc	510-3016-150
C 107	5.1 pF ±5% 50V N150 disc	510-3216-519
C 110	1000 pF 500V feedthrough	510-3151-102
C 111	1000 pF ±20% 50V Y5U disc	510-3002-102
C 112	1000 pF ±20% 50V Y5U disc	510-3002-102

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 113	10 pF ±5% 100V 1DM10	510-0202-100
C 114	1000 pF ±20% 50V Y5U disc	510-3202-102
C 200	47 µF 10V radial aluminum	510-4110-470
C 201	8.2 pF ±5% 50V NPO disc	510-3213-829
C 202	11 pF ±5% 50V NPO disc	510-3213-110
C 203	.01 µF ±20% 16V Y5S disc	510-3210-103
C 204	27 pF ±5% 100V 1DM10	510-0202-270
C 206	68 pF ±5% 100V 1DM10	510-0202-680
C 207	39 pF ±5% 100V 1DM10	510-0202-390
C 208	.1 µF ±20% 16V Y5S disc	510-3210-104
C 209	3 pF ±5% 500V comp	510-9502-309
C 211	.22 µF 3V Y5T disc	510-3209-224
C 212	.22 µF ±10% 35V molded tant	510-2033-228
C 213	.1 µF ±20% 16V Y5S disc	510-3210-104
C 214	1500 pF ±5% 500V 4DM20	510-0208-152
C 215	.01 µF ±20% 16V Y5S disc	510-3210-103
C 216	.22 µF 3V Y5T disc	510-3209-224
C 217	.1 µF ±20% 16V Y5S disc	510-3210-104
C 218	1500 pF ±5% 500V 4DM20	510-0208-152
C 219	15 pF ±5% 100V 1DM10	510-0202-150
C 220	15 pF ±5% 100V 1DM10	510-0202-150
C 221	.01 µF ±20% 16V Y5S disc	510-3210-103
C 222	.22 µF 3V Y5T disc	510-3209-224
C 223	.1 µF ±20% 16V Y5S disc	510-3210-104
C 224	1500 pF ±5% 500V 4DM20	510-0208-152
C 225	100 pF ±20% 50V Y5U disc	510-3202-101
C 226	.01 µF ±20% 16V Y5S disc	510-3210-103
C 227	.1 µF ±20% 16V Y5S disc	510-3210-104
C 228	.1 µF 10V Y5U comp disc	510-3208-104
C 229	22 pF ±5% 100V 1DM10	510-0202-220
C 230	4700 pF ±20% 50V Y5U disc	510-3202-472
C 231	.1 µF 10V Y5U comp disc	510-3208-104
C 232	10 pF ±5% 100V 1DM15 prep	510-0201-100
C 233	.1 µF ±20% 16V Y5S disc	510-3210-104
C 234	.1 µF 10V Y5U comp disc	510-3208-104
C 235	.047 µF ±10% 35V submin	510-2575-477
C 236	1000 pF ±20% 50V Y5U disc	510-3204-102
C 237	.01 µF ±20% 16V Y5S disc	510-3210-103
C 238	100 pF ±5% 100V 1DM15 prep	510-0201-102
C 239	1500 pF ±5% NPO axial multi	510-3541-152
C 240	220 µF 16V aluminum	510-4006-004
C 241	100 pF ±5% 100V 1DM15 prep	510-0201-102
C 242	100 pF ±5% 100V 1DM15 prep	510-0201-102
C 243	1 µF ±10% 35V submin	510-2575-109
C 244	1 µF ±10% 35V submin	510-2575-109
C 245	5.6 µF ±20% 15V molded	510-2023-569
C 246	1 µF ±10% 35V submin	510-2575-109
C 247	680 pF 50V X5F ceramic	510-3262-681
C 248	6.8 µF ±20% 35V dip prep	510-2245-689
C 249	.1 µF 10V Y5U comp disc	510-3208-104
C 250	1 µF ±10% 35V submin	510-2575-109
C 251	.1 µF ±20% 16V Y5S disc	510-3210-104
C 252	.01 µF ±10% 250V flat foil	510-1203-103
C 253	.01 µF ±10% 250V flat foil	510-1203-103
C 254	.01 µF ±10% 250V flat foil	510-1203-103
C 255	.01 µF ±20% 16V Y5S disc	510-3210-103
C 256	5.6 µF ±20% 15V molded	510-2023-569
C 257	470 µF 16V aluminum	510-4116-471
C 258	.1 µF ±20% 16V Y5S disc	510-3210-104
C 259	2200 pF ±20% 50V Y5U disc	510-3202-222
C 260	1000 µF 16V aluminum	510-4006-005
C 261	.01 µF ±20% 16V Y5S disc	510-3210-103
C 262	47 pF ±5% 50V N750 disc	510-3220-470
C 263	130 pF ±5% 50V NPO disc	510-3213-131
C 264	270 pF ±5% 50V N750 disc	510-3220-271
C 265	.01 µF ±20% 16V Y5S disc	510-3210-103
C 266	.1 µF ±20% 16V Y5S disc	510-3210-104
C 269	1.9-15.7 pF vertical PC mt	187-0109-005
C 270	1.9-15.7 pF vertical PC mt	187-0109-005
C 271	39 pF ±5% 50V N330 disc	510-3218-390
C 272	39 pF ±5% 50V N330 disc	510-3218-390
C 273	91 pF ±5% 100V 1DM10	510-0202-910
C 274	300 pF ±5% 100V 1DM10	510-0202-301
C 275	91 pF ±5% 100V 1DM10	510-0202-910
C 276	300 pF ±5% 100V 1DM10	510-0202-301
C 277	100 pF ±5% 50V N150 disc	510-3216-101
C 278	3 pF ±5% 500V composition	510-9502-309
C 279	.01 µF ±20% 16V Y5S disc	510-3210-103
C 280	91 pF ±5% 50V N150 disc	510-3216-910
C 281	1000 pF ±20% 50V Y5U disc	510-3204-102
C 282	82 pF ±5% 100V 1DM15 prep	510-0201-820
C 283	.01 µF ±20% 16V Y5S disc	510-3210-103
C 284	1.8 pF ±5% 50V NPO disc	510-3213-189
C 285	.01 µF ±20% 16V Y5S disc	510-3210-103
C 286	3 pF ±5% 500V composition	510-9502-309
C 287	10 pF ±20% 50V Y5U disc	510-3202-100
C 288	1000 pF ±20% 50V Y5U disc	510-3204-102
C 289	3.3 µF ±10% 15V submin	510-2073-339
C 290	3.3 µF ±10% 15V submin	510-2073-339
C 295	.01 µF ±20% 16V Y5S disc	510-3210-103
C 296	.1 µF ±10% Y5R 50V submin	510-3109-104
C 297	.1 µF ±10% Y5R 50V submin	510-3109-104
C 298	.1 µF ±10% Y5R 50V submin	510-3109-104
C 299	.1 µF ±10% Y5R 50V submin	510-3109-104

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CH001	Casting	015-0805-503
CH002	Connector mounting plate	017-1666-003
CH202	Front cover casting	017-1703-011
CR101	Ge diode 1N67A	523-1500-067
CR201	Ge diode 1N67A	523-1500-067
CR203	Ge diode 1N67A	523-1500-067
CR204	Ge diode 1N67A	523-1500-067
CR205	Ge diode 1N67A	523-1500-067
CR206	Ge diode 1N67A	523-1500-067
CR207	Ge diode 1N67A	523-1500-067
CR208	Ge diode 1N67A	523-1500-067
CR209	9.1V ±5% 1W zener	523-2503-919
CR212	Ge diode 1N67A	523-1500-067
EP001	Helical tuning cup	013-1393-001
EP010	Male contact	016-1932-002
EP030	Insulated pad adhesive backed	574-5005-110
EP100	Black ext plastic tubing	042-0240-770
EP101	Helical coil form	013-1302-001
EP102	Helical coil form	013-1302-001
EP103	Helical coil form	013-1302-001
EP104	Helical coil form	013-1302-001
EP105	Helical coil form	013-1302-001
EP106	Helical coil form	013-1302-001
EP107	Helical coil form	013-1302-001
EP108	Standoff terminal red	260-0002-001
EP112	Standoff terminal white	260-0001-001
EP202	Crystal pin insulator long slot	018-1080-002
EP209	Compression washer 77 CS	574-5008-001
EP210	Compression washer 77 CS	574-5008-001
EP213	0.138 x 0.070 ferrite bead	517-2002-004
EP405	Ferrite bead .14 x .13	517-2002-001
HW002	6-32 panhead taptite 1/4"	575-0606-008
HW004	6-32 x .078 NPB nut	560-2106-008
HW005	Lockwasher int 6 x .018 NPB	596-2106-009
HW006	4-40 panhead philips screw	575-0604-010
HW007	4-40 x .375 panhead phil TT	575-0604-012
HW019	Shoulder screw	013-1350-002
HW021	6-32 panhead philips ZPS	575-1606-012
HW024	5/8-24 x .094 hex nut SPB	560-9078-028
HW028	Tension lock nut CPS	560-1810-022
HW030	6-32 panhead philips ZPS	575-1606-008
HW101	6-32 panhead slot nylon screw	575-4506-008
HW200	Teflon flat washer	596-9400-004

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
J 200	Male conntr housing w/insert	117-0336-103
J 201	Solderless pin	586-3502-002
J 202	Solderless pin	586-3502-002
J 203	Solderless pin	586-3502-002
J 209	Solderless pin	586-3502-002
J 210	Solderless pin	586-3502-002
J 211	Solderless pin	586-3502-002
J 212	Solderless pin	586-3502-002
J 213	Solderless pin	586-3502-002
J 214	Solderless pin	586-3502-002
J 215	Solderless pin	586-3502-002
J 402	Solderless pin	586-3502-002
J 250	Female coax UHF TBO	142-0102-004
L 101	Helical inductor	016-1929-001
L 102	Helical inductor	016-1929-001
L 103	Helical inductor	016-1929-001
L 104	Helical inductor	016-1929-001
L 105	Helical inductor	016-1929-001
L 106	0.115-0.14 µH variable induct	542-1007-002
L 107	Helical inductor	016-1929-002
L 108	Helical inductor	016-1929-003
L 202	1 µH ±10% choke	542-3502-001
L 204	5-8.6 µH variable inductor	542-1012-001
L 205	5-8.6 µH variable inductor	542-1012-001
L 209	50 µH ±5% choke	542-3502-003
L 211	6.8 µH ±10% RF choke	542-3504-689
L 212	20 µH ±5% choke	542-3502-002
L 213	20 µH ±5% choke	542-3502-002
L 206	20 µH 150 mA filter choke	542-5007-001
MP101	Crystal clip	032-0589-001
MP113	Front end shield	017-2097-001
MP201	Connector shield	013-1198-001
MP201	IF shield	017-2013-001
NP001	Receiver label 150-174 MHz	559-9001-236
Q 101	J-FET low noise RF TO-92	576-0006-009
Q 102	Si NPN 1 GHz amp TO-72	576-0003-029
Q 202	Si NPN FM osc/mul TO-92	576-0003-002
Q 203	NPN gen purp	576-0003-058
Q 204	NPN gen purp	576-0003-058
Q 206	NPN gen purp	576-0003-058
Q 207	Si NPN audio driverMPS-U01	576-0002-027
Q 208	NPN gen purp	576-0003-058

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 209	NPN 65W 6A TO-220	576-0002-046
Q 210	NPN 65W 6A TO-220	576-0002-046
Q 212	Si NPN VHF/UHF amp/osc	576-0003-051
Q 213	Si NPN FM osc/mul TO-92	576-0003-002
Q 214	Si NPN FM osc/mul TO-92	576-0003-002
Q 215	Si NPN FM osc/mul TO-92	576-0003-002
R 101	2.7k ohm ±5% 1/4W CF	569-0513-272
R 102	470 ohm ±5% 1/4W CF	569-0513-471
R 103	8.2k ohm ±5% 1/4W CF	569-0513-822
R 104	2.7k ohm ±5% 1/4W CF	569-0513-272
R 105	10k ohm ±5% 1/4W CF	569-0513-103
R 200	150 ohm ±5% 1/4W CF	569-0513-151
R 201	4.7k ohm ±5% 1/4W CF	569-0513-472
R 203	2.2k ohm ±5% 1/4W CF	569-0513-222
R 204	10k ohm ±5% 1/4W CF	569-0513-100
R 205	820 ohm ±5% 1/4W CF	569-0513-821
R 206	10k ohm ±5% 1/4W CF	569-0513-103
R 207	100 ohm ±5% 1/4W CF	569-0513-101
R 208	6.8k ohm ±5% 1/4W CF	569-0513-682
R 211	3.3k ohm ±5% 1/4W CF	569-0513-332
R 212	10k ohm ±5% 1/4W CF	569-0513-103
R 213	1k ohm ±5% 1/4W CF	569-0513-102
R 214	6.8k ohm ±5% 1/4W CF	569-0513-682
R 215	1k ohm ±5% 1/4W CF	569-0513-102
R 216	3.3k ohm ±5% 1/4W CF	569-0513-332
R 217	10k ohm ±5% 1/4W CF	569-0513-103
R 218	1k ohm ±5% 1/4W CF	569-0513-102
R 221	6.8k ohm ±5% 1/4W CF	569-0513-682
R 222	1k ohm ±5% 1/4W CF	569-0513-102
R 223	10 ohm ±5% 1/4W CF	569-0513-100
R 224	100k ohm ±5% 1/4W CF	569-0513-104
R 225	10k ohm ±5% 1/4W CF	569-0513-103
R 226	10 ohm ±5% 1/4W CF	569-0513-100
R 227	100 ohm ±5% 1/4W CF	569-0513-101
R 228	820k ohm ±5% 1/4W CF	569-0513-824
R 229	39k ohm ±5% 1/4W CF	569-0513-393
R 230	1M ohm ±5% 1/4W CF	569-0513-105
R 231	330k ohm ±5% 1/4W CF	569-0513-334
R 232	15k ohm ±5% 1/4W CF	569-0513-153
R 233	10k ohm ±5% 1/4W CF	569-0513-103
R 234	10k ohm ±5% 1/4W CF	569-0513-103
R 235	120k ohm ±5% 1/4W CF	569-0513-123
R 236	270k ohm ±5% 1/4W CF	569-0513-274
R 237	5.6k ohm ±5% 1/4W CF	569-0513-562
R 238	47k ohm ±5% 1/4W CF	569-0513-473
R 239	470k ohm ±5% 1/4W CF	569-0513-474
R 240	68k ohm ±5% 1/4W CF	569-0513-683
R 242	8.2k ohm ±5% 1/4W CF	569-0513-822
R 244	12k ohm ±5% 1/4W CF	569-0513-123
R 245	390k ohm ±5% 1/4W CF	569-0513-394
R 246	180k ohm ±5% 1/4W CF	569-0513-184
R 247	1k ohm ±5% 1/4W CF	569-0513-102
R 248	1k ohm ±5% 1/4W CF	569-0513-102
R 249	2.2k ohm ±5% 1/4W CF	569-0513-222
R 250	1.8k ohm ±5% 1/4W CF	569-0513-182
R 251	2.2k ohm ±5% 1/4W CF	569-0513-222
R 252	100k ohm ±5% 1/4W CF	569-0513-104
R 253	220 ohm ±10% 1/2W CC	569-1504-221
R 254	27 ohm ±5% 1/4W CF	569-0513-270
R 255	220 ohm ±10% 1/2W CC	569-1504-221
R 256	27 ohm ±5% 1/4W CF	569-0513-270
R 257	.27 ohm ±5% 1.2W WW	569-2003-278
R 258	10 ohm ±5% 1/4W CF	569-0513-100
R 259	22k ohm ±5% 1/4W CF	569-0513-223
R 260	2.2 ohm ±5% 1/2W WW	569-2503-229
R 261	.27 ohm ±5% 1.2W WW	569-2003-278
R 262	47 ohm ±5% 1/4W CF	569-0513-470
R 263	22k ohm ±5% 1/4W CF	569-0513-223
R 264	1.5k ohm ±5% 1/4W CF	569-0513-152
R 265	1k ohm ±5% 1/4W CF	569-0513-102
R 266	39 ohm ±10% 1W CC	569-1006-390
R 273	47k ohm ±5% 1/4W CF	569-0513-473
R 274	47k ohm ±5% 1/4W CF	569-0513-473
R 275	27k ohm ±5% 1/4W CF	569-0513-273
R 276	27k ohm ±5% 1/4W CF	569-0513-273
R 277	100 ohm ±5% 1/4W CF	569-0513-101
R 278	100 ohm ±5% 1/4W CF	569-0513-101
R 282	100 ohm ±5% 1/4W CF	569-0513-101
R 283	3.3k ohm ±5% 1/4W CF	569-0513-332
R 284	470 ohm ±5% 1/4W CF	569-0513-471
R 285	22k ohm ±5% 1/4W CF	569-0513-223
R 286	100k ohm ±5% 1/4W CF	569-0513-104
R 287	10k ohm ±5% 1/4W CF	569-0513-103
R 288	2.7k ohm ±5% 1/4W CF	569-0513-272
R 289	1.5k ohm ±5% 1/4W CF	569-0513-152
R 290	1.5k ohm ±5% 1/4W CF	569-0513-152
R 291	56 ohm ±5% 1/4W CF	569-0513-560
R 292	56 ohm ±5% 1/4W CF	569-0513-560
R 295	1.2k ohm ±5% 1/4W CF	569-0513-122
RT201	200 ohm thermistor	569-3001-003
RT202	200 ohm thermistor	569-3001-003

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
T 201	10mm 10.7 MHz IF xformer	592-5013-012
T 202	10mm 455 kHz IF xformer	592-5006-005
T 203	10mm 455 kHz IF xformer	592-5006-005
T 204	10mm 455 kHz IF xformer	592-5006-005
T 205	10mm 455 kHz IF xformer	592-5006-005
T 206	Input/driver transformer	592-1015-001
T 208	10mm 150 MHz transformer	592-5009-016
T 209	10mm 150 MHz transformer	592-5009-016
T 210	10mm 150 MHz transformer	592-5009-016
T 211	18.75 MHz ph mod xformer	592-5009-023
TB001	3-ins 1-gnd terminal strip	586-1001-022
TP202	Red vertical tip jack .08	105-2202-211
TP203	Red vertical tip jack .08	105-2202-211
TP204	Red vertical tip jack .08	105-2202-211
U 101	PC board (front end)	035-0212-001
U 200	PC board RGC	035-0314-001
U 201	FM IF system	544-2002-007
U 202	Quad op amp 3301	544-2005-001
W 054	RG-188A/U coax cable	597-3002-003
W 056	RG-188A/U coax cable	597-3002-003
X 201	Crystal socket	126-0110-014
X 202	Crystal socket	126-0110-014
Y 203	11.155 MHz 32 pF HC-18	519-0009-001
Z 201	10.7 MHz crystal filter	532-0007-002
Z 202	10.7 MHz 2-pole crystal filter	532-0006-001

EXCITER
PART NO. 023-4111-210 (150-160 MHz)
PART NO. 023-4111-310 (160-174 MHz)

A 300	Exciter harness assembly	023-3823-011
A 301	Transmitter bd 150-160 MHz	023-3493-001
A 301	Transmitter bd 160-174 MHz	023-3493-002
A 400	Power terminal assembly	023-4111-012
C 001	33 pF ±5% 50V N150 disc	510-3016-330
C 002	1000 pF ±20% 50V Y5U disc	510-3204-102
C 003	.01 µF ±20% 50V Y5U disc	510-3202-103
C 090	1000 pF ±20% 1kV feedthru	510-3149-102
C 091	1000 pF ±20% 1kV feedthru	510-3149-102
C 260	1000 µF 16V aluminum	510-4006-005
C 300	5.6 µF ±20% 35V tubular	510-2005-569
C 301	.047 µF ±20% 16V Y5S disc	510-3210-473
C 302	.1 µF 10V Y5U disc	510-3208-104
C 303	6800 pF ±20% 50V Y5U disc	510-3202-682
C 304	.1 µF ±10% 250V flatfoil	510-1203-104
C 305	1 µF ±20% 35V dipped	510-2245-109
C 306	1 µF ±20% 35V dipped	510-2245-109
C 307	.1 µF 10V Y5U disc	510-3208-104
C 308	.0047 µF 200V foil	510-1201-472
C 309	390 pF ±5% 100V 1DM15	510-0201-391
C 310	.1 µF 10V Y5U disc	510-3208-104
C 311	5.6 µF ±20% 15V molded	510-2023-569
C 314	1000 pF ±20% 50V Y5U disc	510-3204-102
C 315	470 pF ±5% 100V 1DM15	510-0201-471
C 320	.047 µF ±20% 16V Y5S disc	510-3210-473
C 321	.047 µF ±20% 16V Y5S disc	510-3210-473
C 322	470 pF ±5%N1500 50V	510-3121-471
C 323	470 pF ±5% N1500 50V	510-3121-471
C 324	1000 pF ±20% 50V Y5U disc	510-3204-102
C 325	1.9-15.7 pF vert mount cap	187-0109-005
C 326	1.9-15.7 pF vert mount cap	187-0109-005
C 327	43 pF ±5% 50V NPO disc	510-3213-430
C 328	43 pF ±5% 50V NPO disc	510-3213-430
C 329	56 µF ±20% 6V tubular	510-2001-560
C 332	.01 µF ±20% 16V Y5S disc	510-3210-103
C 333	91 pF ±5% 100V 1DM10	510-0202-910
C 334	300 pF ±5% 100V 1DM10	510-0202-301
C 335	91 pF ±5% 100V 1DM10	510-0202-910
C 336	300 pF ±5% 100V 1DM10	510-0202-301
C 337	1000 pF ±20% 50V Y5U disc	510-3204-102
C 338	.01 µF ±20% 16V Y5S disc	510-3210-103
C 339	.047 µF ±20% 16V Y5S disc	510-3210-473
C 345	5.1 pF ±5% 50V N150 disc	510-3216-519
C 346	82 pF 100V 1DM15 (150-160 MHz)	510-0201-820
C 346	56 pF ±5% 100V 1DM15 (160-174 MHz)	510-0201-560
C 347	470 pF ±5% 100V 1DM15	510-0201-471
C 348	1000 pF ±20% 50V Y5U disc	510-3204-102
C 349	82 pF 100V 1DM15	510-0201-820
C 350	1000 pF ±20% 50V Y5U disc	510-3204-102
C 351	33 pF ±5% 50V N150 disc (150-160 MHz)	510-3216-330
C 351	22 pF ±5% 50V N150 disc (160-174 MHz)	510-3216-220
C 352	1.8 pF ±5% 50V NPO disc	510-3213-189

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 353	43 pF ±5% 50V N150 disc	510-3216-430
C 354	56 pF ±5% 50V N150 disc	510-3216-560
C 355	300 pF 100V 1DM15 (150-160 MHz)	510-0201-301
C 355	100 pF ±20% 50V Y5U disc (160-174 MHz)	510-3202-101
C 356	6.8 pF ±5% 50V N150 disc (150-160 MHz)	510-3216-689
C 356	5.1 pF ±5% 50V N150 disc (160-174 MHz)	510-3216-519
C 357	1000 pF ±20% 50V Y5U disc	510-3204-102
C 358	.56 pF ±5% 500V comp	510-9502-568
C 359	5.1 pF ±5% 50V N150 disc	510-3216-519
C 360	8.2 pF ±5% 50V N150 disc	510-3216-829
C 361	12 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-120
C 361	8.2 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-829
C 362	1 pF ±5% 500V comp	510-9502-109
C 363	.01 µF ±20% 16V Y5S disc	510-3210-103
C 364	5.1 pF ±5% 50V N150 disc	510-3216-519
C 365	2 pF ±5% 500V comp	510-9502-209
C 366	.01 µF ±20% 16V Y5S disc	510-3210-103
C 367	1000 pF ±20% 50V Y5U disc	510-3204-102
C 368	.01 µF ±20% 16V Y5S disc	510-3210-103
C 369	5.6 µF ±20% 35V tubular	510-2005-569
C 370	1000 pF ±20% 50V Y5U disc	510-3204-102
C 371	56 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-560
C 374	1000 pF ±20% 50V Y5U disc	510-3204-102
C 375	27 pF ±5% 50V N750 disc	510-3220-270
C 376	22 pF ±5% 50V N750 disc	510-3220-220
C 377	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 377	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 378	56 pF ±5% 50V N750 disc	510-3220-560
C 381	.01 µF ±20% 50V Y5U disc	510-3202-103
C 382	27 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-270
C 383	56 pF ±5% 50V N750 disc	510-3220-560
C 384	.01 µF ±20% 50V Y5U disc	510-3202-103
C 385	1000 pF ±20% 50V Y5U disc	510-3204-102
C 386	5.6 µF ±20% 35V tubular	510-2005-569
C 387	56 pF ±5% 50V N750 disc	510-3220-560
C 388	56 pF ±5% 50V N750 disc	510-3220-560
C 389	.01 µF ±20% 50V Y5U disc	510-3202-103
C 390	.01 µF ±20% 50V Y5U disc	510-3202-103
C 392	15 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-150
C 392	56 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-560
C 393	22 pF ±5% 50V N750 disc	510-3220-220
C 394	22 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-220
C 394	18 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-180
C 395	12 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-120
C 396	27 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-270
C 397	56 pF ±5% 50V N750 disc	510-3220-560
C 398	1000 pF ±20% 50V Y5U disc	510-3204-102
C 400	33 pF ±5% 50V N750 disc	510-3220-330
C 402	1 µF ±20% 35V dip	510-2245-109
C 403	1 µF ±20% 35V dip	510-2245-109
C 404	1 µF ±20% 35V dip	510-2245-109
C 405	220 µF 16V aluminum	510-4116-221
C 406	1000 pF ±20% 50V Y5U disc	510-3204-102
C 407	33 pF ±5% 50V N750 disc	510-3220-330
C 408	33 pF ±5% 50V N750 disc	510-3220-330
C 409	100 pF ±20% 50V Y5U disc	510-3202-101
C 410	33 pF ±5% 50V N750 disc	510-3220-330
C 411	1000 pF ±20% 50V Y5U disc	510-3204-102
C 412	5.6 µF ±20% 35V tubular	510-2005-569
C 414	100 pF ±20% 50V Y5U disc	510-3202-101
C 415	100 pF ±20% 50V Y5U disc	510-3202-101
C 416	.047 µF ±20% 16V Y5S disc	510-3210-473
C 417	33 pF ±5% 50V N750 disc	510-3220-330
C 418	33 pF ±5% 50V N750 disc	510-3220-330
C 419	1000 pF ±20% 50V Y5U disc	510-3204-102
C 420	33 pF ±5% 50V N750 disc	510-3220-330
C 421	15 µF ±10% 15V submin	510-2073-150
C 422	33 pF ±5% 50V N750 disc	510-3220-330
C 423	33 pF ±5% 50V N750 disc	510-3220-330
C 424	.1 µF ±20% 16V Y5S disc	510-3210-104
C 426	39 pF ±5% 50V N750 disc	510-3220-390
CH001	Casting 581B (G)	015-0805-522
CH002	Connector mounting plate	017-1666-003
CR301	Diode 1N881/1N645	523-1500-881
CR302	Diode 1N881/1N645	523-1500-881
CR303	Si diode 1N4448	523-1500-883

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CR304	Si diode 1N4448	523-1500-883
CR307	9.1V ±5% 1W zener	523-2503-919
CR318	Ge diode 1N67A	523-1500-067
CR320	Ge diode 1N67A	523-1500-067
CR321	Varicap diode SMV1628	523-0009-034
CR322	Varicap diode SMV1628	523-0009-034
CR323	6.2V ±5% 1W zener	523-2503-629
CR345	Ge diode 1N67A	523-1500-067
CR346	Ge diode 1N67A	523-1500-067
CR347	Ge diode 1N67A	523-1500-067
CR350	17V ±5% 1W zener	523-2503-170
CR400	6.2V ±5% 1W zener	523-2503-629
CR401	9.1V ±5% 1W zener	523-2503-919
CR402	6.8V ±5% 1W zener	523-2503-689
CR403	Hot carrier diode 1N5711	523-1500-014
CR404	Hot carrier diode 1N5711	523-1500-014
CR405	Ge diode 1N67A	523-1500-067
CR406	12V ±5% 1W zener	523-2503-120
EP010	Male contact	016-1932-002
EP300	Soldering terminal	016-0104-004
EP301	Soldering terminal	016-0104-003
EP302	Black varnished tubing	042-0240-500
EP306	Insulator pad w/adhesive back	574-5005-110
EP308	0.055 teflon tubing	058-0053-515
EP375	Spacer TO-39	574-9001-001
EP376	1/2" coil shield	578-0002-002
EP377	3/8" coil shield	578-0002-001
EP400	0.14 x 0.14 x 0.07 bead	517-2002-005
EP401	Battery contacts	016-2052-101
EP402	0.03 teflon tubing	058-0053-510
EP403	0.08 teflon tubing	058-0053-520
EP405	0.14 x 0.14 x 0.07 bead	517-2002-005
EP407	0.375 x 0.375 ferrite bead	517-2002-003
HW002	6-32 panhead taptite 1/4"	575-0606-008
HW004	6-32 x 0.078 nut NPB	560-2106-008
HW005	6 x 0.018 NPB lockwasher int	596-2106-009
HW006	4-40 x 0.375 panhead philips	575-0604-012
HW010	4-40 panhead philips screw	575-0604-010
HW015	Rubber grommet #778	574-1006-002
HW019	Shoulder screw	013-1350-002
HW020	Transistor nut	013-1396-001
HW021	6-32 panhead philips ZPS	575-1606-012
HW022	1/4" 28 x 0.109 NPB hex nut	560-9040-012
HW023	3/8" 32 x 0.094 NPB hex nut	560-9062-016
HW024	5/8" 24 x 0.094 SPB hex nut	560-9078-028
HW025	1/4" 0.315 x 1/2 washer	596-4514-020
HW032	4-40 x 0.094 NPB nut	560-2104-008
HW033	4-40 panhead philips ZPS	575-1604-010
J 301	Solderless pin	586-3502-002
J 304	Solderless pin	586-3502-002
J 305	Solderless pin	586-3502-002
J 306	Solderless pin	586-3502-002
J 307	Solderless pin	586-3502-002
J 308	Solderless pin	586-3502-002
J 309	Solderless pin	586-3502-002
J 310	Solderless pin	586-3502-002
J 311	Solderless pin	586-3502-002
J 311	Male conn housing w/insert	117-0336-103
J 312	Female conn housing w/insert	117-0436-103
J 313	UHF female coax TBO	142-0102-004
J 314	Jack	013-0025-010
J 315	Pin receptacle	586-3002-015
L 206	20 µH 150mA filter choke	542-5007-011
L 320	0.22 - 0.37 pF inductor violet	542-1006-117
L 321	1 µH choke	542-3502-005
L 322	1 µH choke	542-3502-005
L 345	0.22-0.37 µH inductor violet	542-1006-117
L 347	RF coil space wound brown	542-1012-111
L 349	RF coil space wound brown	542-1012-111
L 350	RF choke	542-3006-002
L 351	0.115-0.16 µH variable ind	543-1015-025
L 375	2.5T ferrite choke	517-2005-005
L 376	2.5T ferrite choke	517-2005-005
L 377	2.5T ferrite choke	517-2005-005
L 378	2.5T ferrite choke	517-2005-005
MP002	Transmitter shield	017-1977-011
MP004	Exciter insulator	018-1007-001
MP010	Standoff	013-1139-028
MP031	Heat sink	016-2180-001
MP303	Crystal clip	032-0589-001
MP313	Connector shield	013-1198-001
MP377	Spacer TO-39	539-0005-001
NP001	Exciter 150-160 MHz label	559-9001-237
NP001	Exciter 150-174 MHz label	559-9001-239
P 001	Banana plug sub assembly	023-0030-014
Q 320	Si NPN VHF/UHF amp/osc	576-0003-051

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
Q 321	Si NPN VHF/UHF amp/osc	576-0003-051
Q 345	Si NPN 1 GHz amp TO-72	576-0003-029
Q 346	1W 175 MHz amp TO-39	576-0004-008
Q 347	2W 175 MHz amp RO-39	576-0004-031
Q 348	Si PNP 80V 7A TO-220	576-0002-021
Q 349	Si PNP 80V 7A TO-220	576-0002-021
Q 350	NPN gen purp 2N3904	576-0003-058
Q 375	13W VHF amp SOE	576-0004-051
Q 376	30W VHF amp	576-0004-072
Q 400	NPN gen purp 2N3904	576-0003-058
Q 401	Si PNP 80V 7A TO-220	576-0002-021
Q 402	NPN gen purp 2N3904	576-0003-058
Q 403	Si PNP 50 MHz amp TO-92	576-0003-017
Q 404	NPN gen purp 2N3904	576-0003-058
R 002	7.5 ohm ±5% 7W WW	569-2007-759
R 300	100k ohm ±5% 1/4W CF (150-160 MHz)	569-0513-104
R 300	15k ohm ±5% 1/4W CF (160-174 MHz)	569-0513-153
R 301	22k ohm ±5% 1/4W CF	569-0513-223
R 302	100k ohm ±5% 1/4W CF	569-0513-104
R 303	100k ohm ±5% 1/4W CF	569-0513-104
R 304	2.7k ohm ±5% 1/4W CF	569-0513-272
R 305	82k ohm ±5% 1/4W CF	569-0513-823
R 306	82k ohm ±5% 1/4W CF	569-0513-823
R 307	10k ohm ±5% 1/4W CF	569-0513-103
R 308	82k ohm ±5% 1/4W CF	569-0513-823
R 309	10k ohm ±5% 1/4W CF	569-0513-103
R 310	1k ohm ±5% 1/4W CF	569-0513-102
R 311	100k ohm ±5% 1/4W CF	569-0513-104
R 312	100k ohm ±5% 1/4W CF	569-0513-104
R 313	68k ohm ±5% 1/4W CF	569-0513-683
R 314	27k ohm ±5% 1/4W CF (150-160 MHz)	569-0513-273
R 314	15k ohm ±5% 1/4W CF (160-174 MHz)	569-0513-153
R 315	68k ohm ±5% 1/4W CF	569-0513-683
R 316	82k ohm ±5% 1/4W CF	569-0513-823
R 317	1k ohm ±5% 1/4W CF	569-0513-102
R 318	1k ohm ±5% 1/4W CF	569-0513-102
R 319	150k ohm ±5% 1/4W CF	569-0513-154
R 320	1k ohm ±5% 1/4W CF	569-0513-102
R 321	50k ohm 1/8W PC trim pot	562-0004-503
R 323	27k ohm ±5% 1/4W CF	569-0513-273
R 324	50k ohm 1/8W PC trim pot	562-0004-503
R 326	27k ohm ±5% 1/4W CF	569-0513-273
R 327	470 ohm ±5% 1/4W CF	569-0513-471
R 328	27k ohm ±5% 1/4W CF	569-0513-273
R 329	56k ohm ±5% 1/4W CF	569-0513-563
R 330	33k ohm ±5% 1/4W CF	569-0513-333
R 331	33k ohm ±5% 1/4W CF	569-0513-333
R 332	47k ohm ±5% 1/4W CF	569-0513-473
R 333	47k ohm ±5% 1/4W CF	569-0513-473
R 334	100 ohm ±5% 1/4W CF	569-0513-101
R 335	27k ohm ±5% 1/4W CF	569-0513-273
R 336	27k ohm ±5% 1/4W CF	569-0513-273
R 337	470 ohm ±5% 1/4W CF	569-0513-471
R 338	470 ohm ±5% 1/4W CF	569-0513-471
R 339	6800 ohm ±5% 1/4W CF	569-0513-682
R 343	150 ohm ±5% 1/4W CF	569-0513-151
R 345	1.8k ohm ±5% 1/4W CF	569-0513-182
R 346	10 ohm ±5% 1/4W CF	569-0513-100
R 347	10k ohm ±5% 1/4W CF	569-0513-103
R 349	100 ohm ±5% 1/4W CF	569-0513-101
R 350	10 ohm ±5% 1/4W CF	569-0513-100
R 351	3.3k ohm ±5% 1/4W CF	569-0513-332
R 352	220 ohm ±5% 1/4W CF	569-0513-221
R 353	56 ohm ±5% 1/4W CF	569-0513-560
R 354	150 ohm ±5% 1/4W CF	569-0513-151
R 355	3.3k ohm ±5% 1/4W CF	569-0513-332
R 356	150 ohm ±5% 1/4W CF	569-0513-151
R 357	10k ohm ±5% 1/4W CF	569-0513-103
R 358	10k ohm ±5% 1/4W CF	569-0513-103
R 359	10k ohm ±5% 1/4W CF	569-0513-103
R 360	680 ohm ±5% 1/4W CF	569-0513-681
R 361	1k ohm ±5% 1/4W CF	569-0513-102
R 362	56 ohm ±10% 1W CC	569-1006-560
R 363	2.7k ohm ±5% 1/4W CF	569-0513-279
R 364	2.7k ohm ±5% 1/4W CF	569-0513-279
R 365	47 ohm ±5% 1/4W CF	569-0513-470
R 374	1k ohm ±5% 1/4W CF	569-0513-102
R 375	10 ohm ±10% 1/2W CC (150-160 MHz)	569-1504-100
R 375	56 ohm ±10% 1/2W CC (160-174 MHz)	569-1504-560
R 376	56 ohm ±10% 1/2W CC	569-1504-560
R 378	56 ohm ±10% 1/2W CC	569-1504-560
R 379	56 ohm ±10% 1/2W CC (150-160 MHz)	569-1504-560
R 400	1.5k ohm ±5% 1/4W CF	569-0513-152
R 401	1k ohm ±1% 1/8W MF	569-0520-301
R 402	100k ohm ±5% 1/4W CF	569-0513-104
R 403	1k ohm ±1% 1/8W MF	569-0520-301

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 404	100k ohm ±5% 1/4W CF	569-0513-104
R 405	10k ohm ±5% 1/4W CF	569-0513-103
R 406	10k ohm ±1% 1/8W MF	569-0520-401
R 407	1k ohm ±1% 1/8W MF	569-0520-301
R 408	270k ohm ±5% 1/4W CF	569-0513-274
R 409	100k ohm ±5% 1/4W CF	569-0513-104
R 410	10 ohm ±10% 1/2W CC	569-1504-101
R 411	10k ohm ±5% 1/4W CF	569-0513-103
R 412	50k ohm 1/8W PC trim pot	562-0005-503
R 413	100k ohm ±5% 1/4W CF	569-0513-104
R 414	12k ohm ±5% 1/4W CF	569-0513-123
R 415	470k ohm ±5% 1/4W CF	569-0513-474
R 416	10k ohm ±5% 1/4W CF	569-0513-103
R 417	47k ohm ±5% 1/4W CF	569-0513-473
R 418	330 ohm ±10% 1/2W CC	569-1504-331
R 419	1k ohm ±5% 1/4W CF	569-0513-102
R 420	50k ohm 1/8W PC trim pot	562-0005-503
R 421	2.2k ohm ±5% 1/4W CF	569-0513-222
R 422	10k ohm ±5% 1/4W CF	569-0513-103
R 423	1k ohm ±5% 1/4W CF	569-0513-102
R 424	1k ohm ±5% 1/4W CF	569-0513-102
R 425	10k ohm ±5% 1/4W CF	569-0513-103
R 426	1k ohm ±5% 1/4W CF	569-0513-102
R 427	3.3k ohm ±5% 1/4W CF	569-0513-332
R 428	1k ohm ±5% 1/4W CF	569-0513-102
R 429	1.5k ohm ±5% 1/4W CF	569-0513-152
RT320	200 ohm thermistor	569-3001-003
RT321	200 ohm thermistor	569-3001-003
RT400	Thermistor	569-3001-001
T 346	RF transformer brown	592-5022-101
T 348	RF transformer green	592-5022-109
TB002	2-ins 1-gnd terminal strip	586-1001-020
TP301	Red vertical tip jack	105-2202-211
TP302	Red vertical tip jack	105-2202-211
TP303	Red vertical tip jack	105-2202-211
TP304	Red vertical tip jack	105-2202-211
U 300	PC board transmitter	035-0256-001
U 301	Quad op amp 3301	544-2005-001
U 400	PC board power thermal	035-0355-080
W 089	RF-188A/U coax cable	597-3002-003
X 302	Crystal socket	126-0110-014
X 303	Crystal socket	126-0110-014

POWER AMPLIFIER
PART NO. 023-4111-260 (150-160 MHz)
PART NO. 023-4111-360 (160-174 MHz)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 001	Filter cover assembly	023-4111-061
C 901	12 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-120
C 901	22 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-220
C 902	15 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-150
C 901	10 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-100
C 903	33 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-330
C 905	56 pF ±5% 50V N750 disc	510-3220-560
C 906	1000 pF ±20% 50V Y5U disc	510-3202-102
C 907	56 pF ±5% 50V N750 disc	510-3220-560
C 908	56 pF ±5% 50V N750 disc	510-3220-560
C 909	56 pF ±5% 50V N750 disc	510-3220-560
C 910	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 910	68 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-680
C 911	56 pF ±5% 50V N750 disc	510-3220-560
C 912	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 912	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 913	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 914	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 914	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 915	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 916	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 916	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 917	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 918	56 pF ±5% 50V N750 disc	510-3220-560
C 919	56 pF ±5% 50V N750 disc	510-3220-560
C 920	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 920	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 921	56 pF ±5% 50V N750 disc	510-3220-560
C 922	56 pF ±5% 50V N750 disc	510-3220-560
C 923	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 923	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 924	56 pF ±5% 50V N750 disc	510-3220-560
C 925	56 pF ±5% 50V N750 disc	510-3220-560
C 926	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 926	47 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-470
C 927	18 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-180
C 928	22 pF ±5% 50V N750 disc	510-3220-220
C 929	33 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-330
C 929	22 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-220
C 930	10 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-100
C 930	18 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-180
C 931	47 pF ±5% 50V N750 disc	510-3220-470
C 932	.01 µF ±20% 50V Y5U disc	510-3202-103
C 933	10 µF 25V aluminum	510-4006-002
C 934	.01 µF ±20% 50V Y5U disc	510-3202-103
C 935	1000 pF ±20% 50V Y5U disc	510-3202-102
C 936	10 µF 25V aluminum	510-4006-002
C 940	5 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-509
C 941	1.8 pF ±5% 50V NPO disc (160-174 MHz)	510-3213-189
C 942	22 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-220
C 943	10 pF ±5% 50V N750 disc (160-174 MHz)	510-3220-100
C 948	56 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-560
C 951	15 pF ±5% 50V N750 disc (150-160 MHz)	510-3220-150
C 976	1000 pF ±20% 1kV feedthru	510-3149-102
EP407	0.375 x 0.375 ferrite bead	517-2002-003
EP901	Insulator	018-1005-004
EP903	0.055 teflon tubing	058-0053-515
EP904	0.055 teflon tubing	058-0053-515
HW002	4-40 x 0.375 panhead phil TT	575-0604-012
HW005	4-40 panhead philips screw	575-0604-010
HW006	4-40 x 0.025 panhead phil TT	575-0604-008
HW007	4-40 x 0.375 panhead phil TT	575-0604-012
HW008	#4 washer NPB	596-2404-009
HW009	0.225 ID flat washer NPB	596-9410-014
L 901	1.5T ferrite choke	517-2005-003
L 902	1.5T ferrite choke	517-2005-003
L 903	2.5T ferrite choke	517-2005-005
L 904	1.5T ferrite choke	517-2005-003
MP901	PA heatsink	015-0868-102
MP903	Heatsink	016-2112-002
MP908	Standoff	013-1188-007
MP910	PA shield insert	017-2081-021
MP911	PA cover universal heatsink	017-2081-111
MP999	PA shield insert univ heatsink	017-2081-121
NP001	PA 150-160 MHz label	559-9001-238
Q 901	40W 175 MHz amp	576-0004-021
Q 902	40W 175 MHz amp	576-0004-021
Q 903	40W 175 MHz amp	576-0004-021
Q 904	40W 175 MHz amp	576-0004-021
R 901	27 ohm ±10% 1W CC	569-1006-270
R 902	56 ohm ±10% 1W CC	569-1006-560
R 903	10 ohm ±10% 1W CC	569-1006-100
R 904	10 ohm ±10% 1W CC	569-1006-100
R 905	10 ohm ±10% 1W CC	569-1006-100
R 906	10 ohm ±10% 1W CC	569-1006-100
R 907	27 ohm ±10% 1W CC	569-1006-270
R 908	0.56 10W	569-2010-568
U 901	PC board	035-0206-001

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	25A POWER SUPPLY 110V AC 60 Hz PART NO. 023-3341-012	
BK001	Bracket	017-2121-001
C 001	55000 µF aluminum	510-4028-002
C 002	.033 µF ±20% 50V Y5U disc	510-3002-333
C 003	55000 µF aluminum	510-4028-002
C 004	1000 pF ±20% 1kV feedthru	510-3149-102
C 005	10 µF 370V AC oil filled	510-1014-001
CB001	Circuit breaker	534-2006-002
CH001	Chassis	017-1951-012
CR001	6.8V ±5% 1W zener	523-2503-689
CR002	6.8V ±5% 1W zener	523-2503-689
CR003	50V 20A rectifier	523-0016-500
CR004	50V 20A rectifier	523-0016-500
CR007	200V 1A rectifier 1N4003	523-0501-002
CR010	50V 20A rectifier	523-0016-500
EP001	Connector	013-1426-001
EP002	Connector	023-3312-001
EP003	1/4" stud mtng mica washer	574-5005-008
EP004	Molded handle	032-0362-001
EP005	10/16-14 AWG ring terminal	586-0001-002
EP006	Push on terminals	586-3008-001
EP007	Soldering terminal	016-0104-004
EP008	1/4" ring terminal 16-14 AWG	586-0001-013
EP009	Black varnished tubing	042-0240-500
EP029	Terminal lug 2104-10	586-0005-110
EP031	10/8 AWG ring terminal	586-0001-027
EP032	Connector shield	032-0576-001
F 001	5A 250V SE slow blow fuse	534-0002-030
FH001	Fuse holder HKP	534-1002-001
HW000	Capacitor mounting bracket	572-0002-005
HW001	10-32 x 0.375 CPS nut	560-1110-012
HW002	4-40 x 0.094 NPB nut	560-2104-008
HW003	6-32 1/4" panhead taptite	575-0606-008
HW004	6-32 x 0.078 NPB nut	560-2106-008
HW005	9/16 ID rubber grommet	574-0002-004
HW006	Strain relief SV/SVT-18	574-0003-002
HW007	8-18 hex head sheet mtl ZPS	575-3908-016
HW008	10-32 panhead philips ZPS	575-1610-020
HW009	10-32 panhead philips ZPS	575-1610-036
HW010	8-32 x 0.125 CPS nut	560-1108-011
HW011	6 x 0.018 lockwasher int ZPS	596-1106-009
HW012	#10 shakeproof washer	596-1110-012
HW013	4 x 0.015 lockwasher int NPB	596-2104-008
HW014	1/4" 0.315 x 1/2" washer	596-4514-020
HW015	1/4" 28 x 0.109 hex nut NPB	560-9040-012
HW016	4-40 panhead philips ZPS	575-1604-020
HW017	1/4" x 0.025 lockwasher int	596-2114-015
HW018	Rubber grommet	574-0002-014
HW019	8-32 U-type nut CPS	560-1808-004
HW020	Backing plate	013-1479-001
HW021	3/8" 32 x 0.094 nut NPB	560-9062-016
HW022	6-32 panhead philips ZPS	575-1606-012
HW024	Capacitor mounting bracket	572-0002-011
HW025	8 x 0.02 lockwasher int CPS	596-1108-011
HW026	8-32 panhead philips CPS	575-0608-012
HW027	6-32 panhead philips ZPS	575-1606-008
HW030	6-32 panhead philips CPS	575-0606-006
HW032	4-40 x 0.063 nut NPB	560-2104-006
HW034	Cushion w/adhesive backing	018-0920-002
HW035	10-32 panhead	575-9614-012
J 001	Jack	013-0025-010
J 002	125V AC receptacle w/gnd	515-1006-001
L 001	1 µH filter choke	542-5005-011
MP001	Rack panel	017-1828-003
MP002	Heatsink, outer	017-1718-002
MP003	Heatsink, inner	017-1719-003
NP001	25A 120V AC 60 Hz label	559-9001-257
P 001	Banana plug subassembly	023-0030-014
Q 001	Si PNP 80V 7A TO-220	576-0002-021
R 001	27 ohm 10W	569-2010-270
R 002	1k ohm ±10% 1/2W CC	569-1004-102
R 003	10 ohm 1/2W CC	569-1504-100
R 004	220k ohm ±10% 1/2W CC	569-1004-224
R 010	5.6 ohm ±10% 10W WW	569-2010-569
T 001	Ferroresonant transformer	592-3501-002

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
TB001	3-ins 1-gnd terminal strip	586-1001-022
TB002	4-ins 1-gnd terminal strip	586-1001-024
W 006	8 ft AC cord 3-18 black	597-1001-002
	RECEIVER HARNESS PART NO. 023-3823-002	
EP010	Male contact	016-1932-002
EP405	0.14 x 0.13 ferrite bead	517-2002-001
J 001	Pin receptacle	586-3002-015
	EXCITER HARNESS PART NO. 023-3823-011	
EP010	Male contact	016-1932-002
EP011	Female contact	016-1931-002
EP405	0.14 x 0.13 ferrite bead	517-2002-001
	FILTER COVER ASSEMBLY PART NO. 023-4111-061	
C 954	0.56 pF ±5% 500V comp	510-9502-568
C 955	1000 pF ±20% 1kV feedthru	510-3149-102
C 956	1000 pF ±20% 1kV feedthru	510-3149-102
C 957	100 pF ±5% 50V N750 disc	510-3220-101
C 958	33 pF ±5% 50V N150 disc	510-3016-330
C 971	18 pF ±5% 350V underwood	510-0016-018
C 972	40 pF ±5% 350V underwood	510-0016-040
C 973	40 pF ±5% 350V underwood	510-0016-040
C 974	40 pF ±5% 350V underwood	510-0016-040
C 975	18 pF ±5% 350V underwood	510-0016-018
CR901	100V 6A rectifier	523-0015-001
CR902	17V ±5% 1W zener	523-2503-170
CR903	Hot carrier diode 1N5711	523-1500-014
EP001	Soldering terminal	016-0104-004
EP002	Connector shield	032-0576-001
EP003	Soldering terminal	016-0104-004
EP004	1/4" heatshrink tubing	042-0241-555
EP006	Molded handle	032-0362-001
EP007	Rib lock standoff	260-0102-001
EP008	6-ring terminal 16-14 wire	586-0001-010
EP009	Black plastic tubing	042-0240-770
EP012	Terminal lug 2104-10	586-0005-110
EP013	6-ring terminal 16-14 wire	586-0001-010
EP015	14-16 wire contact	534-1004-037
EP407	0.375 x 0.375 ferrite bead	517-2002-003
EP911	Connector	023-3313-001
EP912	Connector	013-1426-001
F 900	5A 125V slow blow MDX	534-0001-008
HW001	1/4" 28 x 0.109 hex nut NPB	560-9040-012
HW002	Fiber washer insulator	596-4414-016
HW003	4-40 x 0.094 nut NPB	560-2104-008
HW004	3/8" 32 x 0.094 hex nut NPB	560-9062-016
HW005	0.5 OD nylon snap bushing	574-0001-005
HW006	4-40 panhead philips screw	575-0604-010
HW007	4-40 panhead philips ZPS	575-1604-020
HW010	1/4" x 0.025 lockwasher int	596-2114-015
HW011	1/4" x 0.018 flat washer SPB	596-9103-018
J 900	N-connector panel mount	515-3007-002
J 901	N-connector panel mount	515-3007-002
J 902	Jack	013-0025-010
L 910	Inductor	016-2019-001
L 911	Inductor	016-2019-001
L 912	Inductor	016-2019-001
L 913	Inductor	016-2019-001
MP001	Heatsink filter cover	017-2081-103
MP005	Fuse body 9835	534-1004-031
MP006	Know 99531/2 washer 9955	534-1004-032
MP007	Fuse spring 1A1853	534-1005-035
MP313	Connector shield	013-1198-001
P 903	Banana plug subassembly	023-0030-014
R 910	100k ohm ±5% 1/4W CF	569-0513-104
RT900	Thermistor	569-3001-001
W 901	RG-188A/U coax cable	597-3002-003
W 904	RG-188A/U coax cable	597-3002-003
W 999	RG-188A/U coax cable	597-3002-003

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	CARD RACK ASSEMBLY PART NO. 023-3823-020	
A 001	Chassis assembly	023-3773-001
A 002	Harness assembly	023-3823-021
A 002	Microphone connector assem	117-5205-102
EP001	Post	586-3504-001
EP002	Black ext plastic tubing	042-0240-770
EP010	Contact assembly male	023-1932-002
EP405	0.14 x 0.13 ferrite bead	517-2002-005
HW002	6-32 panhead taptite 1/4"	575-0606-008
HW003	6-32 panhead philips ZPS	575-1606-012
HW004	6-32 x 0.078 nut NPB	560-2106-008
HW005	6 x 0.018 lockwasher int NPB	596-2106-009
HW006	4-40 panhead philips	575-1604-010
HW007	4-40 x 0.094 nut NPB	560-2104-008
HW008	4-40 panhead philips ZPS	575-1604-012
HW009	3/16" cable clamp	572-0001-002
HW010	4 x 0.015 lockwasher int NPB	596-2104-008
HW015	Wire tie	574-9008-001
HW016	1/8" self-threading nut CPS	560-1818-014
J 001	Male conn housing w/insert	117-0336-103
J 003	3.6 mm jack enclosed	515-2001-011
J 004	Red banana jack	108-0902-001
J 005	Black banana jack	108-0903-001
LS003	Speaker assembly	023-3409-001
MP001	Microphone mounting bracket	017-2003-011
MP002	Card guide	574-9015-001
R 001	1k ohm ±5% 1/4W CF	569-0513-102
U 001	PC board	035-0351-002
	TEST CARD PART NO. 023-3823-022	
EP001	Receptacle	586-3503-001
EP002	Right angle pin male	586-3504-021
U 001	PC board extender card	035-0355-010

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
	CONTROL CARD PART NO. 023-3823-030	
A 600	Harness	023-3823-031
C 600	1000 pF ±20% 50V Y5U ceram	510-3204-102
C 601	6.8 µF ±20% 35V tantalum	510-2245-689
C 602	6.8 µF ±20% 35V tantalum	510-2245-689
C 603	100 µF 10V alum electrolytic	510-4003-005
C 604	100 pF ±20% 50V Y5U ceram	510-3202-101
C 605	6.8 µF ±20% 35V tantalum	510-2245-689
C 606	1 µF ±10% 35V tantalum	510-2575-109
C 607	6.8 µF ±20% 35V tantalum	510-2245-689
C 608	.0047 µF 200V foil	510-1201-472
C 609	.0015 µF 200V foil	510-1201-152
C 610	.015 µF ±10% 250V flat foil	510-1203-153
C 611	560 pF ±5% 100V 1DM15	510-0201-561
C 612	.0047 µF 200V foil	510-1201-472
C 613	.0015 µF 200V foil	510-1201-152
C 614	.015 µF ±10% 250V flat foil	510-1203-153
C 615	560 pF ±5% 100V 1DM15	510-0201-561
C 616	6.8 µF ±20% 35V tantalum	510-2245-689
C 617	1000 pF ±20% 50V Y5U cer	510-3204-102
C 618	6.8 µF ±20% 35V tantalum	510-2245-689
C 619	1 µF ±20% 35V tantalum	510-2245-109
C 620	.01 µF ±20% 16V Y5S cer disc	510-3210-103
C 621	6.8 µF ±20% 35V tantalum	510-2245-689
C 622	6.8 µF ±20% 35V tantalum	510-2245-689
C 623	6.8 µF ±20% 35V tantalum	510-2245-689
C 624	15 µF ±10% 15V tantalum	510-2073-150
C 625	6.8 µF ±20% 35V tantalum	510-2245-689
C 626	1000 pF ±20% 50V Y5U cer	510-3204-102
C 627	1000 pF ±20% 50V Y5U cer	510-3204-102
C 628	1 µF ±20% 35V tantalum	510-2245-109
C 629	1000 pF ±20% 50V Y5U cer	510-3204-102
C 630	47 µF ±20% 15V dipped	510-2243-470
C 631	4700 pF ±20% 50V Y5U cer	510-3202-472
C 632	1 µF ±20% 35V tantalum	510-2245-109
CR600	Diode 1N881/1N645	523-1500-881
CR601	Si diode 1N4448	523-1500-883
CR602	Si diode 1N4448	523-1500-883
CR603	Red LED	549-4001-001
CR604	Si diode 1N4448	523-1500-883
CR605	Diode 1N881/1N645	523-1500-881

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
EP500	Receptacle	586-3503-001
HW000	Panel mount LED socket	550-0006-100
HW600	1/4" 32 x 0.094 hex nut NPB	560-9043-012
HW601	1/4" 6-32 panhead taptite	575-0606-008
HW602	2-56 x 0.063 nut NPB	560-2102-006
HW603	2-56 panhead philips ZPS	575-1602-008
HW604	2 x 0.013 lockwasher int NPB	596-2102-006
HW605	Panel mount LED socket	550-0006-100
MP600	PC board bracket	017-2007-011
Q 600	Si NPN gen purp TO-92	576-0003-058
Q 601	Si NPN gen purp TO-92	576-0003-058
Q 602	Si PNP 50 MHz amp TO-92	576-0003-017
Q 603	Si NPN Darlington TO-92	576-0007-001
Q 604	Si NPN gen purp TO-92	576-0003-058
Q 605	Si NPN gen purp TO-92	576-0003-058
Q 606	Si NPN Darlington TO-92	576-0007-001
Q 607	J-FET 4-12k switch TO-92	576-0006-051
Q 608	J-FET low noise RF TO-92	576-0006-009
Q 609	Si PNP 50 MHz amp TO-92	576-0003-017
R 600	10 ohm ±5% 1/4W CF	569-0513-100
R 601	100k ohm ±5% 1/4W CF	569-0513-104
R 602	1k ohm ±5% 1/4W CF	569-0513-102
R 603	100k ohm ±5% 1/4W CF	569-0513-104
R 604	1k ohm ±5% 1/4W CF	569-0513-102
R 605	1k ohm ±5% 1/4W CF	569-0513-102
R 606	100k ohm ±5% 1/4W CF	569-0513-104
R 607	2.2M ohm ±5% 1/4W CF	569-0513-225
R 608	1k ohm ±5% 1/4W CF	569-0513-102
R 609	10k ohm ±5% 1/4W CF	569-0513-103
R 610	22k ohm ±5% 1/4W CF	569-0513-223
R 611	10k ohm ±5% 1/4W CF	569-0513-103
R 612	1k ohm ±5% 1/4W CF	569-0513-102
R 613	10k ohm ±5% 1/4W CF	569-0513-103
R 614	1k ohm ±5% 1/4W CF	569-0513-102
R 615	180k ohm ±5% 1/4W CF	569-0513-184
R 616	10k ohm ±5% 1/4W CF	569-0513-103
R 617	100k ohm ±5% 1/4W CF	569-0513-104
R 618	100k ohm ±5% 1/4W CF	569-0513-104
R 619	1k ohm ±5% 1/4W CF	569-0513-102
R 620	100k ohm ±5% 1/4W CF	569-0513-104
R 621	330k ohm ±5% 1/4W CF	569-0513-334
R 622	390k ohm ±5% 1/4W CF	569-0513-394
R 623	270k ohm ±5% 1/4W CF	569-0513-274
R 624	330k ohm ±5% 1/4W CF	569-0513-334
R 625	390k ohm ±5% 1/4W CF	569-0513-394
R 626	180k ohm ±5% 1/4W CF	569-0513-184
R 627	330k ohm ±5% 1/4W CF	569-0513-334
R 628	330k ohm ±5% 1/4W CF	569-0513-334
R 629	330k ohm ±5% 1/4W CF	569-0513-334
R 630	390k ohm ±5% 1/4W CF	569-0513-394
R 631	330k ohm ±5% 1/4W CF	569-0513-334
R 632	150k ohm ±10% 1/4W	569-1502-154
R 633	10k ohm ±5% 1/4W CF	569-0513-103
R 634	10k ohm ±5% 1/4W CF	569-0513-103
R 635	10 ohm ±5% 1/4W CF	569-0513-100
R 636	22k ohm ±5% 1/4W CF	569-0513-223
R 637	470k ohm ±5% 1/4W CF	569-0513-474
R 638	4.7k ohm ±5% 1/4W CF	569-0513-472
R 639	2.2k ohm ±5% 1/4W CF	569-0513-222
R 640	8.2k ohm ±5% 1/4W CF	569-0513-822
R 641	270k ohm ±5% 1/4W CF	569-0513-274
R 642	270k ohm ±5% 1/4W CF	569-0513-274
R 643	1k ohm ±5% 1/4W CF	569-0513-102
R 644	2.7k ohm ±5% 1/4W CF	569-0513-272
R 645	18k ohm ±5% 1/4W CF	569-0513-183
R 646	2.7k ohm ±5% 1/4W CF	569-0513-272
R 647	1k ohm ±5% 1/4W CF	569-0513-102
R 648	1k ohm ±5% 1/4W CF	569-0513-102
R 649	10 ohm ±5% 1/4W CF	569-0513-100
R 650	100k ohm ±5% 1/4W CF	569-0513-104
R 651	10k ohm ±5% 1/4W CF	569-0513-103
R 652	10k ohm ±5% 1/4W CF	569-0513-103
R 653	220k ohm ±5% 1/4W CF	569-0513-224
R 654	47k ohm ±5% 1/4W CF	569-0513-473
R 655	1k ohm ±5% 1/4W CF	569-0513-102
R 656	1M ohm ±5% 1/4W CF	569-0513-105
R 657	220k ohm ±5% 1/4W CF	569-0513-224
R 658	220k ohm ±5% 1/4W CF	569-0513-224
R 659	10 ohm ±5% 1/4W CF	569-0513-100
S 600	Slide switch DPDT	583-3003-001
S 601	Slide switch DPDT	583-3003-001
S 602	SPST pushbutton switch	583-4007-001
U 600	PC board	035-0355-030
U 601	Quad op amp 3301	544-2005-001
U 602	Dual NOR gate CMOS 4002	544-3001-135
U 603	Quad op amp 224	544-2020-001

LEVEL ADJUST CARD
PART NO. 023-3823-040

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C 700	1 µF ±10% 35V tantalum	510-2575-109
C 701	1000 pF ±20% 50V Y5U cer	510-3204-102
C 702	.01 µF ±20% 16V Y5S cer	510-3210-103
C 703	6.8 µF ±20% 35V tantalum	510-2245-689
C 704	1 µF ±10% 35V tantalum	510-2575-109
C 705	1000 pF ±20% 50V Y5U cer	510-3204-102
C 706	1 µF ±10% 35V tantalum	510-2575-109
C 707	.1 µF 10V Y5U cer disc	510-3208-104
C 708	6.8 µF ±20% 35V tantalum	510-2245-689
C 709	1 µF ±10% 35V tantalum	510-2575-109
C 710	3300 pF ±20% 50V Y5U cer	510-3202-332
C 711	3300 pF ±20% 50V Y5U cer	510-3202-332
C 712	2.2 µF ±20% 35V tantalum	510-2245-229
C 713	3300 pF ±20% 50V Y5U cer	510-3202-332
C 714	3300 pF ±20% 50V Y5U cer	510-3202-332
C 715	2.2 µF ±20% 35V tantalum	510-2245-229
C 716	1 µF ±10% 35V tantalum	510-2575-109
C 717	2.2 µF ±20% 35V tantalum	510-2245-229
C 718	1 µF ±10% 35V tantalum	510-2575-109
C 720	1 µF ±10% 35V tantalum	510-2575-109
C 721	1 µF ±10% 35V tantalum	510-2575-109
C 722	1 µF ±10% 35V tantalum	510-2575-109
C 723	1 µF ±10% 35V tantalum	510-2575-109
C 724	1 µF ±10% 35V tantalum	510-2575-109
C 725	1 µF ±10% 35V tantalum	510-2575-109
C 726	6.8 µF ±20% 35V tantalum	510-2245-689
CR700	11V ±5% 1W zener	523-2503-110
CR701	Si diode 1N4448	523-1500-883
CR702	Si diode 1N4448	523-1500-883
EP500	Receptacle	586-3503-001
EP700	Red ribbed lock feedthru	260-0202-901
HW700	1/4" 32 x 0.094 hex nut NPB	560-9043-012
HW701	1/4" 6-32 panhead taptite	575-0606-008
MP700	PC board bracket	017-2007-013
MP701	Knob machined 0.425 long	032-0767-022
Q 700	Si NPN power audio MJE2480	576-0002-026
Q 701	Si NPN gen purp TO-92	576-0003-053
Q 702	Si NPN gen purp TO-92	576-0003-053
Q 703	Si NPN gen purp TO-92	576-0003-053
Q 704	Si NPN gen purp TO-92	576-0003-053
Q 705	Si NPN gen purp TO-92	576-0003-053
Q 706	Si NPN gen purp TO-92	576-0003-053
Q 707	Si NPN gen purp TO-92	576-0003-053
Q 708	Si NPN gen purp TO-92	576-0003-053
Q 709	Si NPN gen purp TO-92	576-0003-053
R 700	200k ohm 1/8W PC trim pot	562-0004-204
R 701	27k ohm ±5% 1/4W CF	569-0513-273
R 702	100k ohm ±5% 1/4W CF	569-0513-104
R 703	1k ohm ±5% 1/4W CF	569-0513-102
R 704	100k ohm ±5% 1/4W CF	569-0513-104
R 705	200k ohm 1/8W PC trim pot	562-0004-204
R 706	100k ohm ±5% 1/4W CF	569-0513-104
R 707	1k ohm ±5% 1/4W CF	569-0513-102
R 708	1k ohm ±5% 1/4W CF	569-0513-102
R 709	15 ohm ±10% 1/2W CC	569-1504-150
R 710	10k ohm volume pot	562-0016-005
R 711	1k ohm ±5% 1/4W CF	569-0513-102
R 712	10k ohm ±5% 1/4W CF	569-0513-103
R 713	10k ohm ±5% 1/4W CF	569-0513-103
R 714	200k ohm 1/8W PC trim pot	562-0004-204
R 715	10k ohm ±5% 1/4W CF	569-0513-103
R 716	100k ohm ±5% 1/4W CF	569-0513-104
R 717	200k ohm 1/8W PC trim pot	562-0004-204
R 718	100k ohm ±5% 1/4W CF	569-0513-104
R 719	100k ohm ±5% 1/4W CF	569-0513-104
R 720	10k ohm ±5% 1/4W CF	569-0513-103
R 721	10k ohm ±5% 1/4W CF	569-0513-103
R 722	100k ohm ±5% 1/4W CF	569-0513-104
R 723	4.7k ohm ±5% 1/4W CF	569-0513-472
R 724	10 ohm ±5% 1/4W CF	569-0513-100
R 725	100k ohm ±5% 1/4W CF	569-0513-104
R 726	10k ohm ±5% 1/4W CF	569-0513-103
R 727	33k ohm ±5% 1/4W CF	569-0513-333
R 728	2.2k ohm ±5% 1/4W CF	569-0513-222
R 729	82k ohm ±10% 1/4W	569-1502-823
R 730	330k ohm ±5% 1/4W CF	569-0513-334
R 731	10k ohm ±5% 1/4W CF	569-0513-103
R 732	10k ohm ±5% 1/4W CF	569-0513-103
R 733	330k ohm ±5% 1/4W CF	569-0513-334
R 734	82k ohm ±10% 1/4W	569-1502-823
R 735	2.2k ohm ±5% 1/4W CF	569-0513-222
R 736	10 ohm ±5% 1/4W CF	569-0513-100
R 737	10k ohm ±5% 1/4W CF	569-0513-103
R 738	10k ohm ±5% 1/4W CF	569-0513-103
R 739	100k ohm ±5% 1/4W CF	569-0513-104

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 740	10k ohm ±5% 1/4W CF	569-0513-103
R 741	10 ohm ±5% 1/4W CF	569-0513-100
R 742	10 ohm ±5% 1/4W CF	569-0513-100
R 743	15k ohm ±5% 1/4W CF	569-0513-153
R 744	1k ohm ±5% 1/4W CF	569-0513-102
R 745	100k ohm ±5% 1/4W CF	569-0513-104
R 746	10 ohm ±5% 1/4W CF	569-0513-100
R 747	1k ohm ±5% 1/4W CF	569-0513-102
R 748	10k ohm ±5% 1/4W CF	569-0513-103
R 749	10 ohm ±5% 1/4W CF	569-0513-100
R 751	100k ohm ±5% 1/4W CF	569-0513-104
R 752	100k ohm ±5% 1/4W CF	569-0513-104
R 753	100k ohm ±5% 1/4W CF	569-0513-104
R 754	100k ohm ±5% 1/4W CF	569-0513-104
R 755	10k ohm ±5% 1/4W CF	569-0513-103
R 756	10k ohm ±5% 1/4W CF	569-0513-103
R 757	100k ohm ±5% 1/4W CF	569-0513-104
R 758	100k ohm ±5% 1/4W CF	569-0513-104
R 759	100k ohm ±5% 1/4W CF	569-0513-104
R 761	10k ohm ±5% 1/4W CF	569-0513-103
TP701	Black feedthru terminal	260-0203-001
U 700	PC board	035-0355-040
U 701	Quad analog switch	544-3014-016

TYPE-A CALL GUARD CARD
PART NO. 023-3823-056

C 500	1 µF ±10% 35V tantalum	510-2575-109
C 501	.1 µF 100V polycarb	510-1015-104
C 502	.1 µF 100V polycarb	510-1015-104
C 503	6.8 µF ±20% 35V tantalum	510-2245-689
C 504	1000 pF ±20% 50V Y5U cer	510-3204-102
C 505	1 µF ±20% 35V tantalum	510-2245-109
C 506	1 µF ±20% 35V tantalum	510-2245-109
C 507	1 µF ±20% 35V tantalum	510-2245-109
C 508	.1 µF 100V polycarb	510-1015-104
C 509	.1 µF 100V polycarb	510-1015-104
C 510	6.8 µF ±20% 35V tantalum	510-2245-689
C 511	1000 pF ±20% 50V Y5U cer	510-3204-102
C 512	1 µF ±20% 35V tantalum	510-2245-109
C 513	33 pF ±5% 50V NPO cer disc	510-3213-330
C 514	3.3 µF ±10% 15V tantalum	510-2073-339
C 516	1 µF ±10% 35V tantalum	510-2575-109
CR001	Ge diode 1N67A	523-1500-067
CR002	Ge diode 1N67A	523-1500-067
CR500	Si diode 1N4448	523-1500-883
CR501	Si diode 1N4448	523-1500-883
CR502	Diode 1N881/1N645	523-1500-881
CR503	Red LED	549-4001-001
CR504	Si diode 1N4448	523-1500-883
CR505	Si diode 1N4448	523-1500-883
EP500	Receptacle	586-3503-001
HW501	1/4" 6-32 panhead taptite	575-0606-008
HW502	2-56 x 0.063 nut NPB	560-2102-006
HW503	2-56 panhead philips ZPS	575-1602-008
HW504	Wire tie	574-9008-001
HW505	Panel mount LED socket	550-0006-100
MP500	PC board bracket	017-2007-014
PC500	PC board	035-0355-056
Q 500	Si PNP 50 MHz amp TO-92	576-0003-017
Q 501	Si PNP 50 MHz amp TO-92	576-0003-017
Q 502	Si NPN Darlington TO-92	576-0007-001
Q 503	Si PNP 50 MHz amp TO-92	576-0003-017
Q 504	J-FET low noise RF TO-92	576-0006-009
Q 505	Si NPN gen purp TO-92	576-0003-058
Q 506	Si NPN gen purp TO-92	576-0003-058
Q 507	Si NPN gen purp TO-92	576-0003-058
R 001	2.2k ohm ±5% 1/4W CF	569-0513-222
R 002	10k ohm ±5% 1/4W CF	569-0513-103
R 003	10k ohm ±5% 1/4W CF	569-0513-103
R 004	2.2k ohm ±5% 1/4W CF	569-0513-222
R 005	10k ohm ±5% 1/4W CF	569-0513-103
R 007	1k ohm ±5% 1/4W CF	569-0513-102
R 500	470k ohm ±5% 1/4W CF	569-0513-474
R 501	470k ohm ±5% 1/4W CF	569-0513-474
R 502	1k ohm ±5% 1/4W CF	569-0513-102
R 503	820k ohm ±5% 1/4W CF	569-0513-824
R 504	820k ohm ±5% 1/4W CF	569-0513-824
R 505	30.9k ohm ±1% 1/8W MF	569-0520-448
R 506	15k ohm ±1% 1/8W MF	569-0520-418
R 507	25k ohm multi-turn trim pot	562-0108-253
R 508	10k ohm ±1% 1/8W MF	569-0520-401
R 509	10k ohm ±1% 1/8W MF	569-0520-401
R 510	390k ohm ±5% 1/4W CF	569-0513-391
R 511	10k ohm ±1% 1/8W MF	569-0520-401

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 512	1k ohm ±1% 1/8W MF	569-0520-301
R 513	1k ohm ±1% 1/8W MF	569-0520-301
R 514	10 ohm ±5% 1/4W CF	569-0513-100
R 515	100k ohm ±5% 1/4W CF	569-0513-104
R 516	1k ohm ±5% 1/4W CF	569-0513-102
R 517	10k ohm ±5% 1/4W CF	569-0513-103
R 518	10k ohm ±5% 1/4W CF	569-0513-103
R 519	15k ohm ±1% 1/8W MF	569-0520-418
R 520	100k ohm ±1% 1/8W MF	569-0520-501
R 521	270k ohm ±5% 1/4W CF	569-0513-274
R 522	100k ohm ±5% 1/4W CF	569-0513-104
R 523	1k ohm ±5% 1/4W CF	569-0513-102
R 524	10k ohm ±5% 1/4W CF	569-0513-103
R 526	10 ohm ±5% 1/4W CF	569-0513-100
R 527	10k ohm ±5% 1/4W CF	569-0513-103
R 528	10 ohm ±5% 1/4W CF	569-0513-100
R 529	470k ohm ±5% 1/4W CF	569-0513-474
R 530	1k ohm ±5% 1/4W CF	569-0513-102
R 531	390k ohm ±5% 1/4W CF	569-0513-391
R 532	390k ohm ±5% 1/4W CF	569-0513-391
R 533	30.9k ohm ±1% 1/8W MF	569-0520-448
R 534	15k ohm ±1% 1/8W MF	569-0520-418
R 535	25k ohm multi-turn trim pot	562-0108-253
R 536	10k ohm ±1% 1/8W MF	569-0520-401
R 537	10k ohm ±1% 1/8W MF	569-0520-401
R 538	10k ohm ±1% 1/8W MF	569-0520-401
R 539	100k ohm ±5% 1/4W CF	569-0513-104
R 541	1.2k ohm ±5% 1/4W CF	569-0513-122
R 542	1M ohm ±5% 1/4W CF	569-0513-105
R 543	1k ohm ±1% 1/8W MF	569-0520-301
R 544	1k ohm ±1% 1/8W MF	569-0520-301
R 545	10 ohm ±5% 1/4W CF	569-0513-100
R 546	1M ohm ±5% 1/4W CF	569-0513-105
R 547	1M ohm ±5% 1/4W CF	569-0513-105
R 548	22k ohm ±5% 1/4W CF	569-0513-223
R 549	22k ohm ±5% 1/4W CF	569-0513-223
R 550	470k ohm ±5% 1/4W CF	569-0513-474
S 500	Sub-miniature switch PC mt	583-3001-211
S 501	DPDT slide switch	583-3003-001
TP500	Tip jack vertical PC mount	105-0860-001
TP501	Brown vertical tip jack .08	105-2208-211
TP502	Red vertical tip jack .08	105-2202-211
U 501	Quad op amp 224	544-2020-001
U 502	Quad op amp 224	544-2020-001

4-TONE CALL GUARD CARD
PART NO. 023-3823-050

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
A 500	Switch harness assembly	023-3823-051
C 500	1 µF ±10% 35V tantalum	510-2575-109
C 501	.1 µF 100V polycarbon	510-1015-104
C 502	.1 µF 100V polycarbon	510-1015-104
C 503	6.8 µF ±20% 35V tantalum	510-2245-689
C 504	1000 pF ±20% 50V Y5U cer	510-3204-102
C 505	1 µF ±20% 35V tantalum	510-2245-109
C 506	1 µF ±20% 35V tantalum	510-2245-109
C 507	1 µF ±10% 35V tantalum	510-2575-109
C 508	.1 µF 100V polycarbon	510-1015-104
C 509	.1 µF 100V polycarbon	510-1015-104
C 510	6.8 µF ±20% 35V tantalum	510-2245-689
C 511	1000 pF ±20% 50V Y5U cer	510-3204-102
C 512	1 µF ±20% 35V tantalum	510-2245-109
C 513	1 µF ±20% 35V tantalum	510-2245-109
C 514	1 µF ±10% 35V tantalum	510-2575-109
C 515	.1 µF 100V polycarbon	510-1015-104
C 516	.1 µF 100V polycarbon	510-1015-104
C 517	6.8 µF ±20% 35V tantalum	510-2245-689
C 518	1000 pF ±20% 50V Y5U cer	510-3204-102
C 519	1 µF ±20% 35V tantalum	510-2245-109
C 520	1 µF ±20% 35V tantalum	510-2245-109
C 521	1 µF ±10% 35V tantalum	510-2575-109
C 522	.1 µF 100V polycarbon	510-1015-104
C 523	.1 µF 100V polycarbon	510-1015-104
C 524	6.8 µF ±20% 35V tantalum	510-2245-689
C 525	1000 pF ±20% 50V Y5U cer	510-3204-102
C 526	1 µF ±20% 35V tantalum	510-2245-109
C 527	1 µF ±20% 35V tantalum	510-2245-109
C 528	33 pF ±5% 50V NPO cer disc	510-3213-330
C 529	1 µF ±10% 35V tantalum	510-2575-109
CR500	Diode 1N881/1N645	523-1500-881
CR501	Diode 1N881/1N645	523-1500-881
CR502	Diode 1N881/1N645	523-1500-881
CR503	Diode 1N881/1N645	523-1500-881
CR504	Red LED	549-4001-001
CR505	Red LED	549-4001-001
CR506	Red LED	549-4001-001
CR507	Red LED	549-4001-001
CR508	Si diode 1N448	523-1500-883
CR509	Si diode 1N448	523-1500-883
CR510	Si diode 1N448	523-1500-883

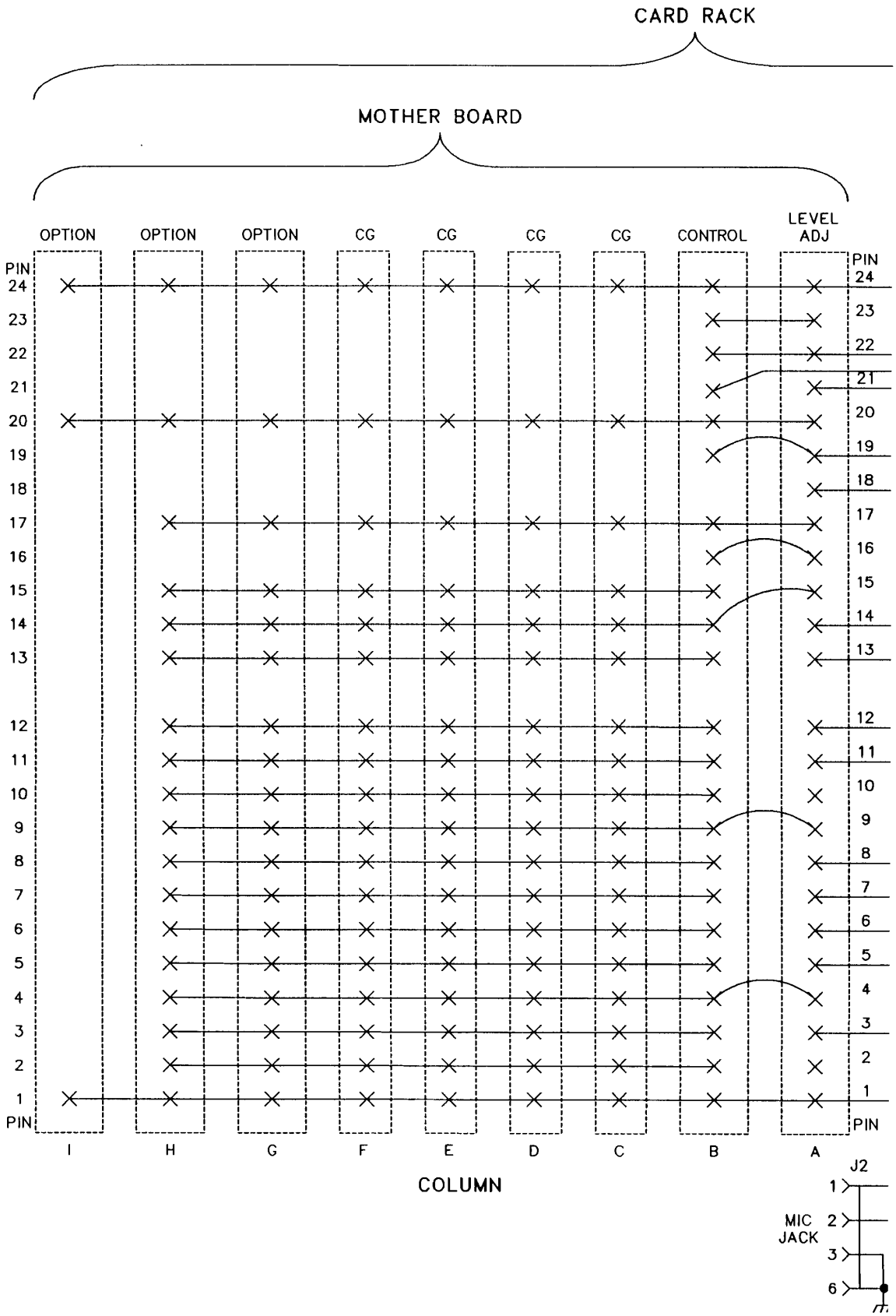
SYMBOL NUMBER	DESCRIPTION	PART NUMBER
CR511	Si diode 1N448	523-1500-883
CR512	Si diode 1N448	523-1500-883
CR513	Si diode 1N448	523-1500-883
CR514	Si diode 1N448	523-1500-883
CR515	Si diode 1N448	523-1500-883
EP500	Receptacle	586-3503-001
HW501	1/4" 6-32 panhead taptite	575-0606-008
HW502	1/4" 32 x 0.094 hex nut NPB	560-9043-012
HW504	Panel mount LED socket	550-0006-100
HW505	Panel mount LED socket	550-0006-100
HW506	Panel mount LED socket	550-0006-100
HW507	Panel mount LED socket	550-0006-100
MP500	Bracket	017-2007-012
MP501	Knob machined .425 long	032-0767-022
Q 500	Si PNP 50 MHz amp TO-92	576-0003-017
Q 501	Si NPN Darlington TO-92	576-0007-001
Q 502	Si PNP 50 MHz amp TO-92	576-0003-017
Q 503	Si NPN Darlington TO-92	576-0007-001
Q 504	Si PNP 50 MHz amp TO-92	576-0003-017
Q 505	Si NPN Darlington TO-92	576-0007-001
Q 506	Si PNP 50 MHz amp TO-92	576-0003-017
Q 507	Si NPN Darlington TO-92	576-0007-001
Q 508	Si PNP 50 MHz amp TO-92	576-0003-017
R 500	470k ohm ±5% 1/4W CF	569-0513-474
R 501	470k ohm ±5% 1/4W CF	569-0513-474
R 502	820k ohm ±5% 1/4W CF	569-0513-824
R 503	820k ohm ±5% 1/4W CF	569-0513-824
R 504	30.9k ohm ±1% 1/8W MF	569-0520-448
R 505	15k ohm ±1% 1/8W MF	569-0520-418
R 506	25k ohm multi-turn trim pot	562-0108-253
R 507	10k ohm ±1% 1/8W MF	569-0520-401
R 508	10k ohm ±1% 1/8W MF	569-0520-401
R 509	10k ohm ±1% 1/8W MF	569-0520-401
R 510	1k ohm ±1% 1/8W MF	569-0520-301
R 511	1k ohm ±1% 1/8W MF	569-0520-301
R 512	10 ohm ±5% 1/4W CF	569-0513-100
R 513	1k ohm ±1% 1/8W MF	569-0520-301
R 514	10k ohm ±5% 1/4W CF	569-0513-103
R 515	100k ohm ±5% 1/4W CF	569-0513-104
R 516	10k ohm ±5% 1/4W CF	569-0513-103
R 517	15k ohm ±1% 1/8W MF	569-0520-418
R 518	100k ohm ±1% 1/8W MF	569-0520-501
R 519	270k ohm ±5% 1/4W CF	569-0513-274
R 520	100k ohm ±5% 1/4W CF	569-0513-104
R 521	470k ohm ±5% 1/4W CF	569-0513-474
R 522	470k ohm ±5% 1/4W CF	569-0513-474
R 523	820k ohm ±5% 1/4W CF	569-0513-824
R 524	820k ohm ±5% 1/4W CF	569-0513-824
R 525	30.9k ohm ±1% 1/8W MF	569-0520-448
R 526	15k ohm ±1% 1/8W MF	569-0520-418
R 527	25k ohm multi-turn trim pot	562-0108-253
R 528	10k ohm ±1% 1/8W MF	569-0520-401
R 529	10k ohm ±1% 1/8W MF	569-0520-401
R 530	10k ohm ±1% 1/8W MF	569-0520-401
R 531	1k ohm ±1% 1/8W MF	569-0520-301
R 532	1k ohm ±1% 1/8W MF	569-0520-301
R 533	10 ohm ±5% 1/4W CF	569-0513-100
R 534	1k ohm ±1% 1/8W MF	569-0520-301
R 535	10k ohm ±5% 1/4W CF	569-0513-103
R 536	100k ohm ±5% 1/4W CF	569-0513-104
R 537	10k ohm ±5% 1/4W CF	569-0513-103
R 538	15k ohm ±1% 1/8W MF	569-0520-418
R 539	100k ohm ±1% 1/8W MF	569-0520-501
R 540	270k ohm ±5% 1/4W CF	569-0513-274
R 541	100k ohm ±5% 1/4W CF	569-0513-104
R 542	470k ohm ±5% 1/4W CF	569-0513-474
R 543	470k ohm ±5% 1/4W CF	569-0513-474
R 544	820k ohm ±5% 1/4W CF	569-0513-824
R 545	820k ohm ±5% 1/4W CF	569-0513-824
R 546	30.9k ohm ±1% 1/8W MF	569-0520-448
R 547	15k ohm ±1% 1/8W MF	569-0520-418
R 548	25k ohm multi-turn trim pot	562-0108-253
R 549	10k ohm ±1% 1/8W MF	569-0520-401
R 550	10k ohm ±1% 1/8W MF	569-0520-401
R 540	270k ohm ±5% 1/4W CF	569-0513-274
R 541	100k ohm ±5% 1/4W CF	569-0513-104
R 542	470k ohm ±5% 1/4W CF	569-0513-474
R 543	470k ohm ±5% 1/4W CF	569-0513-474
R 544	820k ohm ±5% 1/4W CF	569-0513-824
R 545	820k ohm ±5% 1/4W CF	569-0513-824
R 546	30.9k ohm ±1% 1/8W MF	569-0520-448
R 547	15k ohm ±1% 1/8W MF	569-0520-418
R 548	25k ohm multi-turn trim pot	562-0108-253
R 549	10k ohm ±1% 1/8W MF	569-0520-401
R 550	10k ohm ±1% 1/8W MF	569-0520-401

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R 551	10k ohm ±1% 1/8W MF	569-0520-401
R 552	1k ohm ±1% 1/8W MF	569-0520-301
R 553	1k ohm ±1% 1/8W MF	569-0520-301
R 554	10 ohm ±5% 1/4W CF	569-0513-100
R 555	1k ohm ±1% 1/8W MF	569-0520-301
R 556	10k ohm ±5% 1/4W CF	569-0513-103
R 557	100k ohm ±5% 1/4W CF	569-0513-104
R 558	10k ohm ±5% 1/4W CF	569-0513-103
R 559	15k ohm ±1% 1/8W MF	569-0520-418
R 560	100k ohm ±1% 1/8W MF	569-0520-501
R 561	270k ohm ±5% 1/4W CF	569-0513-274
R 562	100k ohm ±5% 1/4W CF	569-0513-104
R 563	470k ohm ±5% 1/4W CF	569-0513-474
R 564	470k ohm ±5% 1/4W CF	569-0513-474
R 565	820k ohm ±5% 1/4W CF	569-0513-824
R 566	820k ohm ±5% 1/4W CF	569-0513-824
R 567	30.9k ohm ±1% 1/8W MF	569-0520-448
R 568	15k ohm ±1% 1/8W MF	569-0520-418
R 569	25k ohm multi-turn trim pot	562-0108-253
R 570	10k ohm ±1% 1/8W MF	569-0520-401
R 571	10k ohm ±1% 1/8W MF	569-0520-401
R 572	10k ohm ±1% 1/8W MF	569-0520-401
R 573	1k ohm ±1% 1/8W MF	569-0520-301
R 574	1k ohm ±1% 1/8W MF	569-0520-301
R 575	10 ohm ±5% 1/4W CF	569-0513-100
R 576	1k ohm ±1% 1/8W MF	569-0520-301
R 577	10k ohm ±5% 1/4W CF	569-0513-103
R 578	100k ohm ±5% 1/4W CF	569-0513-104
R 579	10k ohm ±5% 1/4W CF	569-0513-103
R 580	15k ohm ±1% 1/8W MF	569-0520-418
R 581	100k ohm ±1% 1/8W MF	569-0520-501
R 582	270k ohm ±5% 1/4W CF	569-0513-274
R 583	100k ohm ±5% 1/4W CF	569-0513-104
R 584	470k ohm ±5% 1/4W CF	569-0513-474
R 585	470k ohm ±5% 1/4W CF	569-0513-474
R 586	820k ohm ±5% 1/4W CF	569-0513-824
R 587	820k ohm ±5% 1/4W CF	569-0513-824
R 588	390k ohm ±5% 1/4W CF	569-0513-394
R 589	1k ohm ±5% 1/4W CF	569-0513-102
R 590	390k ohm ±5% 1/4W CF	569-0513-394
R 591	1k ohm ±5% 1/4W CF	569-0513-102
R 592	390k ohm ±5% 1/4W CF	569-0513-394
R 593	1k ohm ±5% 1/4W CF	569-0513-102
R 594	390k ohm ±5% 1/4W CF	569-0513-394
R 595	22k ohm ±5% 1/4W CF	569-0513-223
R 596	22k ohm ±5% 1/4W CF	569-0513-223
R 597	22k ohm ±5% 1/4W CF	569-0513-223
R 598	22k ohm ±5% 1/4W CF	569-0513-223
S 500	Switch	583-2036-007
S 501	Sub-miniature switch PC mt	583-3001-211
S 502	Sub-miniature switch PC mt	583-3001-211
S 503	Sub-miniature switch PC mt	583-3001-211
S 504	Sub-miniature switch PC mt	583-3001-211
TP501	Brown vertical tip jack .08	105-2208-211
TP502	Red vertical tip jack .08	105-2202-211
TP503	Orange vertical tip jack .08	105-2206-211
TP504	Yellow vertical tip jack .08	105-2207-211
TP505	Tip jack vertical PT mount	105-0860-001
U 500	PC board	035-0355-050
U 501	Quad op amp 224	544-2020-001
U 502	Quad op amp 224	544-2020-001
U 503	Quad op amp 224	544-2020-001
U 504	Quad op amp 224	544-2020-001
	CW IDENTIFIER CARD PART NO. 023-3823-330	
BK001	PC board bracket assembly	017-2007-015
C 001	.1 µF ±10% 250V flat foil	510-1203-104
C 002	.33 µF ±10% 35V molded tant	510-2033-338
C 003	1000 pF ±20% 1kV Y5S cer	510-3261-102
C 004	1000 pF ±20% 1kV Y5S cer	510-3261-102
C 005	1000 pF ±20% 1kV Y5S cer	510-3261-102
C 006	.33 µF ±10% 35V molded tant	510-2033-338
C 007	6.8 µF ±20% 35V tantalum	510-2245-689
C 008	1000 pF ±20% 1kV Y5S cer	510-3261-102
C 009	100 µF 10V alum electrolytic	510-4003-005
C 010	.12 µF ±10% 25V flat foil	510-1203-124
C 011	.12 µF ±10% 25V flat foil	510-1203-124
C 012	1 µF ±20% 35V tantalum	510-2245-109
C 013	1 µF ±20% 35V tantalum	510-2245-109
C 014	1 µF ±20% 35V tantalum	510-2245-109
C 015	150 µF 25V alum electrolytic	510-4006-006
CR001	Si diode 1N4448	523-1500-883
CR002	6.2V ±5% 1W zener	523-2503-629
CR003	Red LED	549-4001-001
CR004	Si diode 1N4448	523-1500-883
CR005	Si diode 1N4448	523-1500-883
CR006	Si diode 1N4448	523-1500-883

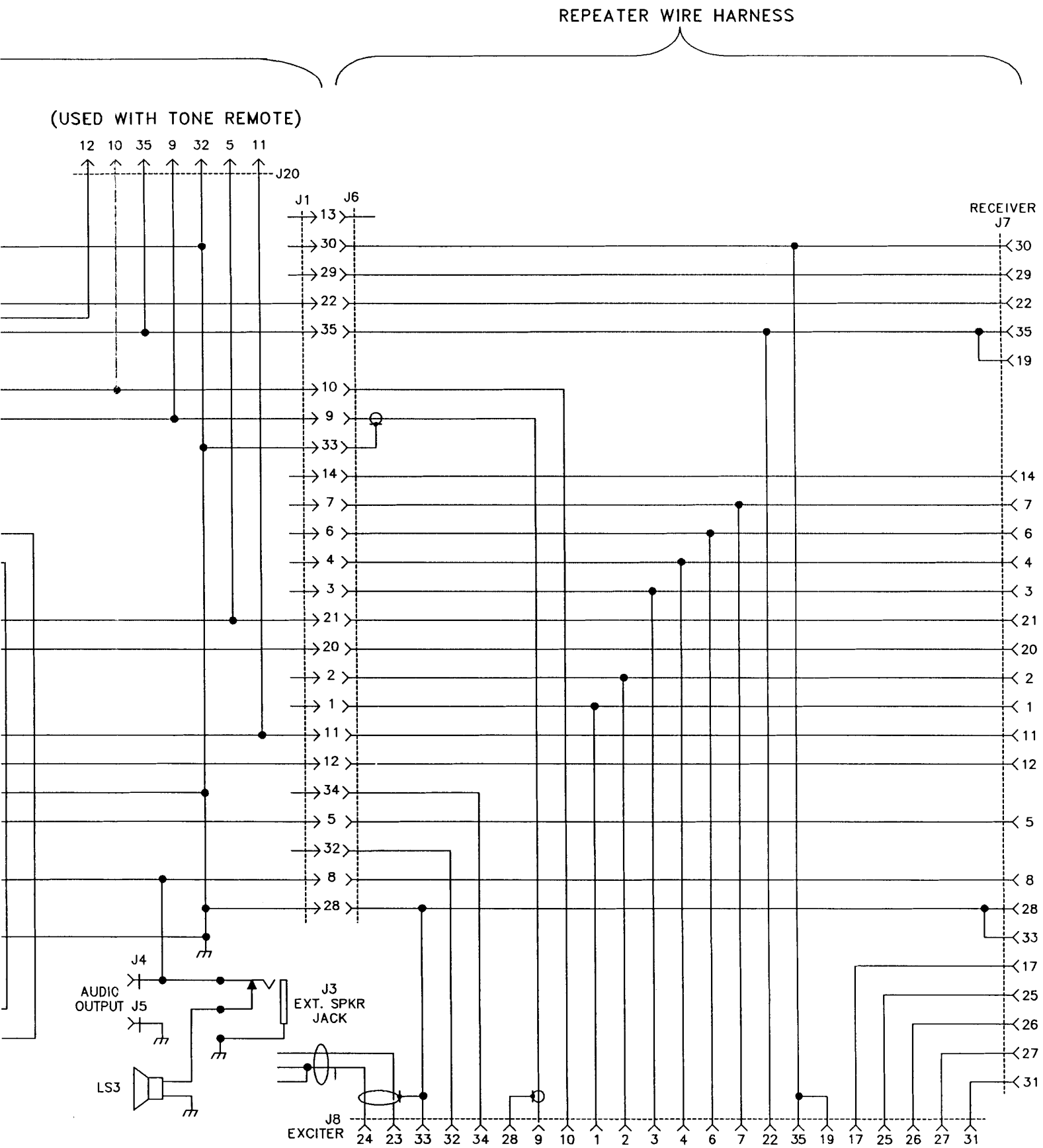
SYMBOL NUMBER	DESCRIPTION	PART NUMBER
EP500	Receptacle	586-3503-001
HW001	1/4" 6-32 panhead taptite	575-0606-010
HW003	Panel mount LED socket	550-0006-100
Q 001	Si NPN audio driver MPS-U01	576-0002-027
Q 003	Si NPN gen purp TO-92	576-0003-058
Q 004	Si NPN 50 MHz amp TO-92	576-0003-017
Q 005	Si PNP 50 MHz amp TO-92	576-0003-017
Q 006	Si NPN gen purp TO-92	576-0003-058
Q 007	J-FET low noise RF TO-92	576-0006-009
Q 008	Si NPN Darlington To-92	576-0007-001
R 001	1M ohm ±5% 1/4W CF	569-0513-105
R 002	200k ohm 1/8W PC trim pot	562-0004-204
R 003	150k ohm ±10% 1/4W	569-1502-154
R 004	10k ohm ±5% 1/4W CF	569-0513-103
R 005	10k ohm ±5% 1/4W CF	569-0513-103
R 006	10k ohm ±5% 1/4W CF	569-0513-103
R 007	1M ohm ±5% 1/4W CF	569-0513-105
R 008	200k ohm 1/8W PC trim pot	562-0004-204
R 009	150k ohm ±10% 1/4W	569-1502-154
R 011	10k ohm ±5% 1/4W CF	569-0513-103
R 012	10k ohm ±5% 1/4W CF	569-0513-103
R 013	10k ohm ±5% 1/4W CF	569-0513-103
R 014	100k ohm ±5% 1/4W CF	569-0513-104
R 015	100k ohm ±5% 1/4W CF	569-0513-104
R 016	10k ohm ±5% 1/4W CF	569-0513-103
R 017	10k ohm ±5% 1/4W CF	569-0513-103
R 018	100 ohm ±10% 1/2W	569-1504-101
R 021	10k ohm ±5% 1/4W CF	569-0513-103
R 022	1k ohm ±5% 1/4W CF	569-0513-102
R 023	470 ohm ±5% 1/4W CF	569-0513-471
R 024	5.6k ohm ±5% 1/4W CF	569-0513-562
R 025	10k ohm ±5% 1/4W CF	569-0513-103
R 026	470 ohm ±5% 1/4W CF	569-0513-471
R 027	50k ohm 1/8W PC trim pot	562-0004-503
R 028	33k ohm ±5% 1/4W CF	569-0513-333
R 029	470k ohm ±5% 1/4W CF	569-0513-474
R 030	100k ohm ±5% 1/4W CF	569-0513-104
R 031	470k ohm ±5% 1/4W CF	569-0513-474
R 032	1k ohm ±5% 1/4W CF	569-0513-102
R 050	470k ohm ±5% 1/4W CF	569-0513-474
S 001	Sub-miniature switch PC mt	583-3001-211
S 002	SPST pushbutton switch	583-4007-001

SYMBOL NUMBER	DESCRIPTION	PART NUMBER
U 001	Quad 2-input NOR	544-3001-103
U 002	Quad 2-input NOR	544-3001-103
U 003	Quad 2-input NOR	544-3001-103
U 004	12-bit binary counter 4040B	544-3014-040
U 005	12-bit binary counter 4040B	544-3014-040
U 006	Bi-polar PROM 1k	544-9050-010
U 007	PC board	035-0355-065
X 001	IC socket	515-5008-002

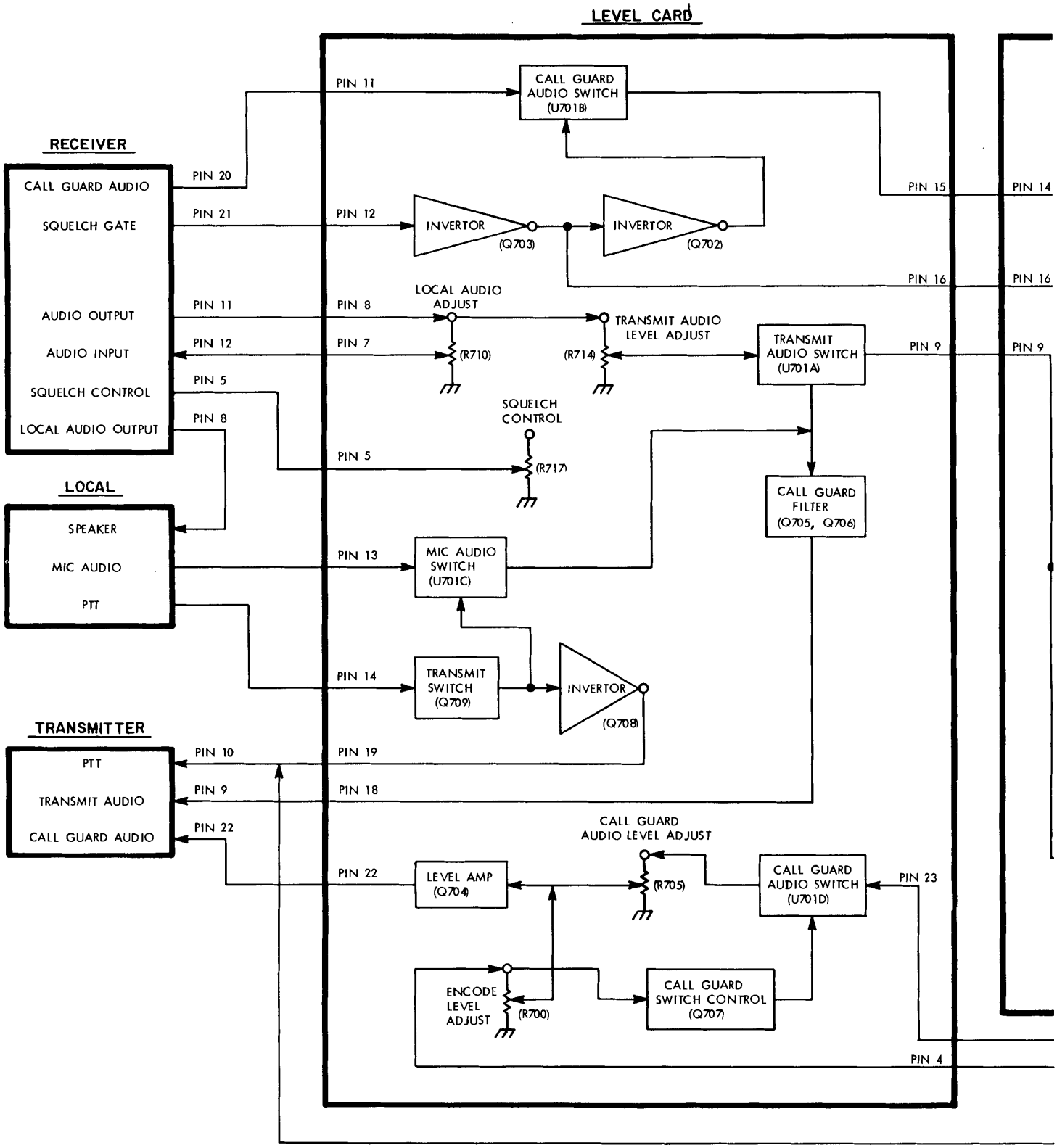
SECTION 7
SCHEMATIC DIAGRAMS AND COMPONENT LAYOUTS

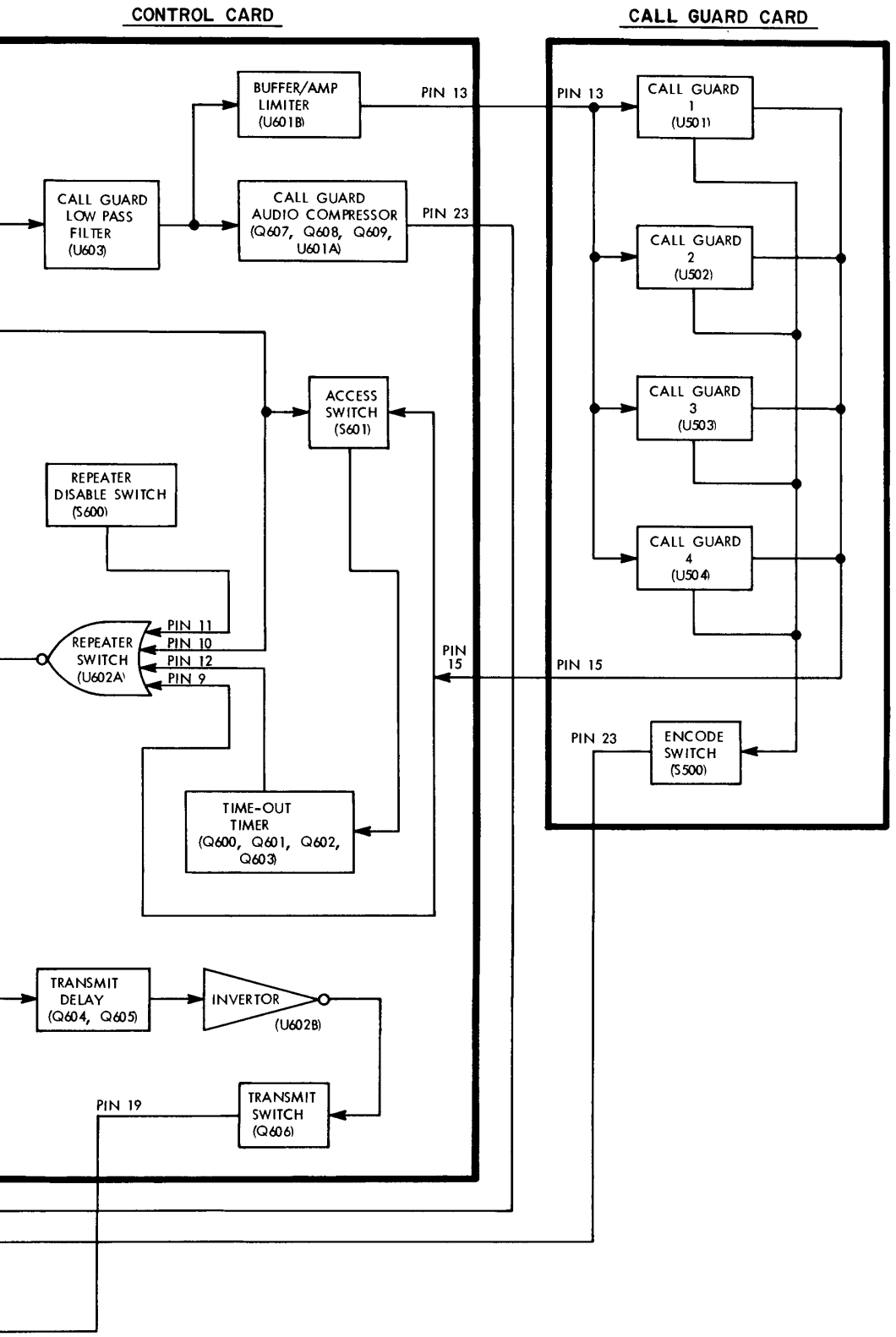


CARD RACK WIRING DIAGRAM
FIGURE 7–1

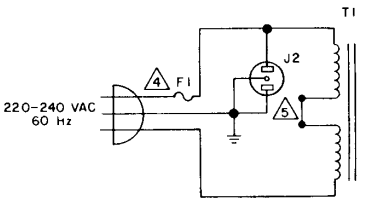

REPEATER WIRE HARNESS
(USED WITH TONE REMOTE)
12 10 35 9 32 5 11
J20
J1
J6
13
30
29
22
35
10
9
33
14
7
6
4
3
21
20
2
1
11
12
34
5
32
8
28
RECEIVER
J7
30
29
22
35
19
14
7
6
4
3
21
20
2
1
11
12
5
8
28
33
17
25
26
27
31
J4
AUDIC
OUTPUT J5
J3
EXT. SPKR
JACK
LS3
J8
EXCITER
24 23 33 32 34 28 9 10 1 2 3 4 6 7 22 35 19 17 25 26 27 31

FOLDOUT→

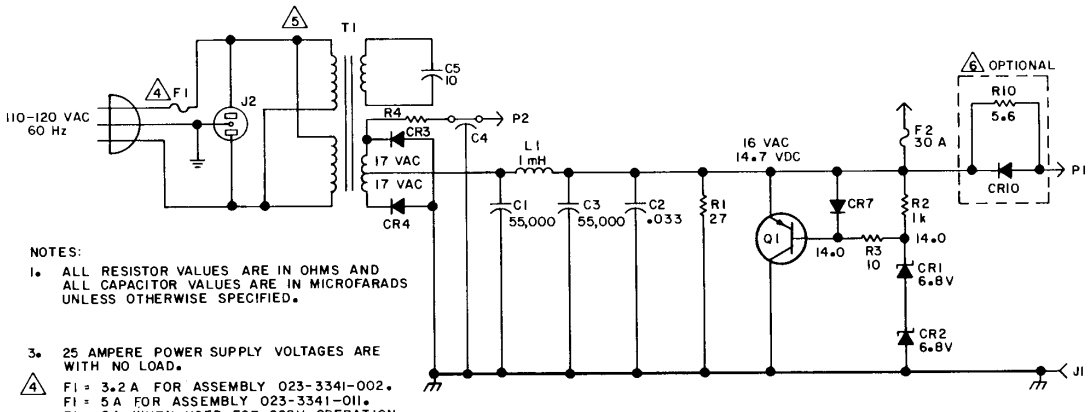

LEVEL CARD
RECEIVER
CALL GUARD AUDIO
SQUELCH GATE
AUDIO OUTPUT
AUDIO INPUT
SQUELCH CONTROL
LOCAL AUDIO OUTPUT
LOCAL
SPEAKER
MIC AUDIO
PTT
TRANSMITTER
PTT
TRANSMIT AUDIO
CALL GUARD AUDIO
PIN 20
PIN 21
PIN 11
PIN 12
PIN 5
PIN 8
PIN 10
PIN 9
PIN 22
PIN 11
PIN 12
PIN 13
PIN 14
PIN 10
PIN 9
PIN 22
CALL GUARD AUDIO SWITCH (U701B)
INVERTOR (Q703)
INVERTOR (Q702)
LOCAL AUDIO ADJUST
(R710)
TRANSMIT AUDIO LEVEL ADJUST
(R714)
TRANSMIT AUDIO SWITCH (U701A)
SQUELCH CONTROL
(R717)
CALL GUARD FILTER (Q705, Q706)
MIC AUDIO SWITCH (U701C)
TRANSMIT SWITCH (Q709)
INVERTOR (Q708)
CALL GUARD AUDIO LEVEL ADJUST
LEVEL AMP (Q704)
(R705)
CALL GUARD AUDIO SWITCH (U701D)
ENCODE LEVEL ADJUST
(R700)
CALL GUARD SWITCH CONTROL (Q707)
PIN 8
PIN 7
PIN 5
PIN 13
PIN 14
PIN 19
PIN 18
PIN 22
PIN 15
PIN 16
PIN 9
PIN 23
PIN 4
PIN 14
PIN 16
PIN 9



CARD RACK BLOCK DIAGRAM
FIGURE 7–2



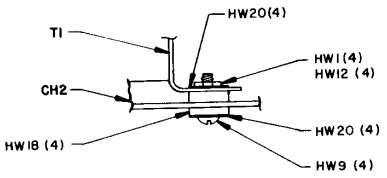
DETAIL A



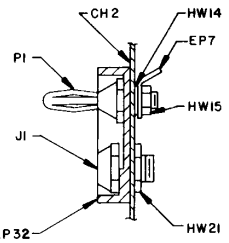
NOTES:

1. ALL RESISTOR VALUES ARE IN OHMS AND ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. 25 AMPERE POWER SUPPLY VOLTAGES ARE WITH NO LOAD.
4. F1 = 3.2A FOR ASSEMBLY 023-3341-002. F1 = 5A FOR ASSEMBLY 023-3341-011. F1 = 2A WHEN USED FOR 220V OPERATION.
5. FOR 110V AC INPUT, PRIMARY WINDINGS ARE IN PARALLEL. FOR 220V AC INPUT, PRIMARY WINDINGS ARE IN SERIES AS IN DETAIL A.
6. THIS BATTERY TAKEOVER AND CHARGE CKT IS OPTIONAL (023-3823-325)

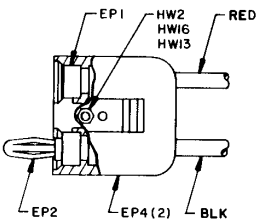
25A POWER SUPPLY SCHEMATIC
FIGURE 7-3



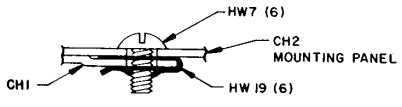
DETAIL A



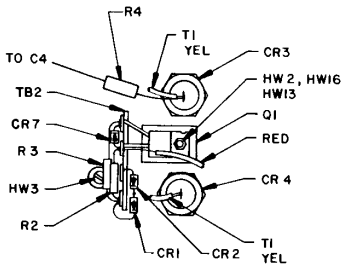
DETAIL B



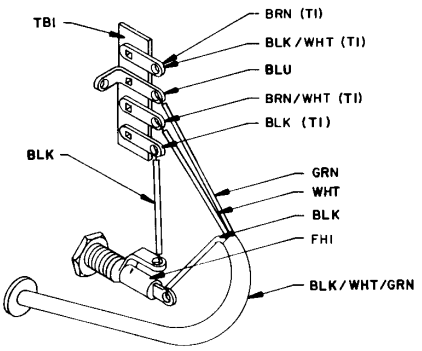
DETAIL C



DETAIL D

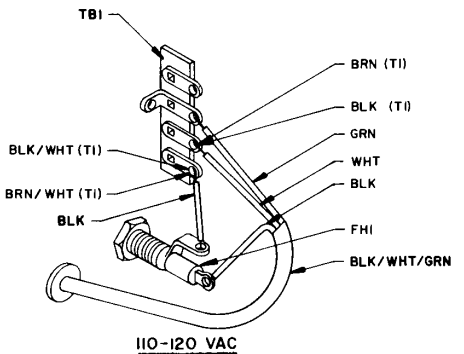


DETAIL E

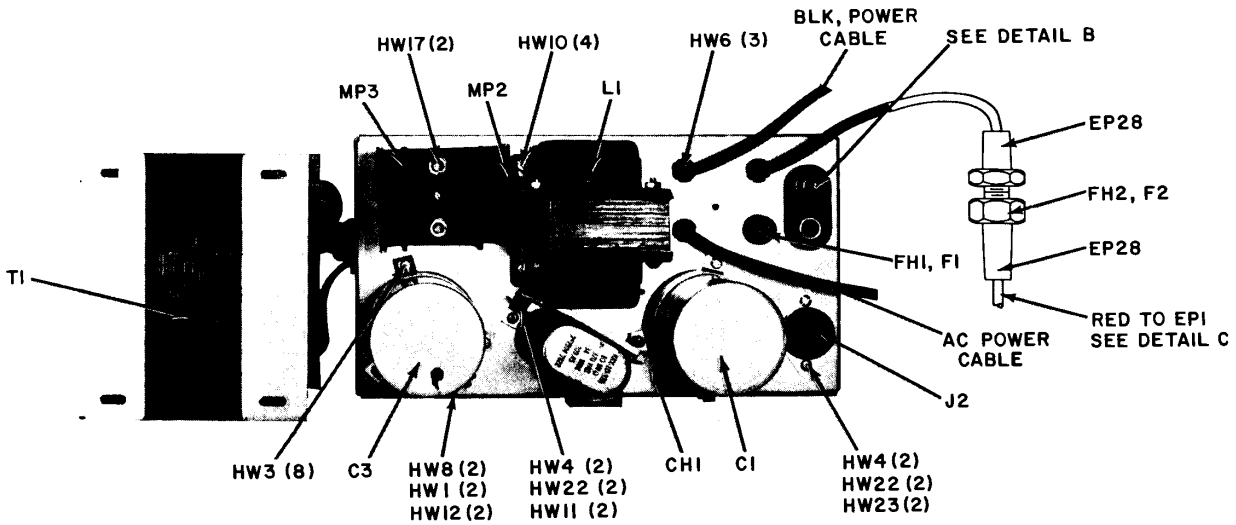


220-230 VAC

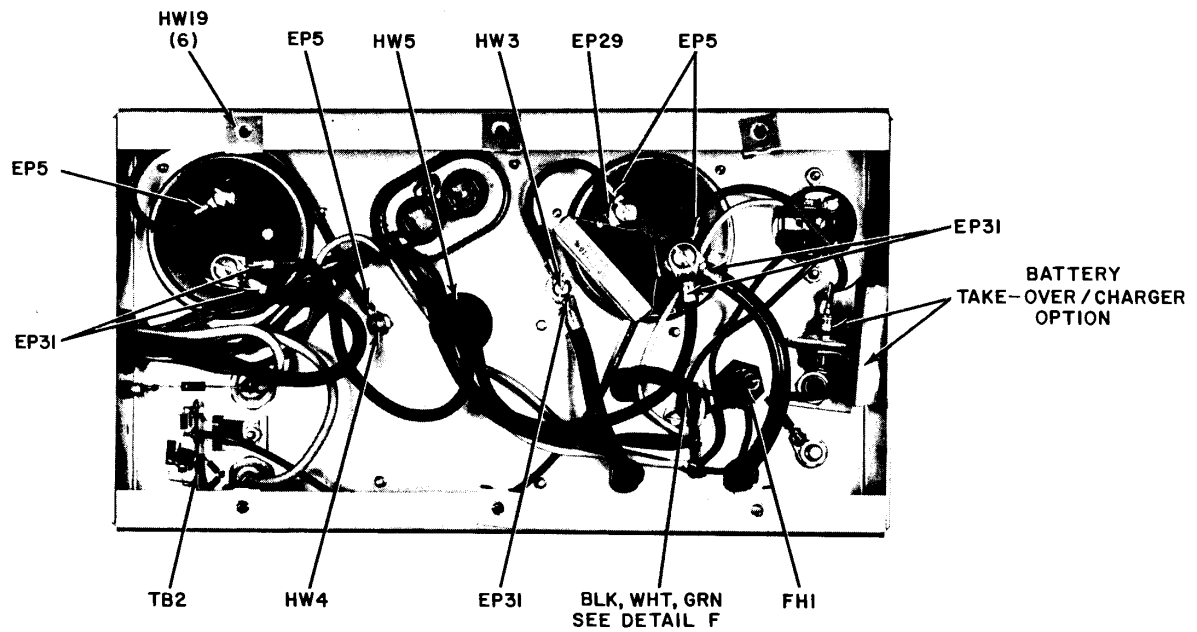
DETAIL F



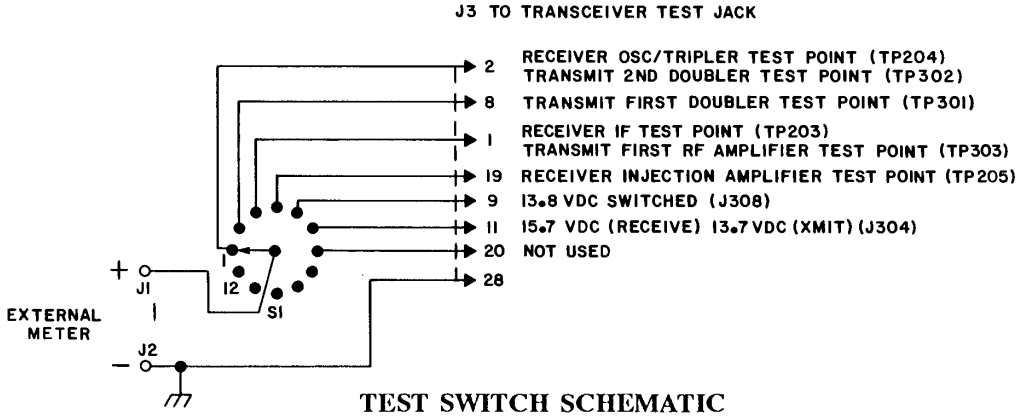
110-120 VAC



25A POWER SUPPLY COMPONENT LAYOUT (TOP)
FIGURE 7–4

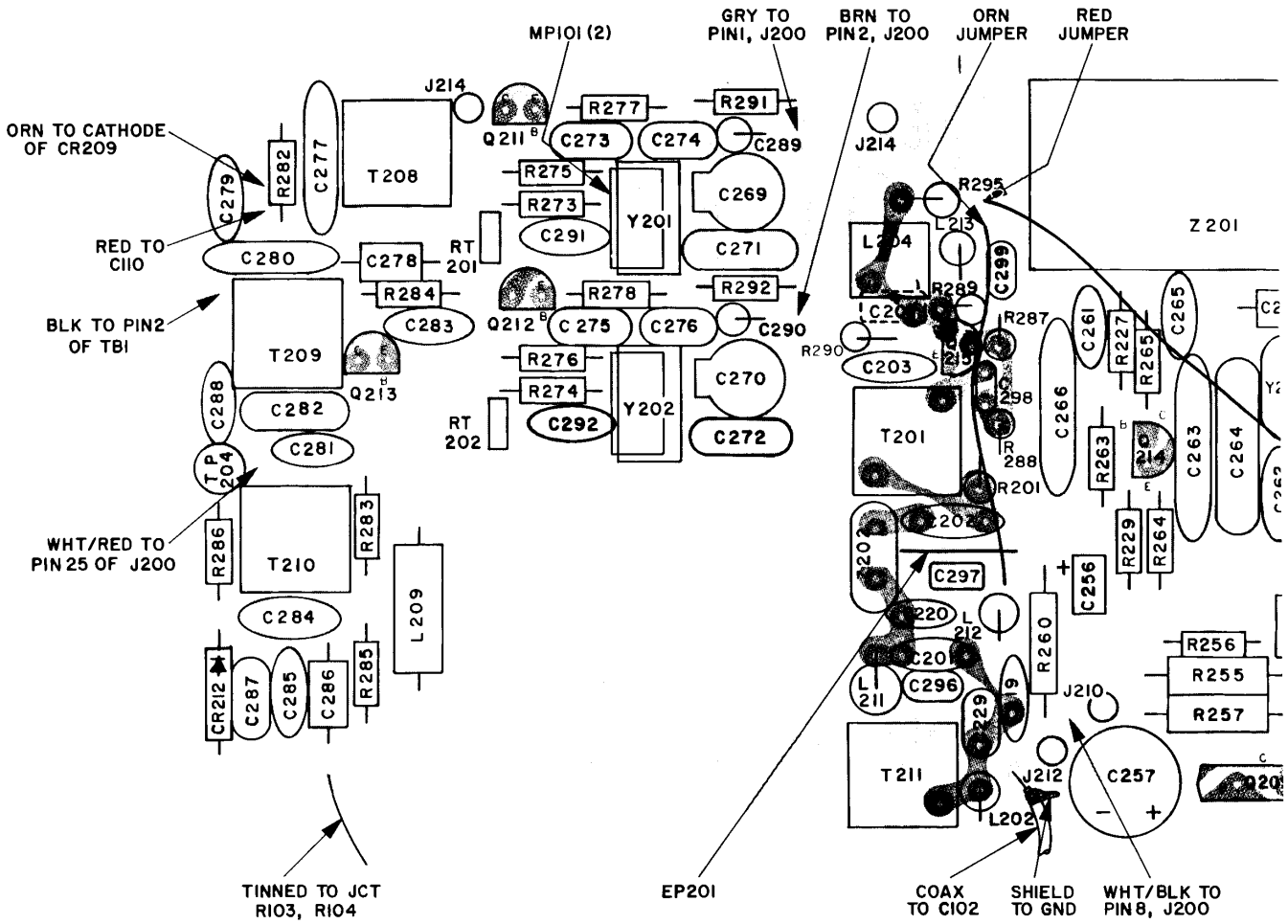


25A POWER SUPPLY COMPONENT LAYOUT (BOTTOM)
FIGURE 7–5

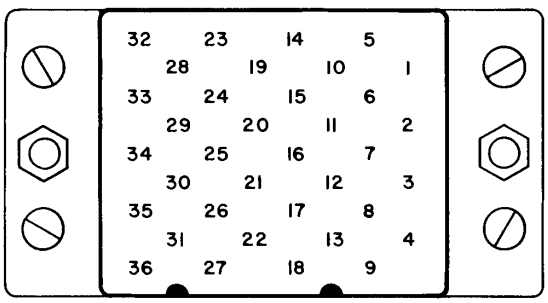


TEST SWITCH SCHEMATIC
FIGURE 7–6

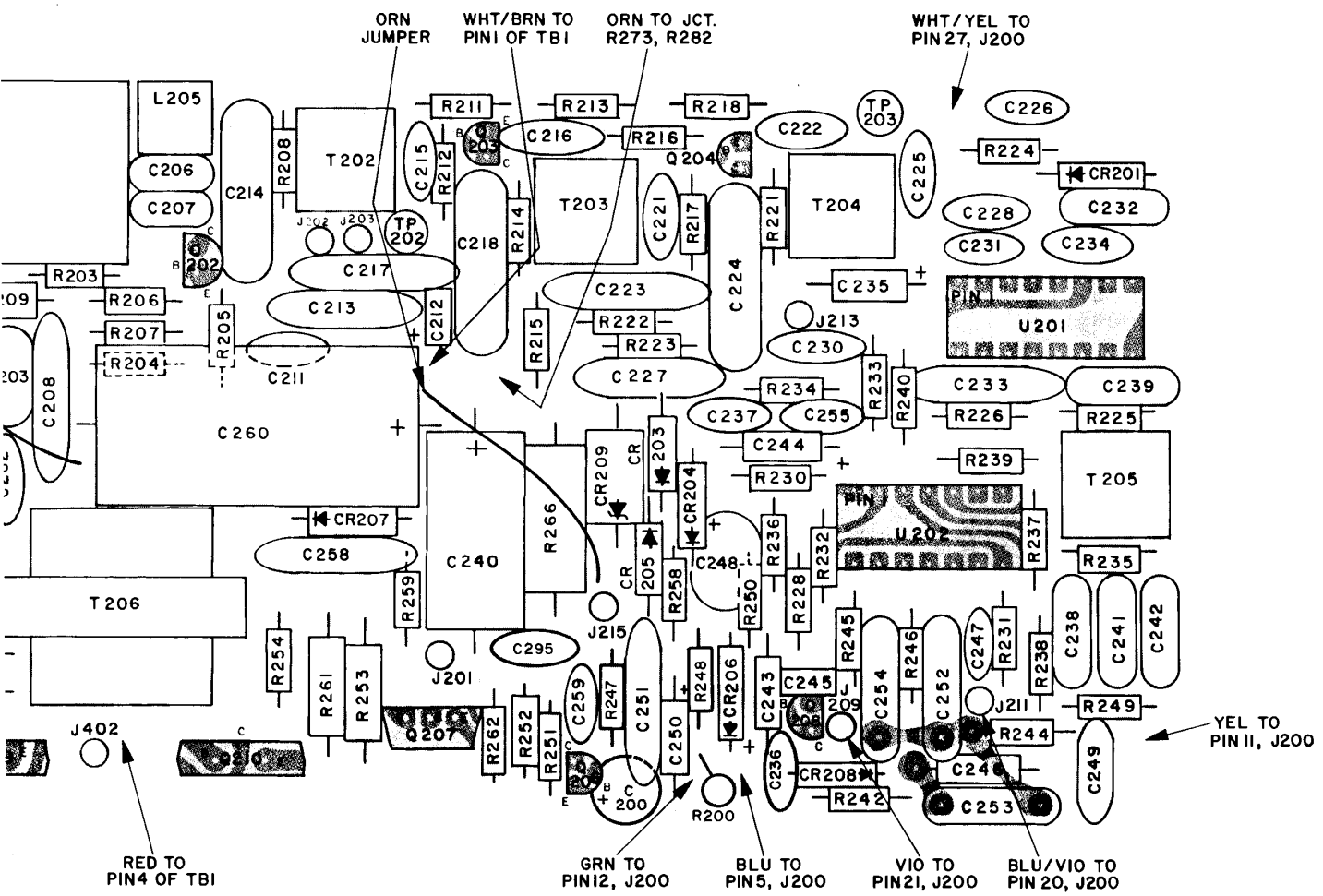
FOLDOUT→



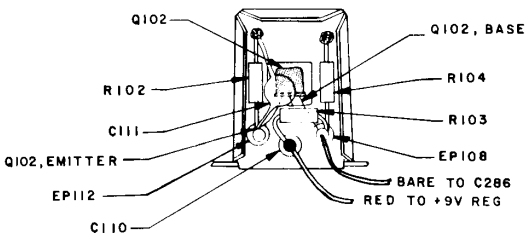
RECEIVER BOARD C(
FIGUR



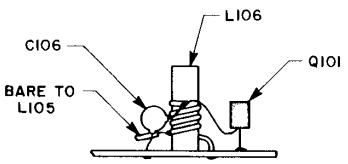
36 PIN JACK



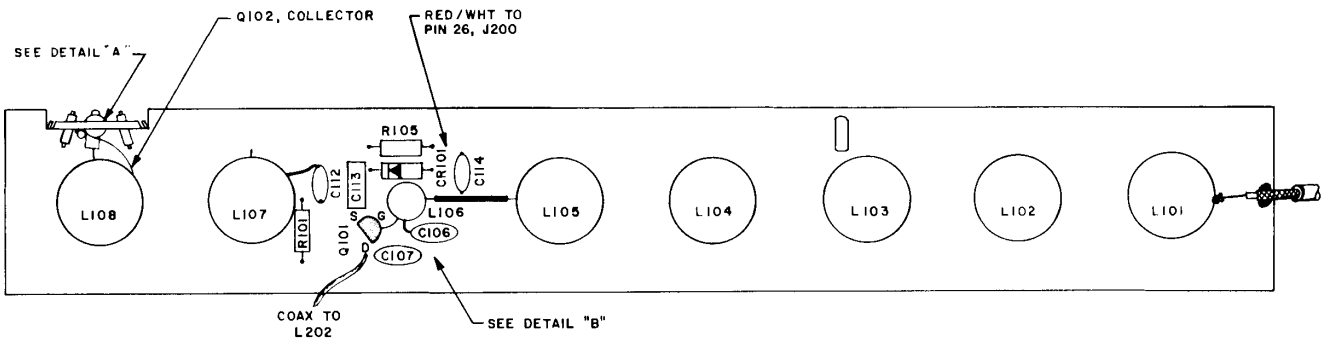
)MPONENT LAYOUT
E 7–7



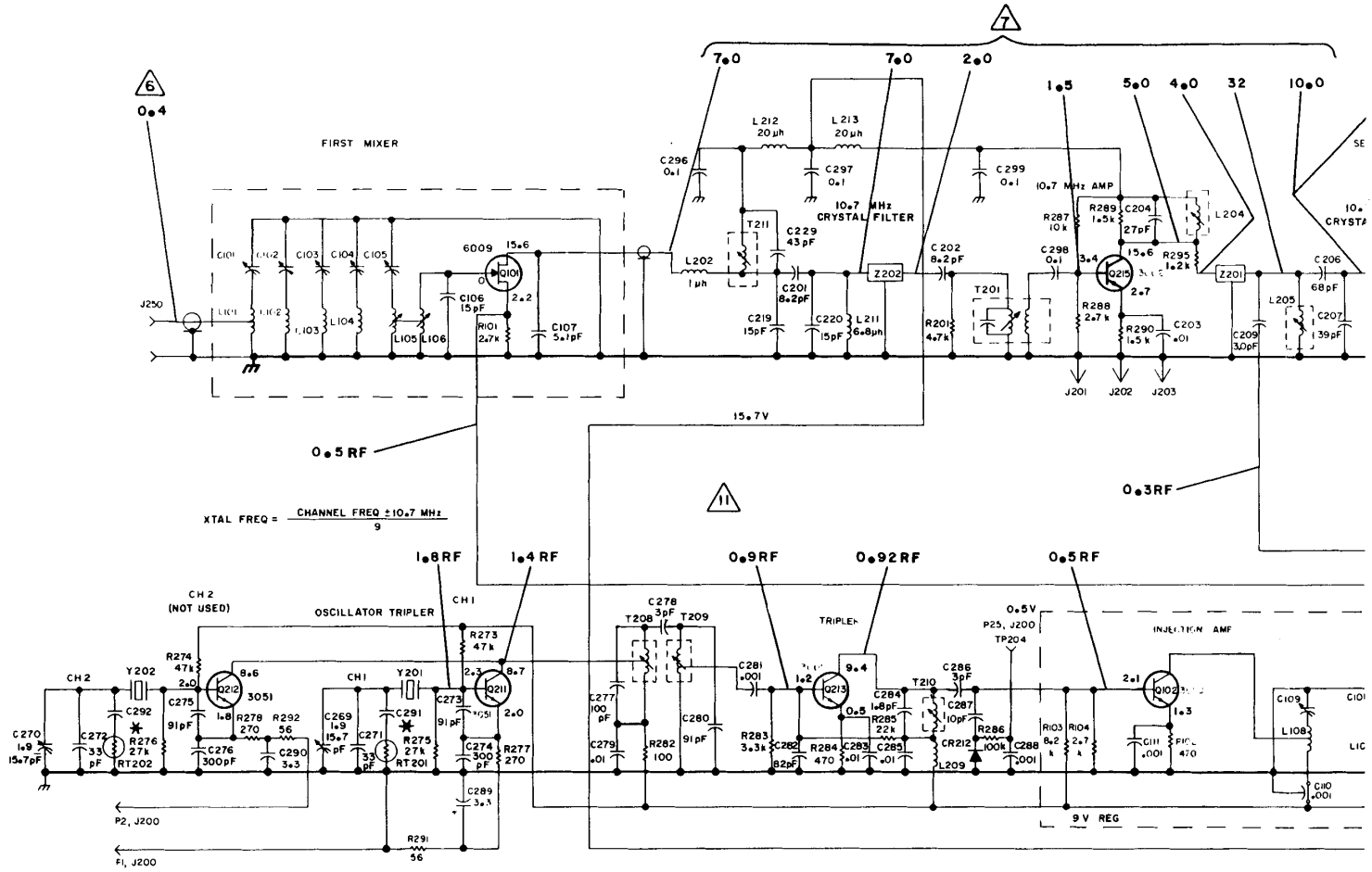
DETAIL "A"



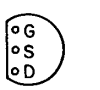
DETAIL B



FRONT END STRIP COMPONENT LAYOUT
FIGURE 7–8

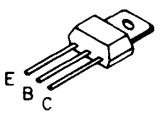


SEMICONDUCTOR BASING IS BOTTOM VIEW UNLESS OTHERWISE INDICATED.

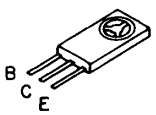


Q101
576-0006-009
Q102
576-0003-029

Q202, Q213, Q214, Q215
576-0003-002
Q203, Q204, Q206, Q208
576-0003-011
Q211, Q212
576-0003-051



Q207
576-0002-027



Q209, Q210
576-0002-029

U201
544-2002-007

U202
544-2005-001

NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS AND CAPACTORS ARE IN MICRO-FARADS.
2. IC U202 HAS SUPPLY VOLTAGE ON PIN 14 AND GROUND ON PIN 7.
3. DC VOLTAGES IN INJECTION STRIP MEASURED WITH XTAL REMOVED.
4. ▭ INDICATES SQUELCHED DC READINGS.
5. * FACTORY SELECTED VALUE.

(6) UNMODULATED INPUT LEVEL IN µV WHICH PRODUCES 20db QUIETING.

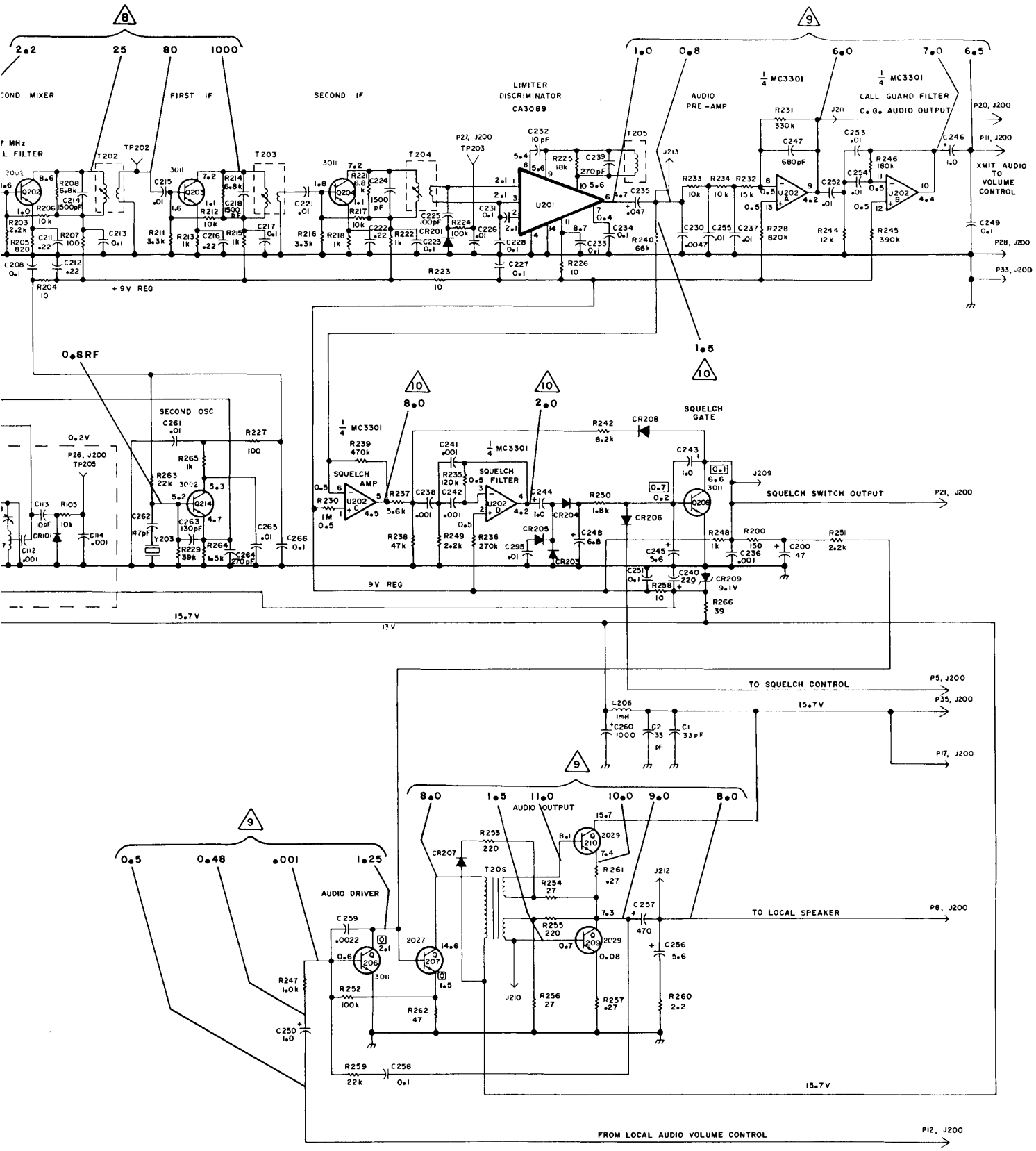
(7) 10.7 MHz UNMODULATED SIGNAL LEVEL IN µV, INJECTED THROUGH A 0.01 µF CAPACITOR, WHICH PRODUCES 20 db AUDIO QUIETING.

(8) SAME AS (7) EXCEPT 455KHz INJECTION SIGNAL.

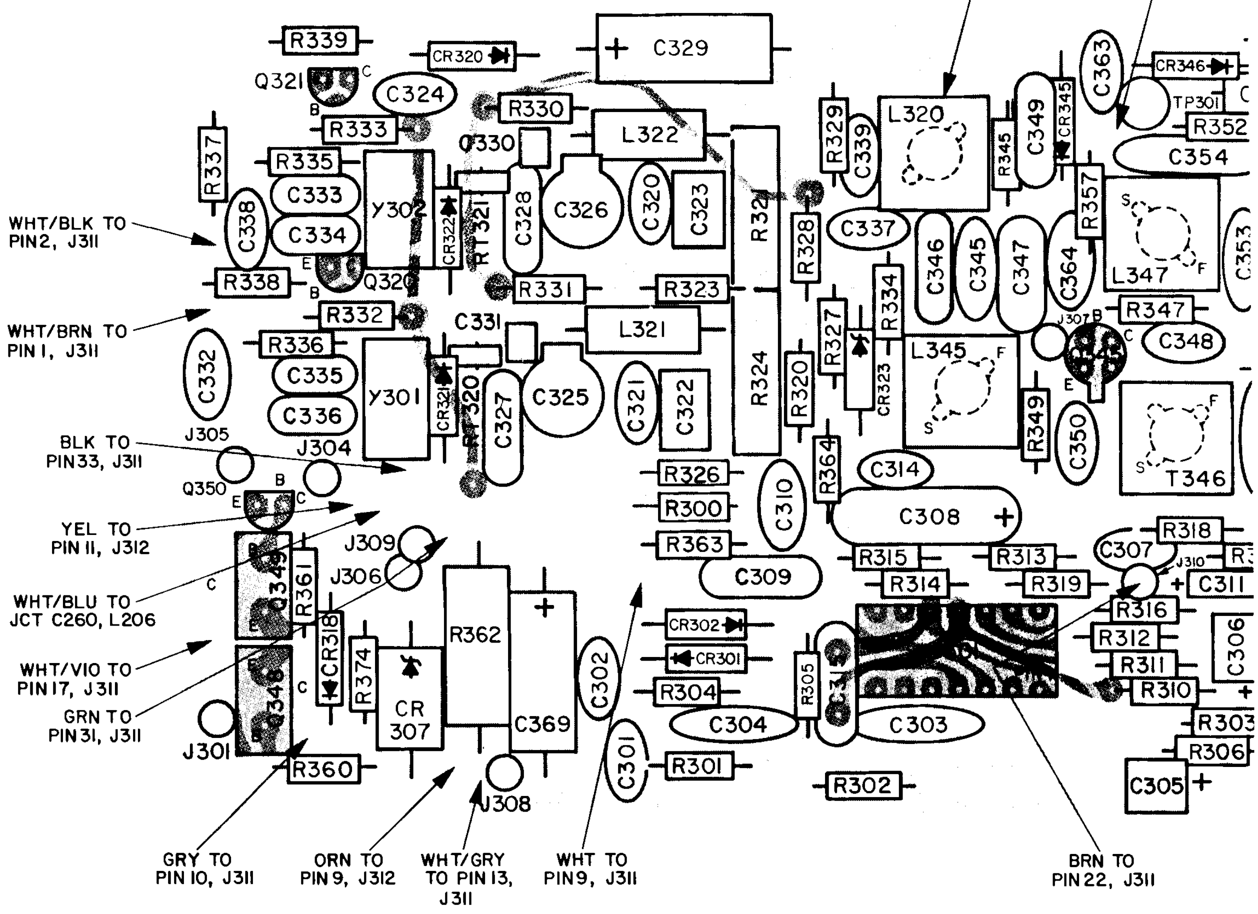
(9) PEAK TO PEAK AUDIO VOLTAGES PRODUCED BY 0.5µV INPUT SIGNAL AT ANTENNA JACK (MODULATED WITH 1KHz AT ±5KHz DEVIATION). AUDIO OUTPUT LEVEL SET FOR 2 WATTS INTO A 3Ω LOAD.

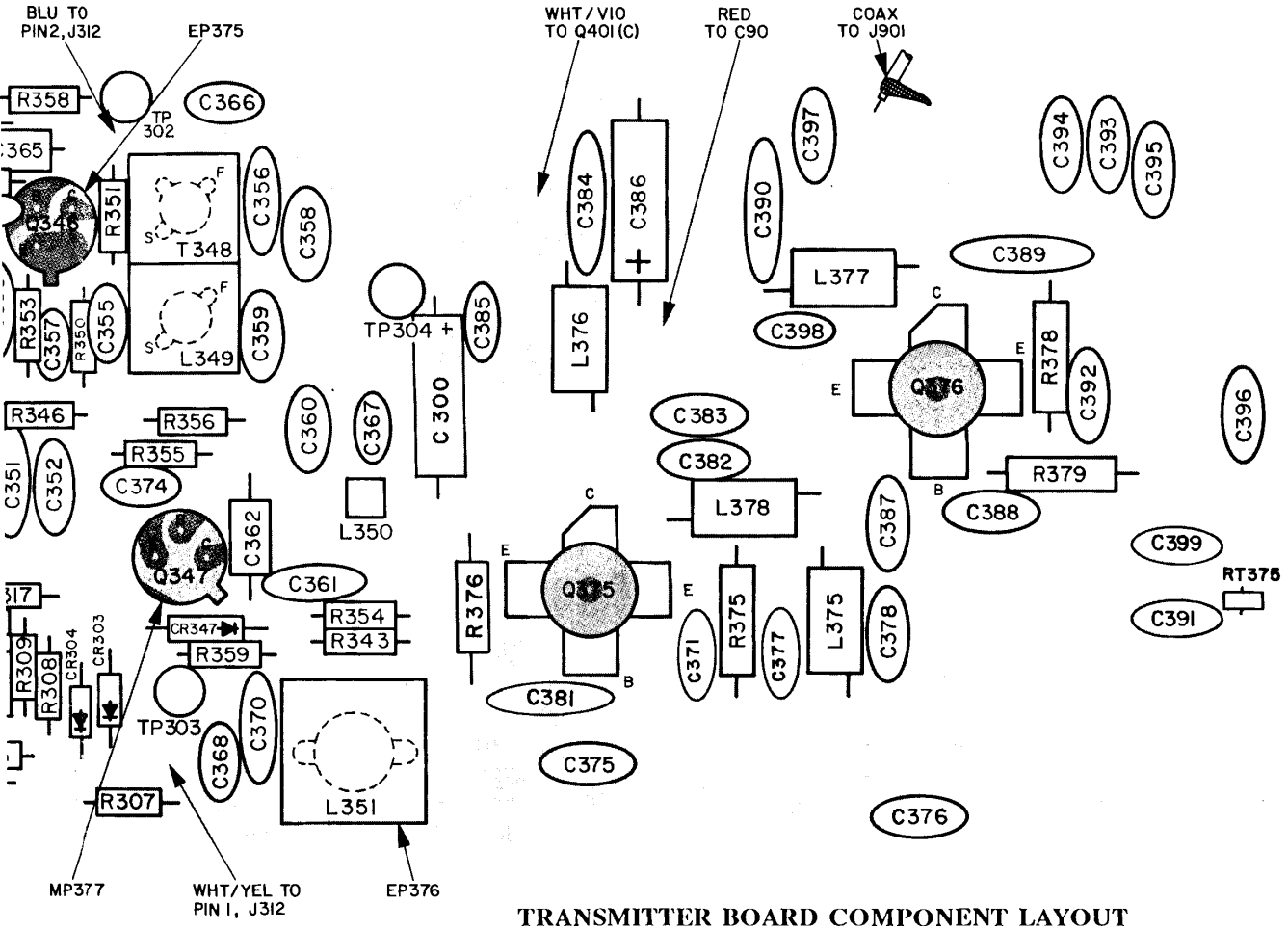
(10) PEAK TO PEAK NOISE VOLTAGES MEASURED WITH NO SIGNAL INPUT.

(11) INJECTION STRIP VOLTAGES ARE RMS.

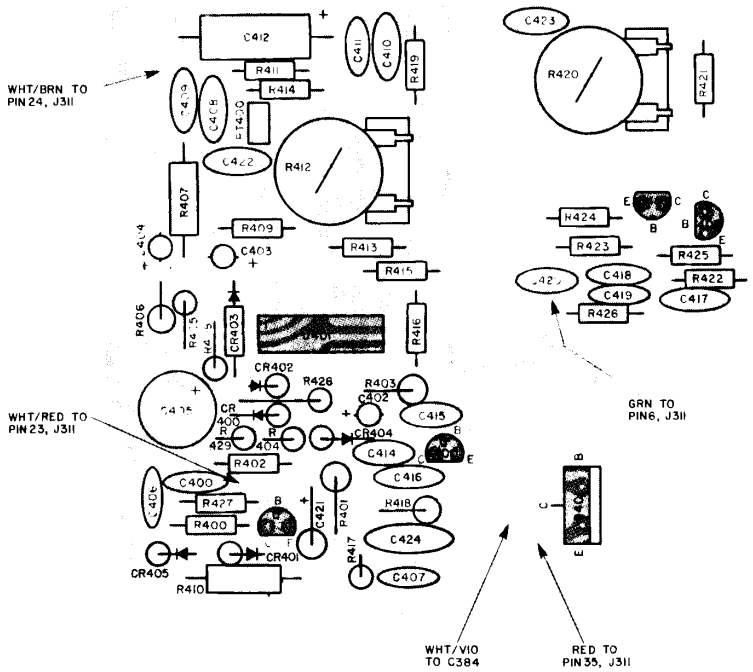


RECEIVER SCHEMATIC DIAGRAM
FIGURE 7–9

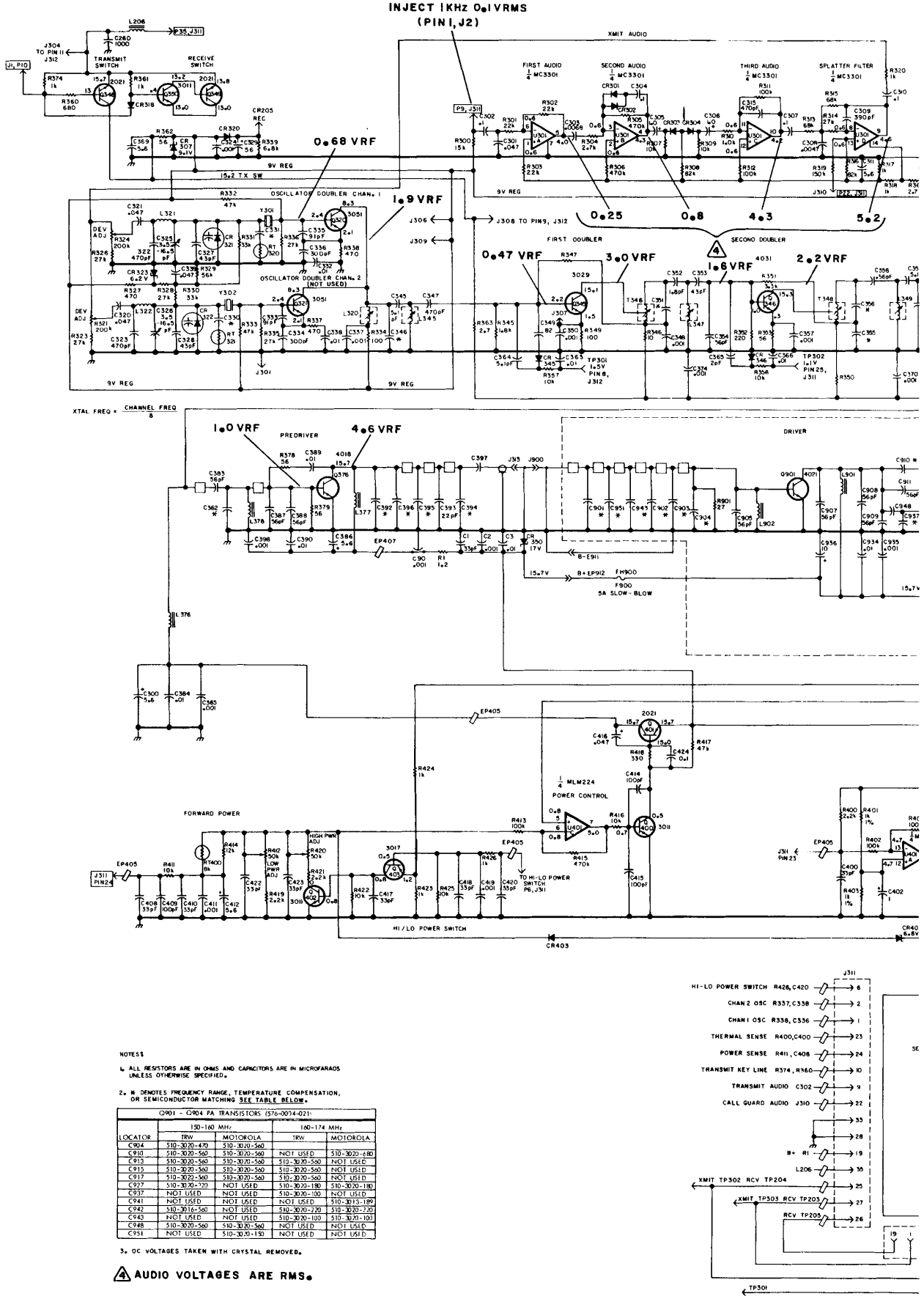

WHT TO PIN8, J312
EP377 (6)
WHT/BLK TO PIN2, J311
WHT/BRN TO PIN1, J311
BLK TO PIN33, J311
YEL TO PIN11, J312
WHT/BLU TO JCT C260, L206
WHT/VIO TO PIN17, J311
GRN TO PIN31, J311
GRY TO PIN10, J311
ORN TO PIN9, J312
WHT/GRY TO PIN13, J311
WHT TO PIN9, J311
BRN TO PIN22, J311



TRANSMITTER BOARD COMPONENT LAYOUT
FIGURE 7–10



POWER CONTROL BOARD COMPONENT LAYOUT
FIGURE 7–11



NOTES:

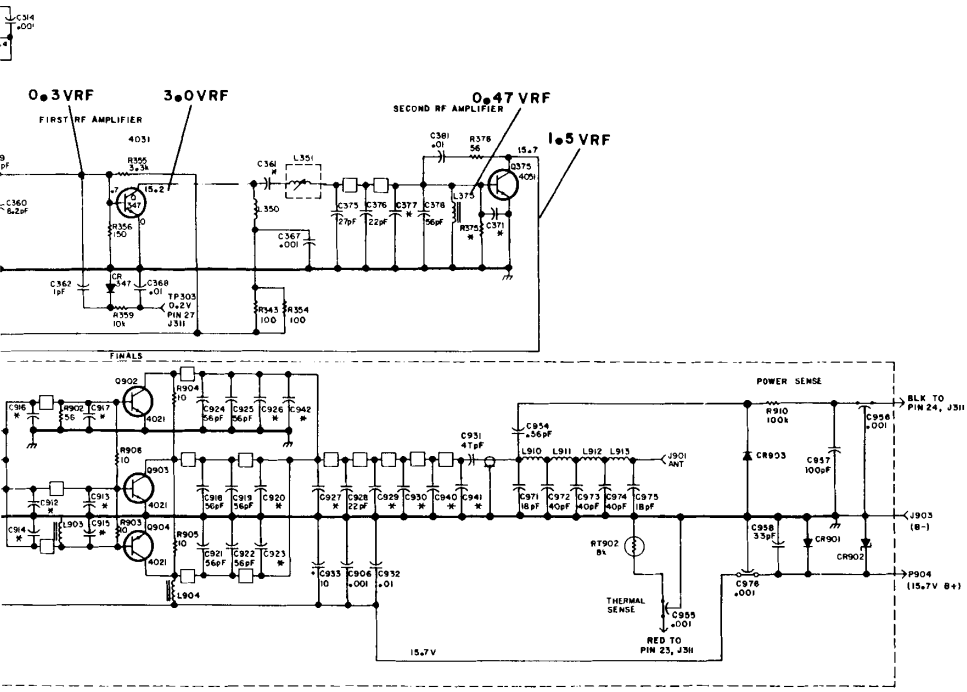
1. ALL RESISTORS ARE IN OHMS AND CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

2. ✱ DENOTES FREQUENCY RANGE, TEMPERATURE COMPENSATION, OR SEMICONDUCTOR MATCHING SEE TABLE BELOW.

Q901 - Q904 PA TRANSISTORS (576-0074-021)				
	150-160 MHz		160-174 MHz	
LOCATOR	TRW	MOTOROLA	TRW	MOTOROLA
Q904	510-3020-470	510-3020-560		
Q910	510-3020-560	510-3020-560	NOT USED	510-3020-680
Q913	510-3020-560	510-3020-560	510-3020-560	NOT USED
Q915	510-3020-560	510-3020-560	510-3020-560	NOT USED
Q917	510-3020-560	510-3020-560	510-3020-560	NOT USED
Q927	510-3020-720	NOT USED	510-3020-180	510-3020-180
Q937	NOT USED	NOT USED	510-3020-100	NOT USED
Q941	NOT USED	NOT USED	NOT USED	510-3013-189
Q942	510-3016-560	NOT USED	510-3020-220	510-3020-720
Q943	NOT USED	NOT USED	510-3020-100	510-3020-100
Q948	510-3020-560	510-3020-560	NOT USED	NOT USED
Q951	NOT USED	510-3020-150	NOT USED	NOT USED

3. DC VOLTAGES TAKEN WITH CRYSTAL REMOVED.

4 AUDIO VOLTAGES ARE RMS.

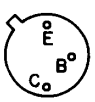


SEMICONDUCTOR BASING IS BOTTOM VIEW UNLESS OTHERWISE INDICATED.

Q320, Q321
576-0003-051

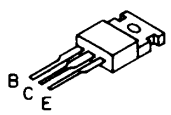
Q350, Q400
Q402
576-0003-011

Q403
576-0003-017

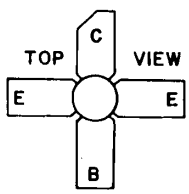


Q345
576-0003-029

Q346, Q347
576-0004-031

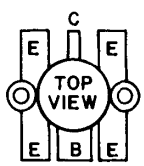


Q348,
Q349, Q401
576-0002-021

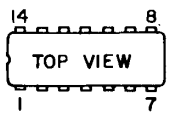


Q375
576-0004-051

Q376
576-0004-018

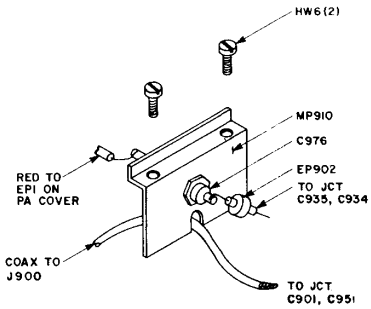


Q901, Q902
Q903, Q904
576-0004-021

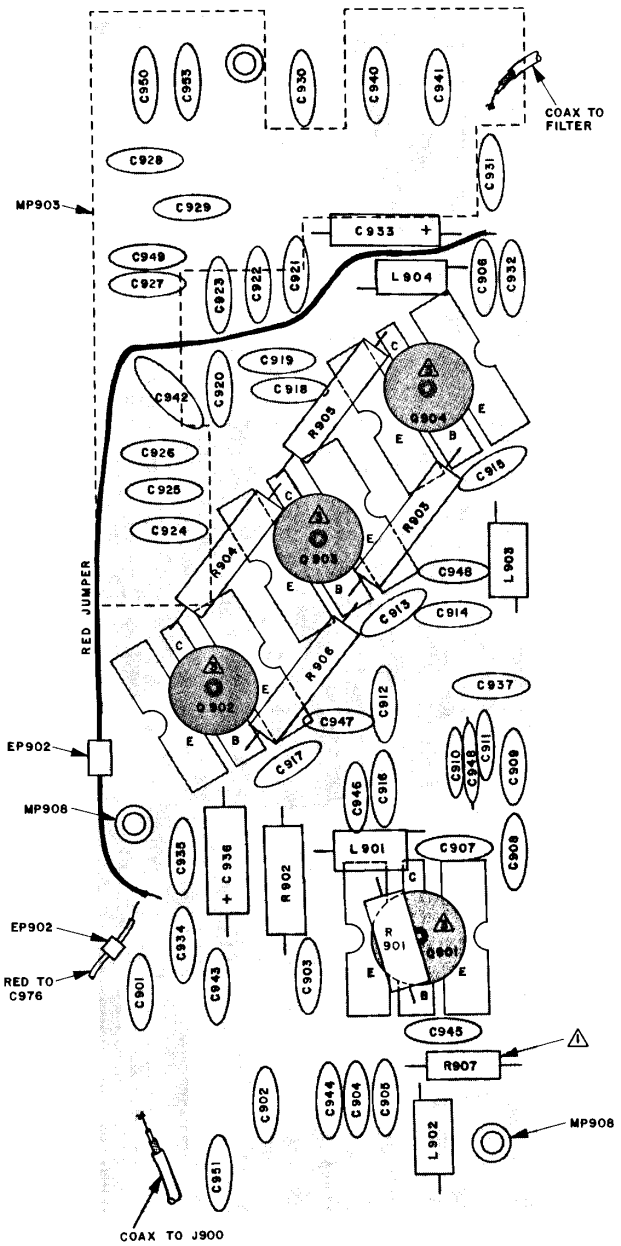


U301
544-2005-001

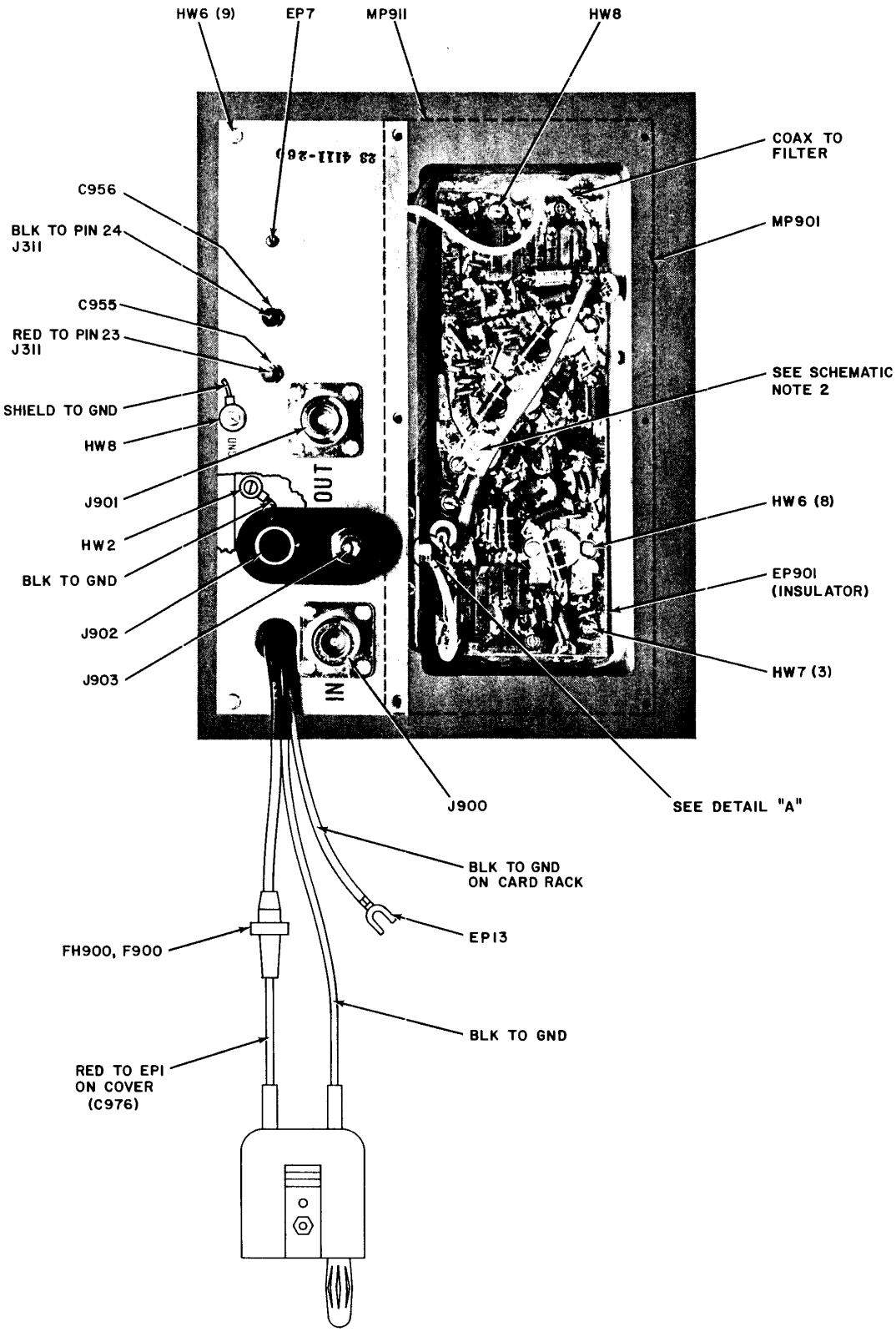
TRANSMITTER SCHEMATIC DIAGRAM
FIGURE 7-12



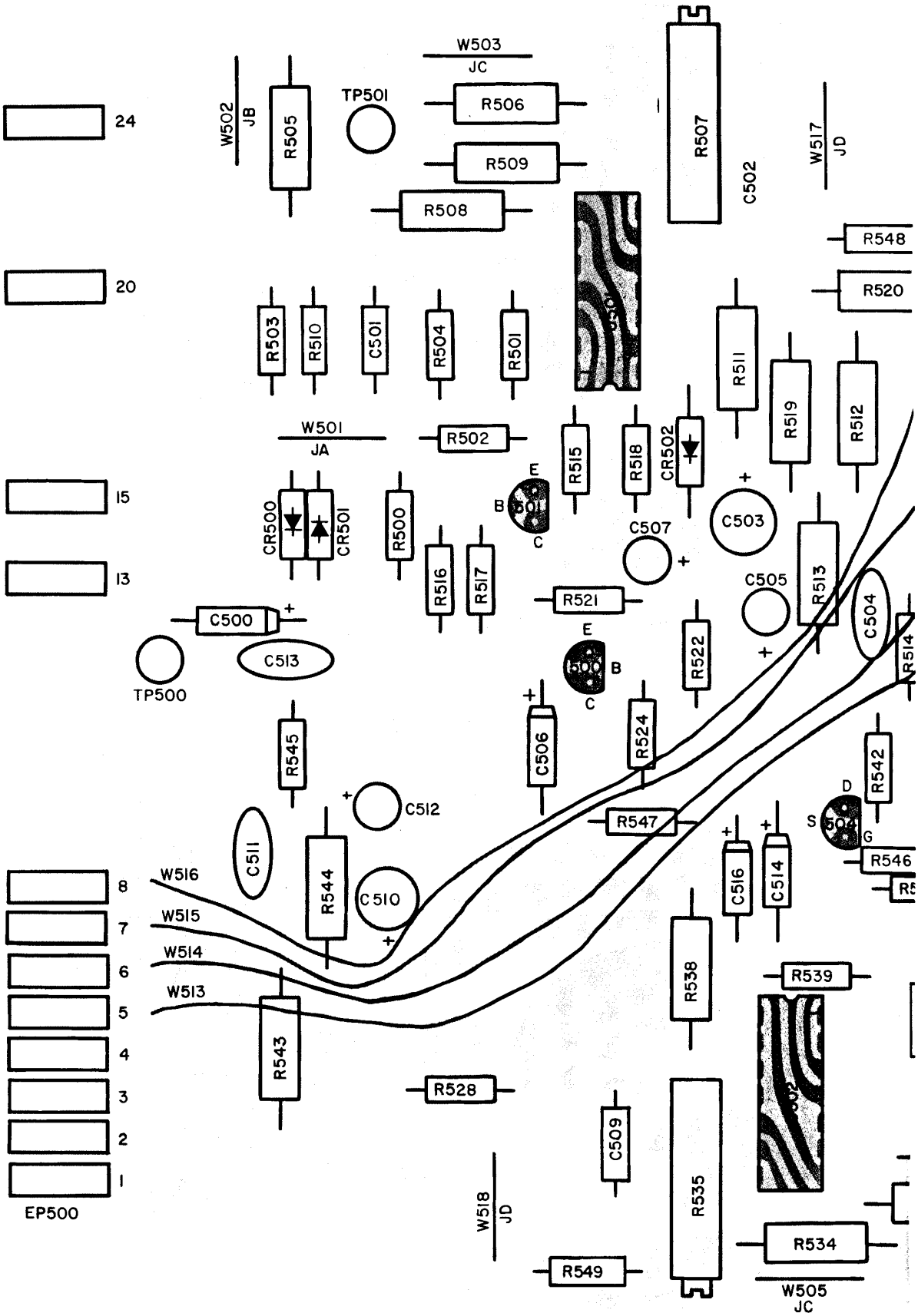
VIEW FROM PC BOARD SIDE
DETAIL "A"

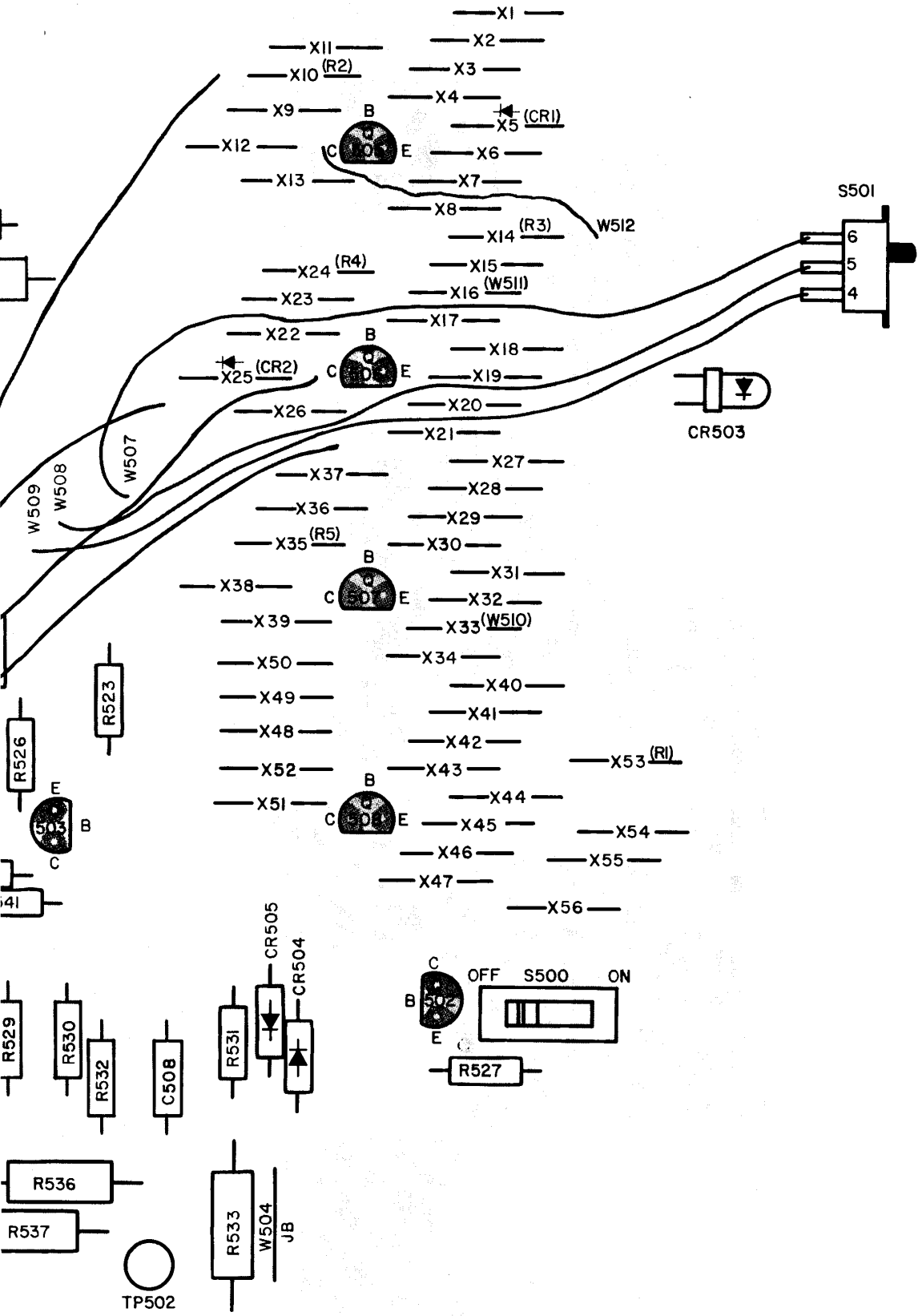


POWER AMPLIFIER COMPONENT LAYOUT
FIGURE 7–13

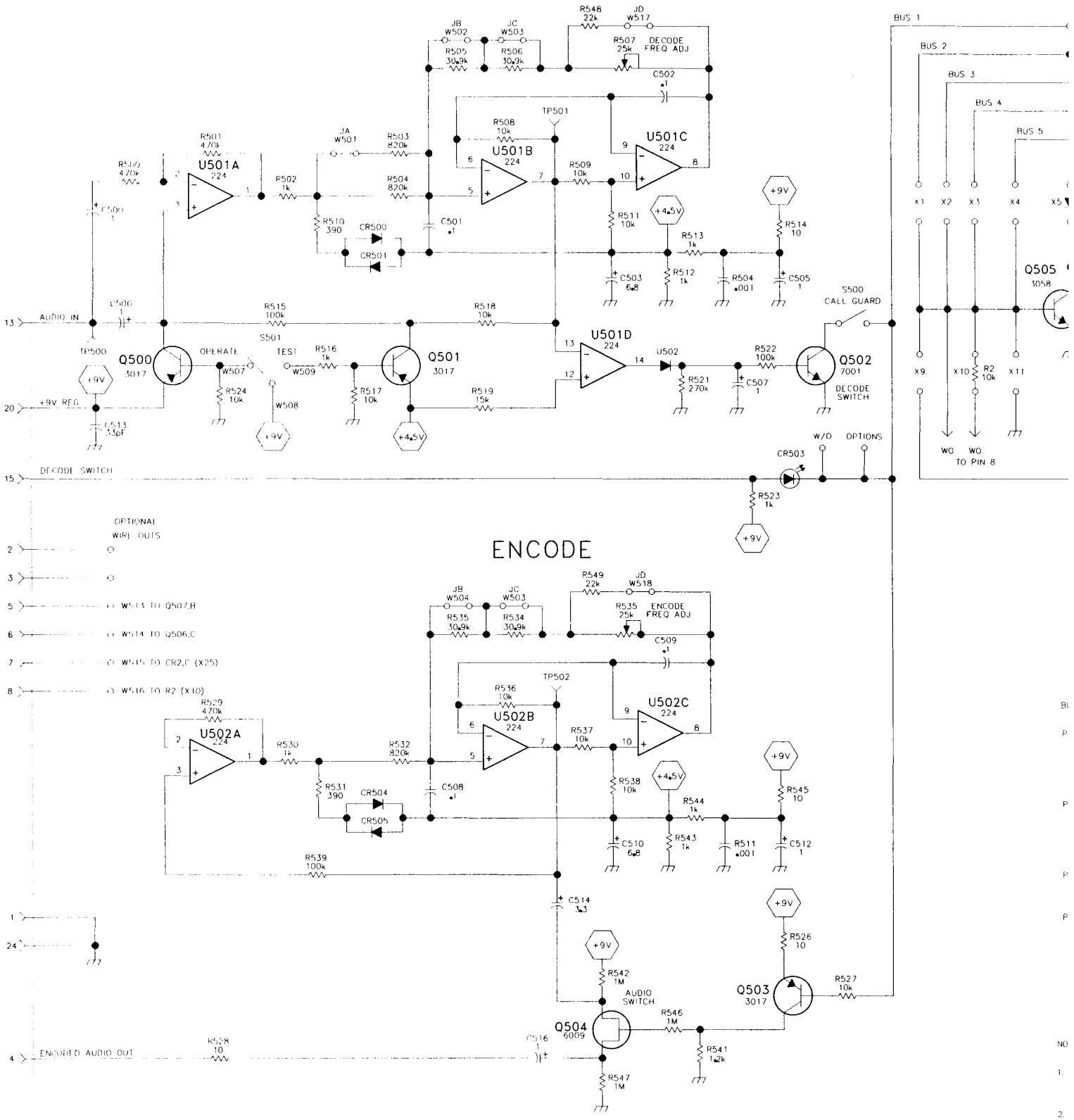


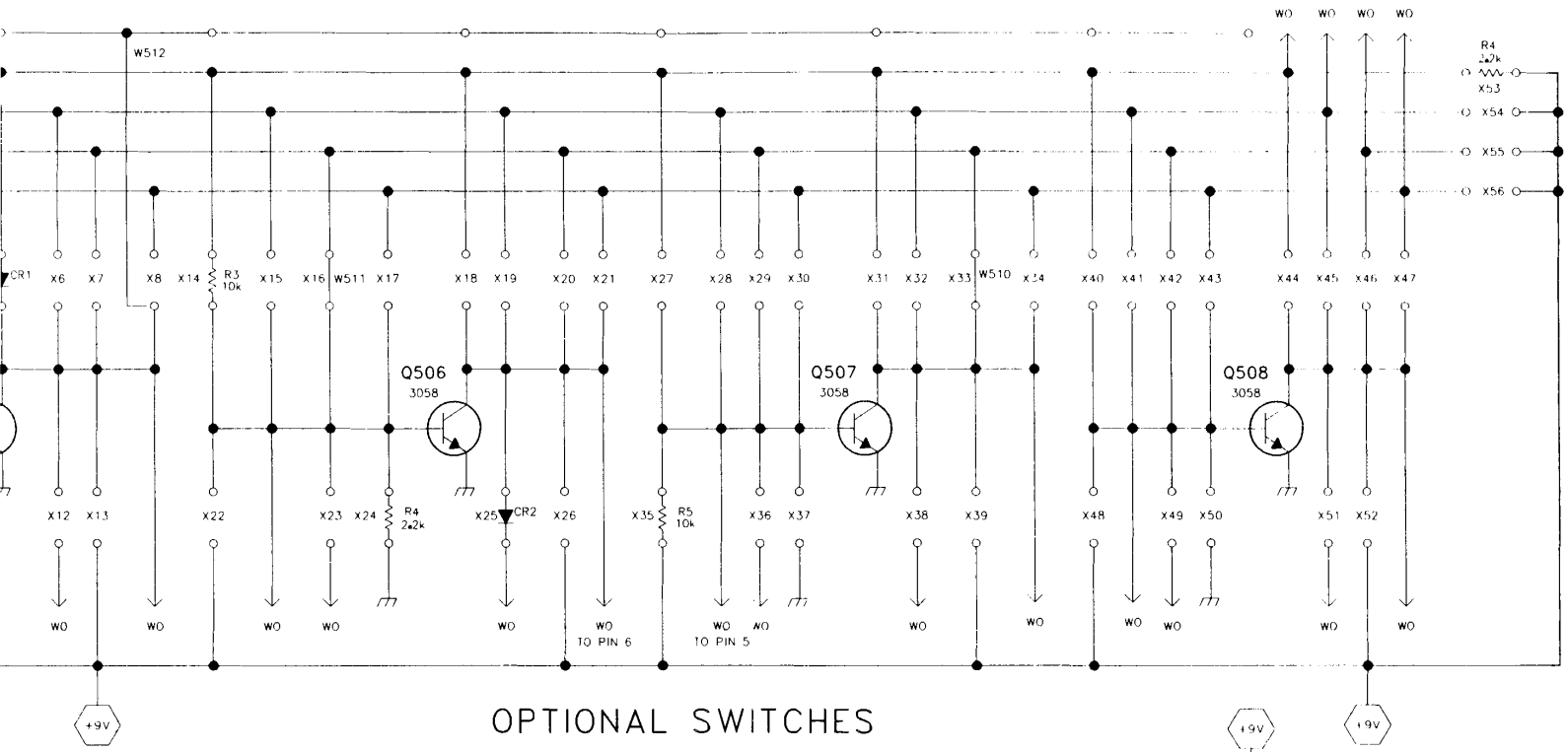
POWER AMPLIFIER AND FILTER COVER ASSEMBLY
FIGURE 7–14


24
20
15
13
8
7
6
5
4
3
2
1
EP500
W502
JB
R505
TP501
W503
JC
R506
R509
R508
R507
C502
W517
JD
R548
R520
R503
R510
C501
R504
R501
R511
R519
R512
W501
JA
R502
R515
R518
CR502
CR500
CR501
R500
R516
R517
C503
C507
C505
R513
C504
R514
R521
C500
C513
TP500
R522
R545
C506
R524
R542
C512
R547
C511
R544
C510
C516
C514
R546
R538
R539
R543
R528
C509
R535
W518
JD
R534
R549
W505
JC
W516
W515
W514
W513

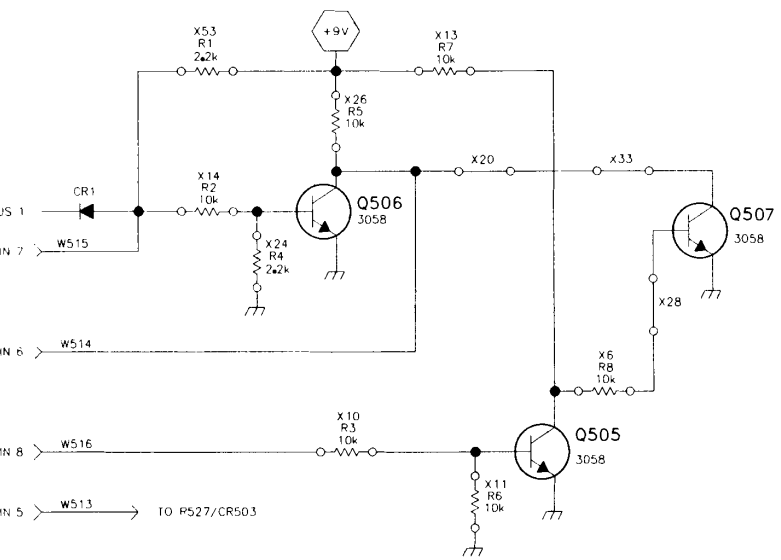


TYPE–A CALL GUARD COMPONENT LAYOUT
FIGURE 7–15

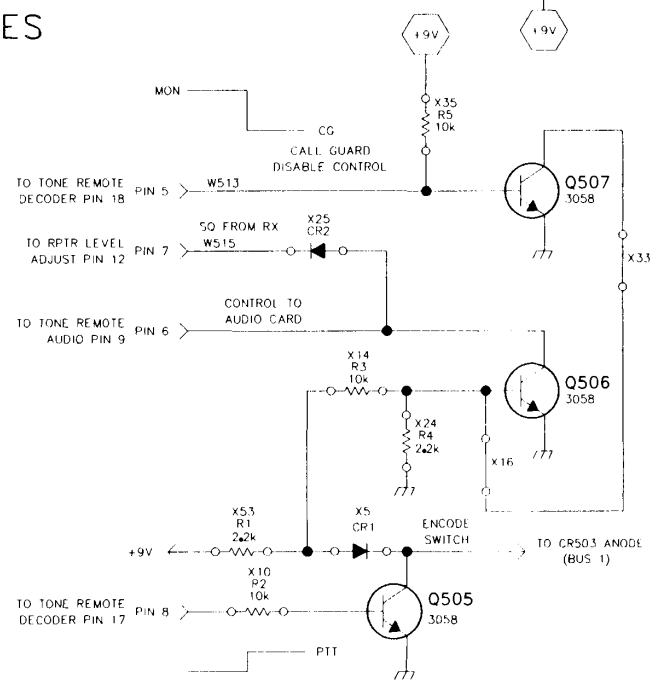

DECODE
ENCODE
U501A
U501B
U501C
U501D
U502A
U502B
U502C
Q500
Q501
Q502
Q503
Q504
Q505
AUDIO_IN
+9V REG
DECODE SWITCH
ENCODED AUDIO OUT
OPTIONAL WIRE OUTS
W513 TO Q507,B
W514 TO Q506,C
W515 TO CR2,C (X25)
W516 TO R2 (X10)
DECODE FREQ ADJ
ENCODE FREQ ADJ
OPERATE
TEST
CALL GUARD
AUDIO SWITCH
W/O OPTIONS
WO TO PIN 8
BUS 1
BUS 2
BUS 3
BUS 4
BUS 5



OPTIONAL SWITCHES



DC REMOTE SWITCHING



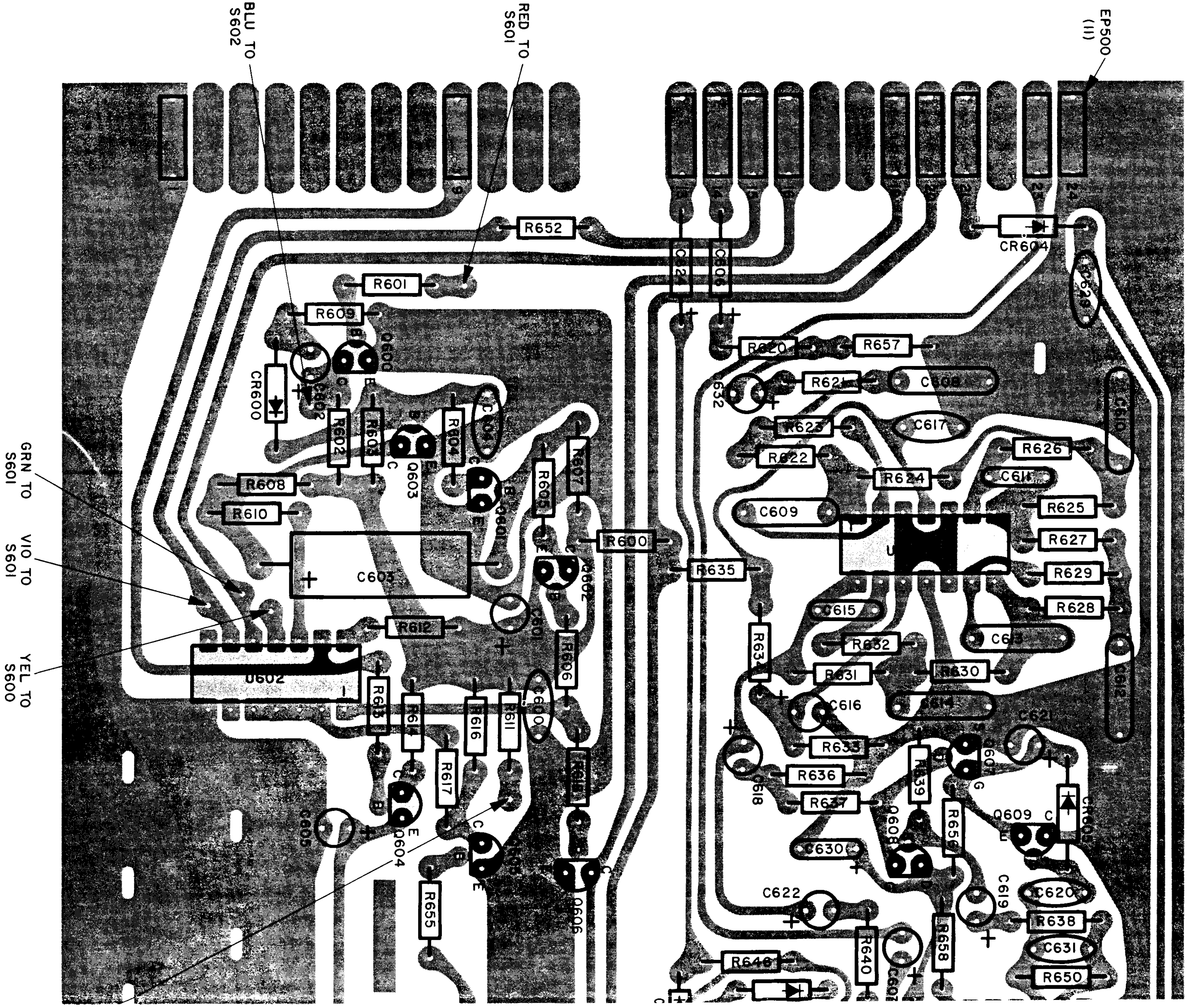
TONE REMOTE SWITCHING

TES:

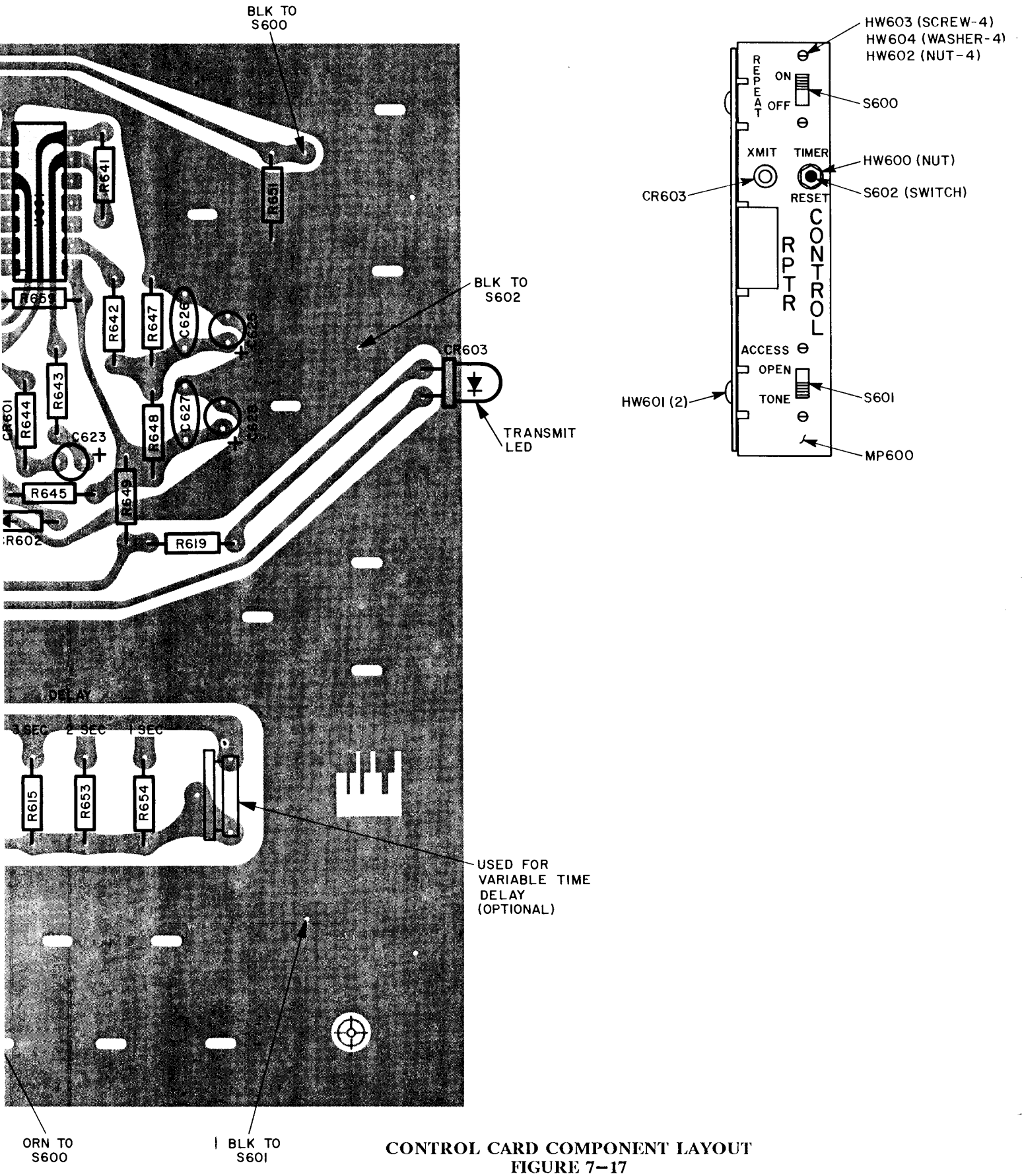
ALL RESISTORS ARE IN OHMS AND CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

U501/U502 PIN 4 IS Vcc AND PIN 11 IS GROUND.

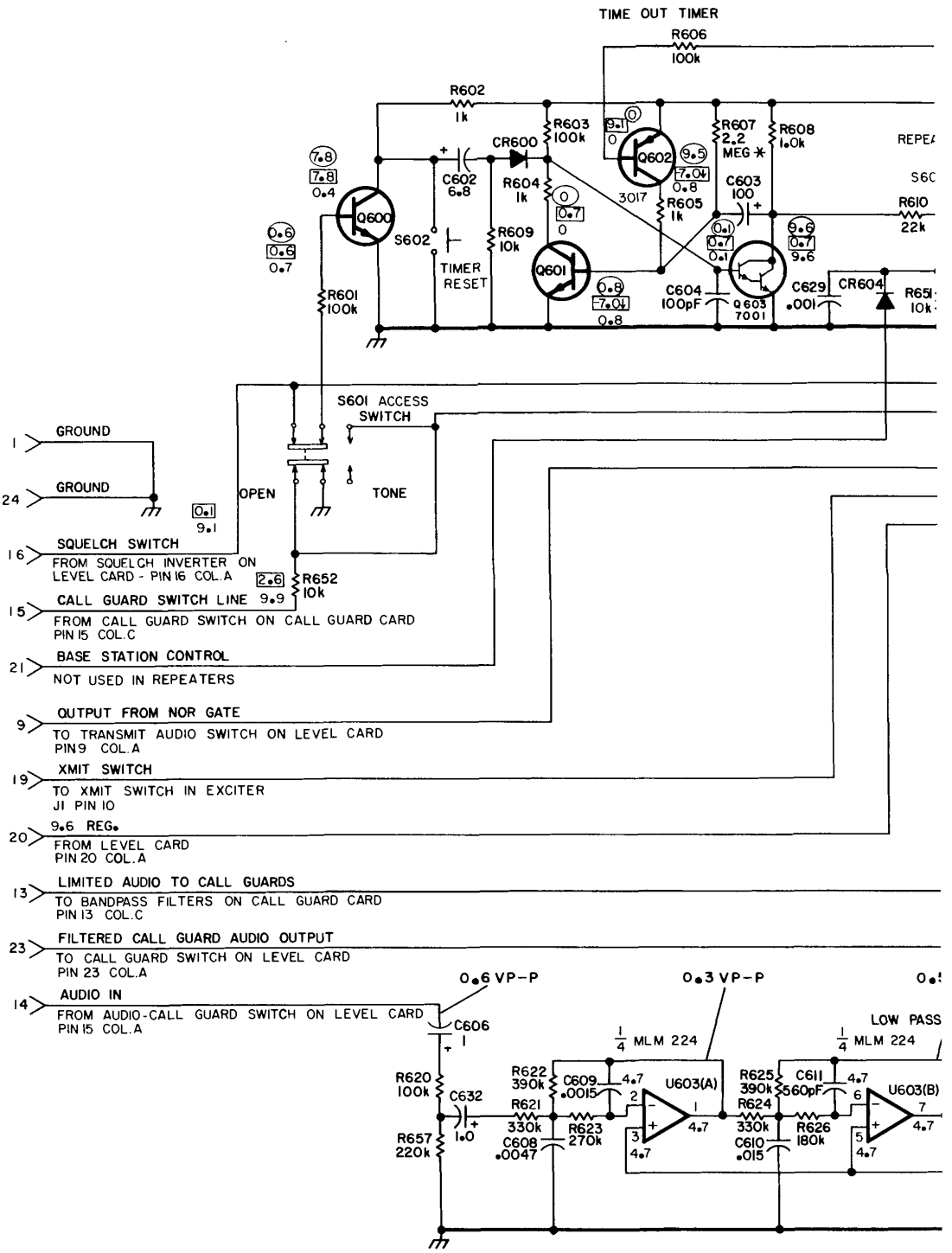
TYPE–A CALL GUARD SCHEMATIC
FIGURE 7–16



BLU TO S602
RED TO S601
EP500 (11)
GRN TO S601
VIO TO S601
YEL TO S600
R652
R601
R609
CR600
Q600
C602
R602
R603
Q603
R604
C604
Q601
R605
R607
R608
R610
C603
R600
Q602
C601
R612
U602
R613
R614
R616
R611
C600
R606
R615
R617
Q604
C605
Q605
Q606
R655
C624
C606
CR604
C629
R620
R657
R621
C608
C632
R623
C617
C610
R622
R626
R624
C611
C609
R625
R627
R635
R629
R628
C615
C613
R634
R632
R631
R630
C612
C616
C614
C621
R633
C618
R636
R639
Q607
R637
CR602
Q609
Q608
R659
C630
C619
C622
C620
R638
R640
R658
C631
R648
R650

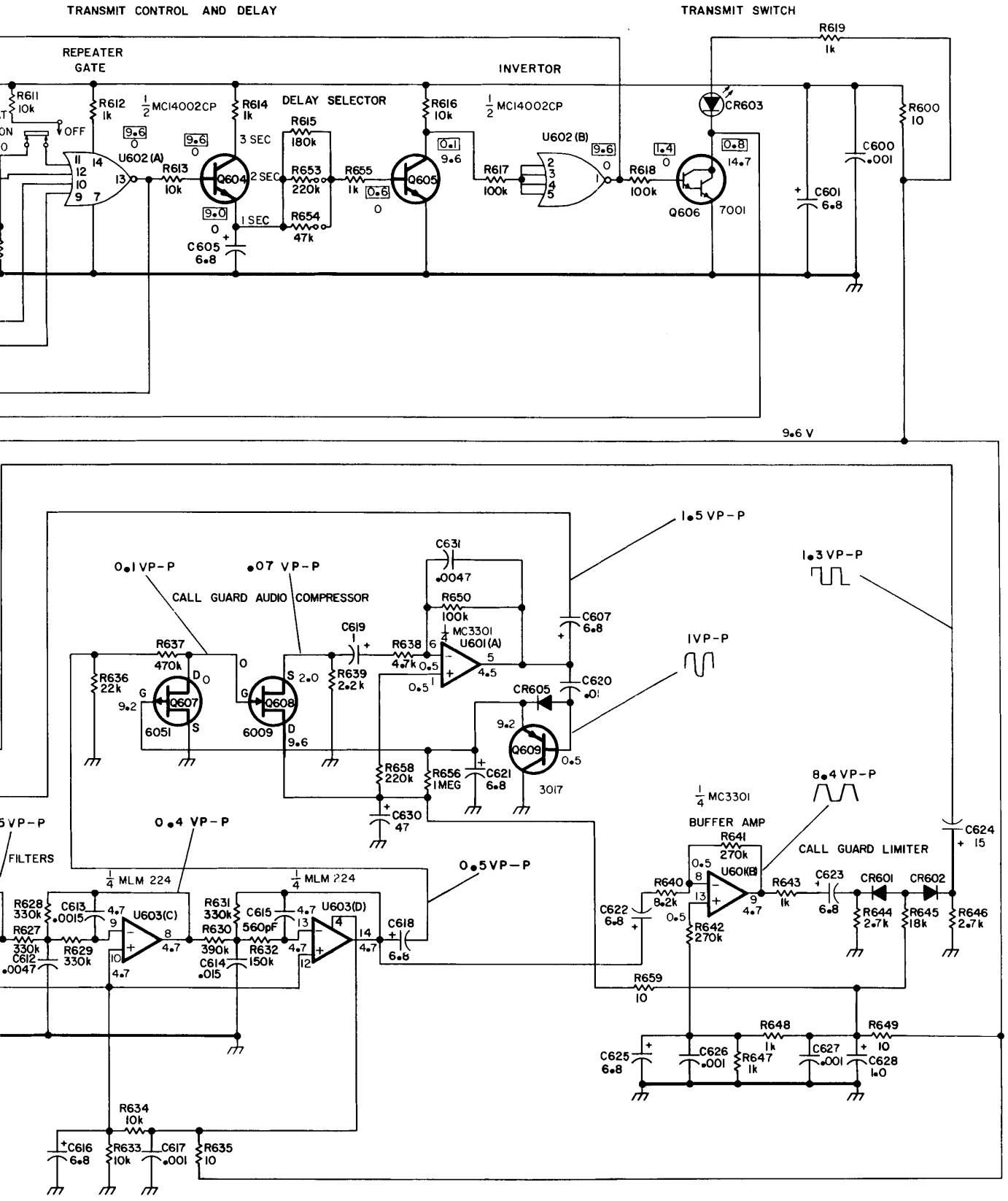


CONTROL CARD COMPONENT LAYOUT
FIGURE 7–17

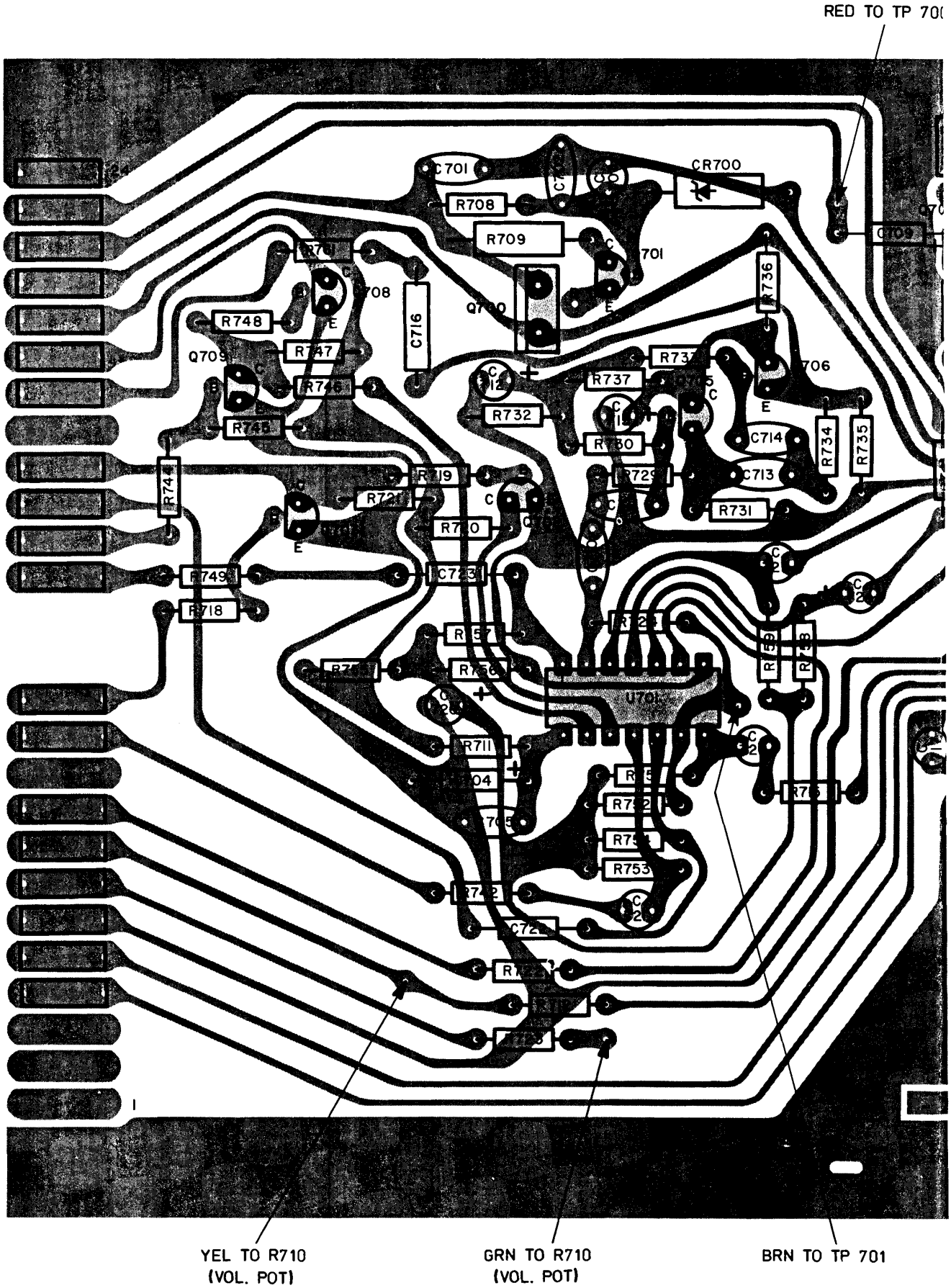


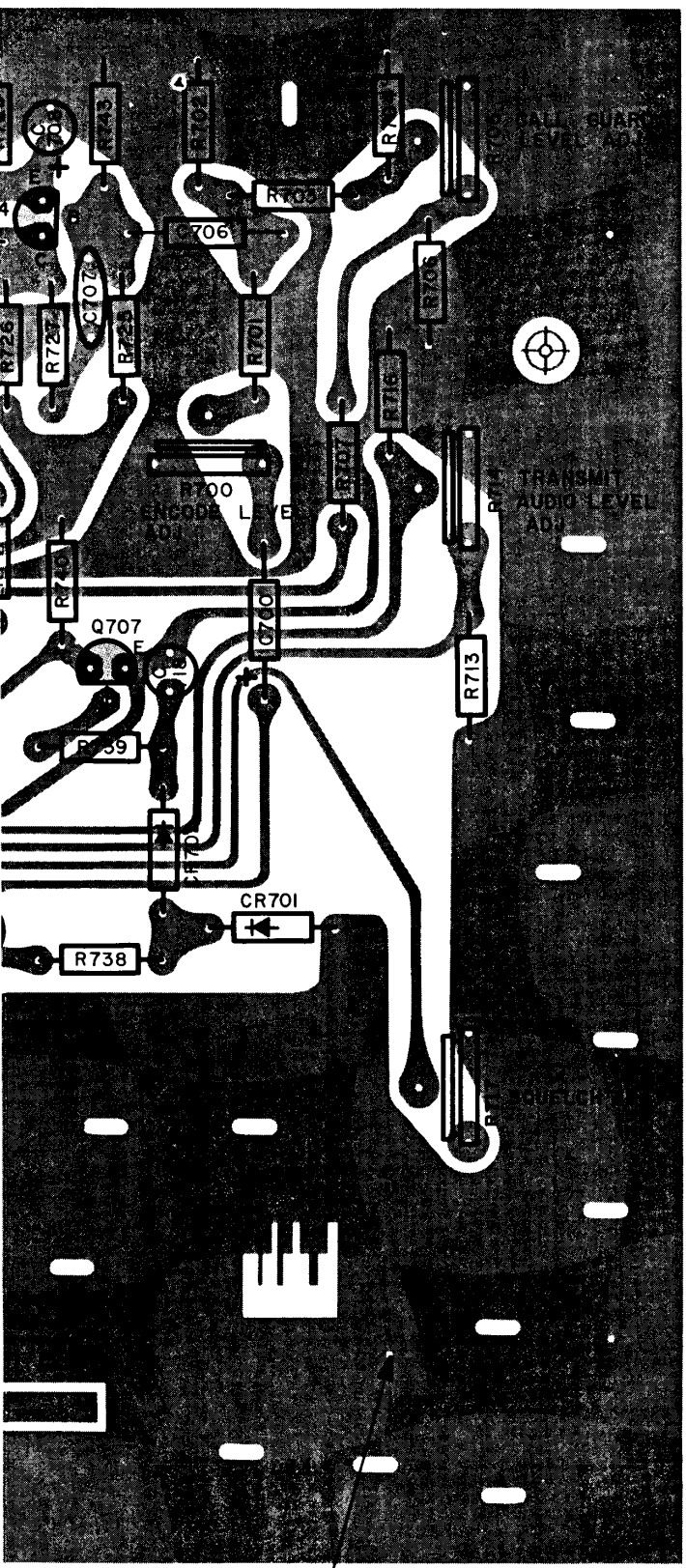
NOTES:

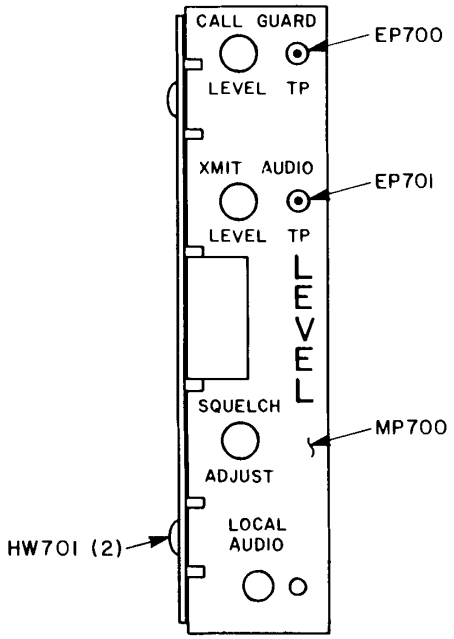
1. ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. DC VOLTAGES MEASURED WITH NO SIGNAL BEING RECEIVED.
   - □ DC VOLTAGES MEASURED IN TRANSMIT.
   - ◯ DC VOLTAGES MEASURED WITH TRANSMITTER TIMED OUT.
   - ✳ FACTORY SELECTABLE.
4. ALL AC WAVEFORMS ARE SINE WAVES UNLESS SHOWN OTHERWISE. AC MEASUREMENTS TAKEN WITH RECEIVER RF INPUT OF 100μV, MODULATED WITH A CALL GUARD TONE AT ± 600Hz DEVIATION.



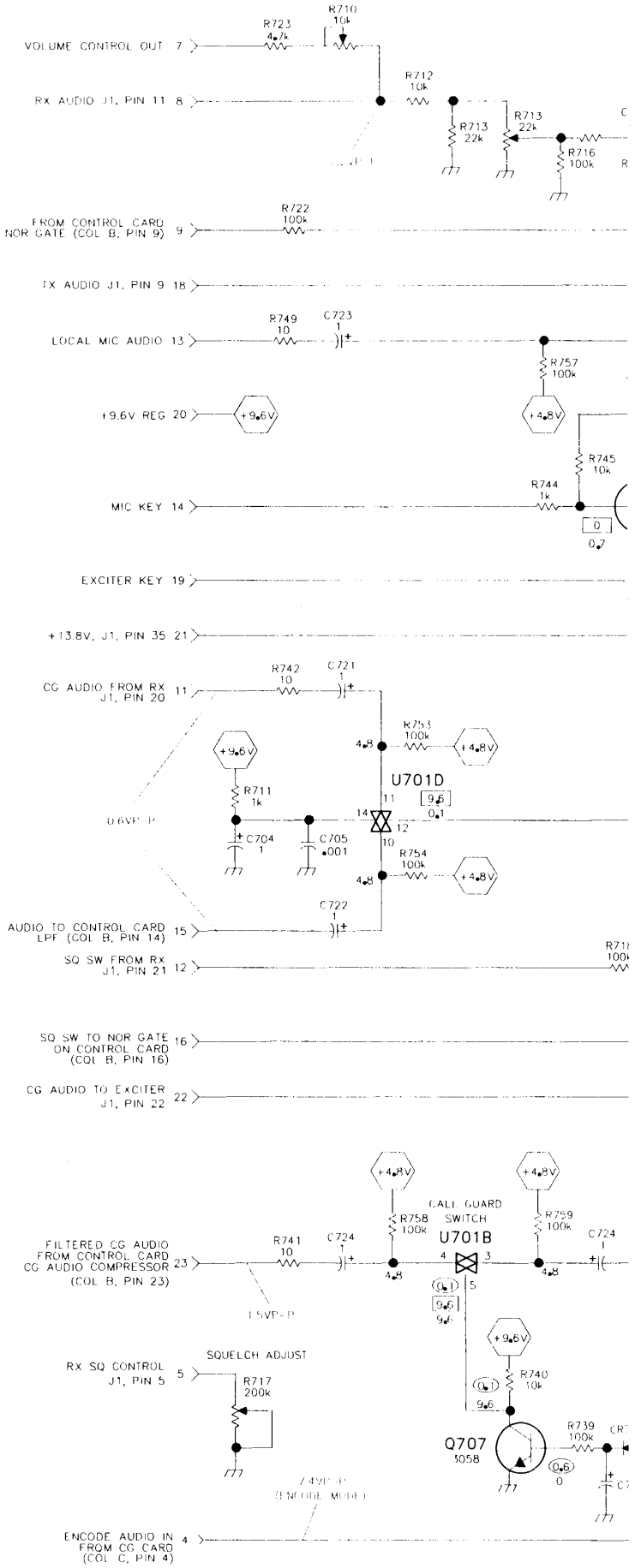
CONTROL CARD SCHEMATIC
FIGURE 7–18

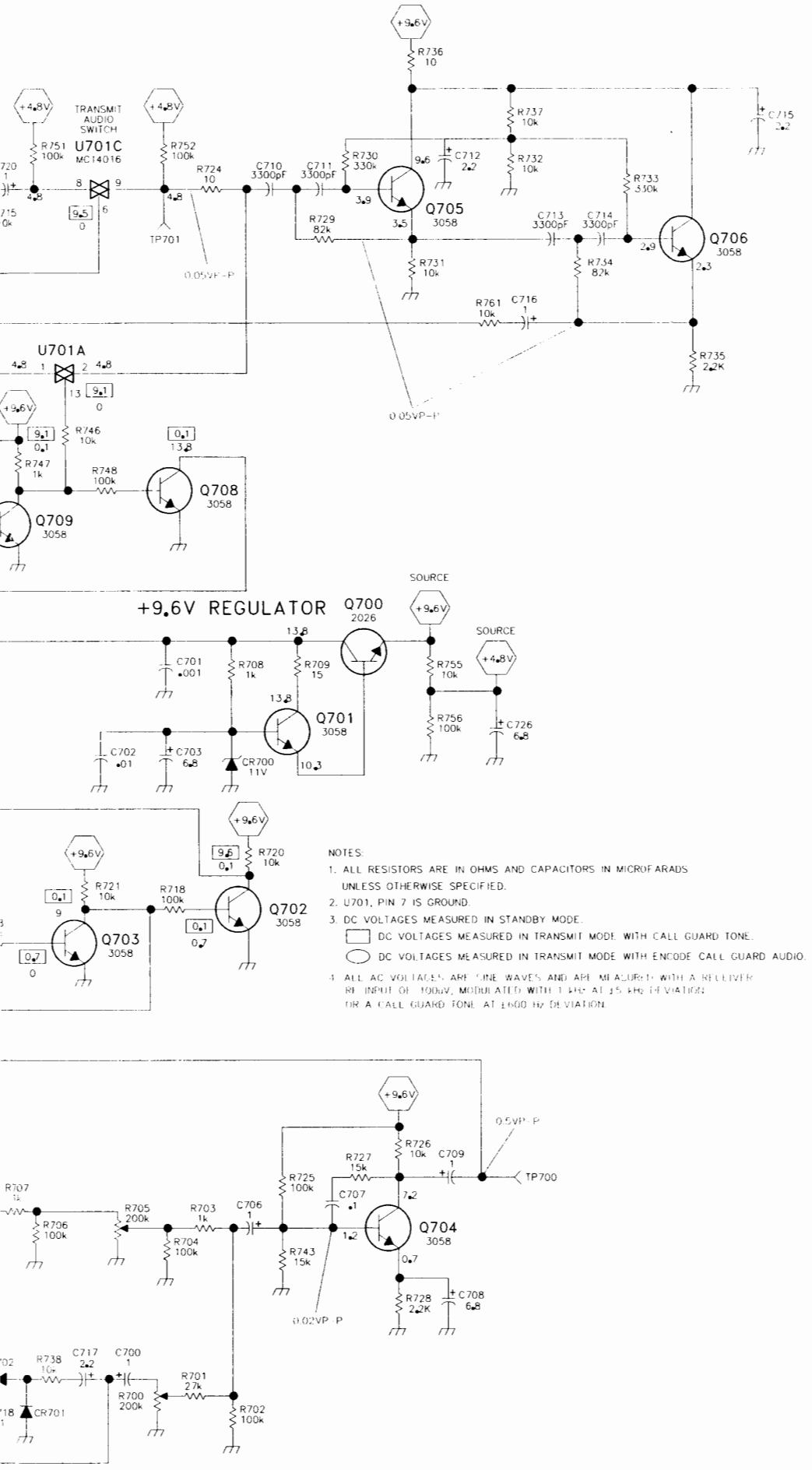

RED TO TP 70(
C701
CR700
R708
R709
C709
R736
Q700
C716
R748
R747
Q709
R746
R745
R737
R732
R730
C714
C713
R734
R735
R744
R719
R721
R720
R731
R749
C723
R718
R757
R756
U701
R711
R752
R751
R753
C722
YEL TO R710
(VOL. POT)
GRN TO R710
(VOL. POT)
BRN TO TP 701



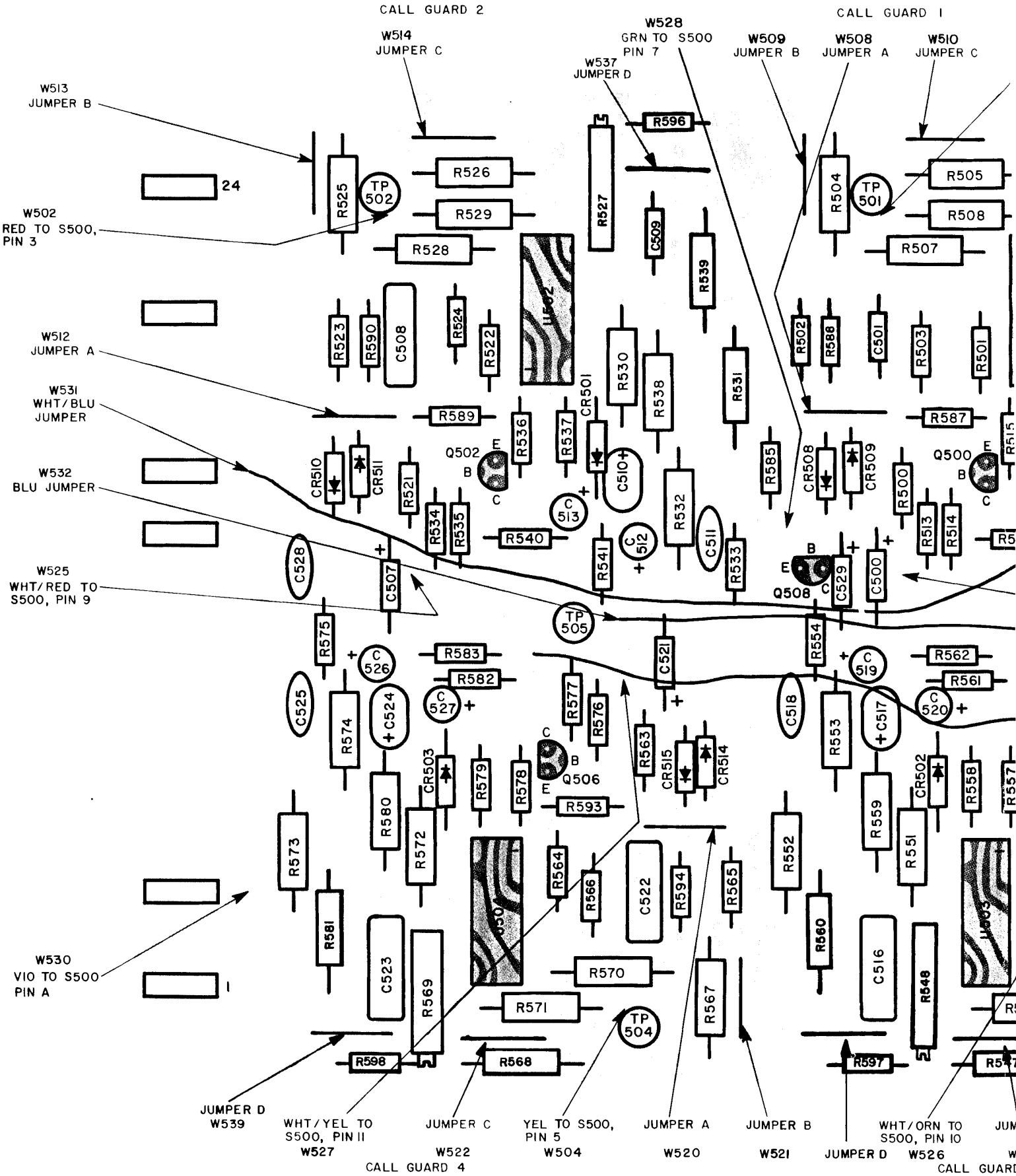


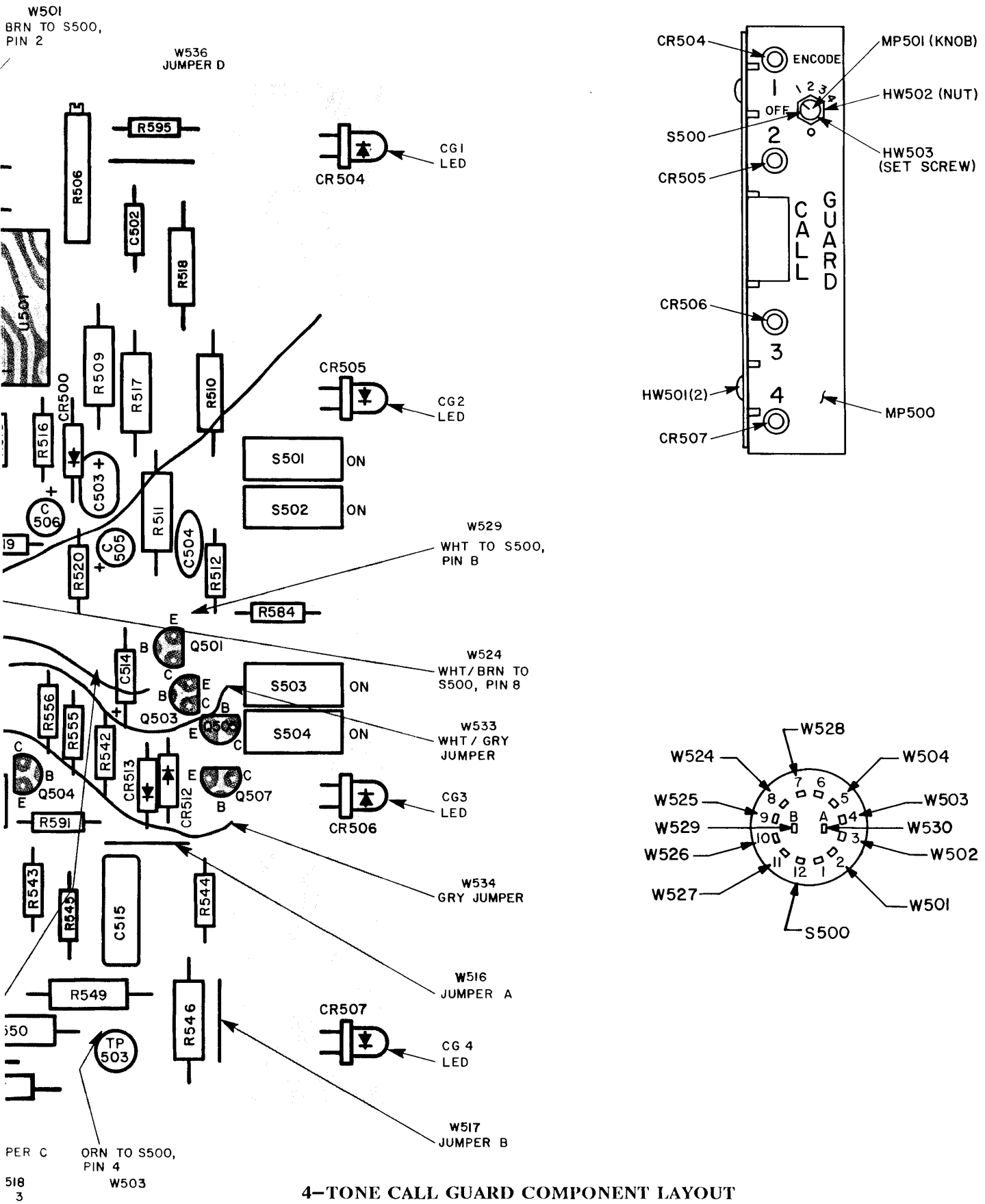
LEVEL ADJUST CARD COMPONENT LAYOUT
FIGURE 7–19


VOLUME CONTROL OUT 7
RX AUDIO J1, PIN 11 8
FROM CONTROL CARD NOR GATE (COL B, PIN 9) 9
RX AUDIO J1, PIN 9 18
LOCAL MIC AUDIO 13
+9.6V REG 20
MIC KEY 14
EXCITER KEY 19
+13.8V, J1, PIN 35 21
CG AUDIO FROM RX J1, PIN 20 11
AUDIO TO CONTROL CARD LPF (COL B, PIN 14) 15
SQ SW FROM RX J1, PIN 21 12
SQ SW TO NOR GATE ON CONTROL CARD (COL B, PIN 16)
CG AUDIO TO EXCITER J1, PIN 22
FILTERED CG AUDIO FROM CONTROL CARD CG AUDIO COMPRESSOR (COL B, PIN 23)
RX SQ CONTROL J1, PIN 5
SQUELCH ADJUST
ENCODE AUDIO IN FROM CG CARD (COL C, PIN 4)
R710 10k
R723 4.7k
R712 10k
R713 22k
R713 22k
R716 100k
R722 100k
R749 10
C723 1
R757 100k
R745 10k
R744 1k
R742 10
C721 1
R753 100k
R711 1k
C704 1
C705 .001
R754 100k
C722 1
R741 10
C724 1
R758 100k
CALL GUARD SWITCH
U701B
U701D
R759 100k
C724 1
R740 10k
R739 100k
Q707 5058
R717 200k
+4.8V
+9.6V



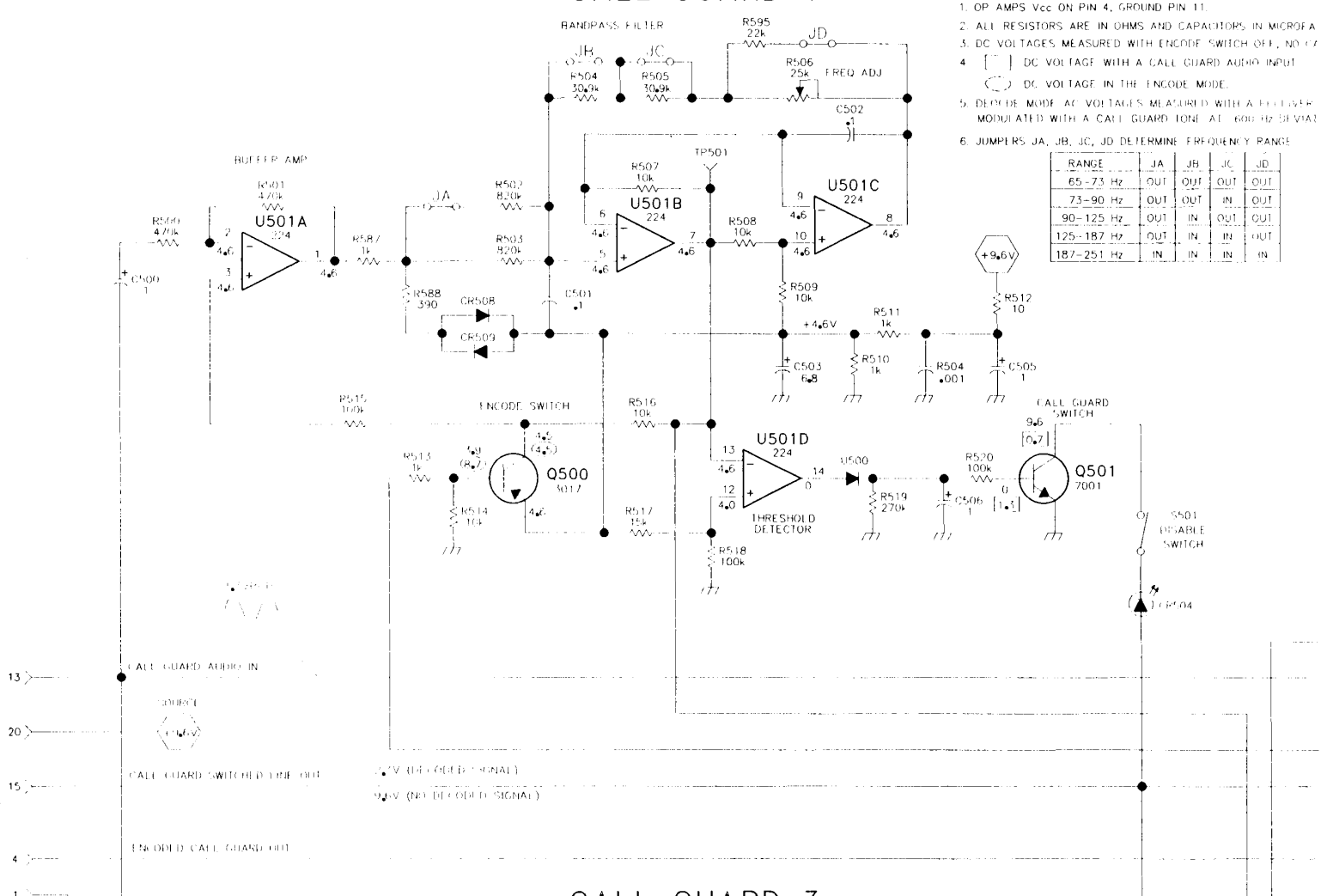
LEVEL ADJUST CARD SCHEMATIC
FIGURE 7–20


CALL GUARD 2
CALL GUARD 1
W514
JUMPER C
W528
GRN TO S500
PIN 7
W537
JUMPER D
W509
JUMPER B
W508
JUMPER A
W510
JUMPER C
W513
JUMPER B
W502
RED TO S500,
PIN 3
W512
JUMPER A
W531
WHT/BLU
JUMPER
W532
BLU JUMPER
W525
WHT/RED TO
S500, PIN 9
W530
VIO TO S500
PIN A
24
1
R596
R526
R529
R528
R525
TP 502
R527
C509
R539
R504
TP 501
R505
R508
R507
R523
R590
C508
R524
R522
U502
R530
R538
R531
R502
R588
C501
R503
R501
R589
R587
CR501
R536
R537
Q502
CR510
CR511
R521
C510
C 513
R532
R585
CR508
CR509
Q500
R500
R513
R514
R540
C 512
R541
C511
R533
C528
C507
Q508
C529
C500
TP 505
R575
C 526
R583
R582
C 527
C521
R554
C 519
R562
R561
C 520
C525
R574
C524
R577
R576
C518
R553
C517
R563
CR515
CR514
Q506
CR503
R579
R578
R593
R580
R572
R573
R564
R566
C522
R594
R565
R552
R559
CR502
R558
R551
R581
C523
R569
U501
R570
R571
TP 504
R567
R560
C516
R548
U503
R598
R568
R597
JUMPER D
W539
WHT/YEL TO
S500, PIN 11
W527
JUMPER C
W522
YEL TO S500,
PIN 5
W504
JUMPER A
W520
JUMPER B
W521
JUMPER D
WHT/ORN TO
S500, PIN 10
W526
CALL GUARD 4
CALL GUARD

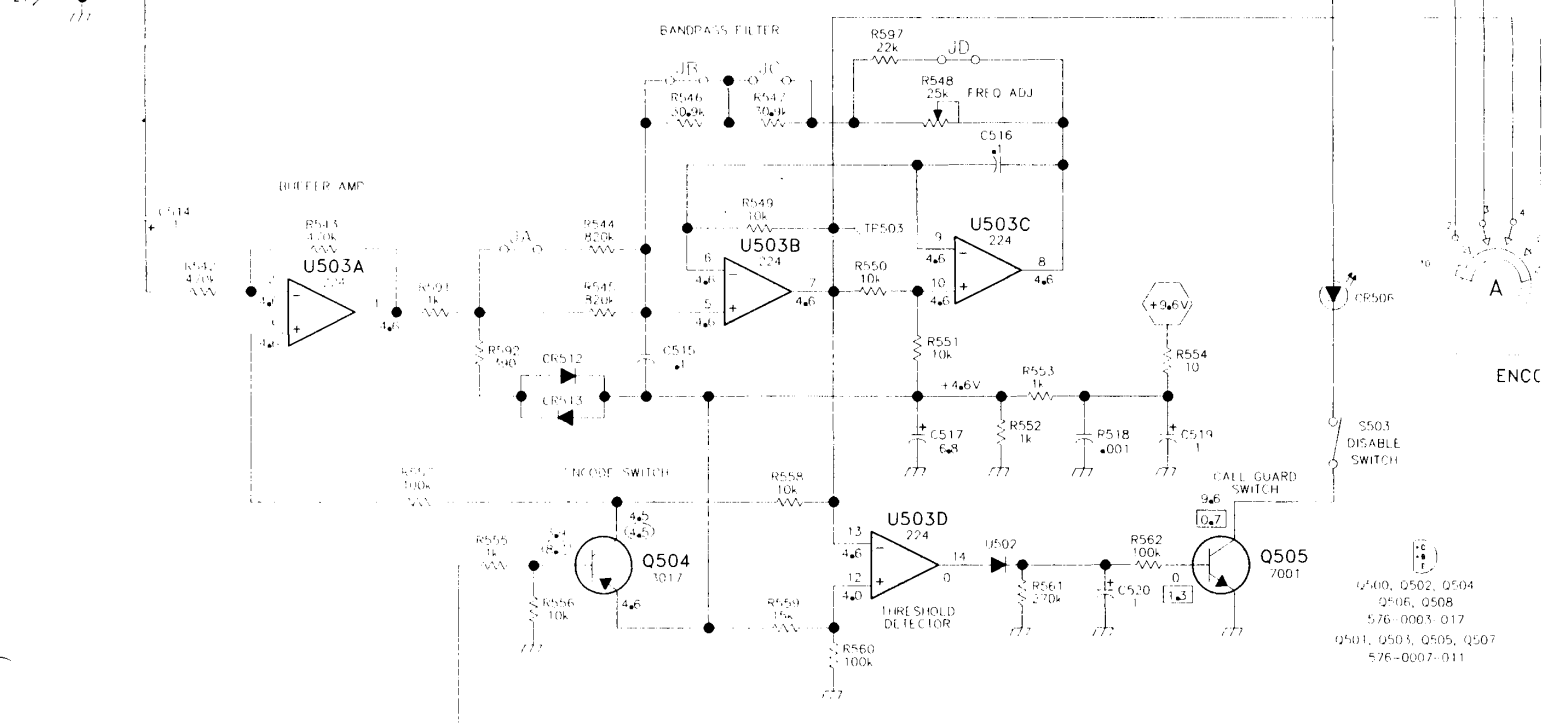


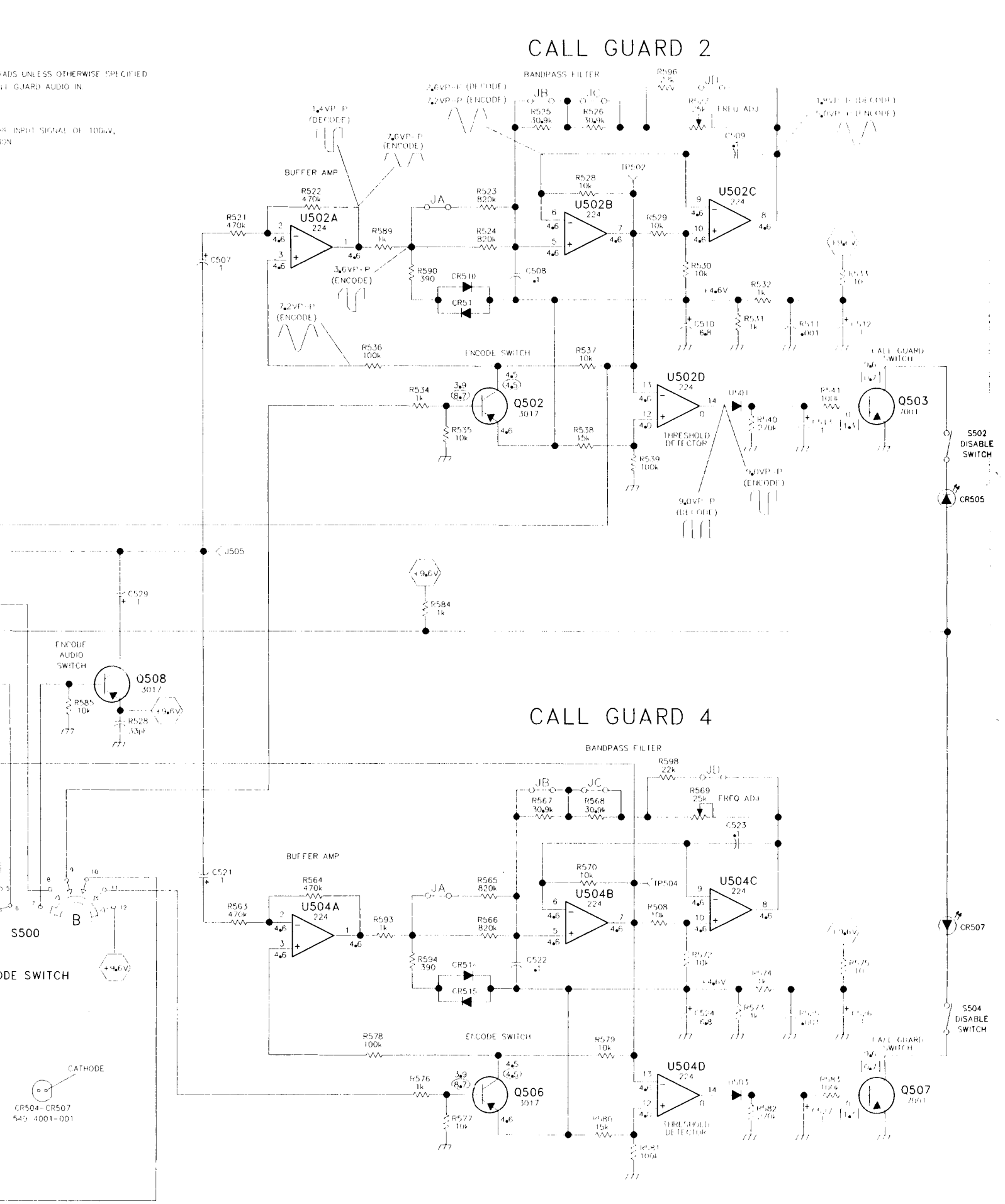
4–TONE CALL GUARD COMPONENT LAYOUT
FIGURE 7–21

CALL GUARD 1

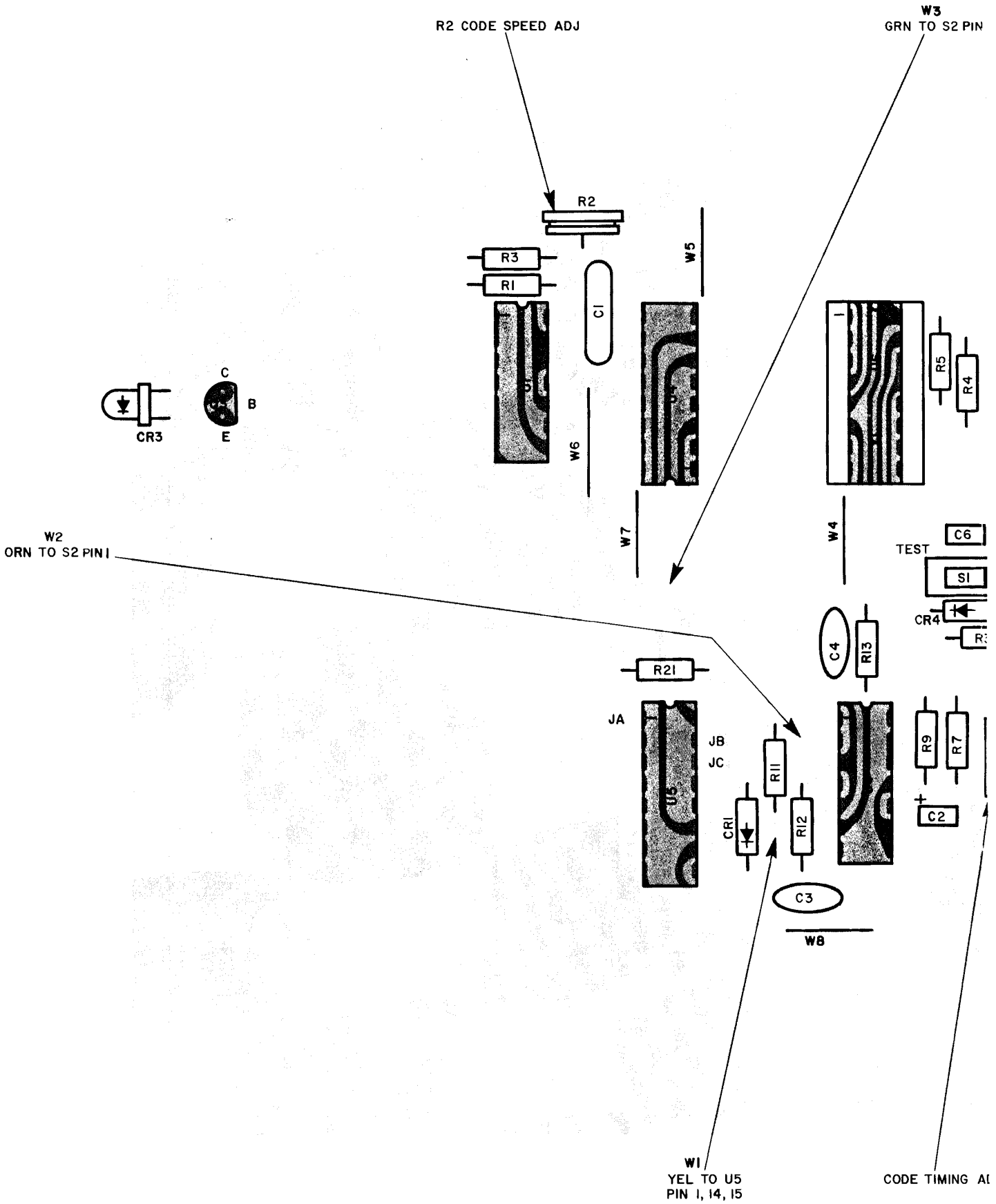


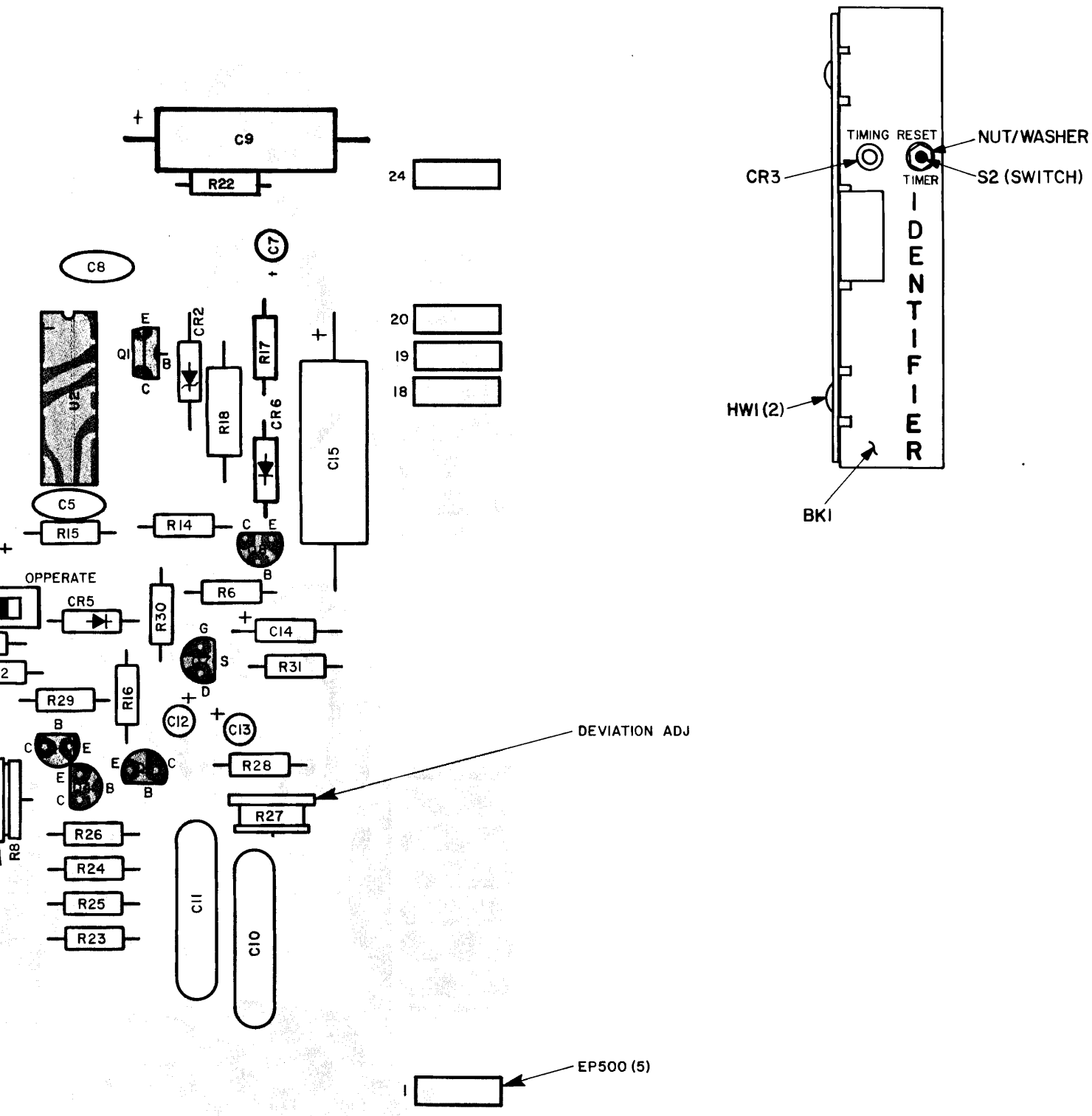
CALL GUARD 3



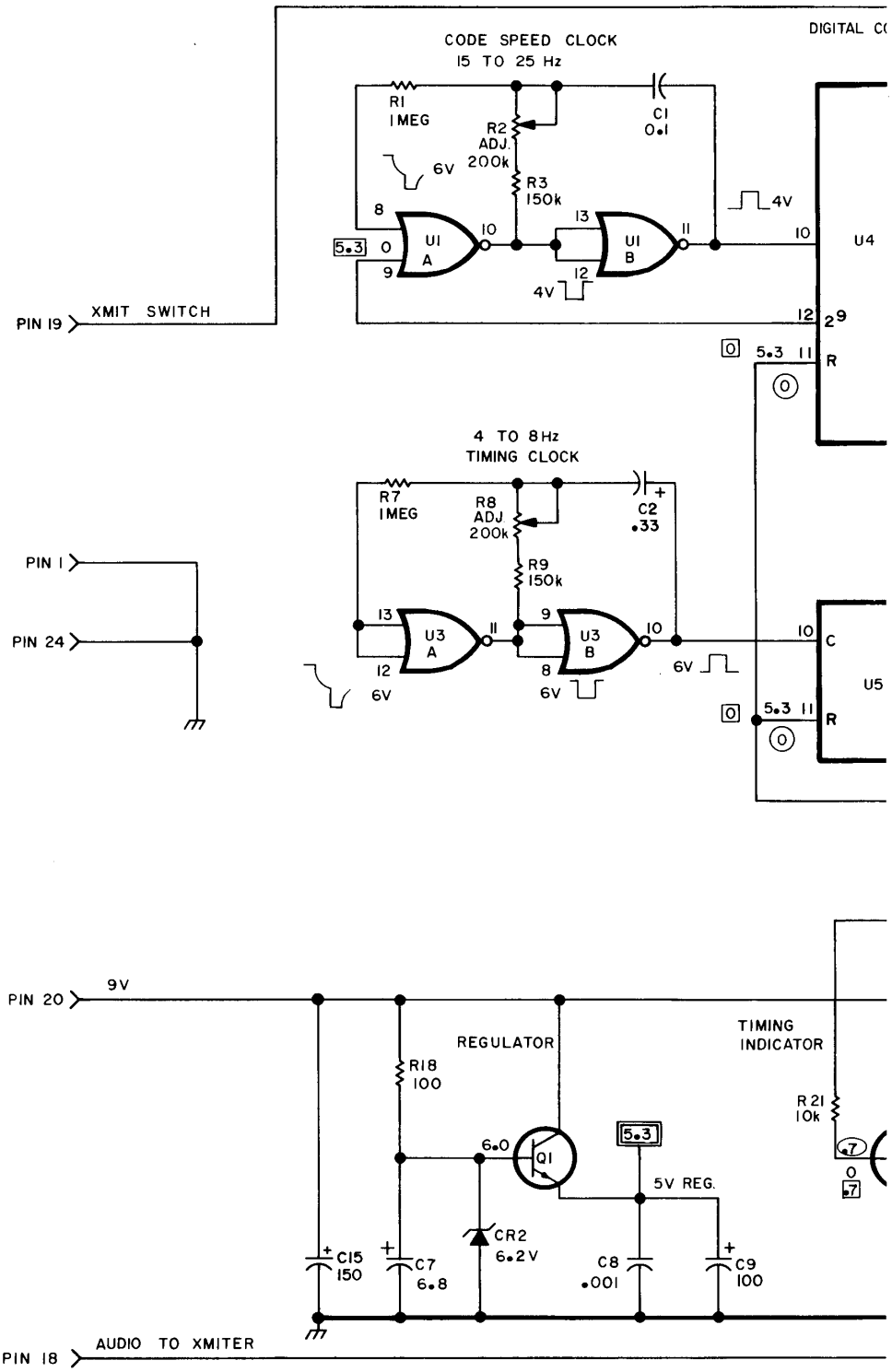


4–TONE CALL GUARD SCHEMATIC
FIGURE 7–22


R2 CODE SPEED ADJ
W3
GRN TO S2 PIN
R2
R3
R1
C1
W5
W6
W7
W4
W2
ORN TO S2 PIN 1
C
B
E
CR3
R5
R4
C6
TEST
S1
CR4
C4
R13
R21
JA
JB
JC
U5
R11
R12
CR1
C3
W8
R9
R7
C2
W1
YEL TO U5
PIN 1, 14, 15
CODE TIMING

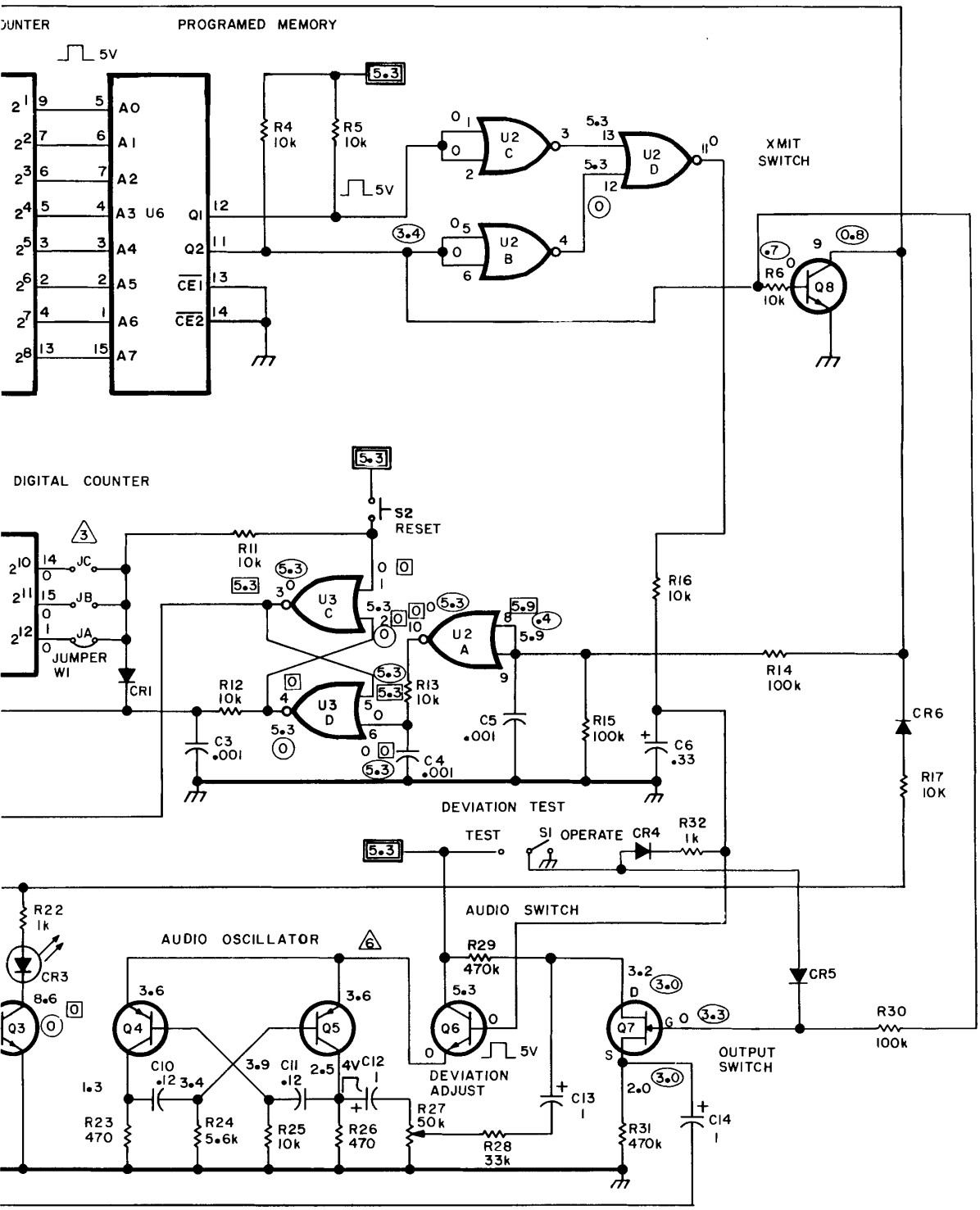


CW IDENTIFIER COMPONENT LAYOUT
FIGURE 7–23



NOTES:

1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICRO FARADS UNLESS OTHERWISE SPECIFIED.
3. SEE TABLE I FOR TIMING RANGE DESIRED.
4. U1, U2 AND U3 HAVE 5 VOLT SUPPLY ON PIN 14 AND GROUND ON PIN 7, U4, U5 AND U6 HAVE 5 VOLT SUPPLY ON PIN 16 AND GROUND ON PIN 8.
5. DC VOLTAGES TAKI
   LED OFF, TEST OI
   DC VOLTAGES
   DC VOLTAGE
6. DC VOLTAGES TAK
   TEST POSITION.



EN WITH A FLUKE 8000A, TIMING
PERATE SWITCH IN "OPERATE" POSITION.
S TAKEN WITH TIMING LED ON.
S TAKEN WHEN IDENTIFYING.
EN WITH TEST/OPERATE SWITCH IN

TABLE 1
TIMING CHART (3)

TIME RANGE	CONNECTION	JUMPER
5-10 MIN	PIN 1, U5 TO CR1 ANODE	JA
2.5-5 MIN	PIN 15, U5 TO CR1 ANODE	JB
1-2 MIN	PIN 14, U5 TO CR1 ANODE	JC

CW IDENTIFIER SCHEMATIC
FIGURE 7-24

EFJohnson®

1100 Series

Part No. 001-1100-003

Includes revisions through
8-96mwp

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