A.R.F. 2001 Scanning Transceiver

1) Owner's Manual
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A.R.F. PRODUCTS, INC.

ENGINEERS AND MANUFACTURERS OF PRECISION ELECTRONIC EQUIPMENT

PRELIMINARY

OWNER'S MANUAL

A.R.F. 2001

SCANNING TRANSCEIVER

HOME OFFICE AND MANUFACTURING PLANT - RATON, NEW MEXICO

RESEARCH AND DEVELOPMENT LABORATORY - BOULDER, COLORADO

AFR 2001

FREQUENCY COUNTER

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A.R.F. PRODUCTS, INC.

Raton, New Mexico

TITLE AFR 2001 FREQUENCY COUNTER

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One Year Limited Warranty

A.R.F. Products, Inc. warrants to the purchaser of each AFR 2001 Frequency Counter that such product shall be free from defects in material and workmanship under normal use and service for a period of one (1) year from the date of sale to the purchaser provided you return your warranty registration card to: A.R.F. Products, Inc., within 10 days of date of purchase. If it should be found within the warranty period and if the Frequency Counter has not been subject to neglect, misuse, accident, improper installation or such defect is caused by service other than that performed by A.R.F. Products, Inc.. A.R.F. Products will, at its' option either replace or repair the Frequency Counter.

To obtain warranty repair the customer must return the Frequency Counter and radio properly packed, freight prepaid, to A.R.F. Products, Inc.. It will be returned freight prepaid

Where permitted by law, this warranty is in lieu of all other warranties expressed or implied and no represenative or person is authorized to assume for us any other liability. Some states do not allow limitations on implied warranties so the above limitation may not be applicable, you may have rights as defined by each state law.

A.R.F. PRODUCTS, INC.
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PART 1

GENERAL INFORMATION

1.1 DESCRIPTION

The AFR 2001 Frequency Counter is an accurate compact instrument specifically designed for installation in the A.R.F. 2001 Eleven Meter Scanning Transceiver.

The counter displays the actual operation frequency of the transceiver in all modes of operation: Receive, Transmit, AM, USB, and LSB. Six one-half inch LED digits display the frequency in megahertz with 100 Hz resolution.

The unit mounts directly behind the front panel replacing the digital clock.

1.2 OPTION

The versatility of the unit can be extended by a modification to measure external frequencies with the addition of a switch and coax cable. See section 3.

PART 2

INSTALLATION

2.1 INTRODUCTION

Before attempting to install and operate the AFR 2001 Frequency Counter carefully read all instructions and become familiar with this manual.

2.2 INSTALLATION INSPECTION

This instrument was carefully inspected mechanically and electrically before shipment and should be in perfect working order upon receipt. Neverthless, the unit should be inspected for physical damage, in transit. If damage has resulted, immediately contact the shipper and refer to the warranty at the beginning of this manual.

2.3 POWER REQUIREMENT

When the counter is in the A.R.F. 2001 Scanning Transceiver no external power connections are required. All power for the counter is obtained from the 2001 Transceiver.

2.4 TOOLS REQUIRED

¼" Nut Driver

Small Diagonal Wire Cutters

Long-Nose Pliers

Small Soldering Iron

(Note: DO NOT use a solder gun, as damage to certain electronic components can result from the large currents induced by the gun).

Solder, rosin flux only (DO NOT use acid core solder).

2.5 PRECAUTIONS

A certain amount of basic knowledge and experience assembling and soldering electronic equipment is necessary to insure proper installation of the counter in the 2001 Transceiver. Unless, you feel confident you can do a good job refer the work to someone with experience.

Before attempting the installation lay out all your tools and the counter to be installed. With the cord unplugged, carefully, remove only the top cover of the transceiver and place cushioning (heavy cloth, rug, etc. - handle protection) between the work surface and the transceiver handles. Turn the transceiver with the front panel down if necessary to obtain a good view of the P.C. board assemblies in the transceiver.

2.6 INSTALLATION PROCEDURE

Refer to 6.1 and locate the following assemblies:

A9 Power Supply (On vertical bracket near transformer).
A2 SSB ASSY (Sideband modulator/demodulator, center board on chassis).
A4 PLL ASSY (On right side of chassis behind 1
Mode (AUL) Switch The power and antenna switches).

Note that all wiring pins on each board have numbers with each number

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corresponding to a particular circuit. The accurate location of these pins will be necessary in the installation procedure.

Note also that the counter to be installed has wires identified by a color or number or both.

Read through the instructions at least once before starting the installation.

Before the counter can be installed the digital clock transformer must be removed from the transceiver. Follow these steps:

2.6.1 Be absolutely certain the power cord is unplugged and the unit is OFF!

2.6.2 REMOVING THE CLOCK

With the transceiver front panel down, remove two ¼" hex nuts holding the clock to the rear of the panel, pull the clock back from the panel (wires still attached). (NOTE: Save all hardware for installation of the counter).

2.6.3 Locate four #22 wires (largest) two green, one white, and one red from the clock transformer to the clock. Cut only these wires and leave some wire with insulation attached to the clock board for for wire connection identification if you plan to reuse the clock in another housing. Three small wires should remain attached from the "f" & "s" switches, DO NOT cut these wires.

2.6.4 Remove two ¼" hex nuts holding the "f" & "s" swich plate. Remove the clock and switch plate with switches and set aside for future use, save the hardware. The ground lug at the left stud will be re-installed later.

2.6.5 Locate the two black wires from the clock transformer to the power output section of the transceiver. BE SURE THE POWER CORD IS NOT CONNECTED TO THE POWER LINE!!

Carefully cut one of the black wires at the fuseholder and the other at the feed-thru capacitor. Cut them short and leave no wire protruding that may cause a short.

With all the transformer wires disconnected, remove the two screws holding the transfomer and carefully pull out until all wires are free from unit. Set the transformer aside with the clock. (Note: Radio Shack supplies several enclosures suitable for mounting the clock and transformers).

2.6.6 INSTALLING THE COUNTER - SEE 6.3.

With the transceiver unit front panel down and the P.C. assembly boards visible, begin the installation.

2.6.7 Locate pins 2 and 10 (nearest the rear of the unit) on the A4 PLL board assy., (see 6.1), disconnect, by carefully unwrapping, the two gray wires connected to pin 10. Trim, connect, and solder these two wires together and cover with insulation tubing supplied in the kit. Note: these two wire ends will now be connected and isolated. Cut the orange wire to pin 2 and pull the end up away from the chassis or any other components. This wire will be left disconnected.

Locate A2 SSB board pin 20. Disconnect the coax cable at pin 20 and the ground pin near it. Tape the end of this cable to prevent accidentally shorting to any components or pins.

These wires disconnected should be left available for possible re-use in the event the counter is ever removed from the transceiver.

2.6.8 With the counter set on the work bench near the top of the transceiver front panel, locate A9 power supply assy. board and remove the hex nut and lockwasher near the top between pins 57 and 87. Install the filter assembly as shown in 6.2 and replace the hex nut and lockwasher to hold the filter in place. Note: This mounting provides ground for the filter and the counter. Be sure the filter does not pivot, when tightening, and short to one of the pins.

2.6.9 Locate pin 8 under the large relay on A9 power supply board (See Fig. 6.2). Carefully attach and solder the large red wire marked 8 from the filter assy to this pin. Be careful when working on these pins as they can be damaged with undue stress or may pop out under excessive heat from a solder iron. The large red wire from the counter will be prewired to the opposite filter terminal. The large black wire from the counter will be prewired to the center (ground) lug of the filter.

2.6.10 Locate the rear of the "mode" (A, U, & L) switch on the transceiver front panel, refer to 6.3. Solder wires 5, 6, and 7 from the counter to the respective pins on the rear of the mode switch. DO NOT remove any wires already connected to the switch and be careful not to create a "solder bridge" between the switch connections.

2.6.11 Connect and solder wire 3 from the counter to pin 3 on the A9 power supply board, (See 6.2).

2.6.12 On the coax cable wire #16 from the counter find the center conductor and the shield wire. Connect and solder the center conductor to A4 board pin 16, and the shield wire to the ground pin nearest pin 16. Be sure the wires do not short across the pins, (See 6.1).

2.6.13 Coax cable #20 connect and solder the center conductor to pin 20 of the A2 board and shield to the ground pin nearest pin 20. Again, be sure the wires do not short across the pins, (See 6.1).

2.6.14 REFER TO 6.3

Locate the two mounting nuts holding the right side handle. Loosen (but do not remove), the rear- nut about four turns. Remove the nut on the end nearest the front panel.

2.6.15 MOUNTING THE COUNTER READOUT AND COUNTER

First place three small flat washers on each of the clock mounting studs, then one brown insulating spacer on each of the two studs, (See 6.3). Place one large flat washer on the left switch stud.

2.6.16 While holding the counter in one hand (counter mtg brackets pointing away from you), carefully guide the counter readout assembly onto the mounting studs. Place a lockwasher and a hex nut on each stud to hold the readout assembly in place. DO NOT OVER TIGHTEN! Avoid excessive strain on the readout wires.

2.6.17 Place the counter forward mounting bracket hole on the panel left switch stud. Place the counter side mounting bracket on the forward handle stud. Install and tighten the handle lock nuts.

2.6.18 Place the ground lug with three black wires attached on the left switch stud, follow with one lockwasher, a hex nut, and tighten. The counter and readout should now appear mechanically aligned without any binding or large gaps around the front of the readout.

2.6.19 Before applying power, go back to procedure 2.6.9 and re-check each step, to be sure a step has not been skipped and that all wiring is correct.

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2001 SERVICE MANUAL

A.R.F. 2001 SCANNING TRANSCEIVER SERVICE MANUAL

1. GENERAL INFORMATION

1.1 Servicing the 2001

The A.R.F. 2001 Personal Communication Transceiver was designed and engineered utilizing latest state of the art electronic components and circuits. Certain circuits developed specifically for this radio; SAM and AMSIL, are new unique breakthroughs in communications technology.

SAM is a servo amplitude modulation for AM that tightly controls carrier level and modulation using feedback in an electronic modulator. Unlike the coventional modulation transformer, SAM allows smooth clean modulation up to 100% but will not exceed 100% regardless of the amount of audio drive to it.

AMSIL is an AM silencing circuit useable in sideband receive when an operator does not wish to listen to undesirable AM traffic while standing by for specific sideband signals. When switched in, AMSIL overrides the squelch keeping the receiver squelched off during no signal and AM signal reception. A sideband signal of 1 microvolt or greater will reliably break the squelch with fast attack slow release operation. Some AM signals excessively off center frequency (600 hz or greater) may occasionally break AMSIL.

Upon examining the schematic of this unit you will become aware of the many integrated circuits used in the design. Do not be dismayed with the apparent complexity and large number of components. As with many complex devices, once broken down and examined by sections you will find signal paths and operating modes easy to understand

1.2 Servicing Qualifications

The technical information in this manual is intended for use by an experienced qualified technican, holder of a current second or first class radiotelephone license, for servicing of the A.R.F. 2001 Scanning Transceiver. Unless you hold such a license, do not attempt to make any repairs or adjustments inside the 2001.

The 2001 transceivers are individually hand calibrated by trained and experienced technicans at the factory using the very best electronic test equipment. Every unit leaves the factory tuned to optimum performance and unless a certain malfunction occurs, any further adjustments are likely to degrade this performance and render the unit in violation of FCC Specifications.

1.3 Precautions

As with any electronic equipment, certain precautions are necessary when working on the 2001 circuits.

Do not use induction type soldering guns in the unit. The strong inductive currents generated by the gun may damage certain components. Stick to small 30 to 75 watt resistance type soldering irons. Static electricity often destroys MOS FET transistors and MOS FET IC's of which there are a number of in the 2001. The use of a grounded soldering iron and personal ground straps will usually prevent such damage. However, a simple practice of touching the chassis with a tool, soldering iron, and your hand before soldering a MOS FET lead/pad will usually work.

The SD305, SD306 transistors, the MM 57150 IC, and the 14000 series IC's are vulnerable and require care in handling and installation. Always disconnect the power cord while working in the unit. With the cover removed and power on beware of lethal line voltages on exposed connections of the fuseholders, power filters, and power transformer.

2. THEORY OF OPERATION

2.1 General

2.1.1 Voltages

Two basic regulated voltages are used throughout the 2001 with both regulators on the power supply board A9. The 14.5 VDC is adjustable and mainly supplies circuits in the receiver (A1), transmitter (A6), Audio Board (A3), SSB board (A2), and the SWR Board (A8). The 8 VDC is not adjustable and primarily supplies the PLL frequency synthesizer board (A4), the SCAN Board (A5), and readout board (A7).

2.1.2 Frequencies

Since the 2001 is designed for single conversion the IF operates only at 10.695 mhz center frequency. Local Oscillation frequencies are above the 27 mhz band at 38 mhz resulting in "high side" mixing. This technique eliminates most undesirable spurious responses yielding a cleaner operating receiver and transmitter.

AM receive local oscillator frequencies range from 37.66 mhz at Channel 1 to 38.1 mhz at Channel 40, and are mixed with the desired CB frequency respectively resulting in 10.695 mhz IF.

AM transmitt generates 10.695 mhz, mixes with the 37.66 to 38.10 mhz frequency to produce a respective frequency in the 27 mhz band.

2.1.3 Lower Sideband Receive

Frequencies for sideband are somewhat more complex. One upper sideband filter is used in the sideband IF passing frequencies approximately 10.695200 mhz to about 10.697200 mhz. Since high side mixing "inverts" the received signal the USB IF filter will respond to a LSB received signal only. The carrier remains as in AM at 10.695 mhz for LSB with sideband signals operating from the lower edge of the USB filter.

2.1.4 Upper Sideband Receive

To use the USB IF filter for a received USB signal the signals must operate down from the upper edge of the sideband filter. The 38 mhz local oscillator and the carrier frequency are both shifted up by 2500 hz to allow the filter to respond to USB signals only. The operating edge of the sideband filter is now 10.697500 mhz.

During AM receive the 10.695 mhz oscillator is not needed for AM detection. The 10.695 mhz oscillator is used in carrier restoration for LSB and 10.6975 mhz for USB at the product detector.

2.1.5 AM and LSB Transmitt

The 10.695 mhz carrier in AM is mixed almost directly with the 38 mhz L.O. to produce the desired 27 mhz signal in the transmitter. In LSB the carrier is injected at the balanced modulation, mixed with the audio to produce a double sideband IF signal with the carrier suppressed. This IF is then filtered in the USB filter producing an USB carrier, suppressed IF signal. It is then mixed with the 38 mhz carrier producing a LSB 27 mhz signal due to the inversion.

2.1.6 USB Transmitt

Signal processing for USB is the same as for LSB except the carrier is shifted up by 2500 hz at 10.697500 mhz. When filtered in the USB filter the lower IF sideband is passed. The IF is then mixed with the 38 mhz L.O. also shifted up by 2500 hz to produce the desired USB 27 mhz signal.

2.2 AM Receive Detail Description

2.2.1 The LP filter networks at 6L2 and 6L3 are shared with the transmitter. The received signal is completed through 6L8 to timed tank 1L1 and 1L5. Diodes 1CR1 and 1CR2 clip excessively large signals to prevent overloading the front end. The signal is coupled into the signal gate (pin 3) of 1Q5, the SD306, dual gate MOS FET RF amplifier. Pin 2, AGC gate, operates from the AGC amplifier and RF gain control. The AGC gate normally operates near 8vDC for full gain and near 1vDC for approximately 45 db less. 1Q5 provides approximately 20 db RF gain.

From the drain of 1Q5 the signal couples to the signal gate of mixer transistor 1Q6. The 38 mhz signal from the PLL is mixed with the 27 mhz signal in 1Q6 to produce the 10.695 mhz IF frequency. Transformer 1T1 tunes at 10.695 mhz. The output of 1T1 couples through the noise blanker series gate diode 1CR5 to the first AM crystal filter 1Y1 and 1Y2 to the input of the first IF amplifier 1U1 (MC1350P). Each MC1350P provides about 45 db gain with excellent stability and AGC characteristics. Amplifier 1U1 times into 1T2 IF transformer than couples out to AM crystal filter 1Y3 and 1Y4 to the input of the second IF amplifier 1U2. 1U2 tunes into IF transformer 1T3. The output of 1T3 couples out to pin 9 for sideband receive and to the base of amplifier 1Q7 for AM. 1Q7 drives the AM detector diodes 1CR10 and 1CR9. Recovered audio is coupled to the audio board through capacitor 1C37 and pin 13. 1R47, 1R50, 1CR8, 1R52, and 1R51 comprise the ANL circuit. Transistor 1Q8 shuts off amplifier 1Q7 during SSB receive.

2.2.3 AGC

AGC DC voltage from the AM detector couples through 1R53 to one of the LM 358 dual op amp inputs pin 5. The gain of the IF AGC op amp is fixed at about 3 but also provides low pass filtering with rolloff at about 20 hz. 1R53, 1R44, 1C35 and 1C38 comprise the filter network. The output of the IF AGC op amp provides a low DC voltage to both IF amplifiers with no signal in. When input signals approach 1uV the AGC voltage is sufficient to start AGC near 5VDC. With strong signals the voltage is near 8VDC.

The other op amp inverts the AGC voltage for use at the RD amplifier through the RF Gain control R1. Voltage with no signal is near 8V and strong signal voltage is near 1V. 1R35 balances the RF op amp. Transistor 1Q4 inverts the AGC voltage and provides a more linear voltage output vs RE input for sharper squelch control at low signal levels. IF AGC voltage is also provided to the "S" meter circuits.

2.2.2 Audio from the receiver board A1 is coupled to the audio board A3, through amplifier transistor 3Q5, to one of the dual op amps in 3U2 pins. The op amp is also a high pass filter suppressing undesirable rumble and low frequency noise. The output (pin 7) couples to one of the four FET switches in 3U4 MC14066 IC. The switch is controlled by 14V receive voltage and is on in receive off in transmit. Audio is also controlled at the output of the switch by the squelch circuit consisting of squelch amplifier 3Q8, 3Q4, and 3Q9. Potentiometer 3R40 adjusts low signal squelch threshold and 3R39 adjusts high signal squelch threshold. After processing through the volume and tone controls, the audio is amplified in 3U3 (TBA-810) IC audio amplifier and from the coupled to the speaker through relay 9K1 and the audio switching circuits.

2.2.4 Noise Blanker

Noise pulses at 1Q5 diam are sampled and coupled to pulse amplifier 1Q1, rectified, filtered, and coupled to amplifier 1Q2. The output network of 1Q2 "stretches" the pulse before coupling to switching transistor 1Q3. During a pulse 1Q3 is saturated holding the anode of 1CR5 low for signal cutoff. Normally the anode is high biasing 1CR5 switch on.

2.3 SIDEBAND RECEIVE

2.3.1 Sideband Signal Path

After the first mixer 1Q6 the sidebands are inverted, LSB becomes USB and vice versa. Sideband receive signals (10.695 mhz) are processed through the entire AM IF circuits through 1T3. In sideband, transistor 1Q7 is switched off by 1Q8 and the IF signal couples out pin 9 to 2Q1 amplifier on the A2 Board. The IF signal is processed through the two sets of USB crystal filters 2Y1, 2ç2, 2Y3, and 2Y4. 2Q3 is a buffer between the crystal sets. After filtering the signal couples through IF Switch 2CR12 to 2U1 (Pin 1) the product detector. In the 1596 product detector the sideband IF signal is mixed with the 10.695 (LSB) or 10.6975 (USB) carrier to produce recivered audio. (Pin 10 carrier input, Pin 12 audio output). Audio is coupled out pin 22 to the audio A3 board where it is processed the same as AM audio.

2.3.2 SSB AGC

SSB AGC is derived from the recovered SSB audio signal amplified by 2Q5. AGC level is set by 2R15. The audio is detected at 2CR5, and 2CR6, filtered and coupled out through pin 12 to the AGC amplifiers in A1. AGC network 2R67, 2R68, and 2C6 provide fast attack slow release.

2.3.3 AM Silencing (AMSIL)

The AM silencing circuit overrides the squelch and squelches anything except a legitimate SSB signal. An AM signal processed through the circuit is detected for AM carrier by diodes 2CR1 and 2CR2. The product detector also responds to the AM signal and some audio output is obtained. However, the AM detector provides a strong negative voltage at the base of 2Q8 strongly keeping it turned off. The audio remains squelched. The low amount of audio from the product detector is not sufficient to drive 2Q4 and detectors 2CR13 and 2CR14 to make 2Q8 turn on.

High pass filter 2C20, 2C21, and 2L1 roll off frequencies below 600 hz in order to prevent an AM carrier appearing at the product detector as a strong beat note. This prevents AM signals approximately within ± 500 hz of the 2001 center frequency from breaking AMSIL. AM carriers over 600 hz appear to the product detector as a sideband tone and will break AMSIL. Since the center frequency of most CB's are within ± 500 hz, most undesirable AM will be silenced.

When a legitimate sideband appears at the AM detectors (2CR1, 2CR2) no carrier is present and the amount of sideband speech rectified is small thus no negative shut off voltage appears at 2Q8 base. The product detector now provides a substantial audio output which is further amplified in 2Q5, filtered through 2C20, 2C21, and 2L1, amplified by 2Q4 and rectified at 2CR13 and 2CR14. The positive going voltage turns 2Q8 and 2Q9 on fast, opening the audio squelch. 2CR15, 2C34, and 2R53 provide a slow release.

2.4 AM TRANSMIT AND SAM

2.4.1 Audio Processing

Microphone audio input is coupled to one of the dual op amps in IC 3U2 (Pin 2). The preamp provides 27 db gain with SAM out and 40 db with SAM in. Audio from the preamp (Pin 1) couples out to the MIC GAIN control and back to audio clipper circuit 3Q1 and 3Q2 where the audio is symetrically clipped by approximately 10 to 15 db. The clipped audio, which is highly distorted and not useable as such, is filtered in a low pass active filter network consisting of 3R24, 3C7, 3R25, 3R26, 3C10, 3CU, and one of the dual op amps in 3U1 (Pin 5). This filter "cleans up" the audio reducing the distortion to low levels. The audio to this point is the same for SSB transmit (Pin 7).

Audio for AM moderation now couples into three of the four switches in IC 3U4 (Pins 9, 2, and 3). For AM a DC voltage at Pin 6 from 14v AM, gates the analog switch on for the signal to appear at output Pin 8 of 3U4. The amount of audio drive at 3R35 is adjusted for desired percent modulatory.

2.4.2 Modulation

The audio is coupled into the other op amp in IC 3U1 (Pin 3) for a gain of about three and drives a darlington power amplifier 3Q7 and 3Q6. This combination is a unique "solid state modulation" with feedback from detectors 6CR4 and 6CR5 in the transmitter for carrier power level control and audio percent modulation feedback control. This modulator cannot modulate the transmitter over 100%. Thus, no automatic audio level controls are needed in this unit.

2.4.3 AM Transmit

A 10.695 mhz carrier switched on by 2CR1D and 2CR11 is coupled to input low pass filter consisting of 6L1 and 6L17 and on to balanced mixer 6U1 (1596) Pin 1. The 10.695 mhz is mixed with the 38 mhz L.O. from the PLL A4 board to produce the appropriate 27 mhz carrier. Balanced output from 6U1 tunes in tank 6T2 primary and 6C44. Carrier is coupled out the secondary of 6T2 through buffer amplifier 6Q8 to the signal gate of 6Q4. 6Q4 AGC is used during SSB transmit but in AM gain is always maximum.

From the drain of 6Q4 the signal is amplified through 6Q3, 6Q2, and 6Q1. 6C11 and 6L4 transformer the transistor 6Q1 low impedance to match the 50 ohm external loads. Low pass filter network 6L2 and 6L3 alternate all harmonics and spurous signals above 27 mhz to less than 60 db. Modulation voltage is supplied to the collectors of 6Q1 and 6Q2 through A2 Pin 31 from the servo amplitude modulation in A3.

In order to modulate a 4 watt carrier to 100% modulation the transmitter must be capable of providing 16 watts of peak power output.

Transistors 6Q1 and 6Q2 are not based up during AM transmit and operate class C for normal AM modulation.

2.5 SSB TRANSMITT

2.5.1 Audio Processing

Audio processing for SSB transmit is the same as AM through IC 3U1. During sideband 3U4 switch (Pin 2 input, Pin 1 output) controlled at Pin 13 by 14v U and L is turned on supplying audio through 3R38 and the input (Pin 1) of the balanced modulator 2U2. The audio is "mixed" with the 10.695/10.6975 mhz carrier in 2U2 to produce a double sideband suppressed carrier output (Pin 6). The DSB signal couples through RF Switch 2CR9, through amplifier 2Q1 and the appropriate sideband is filtered out in 2Y1, 2Y2, 2Y3, and 2Y4. The sideband IF couples out to A6 mixer 6U1. During sideband RF switch 2CR10 and 2CR11 is off preventing the carrier from directly interferring with the sideband IF.

2.5.2 Transmitter

Amplification through the transmitter is the same as AM except 6Q1 and 6Q2 are biased into class AB operation for linearity. Bias is supplied 6Q7 switch in USB or LSB. RF output level control for sideband is detected at 6CR2 amplified by 6Q5 and coupled to the AGC gate of 6Q4. Switch 6Q6 disables the SSB level control during AM transmit.

Line 33 from the A4 assembly is a shutdown voltage occuring whenever the phase locked loop in the synthesizer is unlocked. Unlock commonly results during channel change. With this voltage switching 6Q5 the transmitter is inhibited during any unlock PLL condition. Also during the transition when voltages are switching from transmit to receive, the transmit voltages are just starting to decay when the receive voltages rise to max. Switching input line 3 to 6Q5 immediately cuts off the RF in the transmitter when the receive B+ starts to rise. This switching eliminates a short squeal ordinarily audiable.

2.6 PUBLIC ADDRESS AND TALKBACK

2.6.1 Public Address

When switching the unit to PA the audio from the microphone is processed the same as during CB transmit up through 3U1 output. From this point audio is switched through one of the analog switches in 3U4 (input Pin 3, output Pin 4) by control voltage 14V PA at Pin 5. Audio couples to the input of the audio power amplifier 3U3 bypassing volume and tone controls. The MIC GAIN control serves as the PA volume control. Audio output from 3U3 passes through relays 9K1, 9K2, the INT/EXT switch, and the EXT SPKR jack. The internal speaker is disconnected and audio couples out through the PA speaker jack.

2.6.2 Talkback (INTERCOM)

When the TALKBACK Switch is on, relay 9K2 switches the PA speaker to the input of the audio circuity and the audio output of 3U3 connects to the internal speaker. In this mode sounds at the PA speaker are audiable at the 2001 transceiver.

When the PTT lever on the microphone is squeezed relay 9K2 switches the unit back to the PA mode for two way conversation.

2.7 FREQUENCY GENERATION (ASSEMBLY BOARD A4)

2.7.1 Carrier Frequencies

One of two carrier frequencies is used in all modes except AM receive. The 10.695 is used in AM transmit and in LSB receive and transmit. 10.6975 is used in USB receive and transmit. Oscillator 4Q8 operates from either crystal 4Y3 or 4Y4 depending on the DC voltages to the switching diodes 4CR10 and 4CR11 for the desired mode of operation. Output from the oscillator is taken from the emitter to the A2 assembly.

2.7.2 38 mhz Local Oscillator (PLL)

The local oscillator frequencies are generated in the phase locked loop circuit of 4U1. Frequencies generated range from 37.66 mhz for channel 1 to 38.10 mhz at channel 40. Frequencies generated in the synthesizer are shown in Tables

The stable reference oscillator for the PLL is controlled by crystal 4Y2 at 10.24 mhz. This reference is divided within IC 4U1 by 2048 to 5 khz for use by the comparator in 4U1.

Voltage controlled oscillator 4Q2 is frequency controlled from 4U1 by a phase error signal through loop filter 4R11 to 4R6 by the DC voltage on varactor diode 4CR1. The varactor diode controlled variable capacitance is part of the frequency tank of 4T1 and VCO 4Q2. The VCO tunes through the 38 mhz L.O. region. Output to the respective circuits is coupled through 4Q1 buffer transistor. A sample of the 38 mhz L.O. for control feedback to the PLL IC is coupled from the secondary of 4T1 through buffer amplifier 4Q3 to mix-down-mixer 4Q4.

A separate mix down frequency is generated by 4Q5 and crystal 4Y1 at 11.94666 mhz (12.09666 mhz for units beginning with SN 10508). This oscillator is the voltage controlled crystal oscillator (VCXO). The third harmonic of the VCXO frequency at 35.8398 mhz (36.28998 mhz on later units) is mixed with the 38 mhz VCO frequency in 4Q4 to produce a mix down frequency of from 1.8202 mhz at channel 1 to 2.2602 at channel 40 (1.37 mhz at channel 1 and 1.81 mhz at channel 40 on later units).

From the drain of 4Q4 harmonics are filtered from the mix down frequency in L.P. filter 4L1, amplified at 4Q6 then coupled back to 4U1. The mix down frequency is internally divided in 4U1 to 5 khz as programmed by the BCD inputs from channel selection. The mix-down-divided 5 khz is compared with the reference 5 khz to generate the phase error signal filtered and coupled back to the VCO to complete the phase locked loop.

2.7.3 Microprocessor Control Network

Conceptually, the microprocessor control network (MCN) is the intermediary between the user and the actual frequency synthesis circuits. The intermediary role is carried out by using logic circuits that includes permanant programs stored in memory. The programs are the set of instructions that control the MCN operation in response to keyboard strokes. The MCN includes two registers and a ten channel memory. The display register contains the operating channel number and also provides output to a LED display of the channel number. The recall register stores the previous channel number in the display register. The memory can be used to store up to ten frequently used channel numbers.

The MCN requires an external 250 khz reference oscillator which is provided by IC 4U3 (Pins 1 through 7).

During power up, the memory is erased, channel 9 is loaded into the recall register and channel 19 into the display register. After the power up period, the operating instruction control logic circuits that scan or sense the keyboard, SCAN (lever switch), and microphone push to talk switches to detect switch position, changes the required specific operating instruction. The operating instruction results in a logic command being sent to the phase lock loop (PLL) to tune the transceiver to the channel number indicated in the display register.

The keyboard includes multiple function keys to enhance the operating capability of the network. Fundamentally, the keyboard operates in two distinct modes; memory and all 40 channels.

Depressing the MEM key places the keyboard in the memory mode. Each depression of the MEM key loads and stores the content of the display register into a memory location. The key depression also advances the memory to the next location and load the memory channel into the display register (also appears in the LED display). If the memory location is empty, the LED display will indicate zero in both LED channel number digits.

The display register can be changed or a new channel entered in two ways. First, the depression of the ENTRY (*) key followed by two strokes of the zero (0) key.

The front pannel SCAN lever switch determines wheather busy or open channels will be found in the automatic scanning.

The keyboard is a matrix arrangement of output sensor lines eminating from the processor (4U2). Depressing a key closes a switch at the intersection of specific sensor lines. The processor senses (reads) the switch closed and responds in a preprogrammed way as dictated in the operating instructions.

Depressing the ENTRY key followed by the channel number keys causes the processor to produce a specific output code for each operating channel. The numerical and binary values of the code is shown in Table 2-1. A logic 1 indicates a high positive true state.

Table 2-1 shows that the processor output code is different for the transmit (xmit) and receive (rec) modes of transceiver operation. The required Phase Locked Loop (PLL) programming codes (numerical values of Full Adder output code) are also shown in Table 2-1. A code correction of 92 is required in the receiving mode of operation. The correction occures in the Full Adder Network 4U4 and 4U5. The network simply adds

91 and a carry of 1 to produce a Full Adder output number of 92. When operating in the transmit mode the carry in of 1 effectively adds 1 to the processor output code. The correct add code including the carry in of 1 is applied to the add input lines of the Full Adder (4U4, 4U5) by the action of the switching transistor 4Q10.

The output of the Full Adder Network is applied directly to the programming input lines of the PLL (4U1).

The processor insures that only legitimate output codes are generated by keyboard channel entries. When the processor detects an illegitimate channel entry, the output code is automatically changed to Channel 19.

2.7.4 Scanning

The Automatic Scanning Network provides automatic tuning characteristics of the receiving section of the transceiver design.

Scanning is accomplished by initiating the sequential readout of channels programmed into memory or all 40 channels. The position of the SCAN switch (busy/off/open) causes the readout sequence to START or STOP scanning whenever the receiver squelch (SQ) signal changes state (from a low to high or high to low state). During AUTO SCAN IC 4U1 (Section of pins 10 thru 15) performs as an electronic isolated switch and parallel the fast up scan mode of the keyboard.

SCAN switch functions are processed on the A5 board in IC's 5U1 and 5U2 for proper interface to the microprocessor 4U2. IC 5U1 (Pins 1-6) is the 2H3 scan stepping oscillator controlled by the SCAN SWITCH and logic of 5U2 and 5U1. The output pulses on line 55 control microprocessor 4U2 for incremental scan steps. IC 5U1 (Pins 1-6) provides a 5 second delay for busy channel scan after resquelch. Control line 56 is "low" for scan inhibit, high in normal scan. 5Q1 is an "off rest" switch. When the SCAN switch is in the BUSY position, channel scanning starts whenever the receiver becomes squelches (SQ signal goes to a high state). Scanning continues until a channel is found that causes the receiver to unsquelch (SQ signal goes to a low state). The BUSY position of the SCAN lever switch activates a scan delay circuit to prevent scanning after the receiver is squelched. This allows the user to hear the second half of the voice conversation.

The OPEN switch position of the SCAN lever switch causes the scanning to start whenever the receiver becomes unsquelched. The scan delay is eliminated in this switch position. When transmitting, the keyboard is inhibited to prevent accidental tuning changes which could cause interference with other users.

TABLE
AUTOMATIC SCANNING

SCAN SWITCH POSITION	FUNCTION
Busy	Scan stop when receiver is unsquelched. Resumes scan when receiver squelches (after a 4 second delay).
Off	Scan stop when receiver is unsquelched. Does not automatically resume scan. Scan starts whenever keyboard scan key is depressed.
Open	Scan stop when receiver is unsquelched. Resumes scan when receiver unsquelches.

To exit the memory mode it is necessary to depress the ALL SC key. This key stroke changes the operating instruction from memory scanning to all 40 channel scanning. THIS EXIT METHOD PRESERVES THE CHANNEL NUMBERS STORED IN THE MEMORY LOCATIONS.

The ALL SC mode features a number of useful programs. First of all, in addition to the display register, a recall resistors stores the previous display register channel number. Depressing the recall (RCL) key returns the previous channel number to the display register. Many users like to store the talk channel number in this register and the calling channel number in the display register. A depression of the MONITOR (MON) key automatically places the content of the recall register in the display register, approximately every eleven seconds. If the recall register channel is busy (receiver unsquelched) the receiver will remain tuned until the receiver again squelches. The monitor function is especially useful in monitoring the national emergency channel.

The SCAN lever switch can be to scan all 40 channels as described. In addition, the SCAN key can be used to initiate scanning. However, if the SCAN lever switch is in the off position, the scanning will not automatically restart after a squelch break.

An illegal channel number entry causes the Microprocessor Control Network to automatically correct the channel entry to 19 for transceivers manufactured for the U.S. market and channel 9 for transceivers manufactured for some export markets.

The Voltage Controlled Oscillator (VCO) is designed to be operated over a wide frequency range. The tuning range is restricted by the Microprocessor Control Network in accordance with a fixed set of authorized channel numbers.

2.7.5 Mode and Channel Readouts (Assy. Board A7)

IC's 7U1 and 7U2 decode the BCD information from the 4U2 microprocessor and drive the two digit seven segment readouts for 7DS2 channel number display. IC 7U2 drives the "units" digit and 7U1 the "tens" light. All BCD and segment lines are direct drive.

IC 7U3 logic codes lines through drivers 7Q1 - 7Q4 to readout 7DS1 to display "A" for "AM", "U" for "uppersideband", "L" for "lower sideband", and "PA" for "Public Address".

2.8 POWER SUPPLY

2.8.1 Voltage Regulator

IC 9U1 provides precision voltage regulation at 14.5VDC supplying all functions of the transceiver. Voltage output is adjustable at 9R5. Driver transistor 9Q1 and power pass transistor Q1 both have heat sinking to the chassis. Resistor 9R9 provides current limiting at approximately 4 amps through feedback to 9U1 Pin 3.

IC 9U2, which also has heat sinking to the chassis, provides regulation for the 8 volt line deriving its input from the 14.5v regulated supply. 9U2 also current limits (internally) at approx. 700 ma. Transistor 9Q5 and 9Q4 provide power control for the lamps dimmer circuit.

TABLE 2.1a
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 11.94666 MHz)

CHANNEL DISPLAY	CARRIER FREQUENCY IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQUENCY 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE		NUMERICAL VALUE OF ADDER CODE			BINARY VALUE & PROCESSOR OUTPUT CODE		
						Add Number		Carry	Output Number	Receive And PLL Input	Transmit
				rec	xmit	rec	xmit	In	(N)		
1	26.965	37.66	1.82	364	273	0	91	0	364	101101100	100010001
2	26.975	37.67	1.83	366	275	0	91	0	366	101101110	100010011
3	26.985	37.68	1.84	368	277	0	91	0	368	101110000	100010101
4	27.005	37,70	1.86	372	281	0	91	0	372	101110100	100011001
5	27.015	37.71	1.87	374	283	0	91	0	374	101110110	100011011
6	27.025	37.72	1.88	376	285	0	91	0	376	101111000	100011101
7	27.035	37.73	1.89	378	287	0	91	0	378	101111010	100011111
8	27.055	37.75	1.91	382	291	0	91	0	382	101111110	100100011
9	27.065	37.76	1.92	384	293	0	91	0	384	110000000	100100101
10	27.075	37.77	1.93	386	295	0	91	0	386	110000010	100100111
11	27.085	37.78	1.94	388	297	0	91	0	388	110000100	100101001
12	27.105	37.80	1.96	392	301	0	91	0	392	1110001000	100101101
13	27.115	37.81	1.97	394	303	0	91	0	394	110001010	100101111
14	27.125	37.82	1.98	396	305	0	91	0	396	110001100	100110001
15	27.135	37.83	1.99	398	307	0	91	0	398	110001110	100110011
16	27.155	37.85	2.01	402	311	0	91	0	402	110010010	100110111
17	27.165	37.86	2.02	404	313	0	91	0	404	110010100	100111001
18	27.175	37.87	2.03	406	315	0	91	0	406	110010110	100111011
19	27.185	37.88	2.03	408	317	0	91	0	408	110011000	100111101
20	27.205	37.90	2.06	412	321	0	91	0	412	110011100	101000001
21	27.215	37.91	2.07	414	323	0	91	0	414	110011110	101000011
22	27.225	37.92	2.08	416	325	0	91	0	416	110100000	101000101

TABLE 2.1a
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 11.94666 MHz)

CHANNEL DISPLAY	CARRIER FREQUENCY IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQUENCY 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE		NUMERICAL VALUE OF ADDER CODE			BINARY VALUE & PROCESSOR OUTPUT CODE		
				rec	xmit	Add Number rec	Add Number xmit	Carry In	Output Number (N)	Receive And PLL Input	Transmit
23	27.255	37.95	2.11	422	331	0	91	0	422	110100110	101001011
24	27.235	37.93	2.09	428	327	0	91	0	418	110100010	101000111
25	27.245	37.94	2.10	420	329	0	91	0	420	110100100	101001001
26	27.265	37.96	2.12	424	333	0	91	0	424	110101000	101001101
27	27.275	37.97	2.13	426	335	0	91	0	426	110101010	101001111
28	27.285	37.98	2.14	428	337	0	91	0	428	110101100	101010001
29	27.295	37.99	2.15	430	339	0	91	0	430	110101110	101010011
30	27.305	38.00	2.16	432	341	0	91	0	432	110110000	101010101
31	27.315	38.01	2.17	434	343	0	91	0	434	110110010	101010111
32	27.325	38.02	2.18	436	345	0	91	0	436	110110100	101011001
33	27.335	38.03	2.19	438	347	0	91	0	438	110110110	101011011
34	27.345	38.04	2.20	440	349	0	91	0	440	110111000	101011101
35	27.355	38.05	2.21	442	351	0	91	0	442	110111010	101011111
36	27.365	38.06	2.22	444	353	0	91	0	444	110111100	101100001
37	27.375	38.07	2.23	446	355	0	91	0	446	110111110	101100011
38	27.385	38.08	2.24	448	357	0	91	0	448	111000000	101100101
39	27.395	38.09	2.25	450	359	0	91	0	450	111000010	101100111
40	27.405	38.10	2.26	452	361	0	91	0	452	111000100	101101001

TABLE 2.1b

Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 12.0967 MHz)

CHANNEL DISPLAY	CARRIER FREQ. IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQ. 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE		NUMERICAL VALUE OF ADDER CODE Add Number		Carry In	Output Number (N)	BINARY VALUE OF PROCESSOR OUTPUT CODE		
				rec	xmit	rec	xmit			Receive	Transmit	Xmit Plus Carry In 1
1	26.965	37.66	1.37	182	273	91	0	1	274	010110110	100010001	100010010
2	26.975	37.67	1.38	184	275	91	0	1	276	010111000	100010011	100010100
3	26.985	37.68	1.39	186	277	91	0	1	278	010111010	100010101	100010110
4	27.005	37.70	1.41	190	281	91	0	1	282	010111110	100011001	100011010
5	27.015	37.71	1.42	192	283	91	0	1	284	011000000	100011011	100011100
6	27.025	37.72	1.43	194	285	91	0	1	286	011000010	100011101	100011110
7	27.035	37.73	1.44	196	287	91	0	1	288	011000100	100011111	100100000
8	27.055	37.75	1.46	200	291	91	0	1	292	011001000	100100011	100100100
9	27.065	37.76	1.47	202	293	91	0	1	294	011001010	100100101	100100110
10	27.075	37.77	1.48	204	295	91	0	1	296	011001100	100100111	100101000
11	27.085	37.78	1.49	206	297	91	0	1	298	011001110	100101001	100101010
12	27.105	37.80	1.51	210	301	91	0	1	302	011010010	100101101	100101110
13	27.115	37.81	1.52	212	303	91	0	1	304	011010100	100101111	100110000
14	27.125	37.82	1.53	214	305	91	0	1	306	011010110	100110001	100110010
15	27.135	37.83	1.54	216	307	91	0	1	308	011011000	100110011	100110100
16	27.155	37.85	1.56	220	311	91	0	1	312	011011100	100110111	100111000
17	27.165	37.86	1.57	222	313	91	0	1	314	011011110	100111001	100111010
18	27.175	37.87	1.58	224	315	91	0	1	316	011100000	100111011	100111100
19	27.185	37.88	1.59	226	317	91	0	1	318	011100010	100111101	100111110
20	27.205	37.90	1.61	230	321	91	0	1	322	011100110	101000001	101000010
21	27.215	37.91	1.62	232	323	91	0	1	324	011101000	101000011	101000100
22	27.225	37.92	1.63	234	325	91	0	1	326	011101010	101000101	101000110

TABLE 2.1b
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 12.0967 MHz)

CHANNEL DISPLAY	CARRIER FREQ. IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQ. 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE		NUMERICAL VALUE OF ADDER CODE Add Number		Carry In	Output Number (N)	BINARY VALUE OF PROCESSOR OUTPUT CODE		
				rec	xmit	rec	xmit			Receive	Transmit	Xmit Plus Carry In 1
23	27.255	37.95	1.66	240	331	91	0	1	332	011110000	101001011	101001100
24	27.235	37.93	1.64	236	327	91	0	1	328	011101100	101000111	101001000
25	27.245	37.94	1.65	238	329	91	0	1	330	011101110	101001001	101001010
26	27.265	37.96	1.67	242	333	91	0	1	334	011110010	101001101	101001110
27	27.275	37.97	1.68	244	335	91	0	1	336	011110100	101001111	101010000
28	27.285	37.98	1.69	246	337	91	0	1	338	011110110	101010001	101010010
29	27.295	37.99	1.70	248	339	91	0	1	340	011111000	101010011	101010100
30	27.305	38.00	1.71	250	341	91	0	1	342	011111010	101010101	101010110
31	27.315	33.01	1.72	252	343	91	0	1	344	011111100	101010111	101011000
32	37.325	38.02	1.73	254	345	91	0	1	346	011111110	101011001	101011010
33	27.335	38.03	1.74	256	347	91	0	1	348	100000000	101011011	101011100
34	27.345	38.04	1.75	258	349	91	0	1	350	100000010	101011101	101011110
35	27.355	38.05	1.76	260	351	91	0	1	352	100000100	101011111	101100000
36	27.365	38.06	1.77	262	353	91	0	1	354	100000110	101100001	101100010
37	27.375	38.07	1.78	264	355	91	0	1	356	100001000	101100011	101100100
38	27.385	38.08	1.79	266	357	91	0	1	358	100001010	101100101	101100110
39	27.395	38.09	1.80	268	359	91	0	1	360	100001100	101100111	101101000
40	27.405	38.10	1.81	270	361	91	0	1	362	100001110	101101001	101101010

A.R.F. 2001 SCANNING TRANSCEIVER SERVICE MANUAL

1. GENERAL INFORMATION

1.1 Servicing the 2001

The A.R.F. 2001 Personal Communication Transceiver was designed and engineered utilizing latest state of the art electronic components and circuits. Certain circuits developed specifically for this radio; SAM and AMSIL, are new unique breakthroughs in communications technology.

SAM is a servo amplitude modulation for AM that tightly controls carrier level and modulation using feedback in an electronic modulator. Unlike the coventional modulation transformer, SAM allows smooth clean modulation up to 100% but will not exceed 100% regardless of the amount of audio drive to it.

AMSIL is an AM silencing circuit useable in sideband receive when an operator does not wish to listen to undesirable AM traffic while standing by for specific sideband signals. When switched in, AMSIL overrides the squelch keeping the receiver squelched off during no signal and AM signal reception. A sideband signal of 1 microvolt or greater will reliably break the squelch with fast attack slow release operation. Some AM signals excessively off center frequency (600 hz or greater) may occasionally break AMSIL.

Upon examining the schematic of this unit you will become aware of the many integrated circuits used in the design. Do not be dismayed with the apparent complexity and large number of components. As with many complex devices, once broken down and examined by sections you will find signal paths and operating modes easy to understand

1.2 Servicing Qualifications

The technical information in this manual is intended for use by an experienced qualified technican, holder of a current second or first class radiotelephone license, for servicing of the A.R.F. 2001 Scanning Transceiver. Unless you hold such a license, do not attempt to make any repairs or adjustments inside the 2001.

The 2001 transceivers are individually hand calibrated by trained and experienced technicans at the factory using the very best electronic test equipment. Every unit leaves the factory tuned to optimum performance and unless a certain malfunction occurs, any further adjustments are likely to degrade this performance and render the unit in violation of FCC Specifications.

1.3 Precautions

As with any electronic equipment, certain precautions are necessary when working on the 2001 circuits.

Do not use induction type soldering guns in the unit. The strong inductive currents generated by the gun may damage certain components. Stick to small 30 to 75 watt resistance type soldering irons. Static electricity often destroys MOS FET transistors and MOS FET IC's of which there are a number of in the 2001. The use of a grounded soldering iron and personal ground straps will usually prevent such damage. However, a simple practice of touching the chassis with a tool, soldering iron, and your hand before soldering a MOS FET lead/pad will usually work.

The SD305, SD306 transistors, the MM 57150 IC, and the 14000 series IC's are vulnerable and require care in handling and installation. Always disconnect the power cord while working in the unit.
With the cover removed and power on beware of lethal line voltages on exposed connections of the fuseholders, power filters, and power transformer.

2. THEORY OF OPERATION

2.1 General

2.1.1 Voltages

Two basic regulated voltages are used throughout the 2001 with both regulators on the power supply board A9. The 14.5 VDC is adjustable and mainly supplies circuits in the receiver (A1), transmitter (A6), Audio Board (A3), SSB board (A2), and the SWR Board (A8). The 8 VDC is not adjustable and primarily supplies the PLL frequency synthesizer board (A4), the SCAN Board (A5), and readout board (A7).

2.1.2 Frequencies

Since the 2001 is designed for single conversion the IF operates only at 10.695 mhz center frequency. Local Oscillation frequencies are above the 27 mhz band at 38 mhz resulting in "high side" mixing. This technique eliminates most undesirable spurious responses yielding a cleaner operating receiver and transmitter.

AM receive local oscillator frequencies range from 37.66 mhz at Channel 1 to 38.1 mhz at Channel 40, and are mixed with the desired CB frequency respectively resulting in 10.695 mhz IF.

AM transmitt generates 10.695 mhz, mixes with the 37.66 to 38.10 mhz frequency to produce a respective frequency in the 27 mhz band.

2.1.3 Lower Sideband Receive

Frequencies for sideband are somewhat more complex. One upper sideband filter is used in the sideband IF passing frequencies approximately 10.695200 mhz to about 10.697200 mhz. Since high side mixing "inverts" the received signal the USB IF filter will respond to a LSB received signal only. The carrier remains as in AM at 10.695 mhz for LSB with sideband signals operating from the lower edge of the USB filter.

2.1.4 Upper Sideband Receive

To use the USB IF filter for a received USB signal the signals must operate down from the upper edge of the sideband filter. The 38 mhz local oscillator and the carrier frequency are both shifted up by 2500 hz to allow the filter to respond to USB signals only. The operating edge of the sideband filter is now 10.697500 mhz.

During AM receive the 10.695 mhz oscillator is not needed for AM detection. The 10.695 mhz oscillator is used in carrier restoration for LSB and 10.6975 mhz for USB at the product detector.

2.1.5 AM and LSB Transmitt

The 10.695 mhz carrier in AM is mixed almost directly with the 38 mhz L.O. to produce the desired 27 mhz signal in the transmitter. In LSB the carrier is injected at the balanced modulation, mixed with the audio to produce a double sideband IF signal with the carrier suppressed. This IF is then filtered in the USB filter producing an USB carrier, suppressed IF signal. It is then mixed with the 38 mhz carrier producing a LSB 27 mhz signal due to the inversion.

2.1.6 USB Transmitt

Signal processing for USB is the same as for LSB except the carrier is shifted up by 2500 hz at 10.697500 mhz. When filtered in the USB filter the lower IF sideband is passed. The IF is then mixed with the 38 mhz L.O. also shifted up by 2500 hz to produce the desired USB 27 mhz signal.

2.2 AM Receive Detail Description

2.2.1 The LP filter networks at 6L2 and 6L3 are shared with the transmitter. The received signal is completed through 6L8 to timed tank 1L1 and 1L5. Diodes 1CR1 and 1CR2 clip excessively large signals to prevent overloading the front end. The signal is coupled into the signal gate (pin 3) of 1Q5, the SD306, dual gate MOS FET RF amplifier. Pin 2, AGC gate, operates from the AGC amplifier and RF gain control. The AGC gate normally operates near 8vDC for full gain and near 1vDC for approximately 45 db less. 1Q5 provides approximately 20 db RF gain.

From the drain of 1Q5 the signal couples to the signal gate of mixer transistor 1Q6. The 38 mhz signal from the PLL is mixed with the 27 mhz signal in 1Q6 to produce the 10.695 mhz IF frequency. Transformer 1T1 tunes at 10.695 mhz. The output of 1T1 couples through the noise blanker series gate diode 1CR5 to the first AM crystal filter 1Y1 and 1Y2 to the input of the first IF amplifier 1U1 (MC1350P). Each MC1350P provides about 45 db gain with excellent stability and AGC characteristics. Amplifier 1U1 times into 1T2 IF transformer than couples out to AM crystal filter 1Y3 and 1Y4 to the input of the second IF amplifier 1U2. 1&2 tunes into IF transformer 1T3. The output of 1T3 couples out to pin 9 for sideband receive and to the base of amplifier 1Q7 for AM. 1Q7 drives the AM detector diodes 1CR10 and 1CR9. Recovered audio is coupled to the audio board through capacitor 1C37 and pin 13. 1R47, 1R50, 1CR8, 1R52, and 1R51 comprise the ANL circuit. Transistor 1Q8 shuts off amplifier 1Q7 during SSB receive.

2.2.3 AGC

AGC DC voltage from the AM detector couples through 1R53 to one of the LM 358 dual op amp inputs pin 5. The gain of the IF AGC op amp is fixed at about 3 but also provides low pass filtering with rolloff at about 20 hz. 1R53, 1R44, 1C35 and 1C38 comprise the filter network. The output of the IF AGC op amp provides a low DC voltage to both IF amplifiers with no signal in. When input signals approach 1uV the AGC voltage is sufficient to start AGC near 5VDC. With strong signals the voltage is near 8VDC.

The other op amp inverts the AGC voltage for use at the RD amplifier through the RF Gain control R1. Voltage with no signal is near 8V and strong signal voltage is near 1V. 1R35 balances the RF op amp. Transistor 1Q4 inverts the AGC voltage and provides a more linear voltage output vs RE input for sharper squelch control at low signal levels. IF AGC voltage is also provided to the "S" meter circuits.

2.2.2 Audio from the receiver board A1 is coupled to the audio board A3, through amplifier transistor 3Q5, to one of the dual op amps in 3U2 pins. The op amp is also a high pass filter suppressing undesirable rumble and low frequency noise. The output (pin 7) couples to one of the four FET switches in 3U4 MC14066 IC. The switch is controlled by 14V receive voltage and is on in receive off in transmit. Audio is also controlled at the output of the switch by the squelch circuit consisting of squelch amplifier 3Q8, 3Q4, and 3Q9. Potentiometer 3R40 adjusts low signal squelch threshold and 3R39 adjusts high signal squelch threshold. After processing through the volume and tone controls, the audio is amplified in 3U3 (TBA-810) IC audio amplifier and from the coupled to the speaker through relay 9K1 and the audio switching circuits.

2.2.4 Noise Blanker

Noise pulses at 1Q5 diam are sampled and coupled to pulse amplifier 1Q1, rectified, filtered, and coupled to amplifier 1Q2. The output network of 1Q2 "stretches" the pulse before coupling to switching transistor 1Q3. During a pulse 1Q3 is saturated holding the anode of 1CR5 low for signal cutoff. Normally the anode is high biasing 1CR5 switch on.

2.3 SIDEBAND RECEIVE

2.3.1 Sideband Signal Path

After the first mixer 1Q6 the sidebands are inverted, LSB becomes USB and vice versa. Sideband receive signals (10.695 mhz) are processed through the entire AM IF circuits through 1T3. In sideband, transistor 1Q7 is switched off by 1Q8 and the IF signal couples out pin 9 to 2Q1 amplifier on the A2 Board. The IF signal is processed through the two sets of USB crystal filters 2Y1, 2Y2, 2Y3, and 2Y4. 2Q3 is a buffer between the crystal sets. After filtering the signal couples through IF Switch 2CR12 to 2U1 (Pin 1) the product detector. In the 1596 product detector the sideband IF signal is mixed with the 10.695 (LSB) or 10.6975 (USB) carrier to produce recivered audio. (Pin 10 carrier input, Pin 12 audio output). Audio is coupled out pin 22 to the audio A3 board where it is processed the same as AM audio.

2.3.2 SSB AGC

SSB AGC is derived from the recovered SSB audio signal amplified by 2Q5. AGC level is set by 2R15. The audio is detected at 2CR5, and 2CR6, filtered and coupled out through pin 12 to the AGC amplifiers in A1. AGC network 2R67, 2R68, and 2C6 provide fast attack slow release.

2.3.3 AM Silencing (AMSIL)

The AM silencing circuit overrides the squelch and squelches anything except a legitimate SSB signal. An AM signal processed through the circuit is detected for AM carrier by diodes 2CR1 and 2CR2. The product detector also responds to the AM signal and some audio output is obtained. However, the AM detector provides a strong negative voltage at the base of 2Q8 strongly keeping it turned off. The audio remains squelched. The low amount of audio from the product detector is not sufficient to drive 2Q4 and detectors 2CR13 and 2CR14 to make 2Q8 turn on.

High pass filter 2C20, 2C21, and 2L1 roll off frequencies below 600 hz in order to prevent an AM carrier appearing at the product detector as a strong beat note. This prevents AM signals approximately within ± 500 hz of the 2001 center frequency from breaking AMSIL. AM carriers over 600 hz appear to the product detector as a sideband tone and will break AMSIL. Since the center frequency of most CB's are within ± 500 hz, most undesirable AM will be silenced.

When a legitimate sideband appears at the AM detectors (2CR1, 2CR2) no carrier is present and the amount of sideband speech rectified is small thus no negative shut off voltage appears at 2Q8 base. The product detector now provides a substantial audio output which is further amplified in 2Q5, filtered through 2C20, 2C21, and 2L1, amplified by 2Q4 and rectified at 2CR13 and 2CR14. The positive going voltage turns 2Q8 and 2Q9 on fast, opening the audio squelch. 2CR15, 2C34, and 2R53 provide a slow release.

2.4 AM TRANSMIT AND SAM

2.4.1 Audio Processing

Microphone audio input is coupled to one of the dual op amps in IC 3U2 (Pin 2). The preamp provides 27 db gain with SAM out and 40 db with SAM in. Audio from the preamp (Pin 1) couples out to the MIC GAIN control and back to audio clipper circuit 3Q1 and 3Q2 where the audio is symetrically clipped by approximately 10 to 15 db. The clipped audio, which is highly distorted and not useable as such, is filtered in a low pass active filter network consisting of 3R24, 3C7, 3R25, 3R26, 3C10, 3CU, and one of the dual op amps in 3U1 (Pin 5). This filter "cleans up" the audio reducing the distortion to low levels. The audio to this point is the same for SSB transmit (Pin 7).

Audio for AM moderation now couples into three of the four switches in IC 3U4 (Pins 9, 2, and 3). For AM a DC voltage at Pin 6 from 14v AM, gates the analog switch on for the signal to appear at output Pin 8 of 3U4. The amount of audio drive at 3R35 is adjusted for desired percent modulatory.

2.4.2 Modulation

The audio is coupled into the other op amp in IC 3U1 (Pin 3) for a gain of about three and drives a darlington power amplifier 3Q7 and 3Q6. This combination is a unique "solid state modulation" with feedback from detectors 6CR4 and 6CR5 in the transmitter for carrier power level control and audio percent modulation feedback control. This modulator cannot modulate the transmitter over 100%. Thus, no automatic audio level controls are needed in this unit.

2.4.3 AM Transmit

A 10.695 mhz carrier switched on by 2CR1D and 2CR11 is coupled to input low pass filter consisting of 6L1 and 6L17 and on to balanced mixer 6U1 (1596) Pin 1. The 10.695 mhz is mixed with the 38 mhz L.O. from the PLL A4 board to produce the appropriate 27 mhz carrier. Balanced output from 6U1 tunes in tank 6T2 primary and 6C44. Carrier is coupled out the secondary of 6T2 through buffer amplifier 6Q8 to the signal gate of 6Q4. 6Q4 AGC is used during SSB transmit but in AM gain is always maximum.

From the drain of 6Q4 the signal is amplified through 6Q3, 6Q2, and 6Q1. 6C11 and 6L4 transformer the transistor 6Q1 low impedance to match the 50 ohm external loads. Low pass filter network 6L2 and 6L3 alternate all harmonics and spurous signals above 27 mhz to less than 60 db. Modulation voltage is supplied to the collectors of 6Q1 and 6Q2 through A2 Pin 31 from the servo amplitude modulation in A3.

In order to modulate a 4 watt carrier to 100% modulation the transmitter must be capable of providing 16 watts of peak power output.

Transistors 6Q1 and 6Q2 are not based up during AM transmit and operate class C for normal AM modulation.

2.5 SSB TRANSMITT

2.5.1 Audio Processing

Audio processing for SSB transmit is the same as AM through IC 3U1. During sideband 3U4 switch (Pin 2 input, Pin 1 output) controlled at Pin 13 by 14v U and L is turned on supplying audio through 3R38 and the input (Pin 1) of the balanced modulator 2U2. The audio is "mixed" with the 10.695/10.6975 mhz carrier in 2U2 to produce a double sideband suppressed carrier output (Pin 6). The D5B signal couples through RF Switch 2CR9, through amplifier 2Q1 and the appropriate sideband is filtered out in 2Y1, 2Y2, 2Y3, and 2Y4. The sideband IF couples out to A6 mixer 6U1. During sideband RF switch 2CR10 and 2CR11 is off preventing the carrier from directly interferring with the sideband IF.

2.5.2 Transmitter

Amplification through the transmitter is the same as AM except 6Q1 and 6Q2 are biased into class AB operation for linearity. Bias is supplied 6Q7 switch in USB or LSB. RF output level control for sideband is detected at 6CR2 amplified by 6Q5 and coupled to the AGC gate of 6Q4. Switch 6Q6 disables the SSB level control during AM transmit. Line 33 from the A4 assembly is a shutdown voltage occuring whenever the phase locked loop in the synthesizer is unlocked. Unlock commonly results during channel change. With this voltage switching 6Q5 the transmitter is inhibited during any unlock PLL condition. Also during the transition when voltages are switching from transmit to receive, the transmit voltages are just starting to decay when the receive voltages rise to max. Switching input line 3 to 6Q5 immediately cuts off the RF in the transmitter when the receive B+ starts to rise. This switching eliminates a short squeal ordinarily audiable.

2.6 PUBLIC ADDRESS AND TALKBACK

2.6.1 Public Address

When switching the unit to PA the audio from the microphone is processed the same as during CB transmit up through 3U1 output. From this point audio is switched through one of the analog switches in 3U4 (input Pin 3, output Pin 4) by control voltage 14V PA at Pin 5. Audio couples to the input of the audio power amplifier 3U3 bypassing volume and tone controls. The MIC GAIN control serves as the PA volume control. Audio output from 3U3 passes through relays 9K1, 9K2, the INT/EXT switch, and the EXT SPKR jack. The internal speaker is disconnected and audio couples out through the PA speaker jack.

2.6.2 Talkback (INTERCOM)

When the TALKBACK Switch is on, relay 9K2 switches the PA speaker to the input of the audio circuity and the audio output of 3U3 connects to the internal speaker. In this mode sounds at the PA speaker are audiable at the 2001 transceiver.

When the PTT lever on the microphone is squeezed relay 9K2 switches the unit back to the PA mode for two way conversation.

2.7 FREQUENCY GENERATION (ASSEMBLY BOARD A4)

2.7.1 Carrier Frequencies

One of two carrier frequencies is used in all modes except AM receive. The 10.695 is used in AM transmit and in LSB receive and transmit. 10.6975 is used in USB receive and transmit. Oscillator 4Q8 operates from either crystal 4Y3 or 4Y4 depending on the DC voltages to the switching diodes 4CR10 and 4CR11 for the desired mode of operation. Output from the oscillator is taken from the emitter to the A2 assembly.

2.7.2 38 mhz Local Oscillator (PLL)

The local oscillator frequencies are generated in the phase locked loop circuit of 4U1. Frequencies generated range from 37.66 mhz for channel 1 to 38.10 mhz at channel 40. Frequencies generated in the synthesizer are shown in Tables

The stable reference oscillator for the PLL is controlled by crystal 4Y2 at 10.24 mhz. This reference is divided within IC 4U1 by 2048 to 5 khz for use by the comparator in 4U1.

Voltage controlled oscillator 4Q2 is frequency controlled from 4U1 by a phase error signal through loop filter 4R11 to 4R6 by the DC voltage on varactor diode 4CR1. The varactor diode controlled variable capacitance is part of the frequency tank of 4T1 and VCO 4Q2. The VCO tunes through the 38 mhz L.O. region. Output to the respective circuits is coupled through 4Q1 buffer transistor. A sample of the 38 mhz L.O. for control feedback to the PLL IC is coupled from the secondary of 4T1 through buffer amplifier 4Q3 to mix-down-mixer 4Q4.

A separate mix down frequency is generated by 4Q5 and crystal 4Y1 at 11.94666 mhz (12.09666 mhz for units beginning with SN 10508). This oscillator is the voltage controlled crystal oscillator (VCXO). The third harmonic of the VCXO frequency at 35.8398 mhz (36.28998 mhz on later units) is mixed with the 38 mhz VCO frequency in 4Q4 to produce a mix down frequency of from 1.8202 mhz at channel 1 to 2.2602 at channel 40 (1.37 mhz at channel 1 and 1.81 mhz at channel 40 on later units).

From the drain of 4Q4 harmonics are filtered from the mix down frequency in L.P. filter 4L1, amplified at 4Q6 then coupled back to 4U1. The mix down frequency is internally divided in 4U1 to 5 khz as programmed by the BCD inputs from channel selection. The mix-down-divided 5 khz is compared with the reference 5 khz to generate the phase error signal filtered and coupled back to the VCO to complete the phase locked loop.

2.7.3 Microprocessor Control Network

Conceptually, the microprocessor control network (MCN) is the intermediary between the user and the actual frequency synthesis circuits. The intermediary role is carried out by using logic circuits that includes permanant programs stored in memory. The programs are the set of instructions that control the MCN operation in response to keyboard strokes. The MCN includes two registers and a ten channel memory. The display register contains the operating channel number and also provides output to a LED display of the channel number. The recall register stores the previous channel number in the display register. The memory can be used to store up to ten frequently used channel numbers.

The MCN requires an external 250 khz reference oscillator which is provided by IC 4U3 (Pins 1 through 7).

During power up, the memory is erased, channel 9 is loaded into the recall register and channel 19 into the display register. After the power up period, the operating instruction control logic circuits that scan or sense the keyboard, SCAN (lever switch), and microphone push to talk switches to detect switch position, changes the required specific operating instruction. The operating instruction results in a logic command being sent to the phase lock loop (PLL) to tune the transceiver to the channel number indicated in the display register.

The keyboard includes multiple function keys to enhance the operating capability of the network. Fundamentally, the keyboard operates in two distinct modes; memory and all 40 channels.

Depressing the MEM key places the keyboard in the memory mode. Each depression of the MEM key loads and stores the content of the display register into a memory location. The key depression also advances the memory to the next location and load the memory channel into the display register (also appears in the LED display). If the memory location is empty, the LED display will indicate zero in both LED channel number digits.

The display register can be changed or a new channel entered in two ways. First, the depression of the ENTRY (*) key followed by two strokes of the zero (0) key.

The front pannel SCAN lever switch determines wheather busy or open channels will be found in the automatic scanning.

The keyboard is a matrix arrangement of output sensor lines eminating from the processor (4U2). Depressing a key closes a switch at the intersection of specific sensor lines. The processor senses (reads) the switch closed and responds in a preprogrammed way as dictated in the operating instructions.

Depressing the ENTRY key followed by the channel number keys causes the processor to produce a specific output code for each operating channel. The numerical and binary values of the code is shown in Table 2-1. A logic 1 indicates a high positive true state.

Table 2-1 shows that the processor output code is different for the transmit (xmit) and receive (rec) modes of transceiver operation. The required Phase Locked Loop (PLL) programming codes (numerical values of Full Adder output code) are also shown in Table 2-1. A code correction of 92 is required in the receiving mode of operation. The correction occures in the Full Adder Network 4U4 and 4U5. The network simply adds

91 and a carry of 1 to produce a Full Adder output number of 92. When operating in the transmit mode the carry in of 1 effectively adds 1 to the processor output code. The correct add code including the carry in of 1 is applied to the add input lines of the Full Adder (4U4, 4U5) by the action of the switching transistor 4Q10.

The output of the Full Adder Network is applied directly to the programming input lines of the PLL (4U1).

The processor insures that only legitimate output codes are generated by keyboard channel entries. When the processor detects an illegitimate channel entry, the output code is automatically changed to Channel 19.

2.7.4 Scanning

The Automatic Scanning Network provides automatic tuning characteristics of the receiving section of the transceiver design.

Scanning is accomplished by initiating the sequential readout of channels programmed into memory or all 40 channels. The position of the SCAN switch (busy/off/open) causes the readout sequence to START or STOP scanning whenever the receiver squelch (SQ) signal changes state (from a low to high or high to low state). During AUTO SCAN IC 4U1 (Section of pins 10 thru 15) performs as an electronic isolated switch and parallel the fast up scan mode of the keyboard.

SCAN switch functions are processed on the A5 board in IC's 5U1 and 5U2 for proper interface to the microprocessor 4U2. IC 5U1 (Pins 1-6) is the 2H3 scan stepping oscillator controlled by the SCAN SWITCH and logic of 5U2 and 5U1. The output pulses on line 55 control microprocessor 4U2 for incremental scan steps. IC 5U1 (Pins 1-6) provides a 5 second delay for busy channel scan after resquelch. Control line 56 is "low" for scan inhibit, high in normal scan. SQ1 is an "off rest" switch. When the SCAN switch is in the BUSY position, channel scanning starts whenever the receiver becomes squelches (SQ signal goes to a high state). Scanning continues until a channel is found that causes the receiver to unsquelch (SQ signal goes to a low state). The BUSY position of the SCAN lever switch activates a scan delay circuit to prevent scanning after the receiver is squelched. This allows the user to hear the second half of the voice conversation.

The OPEN switch position of the SCAN lever switch causes the scanning to start whenever the receiver becomes unsquelched. The scan delay is eliminated in this switch position. When transmitting, the keyboard is inhibited to prevent accidental tuning changes which could cause interference with other users.

TABLE
AUTOMATIC SCANNING

SCAN SWITCH POSITION	FUNCTION
Busy	Scan stop when receiver is unsquelched. Resumes scan when receiver squelches (after a 4 second delay).
Off	Scan stop when receiver is unsquelched. Does not automatically resume scan. Scan starts whenever keyboard scan key is depressed.
Open	Scan stop when receiver is unsquelched. Resumes scan when receiver unsquelches.

To exit the memory mode it is necessary to depress the ALL SC key. This key stroke changes the operating instruction from memory scanning to all 40 channel scanning. THIS EXIT METHOD PRESERVES THE CHANNEL NUMBERS STORED IN THE MEMORY LOCATIONS.

The ALL SC mode features a number of useful programs. First of all, in addition to the display register, a recall resistors stores the previous display register channel number. Depressing the recall (RCL) key returns the previous channel number to the display register. Many users like to store the talk channel number in this register and the calling channel number in the display register. A depression of the MONITOR (MON) key automatically places the content of the recall register in the display register, approximately every eleven seconds. If the recall register channel is busy (receiver unsquelched) the receiver will remain tuned until the receiver again squelches. The monitor function is especially useful in monitoring the national emergency channel.

The SCAN lever switch can be to scan all 40 channels as described. In addition, the SCAN key can be used to initiate scanning. However, if the SCAN lever switch is in the off position, the scanning will not automatically restart after a squelch break.

An illegal channel number entry causes the Microprocessor Control Network to automatically correct the channel entry to 19 for transceivers manufactured for the U.S. market and channel 9 for transceivers manufactured for some export markets.

The Voltage Controlled Oscillator (VCO) is designed to be operated over a wide frequency range. The tuning range is restricted by the Microprocessor Control Network in accordance with a fixed set of authorized channel numbers.

2.7.5 Mode and Channel Readouts (Assy. Board A7)

IC's 7U1 and 7U2 decode the BCD information from the 4U2 microprocessor and drive the two digit seven segment readouts for 7DS2 channel number display. IC 7U2 drives the "units" digit and 7U1 the "tens" light. All BCD and segment lines are direct drive.

IC 7U3 logic codes lines through drivers 7Q1 - 7Q4 to readout 7DS1 to display "A" for "AM", "U" for "uppersideband", "L" for "lower sideband", and "PA" for "Public Address".

2.8 POWER SUPPLY

2.8.1 Voltage Regulator

IC 9U1 provides precision voltage regulation at 14.5VDC supplying all functions of the transceiver. Voltage output is adjustable at 9R5. Driver transistor 9Q1 and power pass transistor Q1 both have heat sinking to the chassis. Resistor 9R9 provides current limiting at approximately 4 amps through feedback to 9U1 Pin 3.

IC 9U2, which also has heat sinking to the chassis, provides regulation for the 8 volt line deriving its input from the 14.5v regulated supply. 9U2 also current limits (internally) at approx. 700 ma. Transistor 9Q5 and 9Q4 provide power control for the lamps dimmer circuit.

TABLE 2.1a
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 11.94666 MHz)

CHANNEL DISPLAY	CARRIER FREQUENCY IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQUENCY 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE rec	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE xmit	NUMERICAL VALUE OF ADDER CODE Add Number rec	NUMERICAL VALUE OF ADDER CODE Add Number xmit	NUMERICAL VALUE OF ADDER CODE Carry In	BINARY VALUE & PROCESSOR OUTPUT CODE Output Number (N)	BINARY VALUE & PROCESSOR OUTPUT CODE Receive And PLL Input	BINARY VALUE & PROCESSOR OUTPUT CODE Transmit
1	26.965	37.66	1.82	364	273	0	91	0	364	101101100	100010001
2	26.975	37.67	1.83	366	275	0	91	0	366	101101110	100010011
3	26.985	37.68	1.84	368	277	0	91	0	368	101110000	100010101
4	27.005	37.70	1.86	372	281	0	91	0	372	101110100	100011001
5	27.015	37.71	1.87	374	283	0	91	0	374	101110110	100011011
6	27.025	37.72	1.88	376	285	0	91	0	376	101111000	100011101
7	27.035	37.73	1.89	378	287	0	91	0	378	101111010	100011111
8	27.055	37.75	1.91	382	291	0	91	0	382	101111110	100100011
9	27.065	37.76	1.92	384	293	0	91	0	384	110000000	100100101
10	27.075	37.77	1.93	386	295	0	91	0	386	110000010	100100111
11	27.085	37.78	1.94	388	297	0	91	0	388	110000100	100101001
12	27.105	37.80	1.96	392	301	0	91	0	392	1110001000	100101101
13	27.115	37.81	1.97	394	303	0	91	0	394	110001010	100101111
14	27.125	37.82	1.98	396	305	0	91	0	396	110001100	100110001
15	27.135	37.83	1.99	398	307	0	91	0	398	110001110	100110011
16	27.155	37.85	2.01	402	311	0	91	0	402	110010010	100110111
17	27.165	37.86	2.02	404	313	0	91	0	404	110010100	100111001
18	27.175	37.87	2.03	406	315	0	91	0	406	110010110	100111011
19	27.185	37.88	2.03	408	317	0	91	0	408	110011000	100111101
20	27.205	37.90	2.06	412	321	0	91	0	412	110011100	101000001
21	27.215	37.91	2.07	414	323	0	91	0	414	110011110	101000011
22	27.225	37.92	2.08	416	325	0	91	0	416	110100000	101000101

TABLE 2.1a
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 11.94666 MHz)

CHANNEL DISPLAY	CARRIER FREQUENCY IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQUENCY 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE		NUMERICAL VALUE OF ADDER CODE			BINARY VALUE & PROCESSOR OUTPUT CODE		
				rec	xmit	Add Number rec	Add Number xmit	Carry In	Output Number (N)	Receive And PLL Input	Transmit
23	27.255	37.95	2.11	422	331	0	91	0	422	110100110	101001011
24	27.235	37.93	2.09	428	327	0	91	0	418	110100010	101000111
25	27.245	37.94	2.10	420	329	0	91	0	420	110100100	101001001
26	27.265	37.96	2.12	424	333	0	91	0	424	110101000	101001101
27	27.275	37.97	2.13	426	335	0	91	0	426	110101010	101001111
28	27.285	37.98	2.14	428	337	0	91	0	428	110101100	101010001
29	27.295	37.99	2.15	430	339	0	91	0	430	110101110	101010011
30	27.305	38.00	2.16	432	341	0	91	0	432	110110000	101010101
31	27.315	38.01	2.17	434	343	0	91	0	434	110110010	101010111
32	27.325	38.02	2.18	436	345	0	91	0	436	110110100	101011001
33	27.335	38.03	2.19	438	347	0	91	0	438	110110110	101011011
34	27.345	38.04	2.20	440	349	0	91	0	440	110111000	101011101
35	27.355	38.05	2.21	442	351	0	91	0	442	110111010	101011111
36	27.365	38.06	2.22	444	353	0	91	0	444	110111100	101100001
37	27.375	38.07	2.23	446	355	0	91	0	446	110111110	101100011
38	27.385	38.08	2.24	448	357	0	91	0	448	111000000	101100101
39	27.395	38.09	2.25	450	359	0	91	0	450	111000010	101100111
40	27.405	38.10	2.26	452	361	0	91	0	452	111000100	101101001

TABLE 2.1b
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 12.0967 MHz)

CHANNEL DISPLAY	CARRIER FREQ. IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQ. 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE		NUMERICAL VALUE OF ADDER CODE Add Number		Carry In	Output Number (N)	BINARY VALUE OF PROCESSOR OUTPUT CODE		
				rec	xmit	rec	xmit			Receive	Transmit	Xmit Plus Carry In 1
1	26.965	37.66	1.37	182	273	91	0	1	274	010110110	100010001	100010010
2	26.975	37.67	1.38	184	275	91	0	1	276	010111000	100010011	100010100
3	26.985	37.68	1.39	186	277	91	0	1	278	010111010	100010101	100010110
4	27.005	37.70	1.41	190	281	91	0	1	282	010111110	100011001	100011010
5	27.015	37.71	1.42	192	283	91	0	1	284	011000000	100011011	100011100
6	27.025	37.72	1.43	194	285	91	0	1	286	011000010	100011101	100011110
7	27.035	37.73	1.44	196	287	91	0	1	288	011000100	100011111	100100000
8	27.055	37.75	1.46	200	291	91	0	1	292	011001000	100100011	100100100
9	27.065	37.76	1.47	202	293	91	0	1	294	011001010	100100101	100100110
10	27.075	37.77	1.48	204	295	91	0	1	296	011001100	100100111	100101000
11	27.085	37.78	1.49	206	297	91	0	1	298	011001110	100101001	100101010
12	27.105	37.80	1.51	210	301	91	0	1	302	011010010	100101101	100101110
13	27.115	37.81	1.52	212	303	91	0	1	304	011010100	100101111	100110000
14	27.125	37.82	1.53	214	305	91	0	1	306	011010110	100110001	100110010
15	27.135	37.83	1.54	216	307	91	0	1	308	011011000	100110011	100110100
16	27.155	37.85	1.56	220	311	91	0	1	312	011011100	100110111	100111000
17	27.165	37.86	1.57	222	313	91	0	1	314	011011110	100111001	100111010
18	27.175	37.87	1.58	224	315	91	0	1	316	011100000	100111011	100111100
19	27.185	37.88	1.59	226	317	91	0	1	318	011100010	100111101	100111110
20	27.205	37.90	1.61	230	321	91	0	1	322	011100110	101000001	101000010
21	27.215	37.91	1.62	232	323	91	0	1	324	011101000	101000011	101000100
22	27.225	37.92	1.63	234	325	91	0	1	326	011101010	101000101	101000110

TABLE 2.1b
Digital Frequency Synthesizer Frequencies
And Digital Tuning Codes
(4Y1 - 12.0967 MHz)

CHANNEL DISPLAY	CARRIER FREQ. IN MHz	SYNTHESIZER FREQUENCY IN MHz	MIX DOWN FREQ. 4Q6 IN MHz	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE rec	NUMERICAL VALUE OF PROCESSOR OUTPUT CODE xmit	NUMERICAL VALUE OF ADDER CODE Add Number rec	NUMERICAL VALUE OF ADDER CODE Add Number xmit	Carry In	Output Number (N)	BINARY VALUE OF PROCESSOR OUTPUT CODE Receive	Transmit	Xmit Plus Carry In 1
23	27.255	37.95	1.66	240	331	91	0	1	332	011110000	101001011	101001100
24	27.235	37.93	1.64	236	327	91	0	1	328	011101100	101000111	101001000
25	27.245	37.94	1.65	238	329	91	0	1	330	011101110	101001001	101001010
26	27.265	37.96	1.67	242	333	91	0	1	334	011110010	101001101	101001110
27	27.275	37.97	1.68	244	335	91	0	1	336	011110100	101001111	101010000
28	27.285	37.98	1.69	246	337	91	0	1	338	011110110	101010001	101010010
29	27.295	37.99	1.70	248	339	91	0	1	340	011111000	101010011	101010100
30	27.305	38.00	1.71	250	341	91	0	1	342	011111010	101010101	101010110
31	27.315	38.01	1.72	252	343	91	0	1	344	011111100	101010111	101011000
32	37.325	38.02	1.73	254	345	91	0	1	346	011111110	101011001	101011010
33	27.335	38.03	1.74	256	347	91	0	1	348	100000000	101011011	101011100
34	27.345	38.04	1.75	258	349	91	0	1	350	100000010	101011101	101011110
35	27.355	38.05	1.76	260	351	91	0	1	352	100000100	101011111	101100000
36	27.365	38.06	1.77	262	353	91	0	1	354	100000110	101100001	101100010
37	27.375	38.07	1.78	264	355	91	0	1	356	100001000	101100011	101100100
38	27.385	38.08	1.79	266	357	91	0	1	358	100001010	101100101	101100110
39	27.395	38.09	1.80	268	359	91	0	1	360	100001100	101100111	101101000
40	27.405	38.10	1.81	270	361	91	0	1	362	100001110	101101001	101101010

3. SERVICE INFORMATION

3.1 General

This section contains information necessary to service and calibrate the A.R.F. 2001 transceiver. Included are performance checks and troubleshooting procedures.

Refer to Figuer 3-1 for the test setups.

3.2 Equipment Required

Refer to Table 3-1 for the list of equipment needed to service the 2001 transceiver. Use any suitable instrument that meets the required specifications.

TABLE 3-1 REQUIRED TEST EQUIPMENT

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS
Oscilloscope	40 mhz min, 50MVP-P to 100VP-P with matching probe
R.F. Signal Generator	Frequency Range - 27 mhz CB Band Output - 0.1 mv to 25 mv rms into 50 ohm load. Modulation - 1Khz internal and 400 hz + 1800 hz external Frequency Accuracy - set with counter stability
Voltmeter, A.C.	Frequency range - 50hz to 10khz Accuracy - ± 2% Range - 1mv to 10V Rms
Voltmeter D.C.	Accuracy - ± 2% Range - 0 to 30V DC
RF Power Meter	Average Responding Accuracy - ± 5% Range - 0 to 20 watts
Frequency Counter	Frequency Range - Audio to 40 mhz Accuracy - better than ± 1 ppm Resolution - 10 hz or better
Oscillator Audio (Note: Two required for SSB transmit testing)	Frequency Range - 100 hz to 10Khz Accuracy - ± 5% Output - 0 to 1 volt RMS Min Output impedance - 600 ohms suitable (not critical)
Volt - OHM - Meter	Most any reliable multi function VOM will suffice
Sampling "TEE", R.F.	Must sample RF output of transceiver for oscilloscope and frequency counter without disturbing the 50 ohm impedance. Note: This feature may be built into some counters and test sets.

3.3 Special Equipment

For proper input signal handling to the transceiver according to the procedures contained in this manual, a means is needed whereby the operator can conveniently control transmit - receive and modulation levels. This section describes a special test box easily constructed from standard components that will perform this function.

The features of the test box include:

- Transmit - Receive Switch
- Modulation On/Off Switch
- Modulation Level Potentiometer
- Microphone Cable With Mating Connector To Plug Into Transceiver
- Audio Input Connectors

The test box components are standard and are not critical in value. All resistors can be 1/4 watt or 1/2 watt, 10% tolerance. Isolation of the ground to the transceiver input is important. Grounding this line can cause hum so this is the reason for the audio transformer. Be sure the AC voltmeter used for measuring the low level audio is also isolated from ground.

With the addition of various other microphone connectors this test box can also be used on other types of transceivers. See Figure 3-2.

3.4 Performance Checks

3.4.1 Control Function Checkout

Function Setting		Function Indication
Preset the 2001 controls as follows:		
Switches:	PA	Off (down)
	Talk Back	Off
	Ext Spkr	Off
	NB	Off
	AMSIL	Off
	SWR	Off
	SAM	Off
	Antenna	Set to match Ant connector loaded into power meter
	Power	Off
	Mode	AM
	Scan	Off
Knob Controls:		
	Dimmer	Full CW
	CAL	Approx, 50%
	Mike Gain	Full CW
	Volume	Approx. 2
	Squelch	Full CCW
	Tone	Approx. CW
	RF Gain	Full CW
	Fine Tune	50% (5)

Function Setting	Function Indication
Plug transceiver into AC outlet	Clock should illuminate but blink on and off.
Depress F Clock Switch	Clock should change at a rapid rate to set time and stop blinking on and off when switch is released.
Depress S Clock Switch	Clock should change at a slow rate to set time.
Power Switch to On	Receive indicator illuminated. LED readouts show A,U, or L and 19.

Function Setting	Function Indication
Adjust Dim Control	Meter lamps and levellights illuminate from low to very bright.
Mode SW to AM	LED Displays A
Mode SW to USB	LED Displays U
Mode SW to LSB	LED Displays L
PA Switch to On	LED Displays PA Channel Display Blank
Increase Volume	Audible Noise
Increase Squelch	Squelch break near 3 on knob
Rotate Tone	Tone change CWTS highs near 0
NB On	Slight decrease in noise volume
AMSIL On	AMSIL indicator illuminates

3.4.2 Keyboard Function Checkout

Note - to quickly clear the memory or clear a keyboard malfunction unplug the transceiver from the AC power line for 10 seconds, then repower and resume operation.

Function Setting	Function Indication
Depress Slo (Key 3)	Scans channels upward slow
Momentary Lit Rol (Key 6)	Displays 09
Depress slo (Key 2)	Scans channels downward slow
Momentary Lit Help (Key 9)	Displays 09
Depress FST (Key 1)	Scans channels downward fast
Depress FST (Key 0)	Scans channels upward fast
Momentary Lit MEM (Key 8)	Displays 01
Enter Memory As Follows:	
Enter - 7 - Enter - MEM	Loads Ch 7 into memory
Enter - 5 - Enter - MEM	Loads Ch 5 into memory
Enter - 3 - Enter - MEM	Loads Ch 3 into memory

Set Squelch to 0 Momentary depress SCAN (5) Set SCAN Switch to Open	Scans Ch 7, 5, and 3
Squelch Full CW	Scan Stops
Squelch Full CCW	Scan resumes, 7, 5, and 3
Scan Switch to Off Depress All SC (Key 7) Depress SCAN (Key 5) Set SCAN SW To Busy Squelch Full CW	After approx 5 sec. delay scans Ch 1 thru 40.
Squelch Full CCW	Scan Stops
SCAN SW to Off	
Recall/Monitor function	
Hit: Enter - 1 - 0 - Enter RCL	Displays Ch 10
Enter - 2 - 0 - Enter	Displays Ch 20
Hit RCL (6)	Pops back to Ch 10
Hit MON (4)	Displays 20
Squelch Full CW	Displays 10 after short pause
Squelch Full CCW	Displays 10 for apporx 5-15 sec. then changes back to 20

3.4.3 Transmitter Performance Check

Note - "2001" designation indicates the unit under test.

Test Procedure	Measurement Requirements
3.4.4 AM Transmit	
Setup per Fig 3-1A for transmitt and modulation test. 2001 to ch 20, AMMODE. Mic Gain:Full CW (max) SAM: Off Audio input level: 30 MV RMS at 1khz	

3.4.5 AM Carrier Output Power (No MOD)

Key transmit on (MOD Off)	Power Output: 3.5 to 4.0 watts
2001 RF Meter	Power Indication: 4 w ± .5 w

3.4.6 AM Carrier Output With MOD

Key transmit on (MOD On)	Scope display-modulated envelope clean at 90% mod.min.
2001 RF Meter	Power indication-increased to 8 to 16w
2001 % MOD Meter	% MOD indication: 90 to 99%

3.4.7 Audio Limiting Threshold

Reduce Test Set Audio Level To Limiting Threshold	Audio Level: 5 to 10 mv rms

3.4.8 50% MOD Meter Check

Reduce test set level for 50% mod scope display	2001 % mod meter indication: 40 to 60%

3.4.9 SAM Check

With 50% Mod set as above switch SAM On.	Scope and meter % mod should increase to 90% mod.
Switch SAM Off. Set test set audio level to 30mv Test Set MOD Off Test Set Transmit Off	

3.4.10 SWR Meter & Indicator Check

Key Transmit On Set SWR Switch To On Adjust CAL for SWR CAL point on % mod meter	SWR meter indication: near 1.0 Hi SWR indicator: Off
Switch Antenna to opposite position with open antenna connector	SWR meter indication: 8 or higher Hi SWR indicator:illuminates
Unkey transmitter. SWR Switch to Off.	

3.4.11 Sideband Transmitt

Set MODE switch to USB Key transmitter On	RF Power output: less than 0.1 w
Test set MOD on (1khz audio at 30mv)	RF power output: 8 to 10 watts with very little ripple on scope euvelope.
MODE Switch to LSB	RF power output: 8 to 10 watts (little ripple)
Test Set MOD Off	RF power output:less than 0.1 w
Unkey transmitter Set Mode Switch to AM	

3.4.12 Carrier Output Frequency

Connect freq counter to sampling "Tee" per fig 3-1A	
"001, ch 20, AM mode. Key transmitter On (Mod Off)	Carrier freq: 27.205000 mhz ± 150 hz
Unkey transmitter	

TEST PROCEDURE	MEASUREMENT REQUIREMENTS
3.4.13 PA/TALKBACK CHECK	
Setup: Plug an external remote speaker into the 2001 PA jack. Position the remote speaker outside or in another room to prevent feedback. Plug the standard 2001 microphone into the transceiver.	
Set MIC Gain to 0 (full CCW) PA Switch to On (up)	Meter lights, studio monitor, and lever lights extinguish. Display indicates PA.
Key microphone switch while speaking into mike slowly increase the Mike Gain for the highest audio level at the speaker without feedback.	Voice should be audible at remote PA speaker.
Unkey Mike	
Set Talkback Switch to On (Intercom function)	Sounds or voices near the remote speaker should be audible at the 2001.
Key Mike	Unit reverts back to PA
Unkey Mike	
Switch PA to Off	Lamps and indicators revert back to normal CB operation.
3.4.14 AM RECEIVE FUNCTION CHECK	
Setup per Figure 3-1B Signal Generator: 0.5 mv RF output, AM mod 1khz at 30%, freq on ch 20, 27.205000 mhz.	
2001: Preset per par 3.4.1, power ON, ch 20, AM mode.	1khz tone mixed with some noise should be audible through 2001 speaker.

TEST PROCEDURE	MEASUREMENT REQUIREMENTS
3.4.15 AM SENSITIVITY (STN/N)	
Set Ext Spkr Switch to On. Adjust Volume for a dB reference level near full scale of AC Voltmeter (1 volt scale) (use 1.0 volts ref if meter has no dB scale)	Speaker inaudible audio output to AC volt meter. Reference: Signal plus noise
Signal Gen: Switch mod to Off (carrier only) maintain exact same output of 0.5 mv	Output: noise only AC meter should decrease at least 10 dB (0.315 volts or less)
Signal Gen: Mod on set to 30%	
3.4.16 AGC CHECK	
Set Sig gen to 10000 mv adjust Volume for dB reference on AC voltmeter	AC voltmeter dB reference level at or near 1 volt.
Reduce sig gen to 1 mv	AC voltmeter level should not decrease more than 10 dB (0.315 volts min) (typical 6 dB)
3.4.17 "S" METER CHECK	
Set Sig Gen to 100 mv	2001 "S" meter should indicate S9 ± ½ division
3.4.18 SQUELCH FUNCTION CHECK	
Sig Gen: set to less than 0.1 mv 30% AM mod. 2001: RF Gain full CW, Ext. spkr Switch Off	Noise audible
Squelch: Adjust for squelch threshold quieting	Squelch control near 3.
Slowly increase RF Generator until squelch just breaks.	Squelch should break with less than 0.5 mv input.
Set squelch full CW (10)	Squelch quiets
Increase sig gen level until squelch just breaks	Squelch should break between 1000 mv and 5000mv
Set Squelch full CCW (0)	

TEST PROCEDURE	MEASUREMENT REQUIREMENTS
<u>3.4.19 RF GAIN FUNCTION CHECK</u>	
Sig Gen: set to less than 0.1mv 30% AM mod 2001: RF gain full CW set squelch for threshold quieting	Noise inaudible
Reset RF Gain full CCW (0) Increase Sig Gen level until squelch just breaks	Sig Gen level at break should be near 100 mv (for approx 45 dB RF Gain range)
Set RF Gain to full CW (10)	
<u>3.4.20 SSB RECEIVE FUNCTION CHECK</u>	
Sig Gen: set to 1 mv output CW no modulation 2001: preset as for AM receive, ch 20, noise audiable, FINE TUNE center (5), mode to USB	Noise audible.
Slowly increase sig gen frequency to about 27.206000 mhz	1khz tone beat note should be audible.
Tune FINE TUNE above and below center (5)	Audible beat should significantly change frequency (pitch)
Reset FINE TUNE to center (5)	
<u>3.4.21 USB SENSITIVITY</u>	
Set sig gen for 0.25 mv at approx 27.206000 mHz. (1khz above center)	1khz audio tone mixed with some noise audible.
Set Ext Spkr On (up)	Tone and noise inaudible
Adjust volume for dB reference level near full scale (1v) on AC voltmeter.	Reference signal plus noise.
Disconnect RF connector at the CB antenna jack of 2001. Measure noise only	Noise only - AC meter should decrease more than 10 dB (less than 0.315 volts)
Note - with RF input disconnected be sure no leakage signal from the generator is still audible.	

Reconnect RF Connector.

3.4.22 LSB SENSITIVITY

Perform LSB sensitivity check the same as for USB except the mode switch will be in LSB and the generator frequency will be 27.204000 mhz (1 khz below center)

3.4.23 SSB AGC CHECK

Setup either in USB or LSB with respective RF frequency for an audible 1 khz tone. Adjust the RF generator for 10000 mv and establish a dB reference on the AC voltmeter with the Ext Spkr Switch on. Reduce the generator level to 1 mv.

AC voltmeter reading should not drop more than 10 dB. (typical 3 dB).

3.4.24 AMSIL SSB SENSITIVITY

Setup same as for sensitivity check with 1 khz audio audible. Switch AMSIL Switch to On.

Slowly increase RF Generator output from minimum until AMSIL squelch breaks.

AMSIL should break between 0.5 and 1.0 mv.

Perform this test on USB and LSB.

3.4.25 AMSIL AM REJECTION

Setup same as above except set RF Gen to center freq 27.205000 mhz and apply 50% AM modulation.

Slowly increase RF Sig Gen output to max. (100 mv)	Squelch should not break for more than a fraction of a second then remain squelched for any RF gain input.

3.4.26 SSB SQUELCH

For USB and LSB setup as for sensitivity. With less than 0.1 mv RF input adjust squelch for quieting threshold.	Noise and 1 khz tone inaudible.
Slowly increase RF gen output until squelch just breaks.	Squelch should break at less than 0.5 mv input.
Adjust squelch to full CW (10)	Noise and 1 khz tone inaudible.
Slowly increase sig gen until squelch just breaks	Squelch should break between 1000 and 5000 mv.

3.5 ALIGNMENT

Note: for all adjustment and component designation numbers the number preceeding the letter indicates the assembly board on which it is located.

Example:		
	6R4	A6 Board (Transmitter) Pot R4
	3R35	A3 Board (Audio) Pot R35
	4C35	A4 Board (PLL Board) Cap C35

3.5.1 Power Supply

Using any pin 1 or pin 8 in the 2001 as a test point, measure the +14.5 UDC using a reliable DC voltmeter. The voltage should measure within ± 0.2 UDC. If not, adjust 9R5 on the power supply board for the proper voltage.

Check the 8 volt line at any pin 51. Voltage should measure within ± 0.3 UDC. This voltage is not adjustable.

3.5.2 A4 PLL Board Alignment

Set fine tune to 5, select channel 20, AM mode, scan to off.

10-24 mhz frequency counter probe to IC 4U1 pin 5. Adjust 4C28 for 5.120000 mhz ± 10 hz.

VCO Balance DC VM to T.P. (test point) adjust 4T1 for 3.8 to 4.1 V DC (Ch 20 only)

AM/L LO frequency counter probe to a$ pin 16, adjust 4R31 for 37.90000 mhz, ± 20 hz.

Transmit LO attach a dummy load or wattmeter to 2001 ant output. Freq counter probe to A4 pin 16, mode switch to AM. Key transmitter and adjust 4R40 for 37.90000 mhz ± 20 hz. Unkey transmitter.

REC USB L.O. freq counter probe to a$ pin 16, set "mode" switch to USB. Adjust 4R29 for 37.902500 mhz ± 20 hz.

Carrier OSL LSB freq counter probe to A4 pin 20, adjust 4C35 for 10.695000 mhz ± 10 hz.

Carrier OSL USB freq counter probe to A4 pin 20.

Adjust 4C38 for 10.697500 mhz ± 10 hz.

Carrier OSC Output Level Scope probe to A4 pin 20.

Mode switch USB and LSB. Measure 900 mv to 1.4 v p-p.

L.O. Output Level Scope probe to A4 pin 16, modes USB, AM, LSB, output 800 mv to 1.3 v p-p. Probe to A4 pin 32 A,U,& L. Output 500 to 800 mv p-p.

3.5.3 Transmitter Alignment

2001 - antenna connected to wattmeter

Mod Control test set to mic connector

Mic gain max CW (10)

Mode - AM

AM power pot 3R29 centered

SAM level pot 6R3 full CCW

Bal pot 6R35 centered (do not disturb if already near center)

Key transmitter without modulation

Tune transmitter for maximum power output, 15 watts

Typical minimu.. (6L44, 6T1, 6L10, 6L7, 6L4, 6L3 and 6L2)

Check power output at ch 1 and 40 (for minimum of 14.5 watts)

Note, ch 1 is usually slightly lower in power than ch 40.

Adjust 6L7 slightly CW to bring ch 1 power up and balance with ch 40.

Reject to ch 20

Adjust pot 3R29 for 6.8 VDC at IC 3U1 pin 2

Adjust pot 6R3 for 4.0 watts output (no mod)

Check carrier output frequency. 27.205000 mhz ± 150 hz

Note - do not key transmitter any longer than necessary to perform required tests.

3.5.4 Audio Clipper

Scope probe to 3Q2 collector

2001 ant connector to wattmeter

Connect test set to 2001 mic connector

Adjust 1khz audio at test unit (30 mv rms). (Not necessary to simultaneously key transmitter).

Setup scope to observe clipped 1khz tone, adjust level for clipping threshold.

Adjust 3R20 for symetrical clipping at top and bottom of 1khz wavescope.

3.5.5 AM Modulation

Setup scope display for the modulation RF envelope.

2001 mic gain to max CW

Key transmitter without modulation. Check and adjust power output if necessary for 3.8 to 4.0 watts.

Apply 1khz audio modulation (30 mv rms) adjust 3R35 for approx 95% modulation.

Note: 90% mod is 8 CM peaks and 0.4 CM valleys

95% mod is 8 CM peaks and 0.2 CM valleys.

Reduce mic gain for maximum modulation threshold

Audio input level should be between 5 to 10 mv rms.

Place SAM switch to On. Further reduce mic gain for max mod threshold. Audio input level should be 1 to 3 mv rms.

Return mic gain to max. Unkey transmitter.

3.5.6 RF Meter Calibrate

Key transmitter with no modulation, AM mode, ch 20

With 3.8 to 4.0 watts output adjust PWR output 3R5 for 4.0 watts on S/RF meter.

Apply full modulation at 1khz S/RF meter should increase to 8 to 16 watts peak power. Unkey transmitter.

3.5.7 % Mod Meter Calibrate

As setup per 3.6.5 key transmitter with full modulation, AM, ch 20, 1khz mod. Adjust % mod cal pot 3R16 for 95% on meter scale.

Reduce % mod to 50%, meter should read 40-60.

3.5.8 Mixer Balance (performed only with a spectrum analyzer, otherwise do not change 6R35 adjustment).

Connect spectrum analyzer probe to 6Q8

Collector or nearby 1k resistor 6R25

Setup a display of 0 to 50 mhz

Key transmitter, AM, ch 20, with no modulation.

Carefully tune pot 6R35 for a minimum 38 mhz spike. 50 to 60 dB below carrier. (ignore other spikes)

Unkey transmitter, remove probe.

3.5.9 Transmitter SWR

With no modulation in AM mode key the transmitter using the listed loads for the respective SWR readings and HI SWR indicator. Set cal level on % mod meter for each SWR load.

Load Resistor	SWR	Limits	HI SWR Indicator
50 ohms	1.0	+ 0.3	Off
100 ohms	2.0	± 0.5	Off
150 ohms	3.0	± 1.0	On
200 ohms	4.0	± 1.0	On
16 ohms	3.0	± 1.0	On

NOTE: Resistors must be carbon type 4 watt minimum.

3.5.10 Transmitter SSB Carrier Suppression

2001 - Set for USB, ch 20, mic gain max, LSB or USB mode zero the power meter, key transmitter without modulation and adjust bal pot 2R45 for the lowest power output as readable on the power meters lowest range. Carrier feed thru should be less than 0.1 watts.

Alternate method using spectrum analyzer. Analyzer probe to 3Q1 collector, key transmitter using 2 khz mod freq and setup display of 10.695 mhz IF. The display will show upper and lower peaks. Adjust 2R45 for minimum carrier, (middle peak).

3.5.11 SSB Transmitter Modulation Drive and ALC

2001 - USB/LSB modes, ch 20, mic gain max, key transmitter with 1khz modulation and adjust 6R4 for approx 9 watts output. Reset the audio input to 1.00 mv rms. Adjust 3R38 for less than 5 watts output. Peak 1T3 for max power output. Readjust 3R38 for 5 watts out. Check both USB & LSB. (whichever is lowest output set to 5W)
(Object: obtain 5 watts output with 1.00 mv rms input).

Change audio input to two tones of 400 hz and 1800 hz mixed at 30 mv rms level. Adjust either audio level for a power output dip that is created when the RF outputs are equal. At this dip set all pot 6R4 for 6 watts power output (10 to 12 watts PEP) check both USB and LSB on ch 1, 20, & 40. Power should maintain 5.5 to 6.5 w. Alternate method - observe for equal peaks on spectrum analyzer.

3.5.12 Receiver RF and IF Alignment

2001 Settings - RF Gain - Full CW (10)
Tone - Middle (5)
Fine Tune - mid (5)
Squelch - Full CCW (0)
Vol - Low (2)
Channel - 20
Mode - AM
NB - Off

Instruments - RF sig gen 27.205 mhz, 1khz, 30% mod. feed RF to ant conn on 2001. Audio output at PA jack J3 fed to 8 load , AC voltmeter. Scope monitor at 3U2 pin 7

RF and IF Alignment

With RF gen at 27.205 mhz ± 100 hz increase the output level for a recovered audio tone suitable for measurement on the 0.3 or 1.0 V AC meter scale (with ext spk Sw On). Use the volume to adjust the output level.

Reduce the RF gen output for a low threshold of recovered audio. Adjust the volume for a suitable meter reading.

Tune 1L1, 1L2, 1T1, 1T2, and 1T3 for maximum output on voltmeter.

Check 10 dB 5 + N/N ratio at ch 1, 20, and 40 for sensitivity of 0.5 mv or better.

Check RF gain for operation. (55 dB typ)

Note - while peaking the receiver keep reducing the gen level to keep below the AGC threshold area.

3.5.13 AGC and S Meter Adjustment

Setup as per

Set RF gen for 100 mf, RF gain max (10), ch 20

Monitor pin 15 of A3 using HIZ DC VM (427A) voltmeter should read 6.5 to 7.5 VDC.

Adjust 8R10 "S CAL" for an S meter reading of 9. Check other S levels as follows:

+ 20	1000 mv	15-25 limit
+10	300 mv	9.5 - 15
9	100 mv	9
7	25 mv	6.5 - 7.5
5	6.5 mv	
3	1.6 mv	Limit ± 0.5 division
1	0.4 mv	

If S7 is too low increase the AGC slightly reset S9 at 100 mv and recheck S7 and +10.

NOTE: Check AGC characteristic from 10 mv to 25 mv input. Be sure recovered audio remains better than 10 dB to 25 mv input.

Juggling of the AGC and S meter settings may be necessary to obtain compromise between the two.

Check the AGC characteristics from 10 mv to 1 mv for 10 dB maximum audio output level change.

3.5.14 Squelch Adjustment

Setup per 10.1 and 10.2, RF gain max (10) int spkr. ch 20. Tone or noise audiable.

Adjust RF gen for minimum output less than 0.1 mv. Set uut squelch to 3 on knob.

Adjust 3R40 for low squelch threshold.

Set RF gen to 2000 mv output, squelch knob to 10 (full cw)

Adjust 3R39 for high squelch threshold

3R40 and 3R39 adjustments interact. Repeat the above steps until no further interaction occurs.

Low threshold

No signal squelch should break between 2.5 to 3.5 on squelch control.

Tight squelch at 10 should break 1000 to 3000 microvolts. (2000 typical at ch 20)

3.5.15 SSB AGC Alignment

2001 USB mode, RF gain max (10), squelch min (0), ch 20. Monitor audio output with scope and AC vm.

Rf gen 10 mv, no AM mod, set siggen for 27.206 mhz for 1 khz tone at recovered audio

Adjust 2R15 for a SSB AGC curve for 10 dB or less with a 10 mv to typical 3 dB. (3 to 4 dB is optimum)

Also, observe recovered tone for squelching or oscillations, reduce AGC 2R15 until such just disappears. Check at all RF input levels up to 300 mv.

Recheck AGC characteristic and also on LSB.

At 100 mv RF S meter should read between S9 ± 1 division.

3.5.16 SSB RF Sensitivity

Check per Paragraph 3.4.21

3.5.17 SSB Squelch

SSB squelch should track closely with AM squelch if all alignments are adjusted properly.

Check per paragraph 3.4.26.

If tight squelch does not break between 1000 and 5000 mv slight adjustment of SSB AGC can be made (2R15).

3.5.18 AM Silencing

Setup per 11.1

Mode USB, squelch 0

Obtain a 1 khz audible tone with sufficient generator level.

Set generator to 0.8 mv and place AMSIL to On.

Adjust 2R30 full CCW until tone squelches (note delay)

Slowly increase 2R30 CW until tone breaks squelch.

Set Gen output to min until tone squelches, then slowly increase gen until tone breaks squelch. (Should break 0.5 to 1 mv)

Repeat above for LSB, re check USB if any adjustments are made on LSB

Set Gen for center FQ 27.205 50% AM mod

Set to USB and LSB while increasing Gen level from zero to 300 k. AM should not break thru more than once for no more than 1 sec.

Problems relating to AMSIL failure on USB usually relate to AM bandwidth. Increasing AM BW improves AMSIL on USB.

3.5.19 Fine Tune

Setup per 3.5.15

Tune fine tune and note a significant change in pitch of output tone.

3.6 TROUBLESHOOTING

3.6.1 General

When the 2001 transceiver operates improperly, first check for obvious evidence of trouble such as broken wires, loose connections, damaged components, shorts between pins, and shorts at shields of coaxial cables. The following sub-sections provide troubleshooting information on each component assembly board in the 2001 transceiver. Listed are signal levels, frequencies, voltages, logic data, and troubleshooting aids.

By using this guide with the schematic and block diagram most repairs should be within the capabilities of a competent technician.

When a malfunction is repaired or an adjustment required the transceiver should be checked per section 3.4 and aligned per section 3.5 for the circuits affected by the repair.

3.6.2 Voltages

Check for proper DC voltages at each line circuit in the transceiver as follows:

Mode	Line No.	Voltage
Any	54	8.0 V DC
Any	1	14.5 V DC
CB	8	14.5 V DC
PA	4	14.5 V DC
CB/AM	6	14.5 V DC
CB/REC	3	14.0 V DC
CB/TRANSMIT	2	14.0 V DC
CB/USB	5	14.5 V DC
CB/LSB	7	14.5 V DC
CB/USB/LSB	10	13.5 V DC

A. R. F. PRODUCTS, INC.

Title
A.R.F. Project No.
Contract No.
Invitation No. Date

Note - Be sure to check each voltage line at every respective board since possible broken wires may exist between boards. Also, when most wires break, the break usually occurs at a connection.

TABLE 3.6 (1)
TABLE OF FREQUENCIES
2001 TRANSCEIVER

CHANNEL	CHANNEL FREQUENCY	L.O. FREQUENCY
1	26.965 mhz	37.66 mhz
2	26.975	37.67
3	26.985	37.68
4	27.005	37.70
5	27.015	37.71
6	27.025	37.72
7	27.035	37.73
8	27.055	37.75
9	27.065	37.76
10	27.075	37.77
11	27.085	37.78
12	27.105	37.80
13	27.115	37.81
14	27.125	37.82
15	27.135	37.83
16	27.155	37.85
17	27.165	37.86
18	27.175	37.87
19	27.185	37.88
20	27.205	37.90

TABLE 3.6 (1)
TABLE OF FREQUENCIES
2001 TRANSCEIVER

CHANNEL	CHANNEL FREQUENCY	L.O. FREQUENCY
21	27.215 mhz	37.91 mhz
22	27.225	37.92
23	27.255	37.95
24	27.235	37.93
25	27.245	37.94
26	27.265	37.96
27	27.275	37.97
28	27.285	37.98
29	27.295	37.99
30	27.305	38.00
31	27.315	38.01
32	27.325	38.02
33	27.335	38.03
34	27.345	38.04
35	27.355	38.05
36	27.365	38.06
37	27.375	38.07
38	27.385	38.08
39	27.395	38.09
40	27.405	38.10

3.6.3 A4 PLL Assembly Board

Three important frequencies are generated in the A4 Board and should be checked at the following test points:

Signal	Test Point	Mode	Approx Level
*38 mhz L.O.	Pin 16	AM/LSB/Rec& Transmit	1.5 VP-P
*38 mhz L.O. Plus 2500 hz	Pin 16	USB/Rec&Transmit	1.5 VP-P
10.695 mhz	Pin 20	LSB/Rec/Transmit and AM/Transmit	1.3 VP-P
10.6975 mhz	Pin 20	USB/Rec/Transmit	1.3 VP-P
5.12 mhz	4U1 Pin 5	CB	8.0 VP-P
10.24 mhz	4U1 Pin 4	CB	7.0 RP-P probe may shift freq on this point
11.9466 mhz	4Q5 Emitter	CB	2.0 VP-P """"""""""

* See Table 3.2 for exact frequencies.

For signal tracing refer to paragraph 2.7.

Malfunctions in PLL frequencies can be checked by voltage measurements of the binary inputs to 4U1 and outputs of 4U2. "Ones" should be high voltage near 7 volts DC and zeros should be less than 1 V DC. See Table 2-1.

The least significant binary line P0 to 4UL is Pin 17 and the most significant P8 is Pin 9. The lines correspond to the 4U1 and 4U2 pins as follows:

4U1 Pins	9	10	11	12	13	14	15	16	17
P Line	P8	P7	P6	P5	P4	P3	P2	P1	P0
Ch 20 Binary Code for AM Receive Table 2.1a	1	1	0	0	1	1	1	0	0

4U2 Pins	1	2	3	4	17	13	20	21	12
AM Rec Ch 20	1	1	0	0	1	1	1	0	0
Ch 20 AM Transmit	1	0	1	0	0	0	0	0	1

Erroneous codes out of 4U2 indicate defective 4U2 or keyboard entry problems. If codes at 4U2 are correct but erroneous at 4U1, suspect divides 4U4 and 4U5.

If 4U2 seems to be completely inoperative, check 4U3 pin 6 for 250 khz reference oscillation. Any binary line voltages floating near 4 or 5 VDC indicate a defective divider 4U4 or 4U5.

3.6.4 A7 Readout Board Assembly

Binary channel codes from 4U2 to the readout decoders are "scanned" with the input to both 7U1 and 7U2 in parallel. A typical malfunction of 7U1 or 7U2 will display erroneous numbers or segments of the numbers. Sometimes the display will blank out. To locate a bad IC just check parallel each input line 49, 50, 51, 52, 53, 54, and 58 with an oscillascope. (Use the Pins at A4 PU Assembly for better accessability). Observe each line for constant switching while scanning the transceiver at the keyboard. Any line completely inactive (high or low) indicates the common input at either 7U1 or 7U2 blown. To determine

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which IC input is defective, desolder one of the IC input pins and recheck. If same results are obtained the IC not desoldered is suspect. Desolder its input pin and recheck. Replace whichever IC is defective.

If 7U1 and 7U2 are good check the voltages at the LED readout 7 DS 2 per table 3.6.2. A proper voltage (high) at a pin without the proper segment illuminated indicates a defective readout.

Pin #	Segment	Pin #	Segment
1	1#	11	Carhode 1 & 2
2	Not Used	12	2B
3	1D	13	2A
4	Not Used	14	2F
5	1C	15	1B
6	2G	16	1A
7	2E	17	Not Used
8	2D	18	1F
9	Not Used	19	Not Used
10	2C	20	1G

For malfunctions of the "MODE" LED readouts first check the pins and voltages of table 3-3 for determination of the readout being defective or the circuits. The inputs to 7U3 are not strobed and can be checked with a DC Voltmeter. If inputs to 7U3 are correct and outputs incorrect then 7U3 is suspect.

3.6.5 A5 Scan/Lamp Board Assembly

Defective lamps can be changed simply by removing the two A5 mounting screws and pulling the board rearward. Any lamps changed in the "studio monitor" box should be carefully checked for physical alignment and proper height from the board surface to prevent the bulb from binding and breaking when inserted into the rear of the monitor box.

Scan function input and outputs can be traced with a DC voltmeter. Input Line 38 from the squelch circuit should be low when the transceiver is not squelched and high when squelched.

Output line 56 (to the A4 Board) should be Low 0V to allow scanning and high (4V) to inhibit scanning.

Output line 55 is the SCAN STEPPING and should be a pulse waveform 7-8 V P_P at approx 6.6 hz). Problems on this assembly are usually related to improper input control voltages or defective IC's.

3.6.6 A1 Receiver Board Assembly

First steps in tracking down a receiver malfunction include checking all respective DC voltages to the board and the presence of 38 mhz L.O. at pin 16. Also, check for the presence of input signal at pin 17.

Using the theory of operation in paragraph 2.2, fig 3.6 (1), table 3.6 (3) and a good oscilloscope standard signal tracing techniques can be employed through the receiver to locate a defective stage. If necessary for troubleshooting, the AGC can be disabled for max receiver gain by jumping the junctions of 1R44, 1C38, and 1R53 at pin 12 to ground.

Problems on this assembly are usually related to open 1N270 diodes or defective FET transistors. The diodes are easily checked using an ohmmeter with one end of the diode unsoldered. A defective diode can cause complete inoperation or AGC instability. Defective FET's usually result in poor receiver sensitivity. 1Q5 (SD 306) is checked at the gates using a DC voltmeter. With no RF signal input and RF gain max CW, 1Q5 pin 2 should be approx 8 volts. Reduce the RF gain to zero full CCW. The voltage at pin 2 should decrease to nearly zero. If not, the FET is defective. (Be sure A1 pin 18 is zero volts).

The other gate (pin 3) is checked in a similar manner. Normal voltage is near 3.2 VDC. When the junction of 1C4, 1RG, and 1R12 is shorted to ground, the voltage should decrease to zero at pin 3.

CAUTION - Perform this test quickly to prevent 1R12 from overheating.

Both gates of FET 1Q6 (SD305) are checked as above. Each gate should be at approx 3.7V then decrease to zero when the junction of 1R15 and 1R16 is shorted to ground. Again do this test quickly to prevent damage to 1R15.

Signal tracing of the noise pulse through the noise blanker requires a high speed quality oscilloscope. The noise pulse is coupled to the receiver through a 6 dB "T" pad. One input is from the signal generator, one from the pulse generator, and the output to the transceiver. The signal generator is set for 30% AM modulation and level at 10 dB $\frac{S+N}{N}$ new sensitivity point using "T" pad. The pulse must be 1 us width, 0.1 us rise and fall times at a rep late of 100 H3 and 1 volt peak.

TABLE 3.6 (3)
A1 Receiver Tests

Note: Tests performed on ch 20 using 30% AM modulation, RF gain max CW, fine tune center (5).

RF Gen Level (RMS)	Test Point	P-P Scope or VM Measurement	Comments
20 mv	1Q5D (pin 1)	0.5 V P-P	Modulated RF Envelope
12 mv	1T1 output	0.5 V P-P	" " (noisy)
10 mv	1U1 input (Pin 4)	0.1 V P-P	" " (filtered)
300 uv	1T2 output	0.1 V P-P	" "
2 mv	1U2 input (pin 4)	0.1 V P-P	" "
1.2 uv	1Q7 Base & A1 pin 9	0.2 V P-:	" "
1.0 uv	1Q7 collector	1.7 V P-P	" "
1.0 uv	Jct 1CR10 & 1C42	0.4 V P-P	Audio
100 uv	Uct 1CR10 & 1C42	0.8 V P-P	Audio
1.0 uv	Audio Out A1 pin 13	60 mv P-P	Audio
100 uv	Audio Out A1 pin 13	100 mv P-P	Audio
0	1U3 pin 7	4 V DC	IF AGC
1 uv	1U3 pin 7	5.2 V DC	IF AGC
100 uv	1U3 pin 7	6.9 V DC	IF AGC
10 mv	1U3 pin 7	8.0 V DC	IF AGC
1 uv	A1 pin 18	7.5 V DC	RF AGC
100 uv	A1 pin 18	5.0 V DC	RF AGC
10 mv	A1 pin 18	3.5 V DC	RF AGC
0	A1 pin 16	1.7 V P-P	38 mhz L.O.
6 mv	A1	0.1 V P-P	27 mhz

3.6.7 A2 Sideband Board Assembly

Reference section 2.3 theory of operation and Table 3.6 (4) for any malfunction of the A2 Board check all respective DC voltage and 10.695/ 10.6975 mhz presence at pin 20.

Either in AM or SSB transmit mode signal tracing can start at pin 20. For SSB receive mode start at pin 9.

Malfunctions of this board are usually caused by defective 1N270 eiodes and can cause AGC malfunction or poor AMSIL operation. Also look carefully for broken jumper wires soldered directly into the board.

The crystal filters are critical and factory tuned for flattness and proper bandwidth using a sweep generator. Once tuned they should never require adjustments unless inadvertent detuning occurs.

TABLE 3.6 (4)
A2 SSB Board Tests

Note: Tests performed on ch 20, RF gain max CW, fine tune at max CW, fine tune centered (5). RF generator carrier only, no modulation. Adjust RF gen to 10.694 mhz for 1 khz recovered audio. Voltages may vary unit to unit. USB levels should be nearly identical.

2001 Mode	RF Gen Level	Test Point	Measurement	Comments
LSB Rec	0	A2 Pin 20	1.4 mv P-P	10.695 mhz input
LSB Rec	1 uv	A2 Pin 9	40 mv P-P	IF input
LSB Rec	1 uv	2Q1 collector	250 mv P-P	10.694 mhz IF
LSB Rec	1 uv	2Y2 output	120 mv P-P	10.694 mhz filtered
LSB Rec	1 uv	2Q3 collector	0.8 V P-P	10.694 mhz filtered
LSB REc	1 uv	2Y4 output	0.3 V P-P	10.694 mhz filtered
LSB Rec	1 uv	A2 pin 22	0.8 V P-P	1 khz audio out
LSB Rec	1 uv	2Q5 collector	3.0 V P-P	1 khz audio to AGC
LSB Rec	1 uv	Jct 2CR5 & 2CR4	2.4 V DC	AGC DC
LSB Rec	100 uv	Jct 2CR5 & 2CR4	3.2 V DC	AGC DC
LSB Rec	1 uv	A2 pin 12	1.5 V DC	AGC DC to A1
LSB Rec	100 uv	A2 pin 12	1.8 V DC	AGC DC to A1
(SSB Transmit Mode - use 1 khz audio modulation to 2001 at 30 mv rms input)				
LSB Xmit		2U2 pin 6	0.8 V P-P	DSB 10.694 mhz
LSB Xmit		2Q1 Base	80 mv P-P	DSB 10.694 mhz
LSB Xmit		2Q1 Collector	250 mv P-P	DSB 10.694 mhz
LSB Xmit		2Q3 Collector	500 mv P-P	Sing Tone 10.694mhz
LSB Xmit		A2 pin 13	80 mv P-P	Sing Tone 10.694mhz
AM Xmit		A2 pin 13	400 mv P-P	Carrier 10.695 mhz

When attempting to tune the SSB IF using a sweep generator/scope, disconnect RF output at board A1 pin 9. Capacatively couple the sweep generator into the base of 2Q1 at A1 pin 9. Sample the IF output at A2 pin 23. Keep the scope gain as high as possible and generator level as low as possible to prevent actuation in the IF. Tune the filter for less than 3 dB ripple in the bandpass region with BW 1800 hz to 2300 hz. 6 dB points should be near 10.695 mhz + 200 hz and 10.695 mhz + 2200 hz (limits ± 200 hz).

3.6.8 A3 Audio Board Assembly

Reference section 2.2 and 2.6 for audio theory of operation and Table 3.6 (5). Since all signals on this board are audio or DC, signal tracing is relatively easy.

First check for broken wires and proper DC voltages to the respective pins. Begin signal tracing at Pin 1 for transmit and PA, at pin 13 for AM receive, and Pin 22 for SSB receive. See figure 3.6 (1) for the internal circuit arrangement of IC's 3U1, 3U2, and 3U4.

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Malfunctions on A3 are usually caused by IC 3U4 the Quad CMOS switch. These switches usually fail by staying closed with a voltage sourcing out of the control gate. This voltage usually disrupts other functions in the transceiver.

TABLE 3.6 (5)
A3 Audio Board Tests

RF Generator Level 100 uv 30% 1 khz mod AM, carrier only on SSB no mod,

1 khz recovered audio.

2001 Mode	Test Point	Measurement	Comments
AM Rec	A3 pin 13	0.1 V P-P	Audio input
AM Rec	3Q5 collector	450 mv P-P	Audio
AM Rec	3U2 pin 7	2 V P-P	Audio
AM Rec	3U4 pin 11	1 V P-P	Audio
AM Rec	A3 pin 43	1 V P-P	Audio to volume
AM Rec	A3 pin 44	Set for 0.1 VP-P	Audio from volume
AM Rec	3U3 pin 8	40 mv P-P	Audio
AM Rec	A3 pin 42	6 V P-P	Audio output
AM Xmit	A3 pin 35	80 mv P-P	Audio in 30 mv rms
AM Xmit	A3 pin 47	1.4 v P-P	Audio to mic gain
AM Xmit	A3 pin 48	1.4 V P-P	Audio from mic gain
AM Xmit	3Q2 collector	2.2 V P-P	Square - clipped audio
AM Xmit	3U1 pin 5	2 V P-P	Sine - op amp input
AM Xmit	3U1 pin 7	2 V P-P	Sine - op amp output
AM Xmit	3U4 pin 8	1.7 V P-P	Audio to Am modulator
AM Xmit	A3 pin 75	12 V P-P	Audio modulation feedback
AM Xmit	3U1 pin 1	7 V P-P	Distorted
AM Xmit	3Q6 collector (A3 pin 37)	12 V P-P	Sine modulation to A6

3.6.9 A6 Transmitter Board

Reference Section 2.4 and 2.5 theory of operation and Table 3.6 (6). Signal tracing on this assembly will be at 27 mhz. Check for broken wires, shorted coax cables, and for proper 10.695 mhz at pin 23 and 38 mhz L.O. at pin 32 and DC voltage.

Using Table 3.6 begin signal tracing at the mixer 6U1 inputs. Note - a scope probe can severely detune an RF stage so always check all stages before suspecting a particular point.

TABLE 3.6 (6)

A6 Transmitter Levels Test Point	All Measurements Peak to Peak AM Transmit Level (Approximate)
38 mhz L.O. (Pin 32)	1.0 V P-P
10.695 mhz (Pin 23)	350 mv
6Q8 Collector	1.4 v
6Q3 Base	1.15 v
6Q3 Collector	20 v
6Q2 Base	2.7 v
6Q2 Collector	25 v
6Q1 Base	7 v
6Q1 Collector	37 v
L4 Output	80 v
A 6 Pin 28	72 v

Low power output problems or inoperative conditions are usually caused by blown 6Q4 FET (5D 306). The DC voltage at Pin 3 should be approx. 4 v and approx 8 v at Pin 2. Short the junction of 6R18, 6R19, and 6Q5 collector to ground, the voltage at 6Q4 Pin 2 should be zero. If any voltage is present the FET is blown.

Leakage or defects of diodes 6CR5 and 6CR4 can cause AM modulation problems. Leakage can cause transmit power to drift excessively and % modulation to change over a period of 5 or 10 seconds.

SSB transmit problems can usually be traced to failure of bias switch 6Q7 to supply bias to 6Q1 and 6Q2 in SSB transmit.

Other low power output problems can be caused by leakage of capacitors in the power output section after 6Q1 and in the LP filter following. Affected are 6C2, 6C3, 6C4, 6C6, 6C10, 6C9 and 6C11. Replace these capacitors only with a quality Mica capacitor of equal value.

3.6.10 A8 SWR Board Assembly

Reference Section 2.4 and 2.5 theory of operation and figure 3.6.1. Check for broken wires, shorted coax cables, and proper DC voltages at the respective pines.

Usual cause for a malfunction on this assembly is broken wires or open 1N270 diodes.

3.6.11 A9 Power Supply

Reference Section 2. theory of operation. Check for broken wires, pins shorted together, and for proper DC voltages at the respective pins.

Check for possible B+ shorts in the transceiver. A shorted B+ will cause the regulator to limit current and fold back on voltage to prevent power supply destruction. Such a short will usually not blow a fuse. Voltage regulator problems can be caused by 9U1, 9U2, 9Q1, or Q1.

3.6.12 A10 Microphone Preamp and Microphone Located In The Base Of The Microphone

Check for broken mic cable wires at the connector or at the mic base. Check for +14 V DC at 2001 transceiver mic connector Pin 4. This pin supplies power to the A10 microphone preamp.

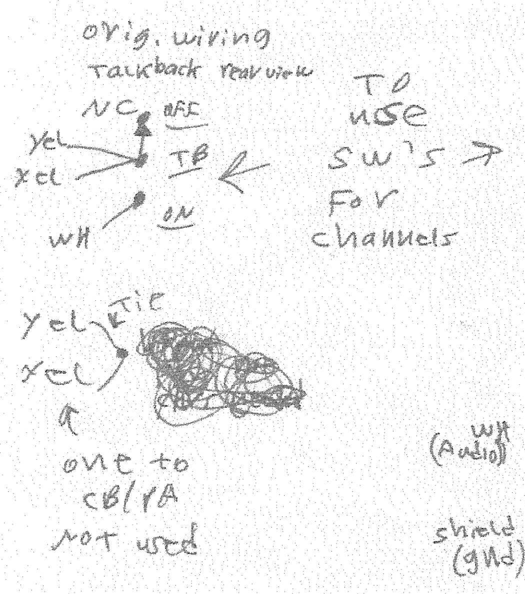
The microphone preamp consists of a single stage low noise FET transistor and a low pass filter.

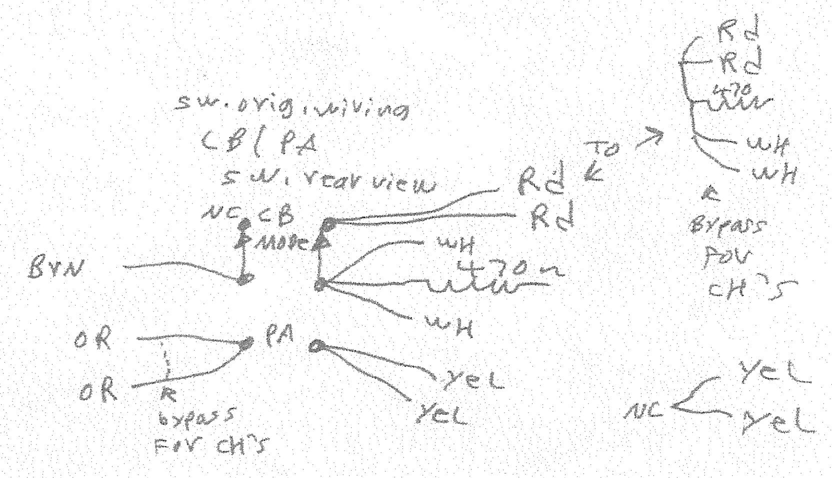
Malfunctions in the mic are usually caused by a defective FET (2N3819) or a broken wire.

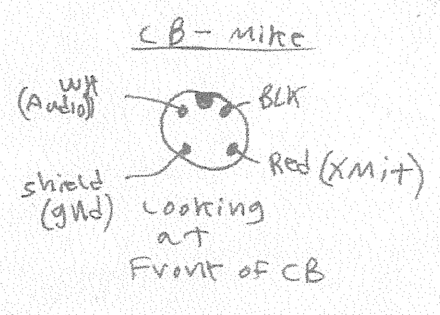
ARF 2001 Schematic

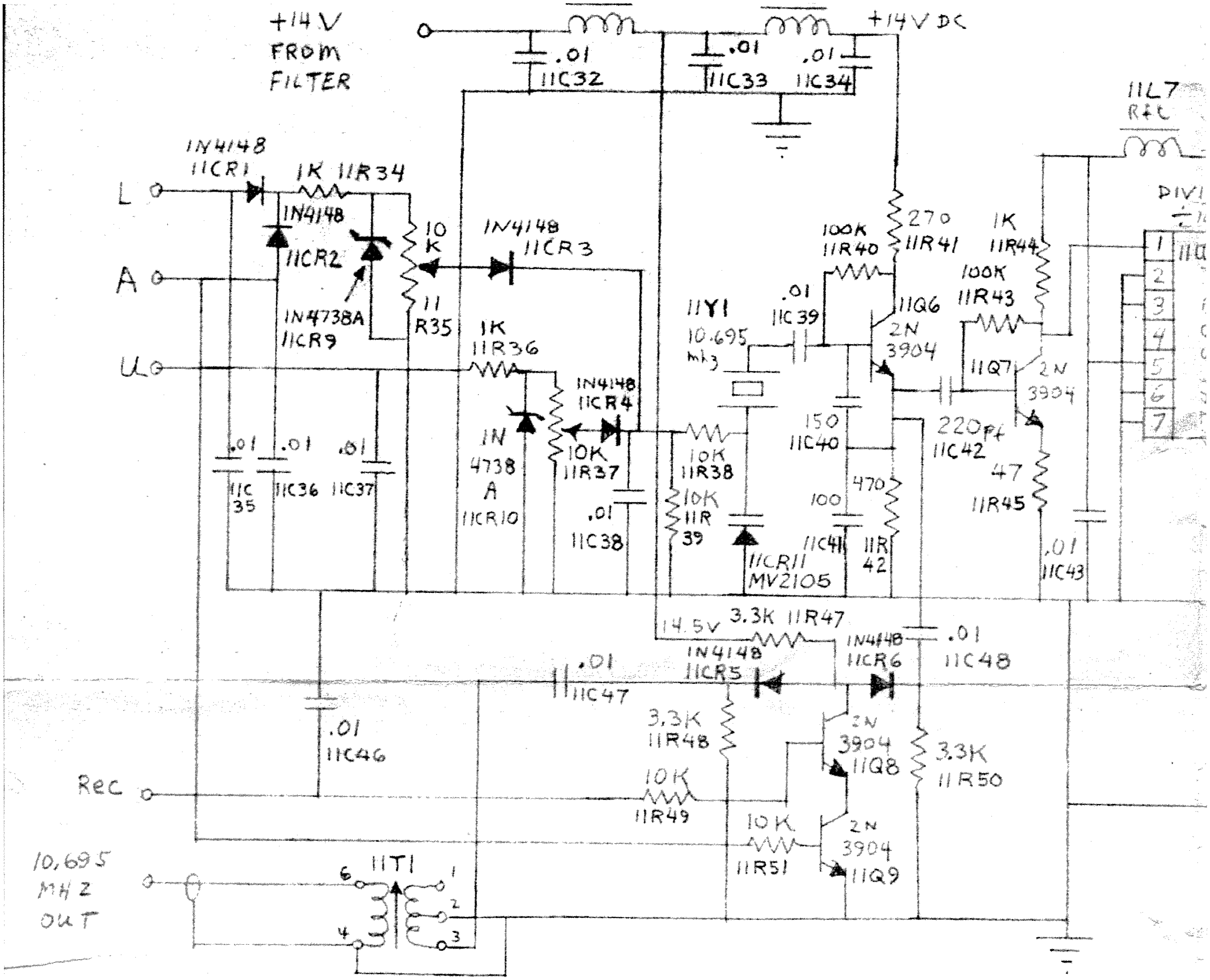
27695

26425









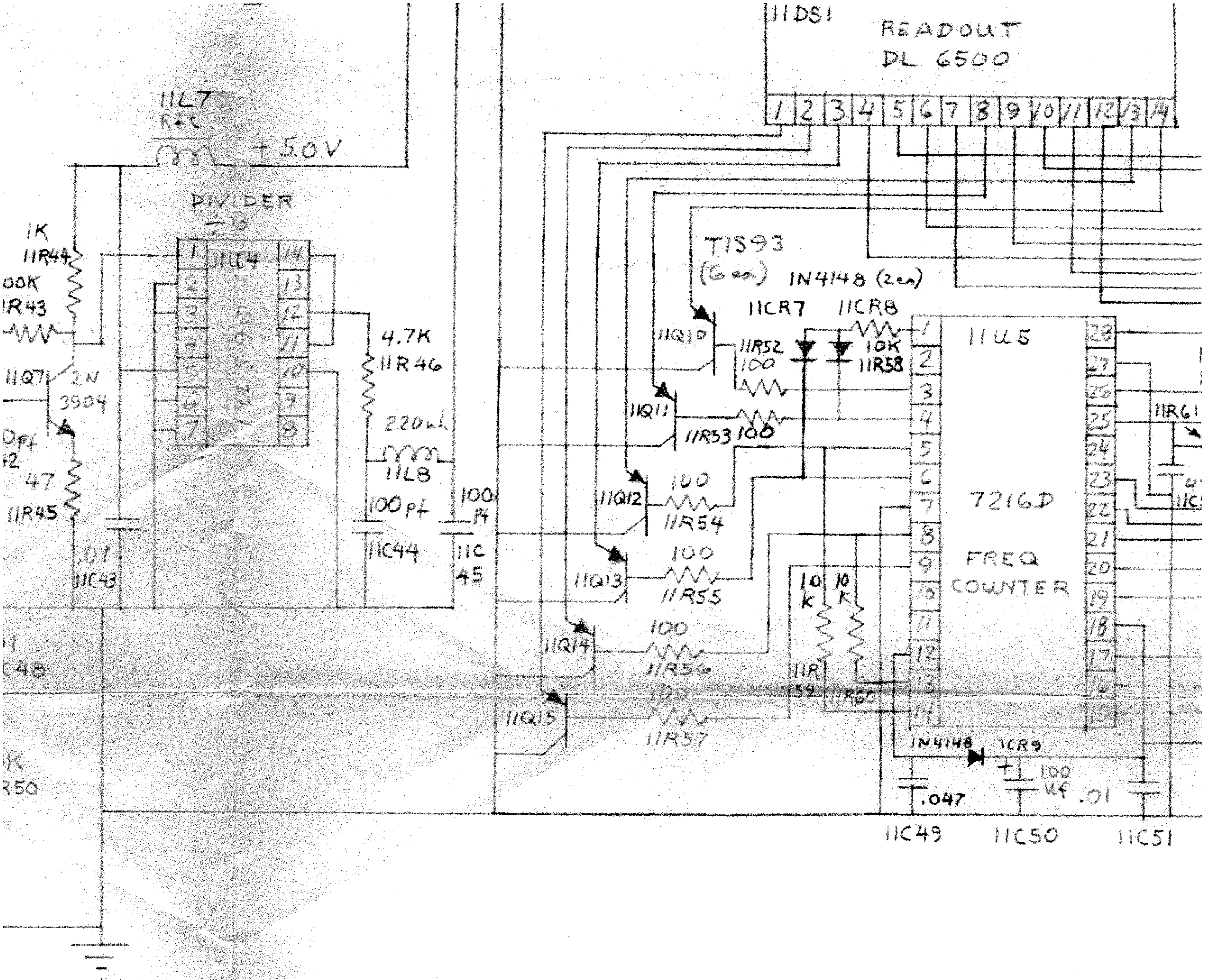
NOTES: 1. CAPACITORS ARE IN uF UNLESS OTHERWISE SPECIFIED
2. INDUCTORS ARE IN uH
3. RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE SPECIFIED

NEXT ASS

A

4

3



ITEM	REQD	PART NO

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DECIMAL TOL: .XX ± .02

.XXX ± .005

ANGLE TOL: ±

MACHINE FINISH ✓

EDGES: MAX R

CORNERS: MAX R

MATERIAL

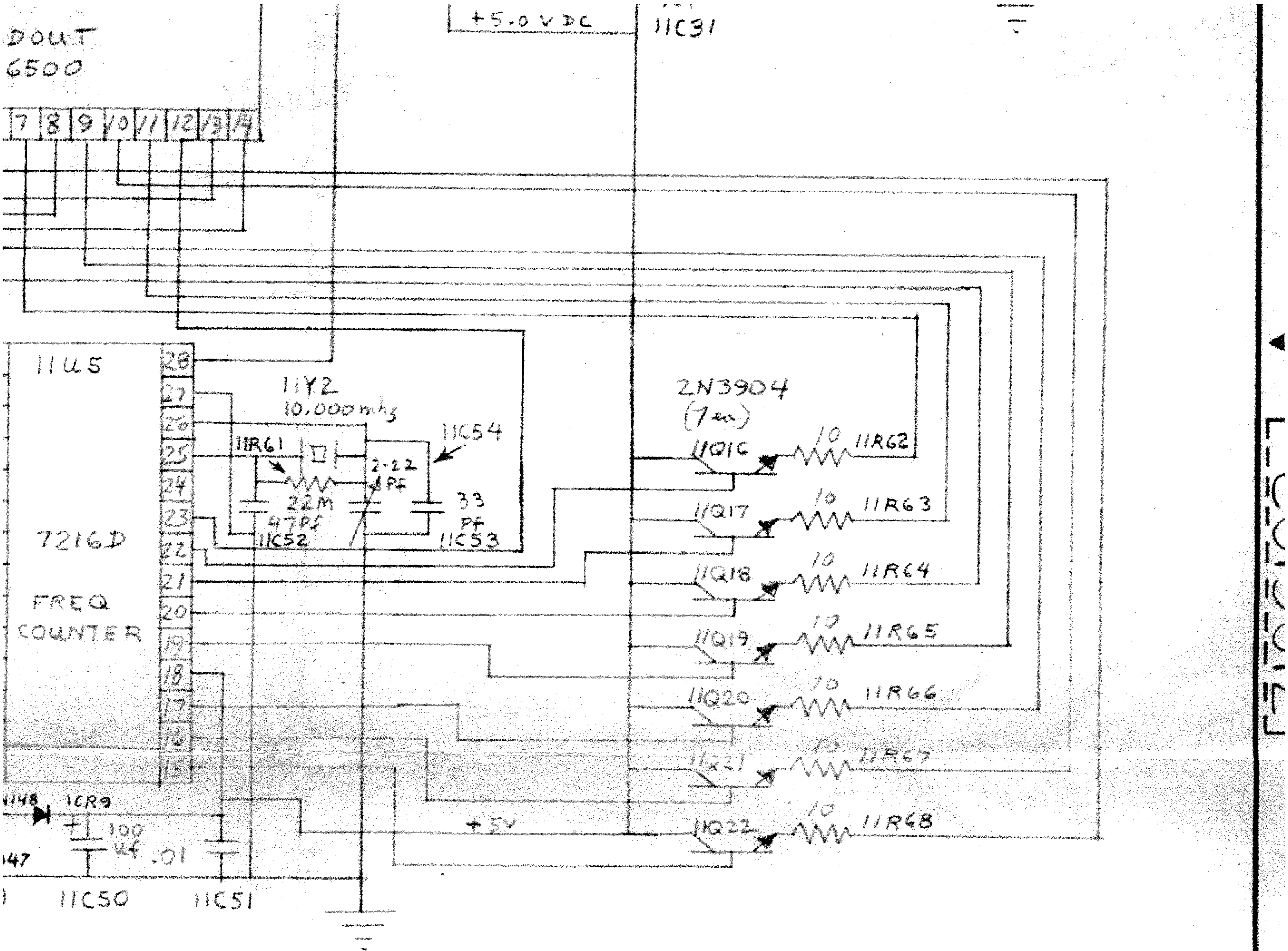
AUTHENTICATION

DRAWN [signature]

CHECKED

VERIFIED

APPROVED



REQD	PART NO.	DESCRIPTION	NOTE

LIST OF PARTS

A.R.F. PRODUCTS, INC.
RATON, NEW MEXICO
BOULDER, COLORADO

AUTHENTICATION	DATE
DRAWN [signature]	10-23-78
CHECKED	
VERIFIED	
APPROVED	

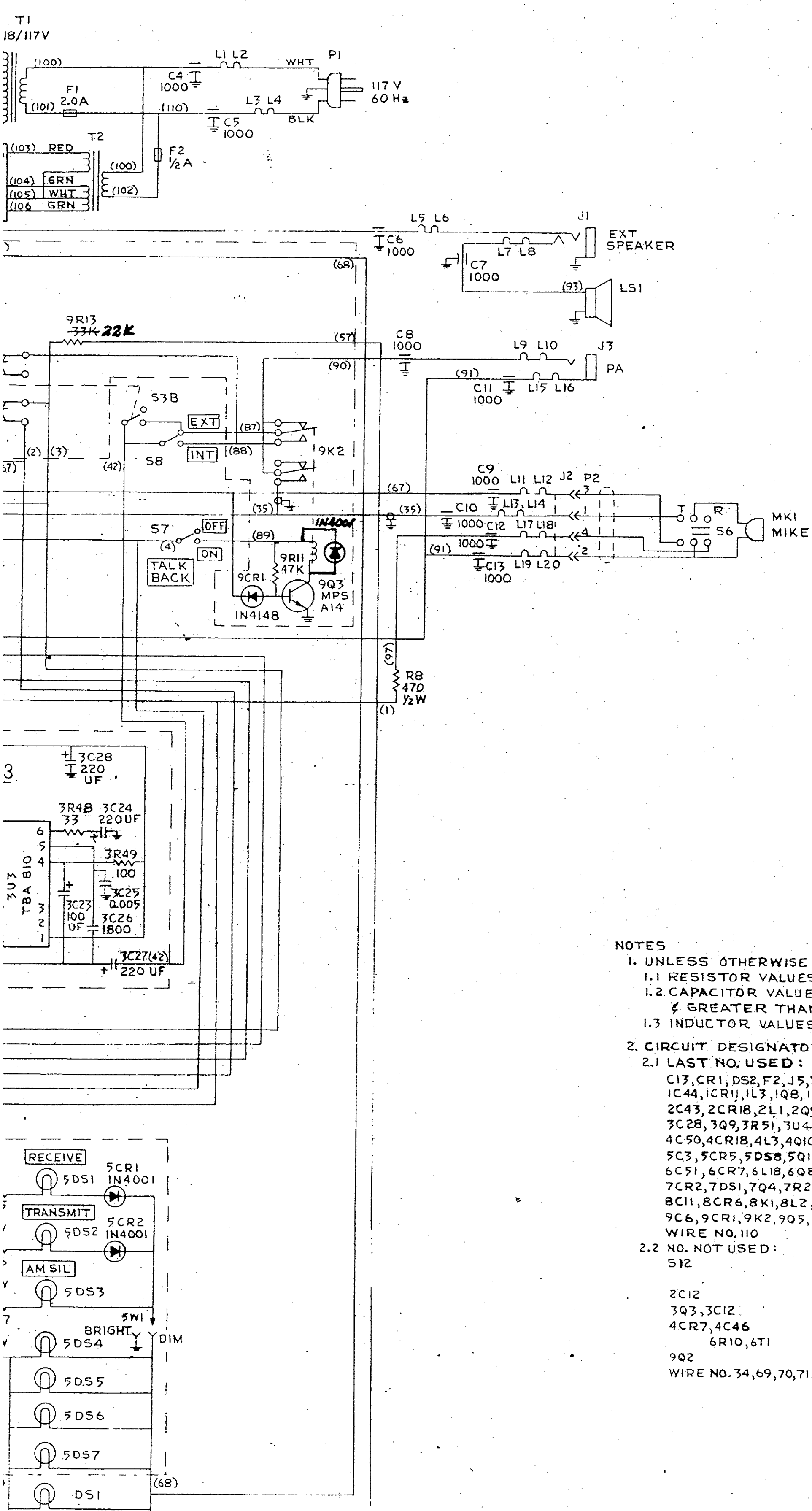
SCHEMATIC
COUNTER, FREQUENCY
CB

SIZE	CODE IDENT NO.	
C	15196	319C102

SCALE | SHEET 6.7

2 | 319C102 | 1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
—	X36	Redrawn With Changes	12 Jun 77	
—	X37	Corrected	23 Jun 77	
—	X38	Revised	18 Jul 77	
—	X39	Revised	20 Jul 77	
—	X40	Revised	29 Aug 77	
—	X41	Revised	12 Sep 77	
—	X42	Revised	17 Oct 77	
—	X43	Revised	2 Nov 77	
—	X44	Revised	17 Nov 77	
—	0	PRODUCTION RELEASE With Change	7 Dec 77	



NOTES

1. UNLESS OTHERWISE SPECIFIED:
   - 1.1 RESISTOR VALUES ARE IN OHMS ±10%, ¼ W
   - 1.2 CAPACITOR VALUES LESS THAN ONE ARE IN MICROFARADS & GREATER THAN ONE ARE IN PICOFARADS.
   - 1.3 INDUCTOR VALUES ARE IN MICROHENRIES.
2. CIRCUIT DESIGNATORS:
   - 2.1 LAST NO. USED:
     C13, CR1, DS2, F2, J5, L20, LS1, M2, MK1, P3, Q1, R9, S16, T2, U1
     1C44, 1CR11, 1L3, 1Q8, 1R57, 1T2, 1U3, 1Y4
     2C43, 2CR18, 2L1, 2Q9, 2R68, 2U2, 2Y4
     3C28, 3Q9, 3R51, 3U4
     4C50, 4CR18, 4L3, 4Q10, 4R51, 4U5, 4Y4
     5C3, 5CR5, 5DS8, 5Q1, 5R14, 5U2, 5W1
     6C51, 6CR7, 6L18, 6Q8, 6R42, 6L17, 6T2, 6U1
     7CR2, 7DS1, 7Q4, 7R29, 7U3
     8C11, 8CR6, 8K1, 8L2, 8Q1, 8R16, 8U1
     9C6, 9CR1, 9K2, 9Q5, 9R13, 9U2
     WIRE NO. 110
   - 2.2 NO. NOT USED:
     S12

     2C12
     3Q3, 3C12
     4CR7, 4C46
     6R10, 6T1
     9Q2
     WIRE NO. 34, 69, 70, 71, 72

ITEM	REQD	PART NO.	DESCRIPTION	NOTE

LIST OF PARTS

UNLESS OTHERWISE SPECIFIED: DECIMAL TOL: .XX ± .02, .XXX ± .005; ANGLE TOL; MACHINE FINISH 125; EDGES; CORNERS; MATERIAL

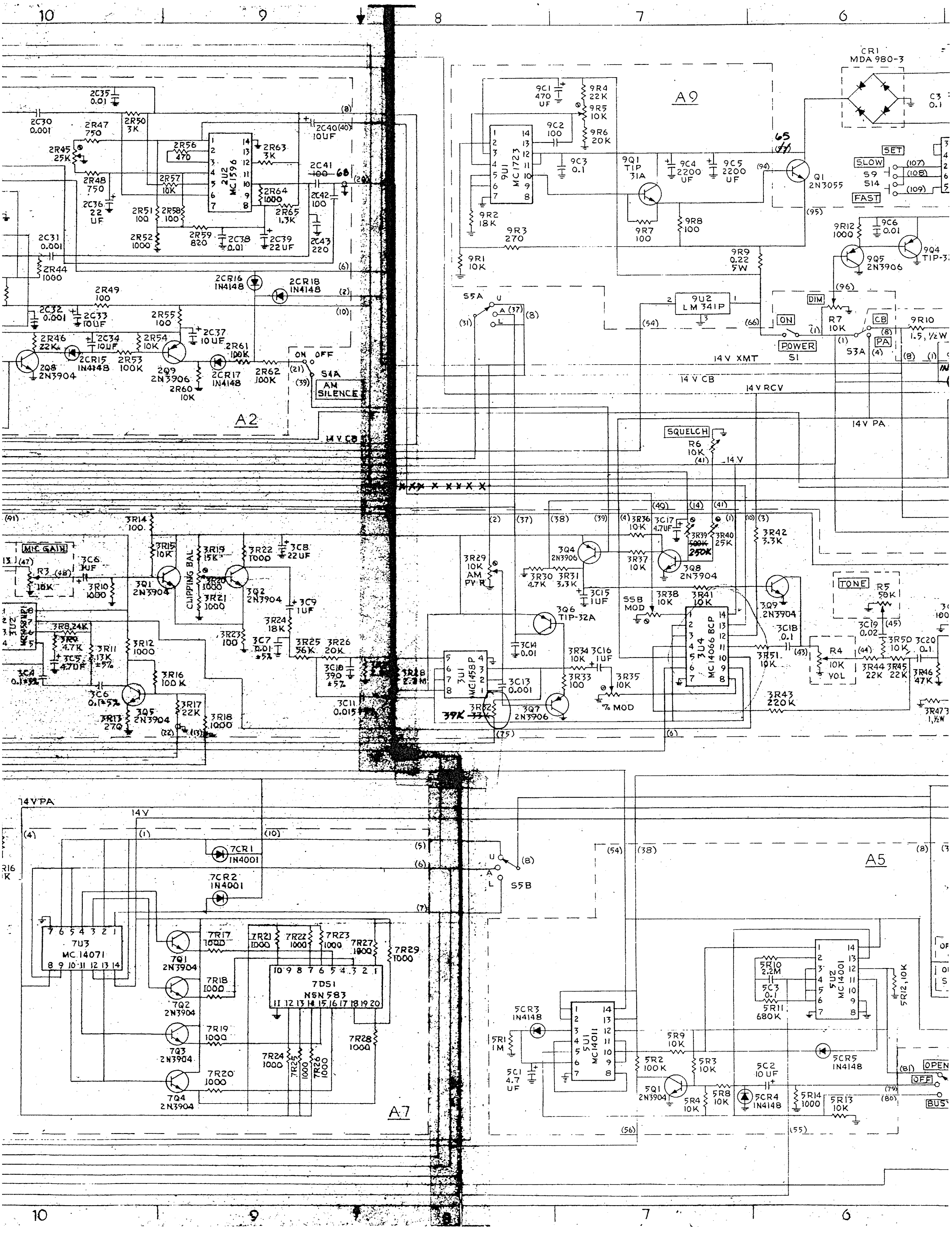
CB-3

AUTHENTICATION / DATE — DRAWN 12 Jun 77; CHECKED; VERIFIED; APPROVED

A.R.F. PRODUCTS, INC. RATON, NEW MEXICO BOULDER, COLORADO

SCHEMATIC, CB TRANSCEIVER BASE

SIZE J — CODE IDENT NO. 15196 — 319J83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A9
A5
A7
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2U2 MC1596
9U1 MC1723
9U2 LM341P
Q1 2N3055
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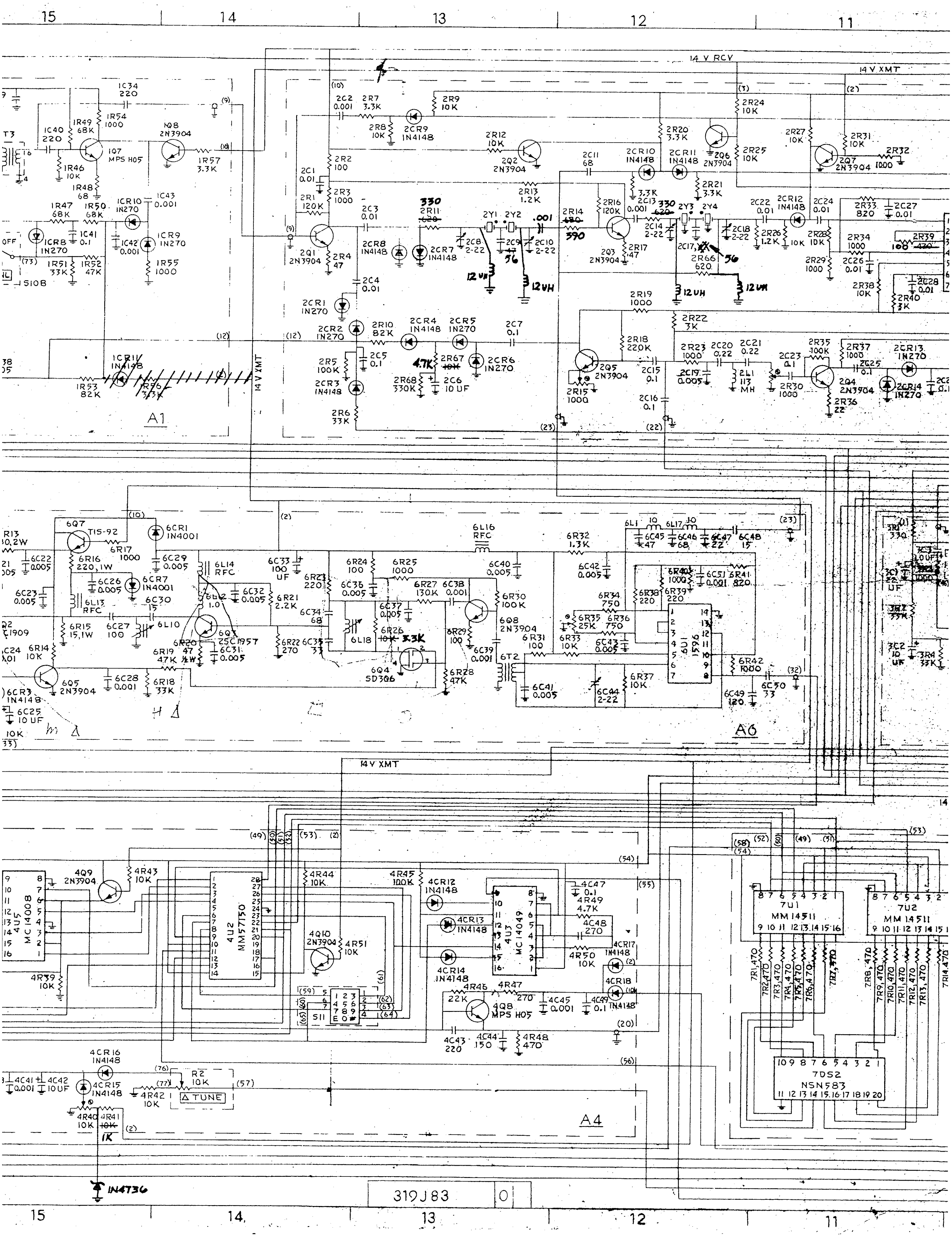
9Q5 2N3906
9Q4 TIP-32
SET
SLOW
FAST
S9
S14
DIM
ON
POWER S1
CB
PA
S3A
S5A
S4A
AM SILENCE
ON OFF
14 V XMT
14 V CB
14 V RCV
14 V PA
14 V
SQUELCH R6 10K
MIC GAIN R3 10K
CLIPPING BAL
3R29 10K AM PWR
3U1 MC1458P
3U4 MC14066 BCP
3Q6 TIP-32A
% MOD
S5B MOD
TONE R5 50K
R4 10K VOL
S5B
7U3 MC14071
7DS1 NSN 583
5U1 MC14011
5U2 MC14001
OPEN
OFF
BUSY



15
14
13
12
11
14 V RCV
14 V XMT
A1
A6
A4
2Q1 2N3904
2Q2 2N3904
2Q3 2N3904
2Q4 2N3904
2Q5 2N3904
2Q6 2N3904
2Q7 2N3904
1Q7 MPS H05
1Q8 2N3904
6Q3 2SC1957
6Q4 SD306
6Q5 2N3904
6Q7 TIS-92
6Q8 2N3904
6U1 1596
4U2 MM57130
4U3 MC14049
4U5 MC14008
4Q8 MPS H05
4Q9 2N3904
4Q10 2N3904
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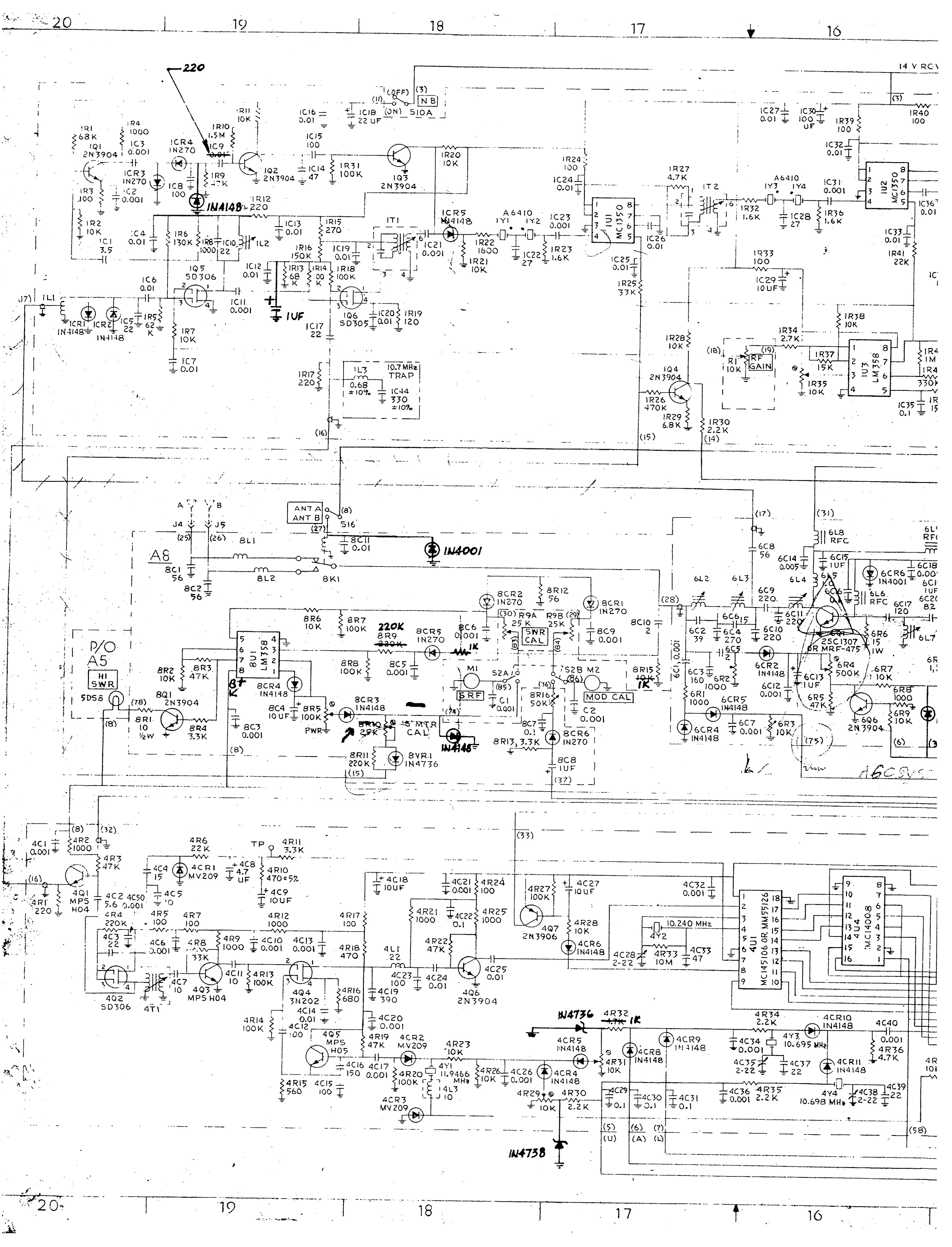
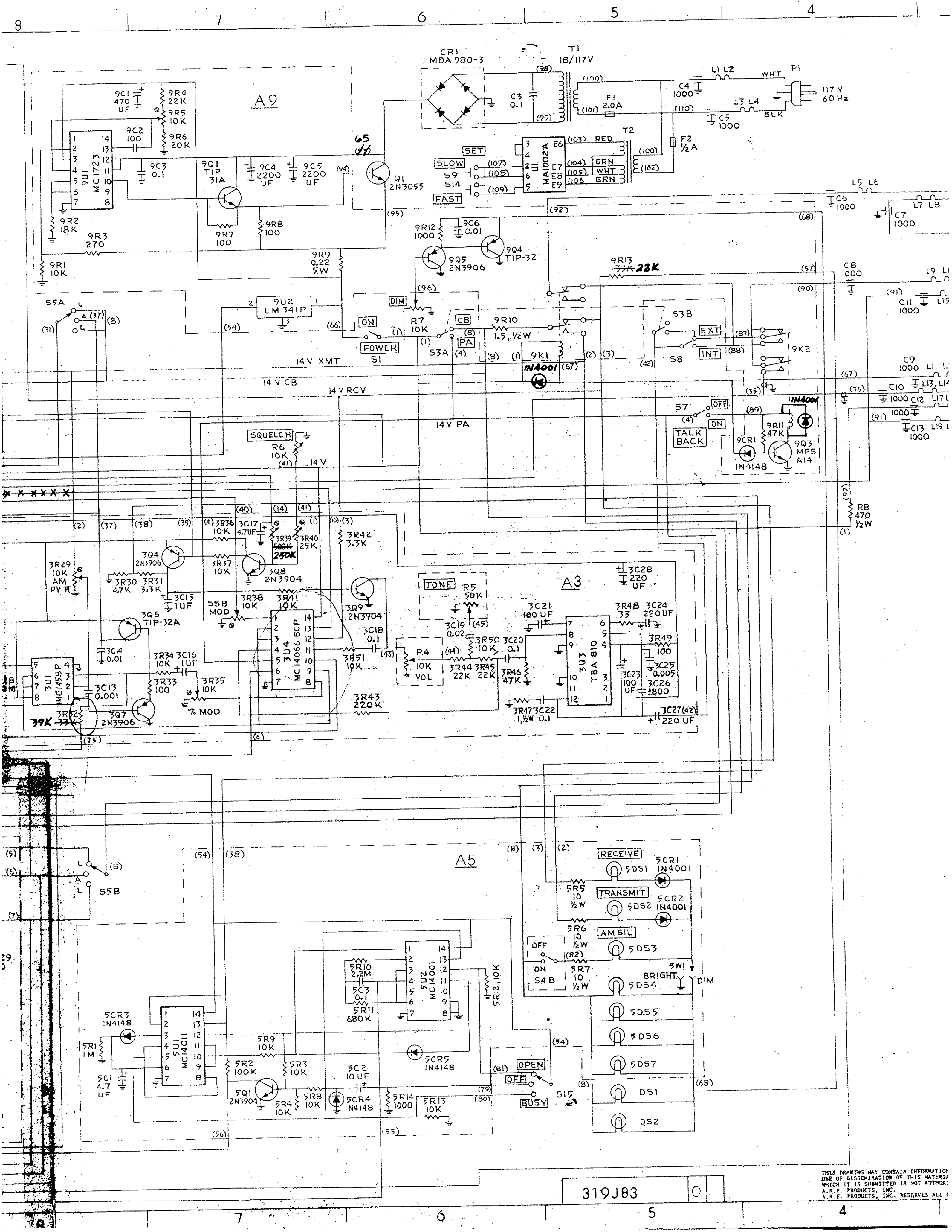


20
19
18
17
16
220
14 V RCV
(OFF)
(ON)
S10A
NB
1C16 0.01
1C18 22 UF
1R11 10K
1R4 1000
1R1 68K
1Q1 2N3904
1C3 0.001
1CR4 1N270
1R10 1.5M
1C9 0.01
1C15 100
1Q2 2N3904
1C14 47
1R31 100K
1Q3 2N3904
1R20 10K
1CR3 1N270
1C8 100
1R9 47K
1R3 100
1C2 0.001
1N4148
1R12 220
1R2 10K
1C1 3.5
1C4 0.01
1R6 130K
1R8 1000
1C10 22
1L2
1C13 0.01
1R15 270
1T1
1CR5 1N4148
A6410
1Y1
1Y2
1R22 1600
1R21 10K
1C21 0.001
1C22 27
1R23 1.6K
1C23 0.001
1U1 MC1350
1R24 100
1C24 0.01
1C26 0.01
1C25 0.01
1R25 33K
1R27 4.7K
1T2
1R32 1.6K
1Y3
1Y4
1C28 27
1R36 1.6K
1C31 0.001
1U2 MC1350
1C27 0.01
1C30 100 UF
1R39 100
1R40 100
1C32 0.01
1C36 0.01
1C33 0.01
1R41 22K
1R33 100
1C29 10 UF
1R16 150K
1C19 0.01
1C12 0.01
1R13 68K
1R14 100K
1R18 100K
1Q5 SD306
1C6 0.01
1C11 0.001
1UF
1Q6 SD305
1C20 0.01
1R19 120
1C17 22
1L1
1CR1 1N4148
1CR2 1N4148
1C5 22
1R5 62K
1R7 10K
1C7 0.01
1R17 220
1L3 0.68 ±10%
10.7 MHz TRAP
1C44 330 ±10%
1R38 10K
1R34 2.7K
1R28 10K
R1 10K
RF GAIN
1R37 15K
1U3 LM358
1R35 10K
1Q4 2N3904
1R26 470K
1R29 6.8K
1R30 2.2K
1C35 0.1
ANT A
ANT B
S16
J4
J5
8L1
8C11 0.01
1N4001
A8
8C1 56
8L2
8K1
8C2 56
8CR2 1N270
8R12 56
8CR1 1N270
8R6 10K
8R7 100K
220K
8R9 330K
8CR5 1N270
1K
8C6 0.001
R9A 25K
R9B 25K
SWR CAL
8C9 0.001
8C10 2
P/O A5
HI SWR
5DS8
8U1 LM358
8R2 10K
8R3 47K
8R8 100K
8C5 0.001
M1
S2A
S2B
M2
S RF
MOD CAL
C1 0.001
C2 0.001
8R15 10K 1K
8R16 50K
8C7 0.1
8CR6 1N270
8R13 3.3K
8C8 1UF
8Q1 2N3904
8R1 10 ½W
8R4 3.3K
8CR4 1N4148
8C4 10 UF
8R5 100K
PWR
8CR3 1N4148
8R10 25K
S MTR CAL
1N4148
8R11 220K
8VR1 1N4736
8C3 0.001
6C8 56
6L8 RFC
6C14 0.005
6C15 1UF
6CR6 1N4001
6L2
6L3
6L4
6L6 RFC
6C9 220
6C6 15
6C4 270
6C11 220
6C17 120
6C2 39
6C10 220
2SC1307 OR MRF-475
6R6 15 1W
6L7
6C1 0.001
6C3 160
6R2 1000
6C5 2
6CR2 1N4148
6C13 1UF
6R4 500K
6R7 10K
6C12 0.001
6R5 47K
6R8 1000
6R1 1000
6CR5 1N4148
6Q6 2N3904
6R9 10K
6CR4 1N4148
6C7 0.001
6R3 10K
4C1 0.001
4R2 1000
4R3 47K
4R1 220
4Q1 MPS H04
4R6 22K
4CR1 MV209
4C4 15
4C5 10
4C8 4.7 UF
TP
4R11 3.3K
4R10 470±5%
4C9 10UF
4C2 5.6
4C50 0.001
4R4 220K
4C3 22
4R5 100
4C6 0.001
4R7 100
4R8 33K
4R9 1000
4R12 1000
4C10 0.001
4C13 0.001
4R17 100
4C18 10UF
4C21 0.001
4R24 100
4R21 1000
4C22 0.1
4R25 1000
4R27 100K
4C27 10UF
4Q7 2N3906
4R28 10K
4CR6 1N4148
4C32 0.001
10.240 MHz
4Y2
4C28 2-22
4R33 10M
4C33 47
4U1 MC145106 OR MM55126
4U4 MC14008
4Q2 SD306
4T1
4C7 10
4Q3 MPS H04
4C11 10
4R13 100K
4Q4 3N202
4R16 680
4R18 470
4L1 22
4C23 100
4C24 0.01
4R22 47K
4Q6 2N3904
4C25 0.01
4C19 390
4C14 0.01
4C20 0.001
4R14 100K
4C12 100
4Q5 MPS H05
4R19 47K
4CR2 MV209
4R23 10K
4C16 150
4C17 0.001
4R20 100K
4Y1 11.9466 MHz
4L3 10
4R26 10K
4C26 0.001
4CR3 MV209
4R15 560
4C15 100
1N4736
4R32 4.7K 1K
4CR5 1N4148
4R31 10K
4CR8 1N4148
4CR9 1N4148
4CR4 1N4148
4R29 10K
4R30 2.2K
1N4738
4C29 0.1
4C30 0.1
4C31 0.1
4R34 2.2K
4C34 0.001
4Y3 10.695 MHz
4CR10 1N4148
4C40 0.001
4R36 4.7K
4C35 2-22
4C37 22
4CR11 1N4148
4C36 0.001
4R35 2.2K
4Y4 10.698 MHz
4C38 2-22
4C39 22
(5) (U)
(6) (A)
(7) (L)
(58)



8
7
6
5
4
CR1
MDA 980-3
T1
18/117V
F1
2.0A
C3
0.1
C4
1000
C5
1000
L1 L2
L3 L4
WHT
BLK
P1
117 V
60 Hz
T2
F2
1/2 A
RED
GRN
WHT
GRN
U1
MA1002A
SET
SLOW
S9
S14
FAST
A9
9C1
470 UF
9R4
22K
9R5
10K
9R6
20K
9C2
100
9U1
MC1723
9C3
0.1
9Q1
TIP 31A
9C4
2200 UF
9C5
2200 UF
Q1
2N3055
9R2
18K
9R3
270
9R1
10K
9R7
100
9R8
100
9R9
0.22
5W
9R12
1000
9C6
0.01
9Q5
2N3906
9Q4
TIP-32
L5 L6
C6
1000
C7
1000
L7 L8
9R13
33K 22K
C8
1000
L9
C11
1000
S5A
U
A
L
9U2
LM 341P
DIM
ON
POWER
S1
R7
10K
CB
PA
S3A
9R10
1.5, 1/2W
9K1
1N4001
S3B
EXT
INT
S8
9K2
C9
1000
C10
1000
C12
1000
C13
1000
14 V XMT
14 V CB
14 V RCV
14 V PA
S7
OFF
ON
TALK BACK
1N4001
9R11
47K
9CR1
1N4148
9Q3
MPS A14
SQUELCH
R6
10K
14 V
R8
470
1/2W
3R29
10K
AM PVR
3R36
10K
3C17
4.7UF
3R39
500K 250K
3R40
25K
3R42
3.3K
3Q4
2N3906
3R37
10K
3Q8
2N3904
3R30
4.7K
3R31
3.3K
3C15
1UF
3C28
220 UF
TONE
R5
50K
A3
S5B
MOD
3R38
10K
3R41
10K
3Q9
2N3904
3Q6
TIP-32A
3U4
MC14066 BCP
3C18
0.1
3C19
0.02
3R50
10K
3C20
0.1
3C21
100 UF
3R48
33
3C24
220UF
3R49
100
3C14
0.01
3U1
MC1458P
3C13
0.001
3R34
10K
3C16
1UF
3R33
100
3R35
10K
% MOD
3R51
10K
R4
10K
VOL
3R44
22K
3R45
22K
3R46
47K
3U3
TBA 810
3C23
100 UF
3C25
0.005
3C26
1800
3R52
39K 33K
3Q7
2N3906
3R43
220K
3R47
1,1/2W
3C22
0.1
3C27
220 UF
A5
RECEIVE
5DS1
5CR1
1N4001
5R5
10
1/2W
TRANSMIT
5DS2
5CR2
1N4001
5R6
10
1/2W
AM SIL
5DS3
OFF
ON
S4B
5R7
10
1/2W
5W1
BRIGHT
DIM
5DS4
5DS5
5DS6
5DS7
DS1
DS2
5R10
2.2M
5C3
0.1
5R11
680K
5U2
MC14001
5R12
10K
5CR3
1N4148
5R1
1M
5C1
4.7 UF
5U1
MC14011
5R9
10K
5R2
100K
5R3
10K
5CR5
1N4148
5Q1
2N3904
5R4
10K
5R8
10K
5C2
10 UF
5CR4
1N4148
5R14
1000
5R13
10K
OPEN
OFF
BUSY
S15
319J83
0
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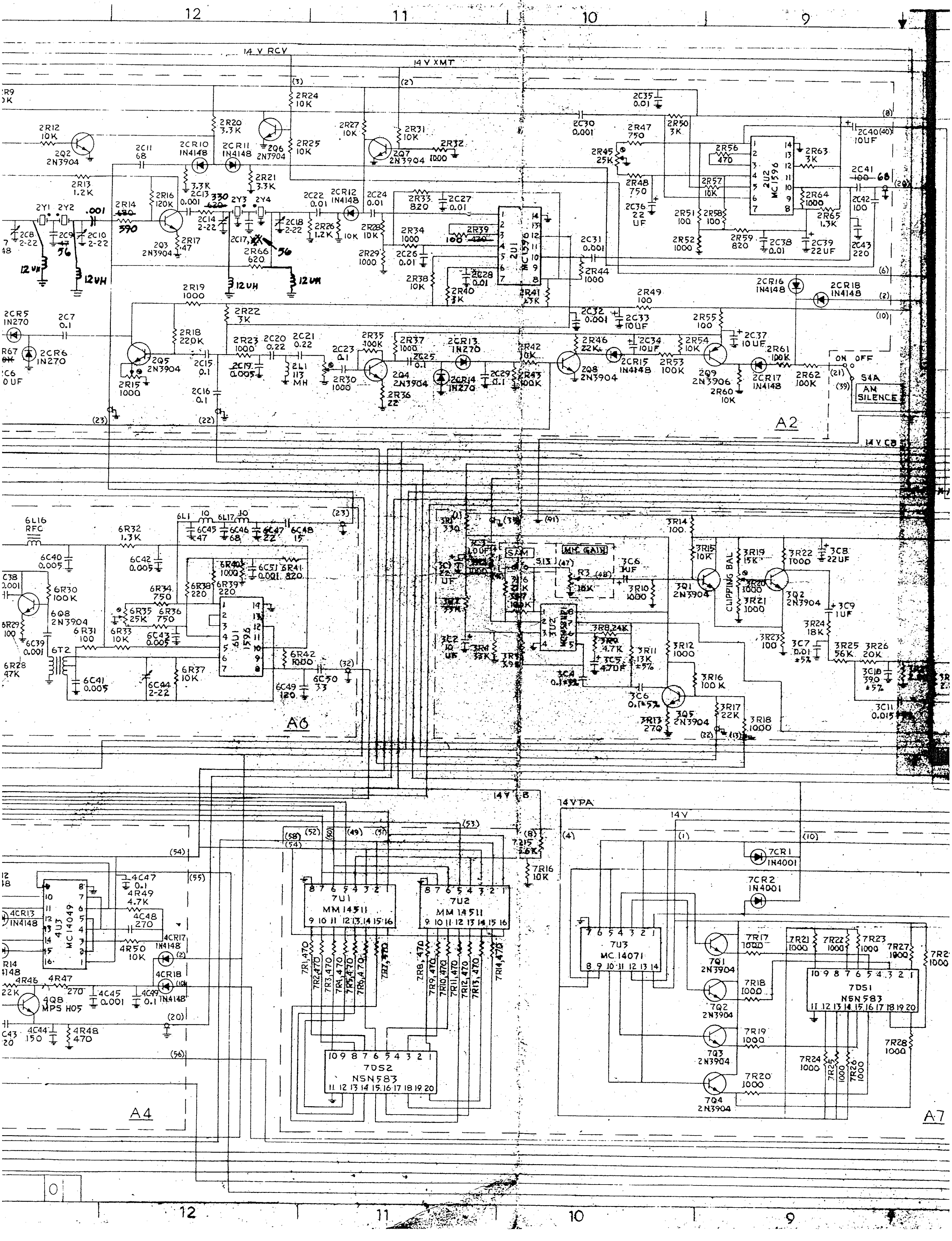
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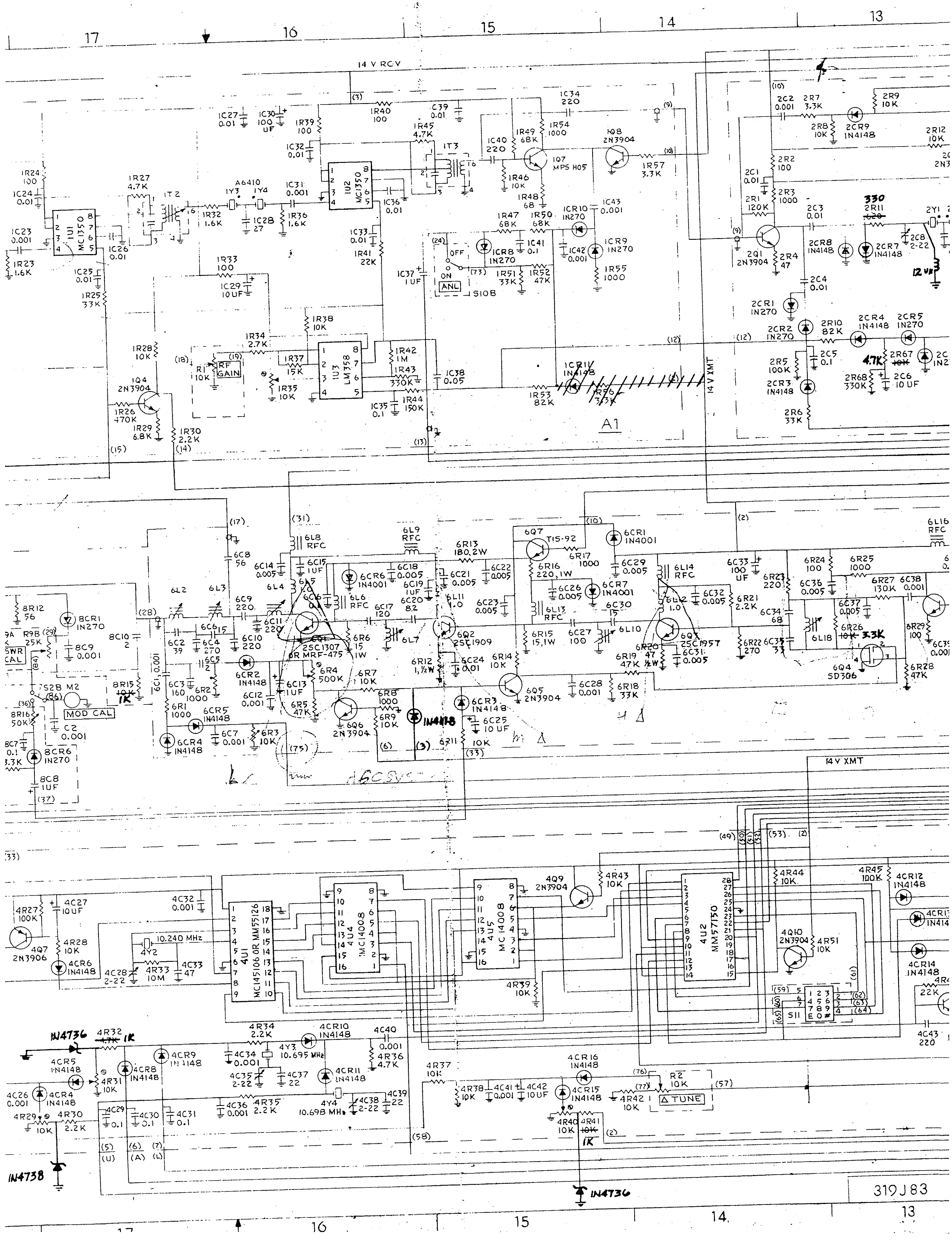
11
10
9
14 V RCV
14 V XMT
2Q2 2N3904
2Q3 2N3904
2Q5 2N3904
2Q6 2N3904
2Q7 2N3904
2Q4 2N3904
2Q8 2N3904
2Q9 2N3906
2U1 MC1596
2U2 MC1596
2CR10 1N4148
2CR11 1N4148
2CR12 1N4148
2CR13 1N270
2CR14 1N270
2CR15 1N4148
2CR16 1N4148
2CR17 1N4148
2CR18 1N4148
2CR5 1N270
2CR6 1N270
2L1 113 MH
12 UH
ON OFF
S4A
AM SILENCE
A2
14 V CB
6L16 RFC
6Q8 2N3904
6T2
6U1 1596
A6
SAM
MIC GAIN
CLIPPING BAL
3Q1 2N3904
3Q2 2N3904
3Q5 2N3904
3U2
14 V B
14 V PA
14 V
4U3 MC14049
4Q8 MPS H05
4CR13 1N4148
4CR17 1N4148
4CR18 1N4148
A4
7U1 MM14511
7U2 MM14511
7DS2 NSN583
7U3 MC14071
7DS1 NSN583
7CR1 1N4001
7CR2 1N4001
7Q1 2N3904
7Q2 2N3904
7Q3 2N3904
7Q4 2N3904
A7
10
12
11
10
9



17
16
15
14
13
14 V RCV
14 V XMT
1U1 MC1350
1U2 MC1350
1U3 LM358
1Q4 2N3904
1Q7 MPS H05
1Q8 2N3904
A6410
RF GAIN
ANL
S108
A1
2Q1 2N3904
6L8 RFC
6L9 RFC
6L6 RFC
6L13 RFC
6L14 RFC
6L16 RFC
6Q1 2SC1307 OR MRF-475
6Q2 2SC1909
6Q3 2SC1957
6Q4 SD306
6Q5 2N3904
6Q6 2N3904
6Q7 TIS-92
MOD CAL
SWR CAL
4U1 MC145106 OR MM55126
4U4 MC14008
4U5 MC14008
4U2 MM57150
4Q7 2N3906
4Q9 2N3904
4Q10 2N3904
10.240 MHz
4Y3 10.695 MHz
4Y4 10.698 MHz
S11
Δ TUNE
IN4736
IN4738
319J83