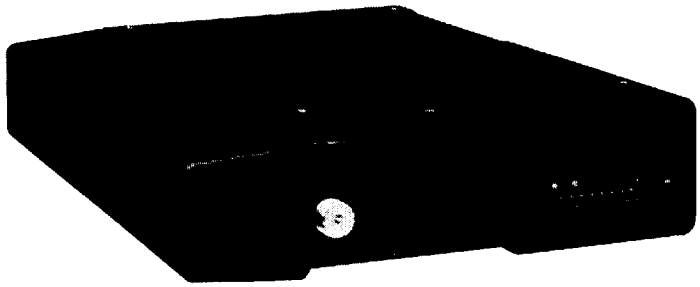
GE Mobile Communications

RANGR™

29-50 MHz



INCLUDES

SERVICE SECTION LBI-38185
BOARD ASSEMBLIES LBI-38186

Maintenance Manual

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FCC FILING NUMBER

GE PART NUMBER	FCC FILING NUMBER	DESCRIPTION
19C852051P1	AXA9HHTR-162-A	29-42 MHz 60W 5 PPM
19C852051P2	-163-A	29-42 MHz 110W 5 PPM
19C852051P3	-162-B	35-50 MHz 60W 5 PPM
19C852051P4	-163-B	35-50 MHz 110W 5 PPM
19C852051P5	-162-A	29-42 MHz 60W 5 PPM NB
19C852051P6	-163-A	29-42 MHz 110W 5 PPM NB
19C852051P7	-162-B	35-50 MHz 60W 5 PPM NB
19C852051P8	-163-B	35-50 MHz 110W 5 PPM NB

WARNING

Although the highest DC voltage in Mobile Two-Way Radio equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!
High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

SYSTEM SPECIFICATIONS

FREQUENCY RANGE	29 to 42 MHz and 35 to 50 MHz
BATTERY DRAIN	
Receive	
Squelched	0.7 Amperes at 13.8 Volts
Unsquelched	2.2 Amperes at 13.8 Volts
Transmit	
60 Watts	15 Amperes at 13.6 Volts
110 Watts	29.5 Amperes at 13.4 Volts
FREQUENCY STABILITY	0.0005%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
DIMENSIONS, LESS ACCESSORIES (H x W x D)	67 mm x 240 mm x 339 mm (2.6 x 9.5 x 13.3 inches)
WEIGHT, LESS ACCESSORIES	4.3 kg (9.5 pounds)

TRANSMITTER

TRANSMIT OUTPUT POWER	60W/110W
CONDUCTED SPURIOUS	-80 dB
MODULATION	±4.5 kHz
AUDIO SENSITIVITY	55 to 110 millivolts
AUDIO FREQUENCY CHARACTERISTICS	Within +1 dB to -4.5 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post-limiter filter per FCC and EIA
DISTORTION	Less than 2% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.3 kHz maximum
MAXIMUM FREQUENCY SEPARATION	29-42 MHz .... 13 MHz 35-50 MHz .... 15 MHz
MICROPHONE LOAD IMPEDANCE	600 ohms
POWER ADJUST RANGE	100% to 50% of rated power
RF OUTPUT IMPEDANCE	50 ohms
FM NOISE	-60 dB
CARRIER ATTACK TIME	40 milliseconds
AUDIO ATTACK TIME	40 milliseconds

CHANNEL GUARD TX TONE DISTORTION	5%

RECEIVER

AUDIO OUTPUT (to 4.0 ohm speaker)	10 Watts with less than 3% distortion
SENSITIVITY 12 dB SINAD (EIA Method)	0.35 µV
SELECTIVITY EIA Two-Signal Method (20 kHz channels)	-90 dB
SPURIOUS RESPONSE	-85 dB
INTERMODULATION 20 kHz	-80 dB
MODULATION ACCEPTANCE	±7.0 kHz
MAXIMUM FREQUENCY SEPARATION	29-42 MHz .... 13 MHz 35-50 MHz .... 15 MHz
FREQUENCY RESPONSE	Within +2 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
RF INPUT IMPEDANCE	50 ohms
HUM/NOISE RATIO UNSQUELCHED SQUELCHED	 -50 dB -70 dB
RECEIVER RECOVERY TIME	200 milliseconds
RECEIVER ATTACK TIME	150 milliseconds
CHANNEL SPACING	20 KHz

* These specifications are intended primarily for use of the serviceman. Refer to the appropriate Specifications Sheet for the complete specifications.

DESCRIPTION

General Electric synthesized RANGR mobile radio combinations are completely solidstate utilizing microcomputer technology and integrated circuits to provide high-quality, high-reliability radios. Standard combinations may

- Microcomputer Controlled Frequency Synthesizer
- Up to 16 channels
- .0005% frequency stability
- Other structured options

The radio locks when the optional lock is installed but is not tamperproof. The cover can be removed in the locked or unlocked position.

The radio set is housed in a weather-resistant case only 6.7 centimeters high. The radio is secured to the vehicle by a bottom mounting plate. When unlocked, the radio may be pulled out of the mounting plate or the top cover removed for servicing.

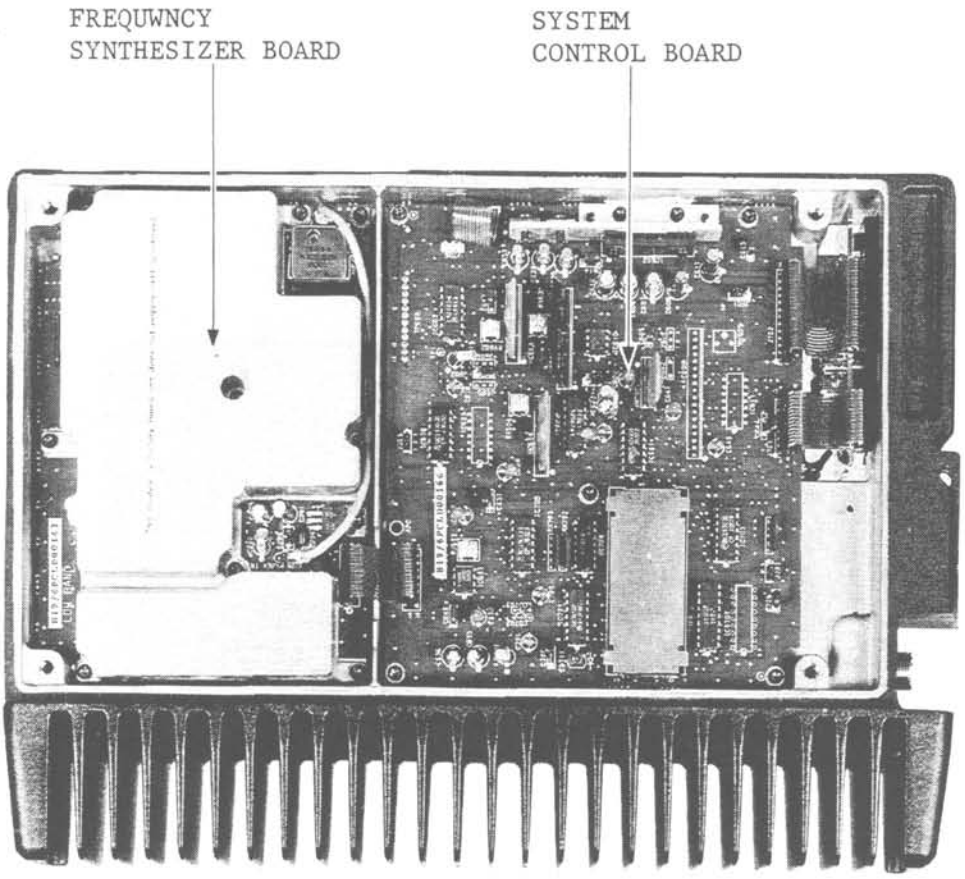
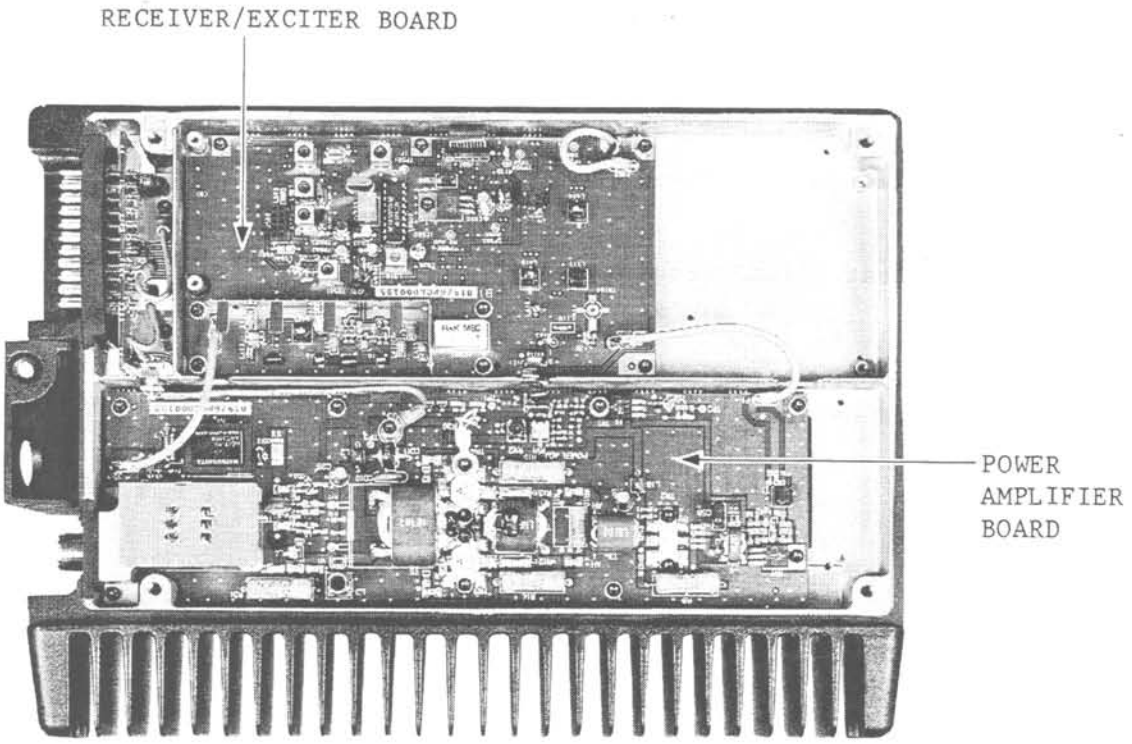
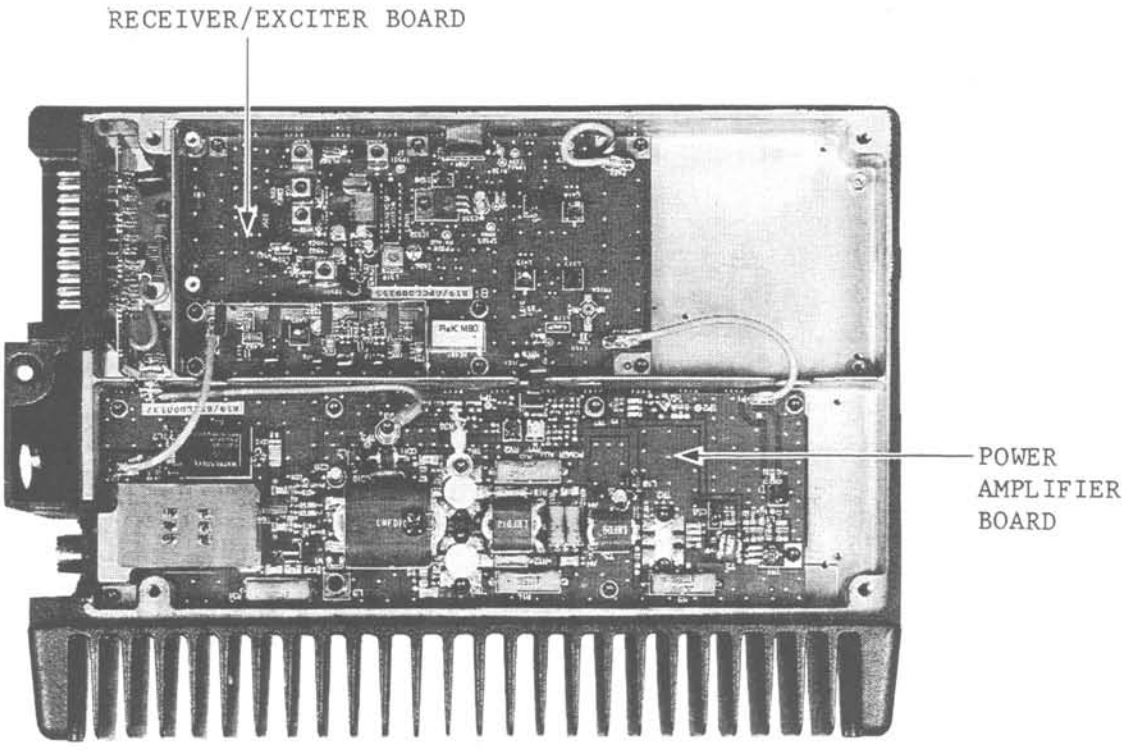


Figure 1. Typical Module Layout (Top View)



- 60 W TYPE -



- 110 W TYPE -

Figure 2. Typical Module Layout (Bottom View)

The basic radio consists of four printed wiring boards mounted in a cast aluminum frame. The four boards are the System Control board, the Frequency Synthesizer board, the Power Amplifier board, and the Receiver/ Exciter board.

The radio is of double-layer construction with tuning adjustments easily accessible from the top of the radio.

The System Control board and the Frequency Synthesizer board are located on the top of the radio, while the Power Amplifier board and the Receiver/Exciter board are located on the bottom.

Interconnections are provided by ribbon cable between the boards. A power bus connects A+ and A- from the front connector to the PA assembly.

SYNTHESIZER/INTERCONNECT

The synthesizer consists of a microcomputer, electrically-erasable PROM (EEPROM), a frequency synthesizer IC, transmit and receive VCO's and associated circuitry. The frequency synthesizer under control of the microcomputer generates all transmit and receive RF frequencies.

The EEPROM stores binary data for all RF frequencies, Channel Guard tones/digital codes, and the timing function of the carrier control timer(CCT). The microcomputer accesses the EEPROM and provides the correct WALSH bits to the Channel Guard circuitry to generate the correct Channel Guard tone or digital code on a per-channel basis.

PROGRAMMING

The EEPROM allows the radio to be programmed or reprogrammed as needed to adapt to changing system requirements. RF frequencies, Channel Guard tones and digital codes, and the CCT function can be reprogrammed.

The EEPROM can be reprogrammed through the radio front connector using the General Electric Universal PROM Programmer Model TQ2310. This programmer allows all information to be loaded simultaneously.

NOTE

When programming, remember that all RF frequencies must be divisible by 5 kHz. Also insure that P707 is connected to J707-2 and 3 to enable programming.

Programming instructions are provided in the respective Programmer Maintenance Manuals.

TRANSMITTER

The transmitter consists of the exciter, frequency synthesizer, transmit VCO, and a power amplifier (PA) assembly. The PA assembly consists of a PA board mounted along the side of the radio next to the heat sink assembly. The PA board also contains an antenna relay and a low-pass filter.

Audio and Channel Guard circuitry for the transmitter is located on the System Control board.

RECEIVER

The receiver consists of the frequency synthesizer, RX VCO, injection amplifiers, front end, IF, and limiter detector. Audio, squelch and Channel Guard circuitry for the receiver is located on the System Control board.

SYSTEM CONTROL FUNCTION

A microprocessor on the System Control board controls the frequency synthesizer, the TX on/off, the decoding of CTCSS tones, the generation of CTCSS tones, etc. The audio processor circuitry for the transmitter and the receiver are located on the System Control board. Squelch circuitry and the digital voice guard circuit are also located on the System Control board.

CONTROL UNITS

S-series control units are available and may be used directly with RANGR radio combinations.

Refer to the applicable Maintenance Manual for detailed description of the Control Unit used with the RANGR radio combinations.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in the Operator's Manual for the control unit used.

MAINTENANCE

The service section of this manual contains the maintenance information to service this radio. The service section includes:

- System interconnections
- Mechanical layout
- Disassembly procedures
- Replacement of IC's, chip capacitors and resistors
- Alignment procedures for the transmitter and receiver
- Troubleshooting Procedure and waveforms

GE Mobile Communications

General Electric Company
Lynchburg, Virginia 24502

(End of "A" Section)

Printed in Japan

ADDENDUM NO. 1 TO LBI-38179 (PCN9)

This addendum corrects information that has not been incorporated into the manual. This information will be incorporated in the next printing of the manual.

Page D8

Change Note ⚠1 from J706 1-2 NORMAL CONNECTION
2-3 NO USE

to J706 1-2 DISABLE NOISE BLANKER
2-3 ENABLE NOISE BLANKER

Page D15

Change Note 1 from TO ADD NOISE BLANKER OPTION. REMOVE W501, AND PLUG NOISE BLANKER BOARD INTO J502. TO DISABLE NOISE BLANKER MOVE P503 FROM J503-2&3 TO J503-1&2 IN RECEIVER UNIT, OR P707 FROM J707-1&2 TO J707-2&3 IN SYSTEM CONTROL UNIT.

to TO ADD NOISE BLANKER OPTION. REMOVE W501, AND PLUG IN NOISE BLANKER BOARD INTO J502. TO DISABLE NOISE BLANKER MOVE P503 FROM J503-2&3 TO J503-1&2 IN RECEIVER UNIT, OR P706 FROM J706-2&3 TO J706-1&2 IN SYSTEM CONTROL UNIT.

ERICSSON GE
Ericsson GE Mobile Communications Inc
Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.

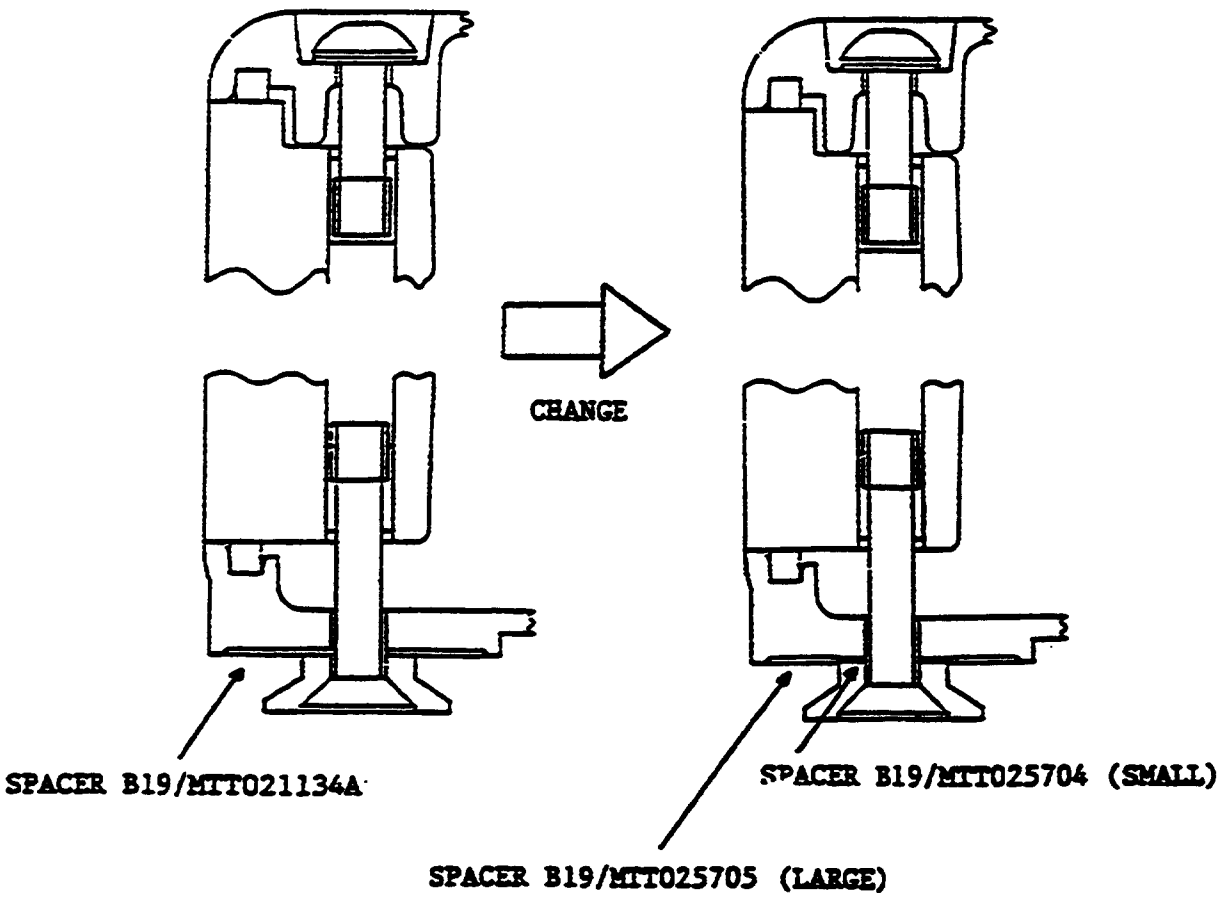
This addendum provides revision A to the Synthesizer board, changes to the mounting hardware and corrections to the service accessories listed on page B2 of LBI-38179.

REV. A - 29-42 MHz SYNTHESIZER B19/CMG-170A
To improve synthesizer lock time. Changed C2104.

C2104 is B19/5CSAC00982 - Tantalum: 1 uF.

To provide a smooth sliding fit into the mounting bracket without scratching the radio unit, the following changes were made:

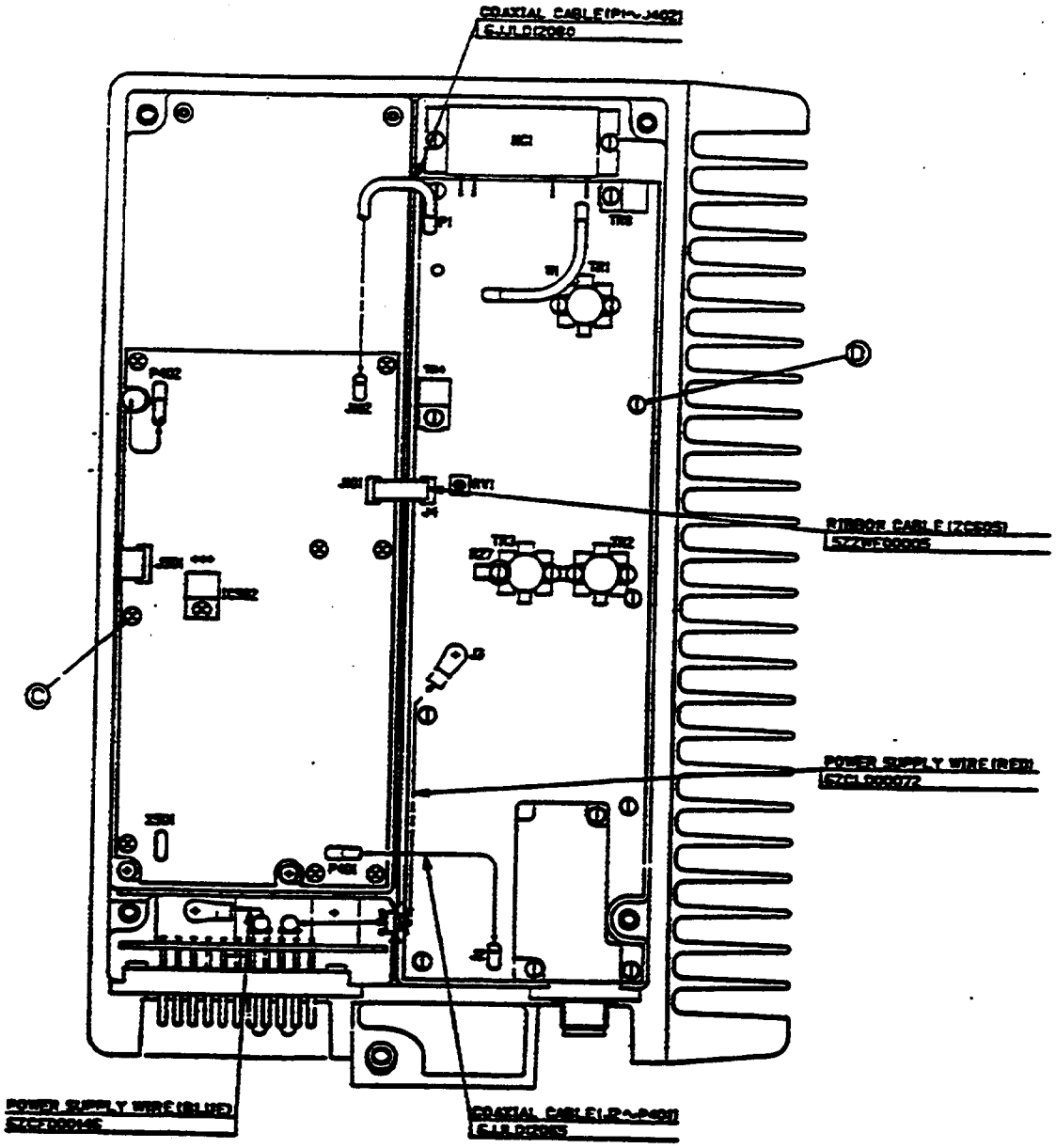
Deleted B19/MTT021134A - Spacer.
Added B19/MTT025704 - Spacer (small).
B19/MTT025705 - Spacer (large).



Corrections to the service accessories are shown below:

DESCRIPTION	PART NO.
EXTENSION CABLE 4 CONDUCTOR	B19/CFQ-3175
EXTENSION CABLE 10 CONDUCTOR	B19/CFQ-3177
EXTENSION CABLE 14 CONDUCTOR	B19/CFQ-3178
EXTENSION CABLE 24 CONDUCTOR	B19/CFQ-3179
COAXIAL CABLE	B19/CFQ-3180
COAXIAL CABLE	B19/CFQ-3234

This addendum corrects Figure 2, Disassembly - Bottom View (page B5), to show the new cable part numbers. Figure 2 is shown below.



Disassembly—Bottom View

ADDENDUM NO. 3 TO LBI-38179
(PCN9)

This addendum provides changes to the RANGR 89 Low Band Radio 19C852051P1 - P8 brought about by the overheating and failure of C47 in the Low Pass Filter of the Power Amplifier Board DA00-CAH-705.

To reduce overheating and failure of C47, capacitors C10, C44 thru C50 are changed as indicated below. The revision raises the filter response knee, thus reducing power applied to the filter.

29MHz - 42MHz RANGR Low Band LPF

19C852051P1 - REV. B
19C852051P2,P5 - REV. C
19C852051P6 - REV. D

PART	BEFORE MODIFICATION		AFTER MODIFICATION	
C10	10pF	B19/5CAAA03094	39pF	B19/5CAAA03100
C44	15pF	B19/5CAAA03101	10pF	B19/5CAAA03094
C45	75pF	B19/5CAAA00123	47pF	B19/5CAAA03080
C46	130pF	B19/5CAAA03120	120pF	B19/5CMAB01439
C47	180pF	B19/5CAAA03098	120pF	B19/5CMAB01439
C48	130pF	B19/5CAAA03120	120pF	B19/5CMAB01439
C49	56pF	B19/5CAAA03095	68pF	B19/5CAAA03090
C50	15pF	B19/5CAAA03101	33pF	B19/5CAAA03140

35MHz - 50MHz RANGR Low Band LPF

19C852051P3 - REV. B
19C852051P4,P7 - REV. C
19C852051P8 - REV. D

PART	BEFORE MODIFICATION		AFTER MODIFICATION	
C10	-	-	30pF	B19/5CAAA03081
C44	15pF	B19/5CAAA03101	10pF	B19/5CAAA03094
C45	56pF	B19/5CAAA03095	18pF	B19/5CAAA03085
C46	100pF	B19/5CAAA03091	90pF	B19/5CMAB01283
C47	130pF	B19/5CAAA03120	90pF	B19/5CMAB01283
C48	100pF	B19/5CAAA03091	100pF	B19/5CMAB01425
C49	47pF	B19/5CAAA03080	47pF	B19/5CAAA03080
C50	15pF	B19/5CAAA03101	22pF	B19/5CAAA03086

This addendum covers a part number change to the RANGR™ mobile radio TOP COVER ASSEMBLY.

Old part number was: B19/MPBC08554
New part number is: B19/MPBC10234

This part number should be changed on page B27 in the table listing for symbol 36.

MAINTENANCE MANUAL

29-42 MHz & 35-50 MHz SYNTHESIZED RANGR

TWO-WAY FM RADIO

SERVICE SECTION

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DESCRIPTION

This section contains the information required to service the radio. Included are disassembly procedures, and procedures for replacing transistors, Integrated Circuits (IC's) and chip components. This section also includes alignment procedures and troubleshooting information (see Table of Contents).

INITIAL ADJUSTMENT

After the radio has been installed (as described in the Installation Manual), the following adjustments should be made by a certified electronics technician.

TRANSMITTER ADJUSTMENT

The adjustment for the transmitter includes measuring the forward and reflected power, and setting the transmitter to rated power output. Then, measure the frequency and modulation and record these measurements for future reference. For the complete transmitter adjustment, refer to the Alignment Procedure (see Table of Contents).

RECEIVER ADJUSTMENT

No adjustment for the input circuit is required. For complete receiver adjustment, refer to the Receiver Alignment Procedure (see Table of Contents).

MAINTENANCE

PREVENTIVE MAINTENANCE

To facilitate troubleshooting of problems on the printed circuit board assemblies, the following service accessories are available:

DESCRIPTION	PART NUMBER
EXTENSION CABLE 4 CONDUCTOR	B19/CFQ-3175
EXTENSION CABLE 10 CONDUCTOR	B19/CFQ-3177
EXTENSION CABLE 14 CONDUCTOR	B19/CFQ-3178
EXTENSION CABLE 24 CONDUCTOR	B19/CFQ-3179
COAXIAL CABLE	B19/CFQ-3180
COAXIAL CABLE	B19/CFQ-3234
TUNING TOOL	B19/MPTC00448

To ensure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. This preventive maintenance should include the checks as listed in Table 1 Maintenance Checks.

MAINTENANCE CHECKS	INTERVAL	
	6 Months	As Required
CONNECTIONS - Ground connections and connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to vehicle chassis must be checked for low impedance. A high impedance may cause excessive voltage drops and alternator noise problems.	X	
ELECTRICAL SYSTEM - Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery will often cause excessive noise or faulty operation.		X
MECHANICAL INSPECTION - Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and parts to make sure that nothing is working loose. Be sure that all screws are properly torqued.	X	
ANTENNA - The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antenna or its base should become coated or poorly grounded, loss of radiation and a weak signal will result.	X	
ALIGNMENT - The transmitter and receiver meter readings should be checked periodically, and the alignment "touched up" when necessary. Refer to applicable Alignment Procedure and troubleshooting sheet for typical voltage readings.		X
FREQUENCY CHECK - Check transmitter frequency and deviation, as required by FCC. Normally, these checks are made when the unit is first put into operation, after the first six months and once a year thereafter.		X

TABLE 1 - MAINTENANCE CHECKS

DISASSEMBLY PROCEDURE

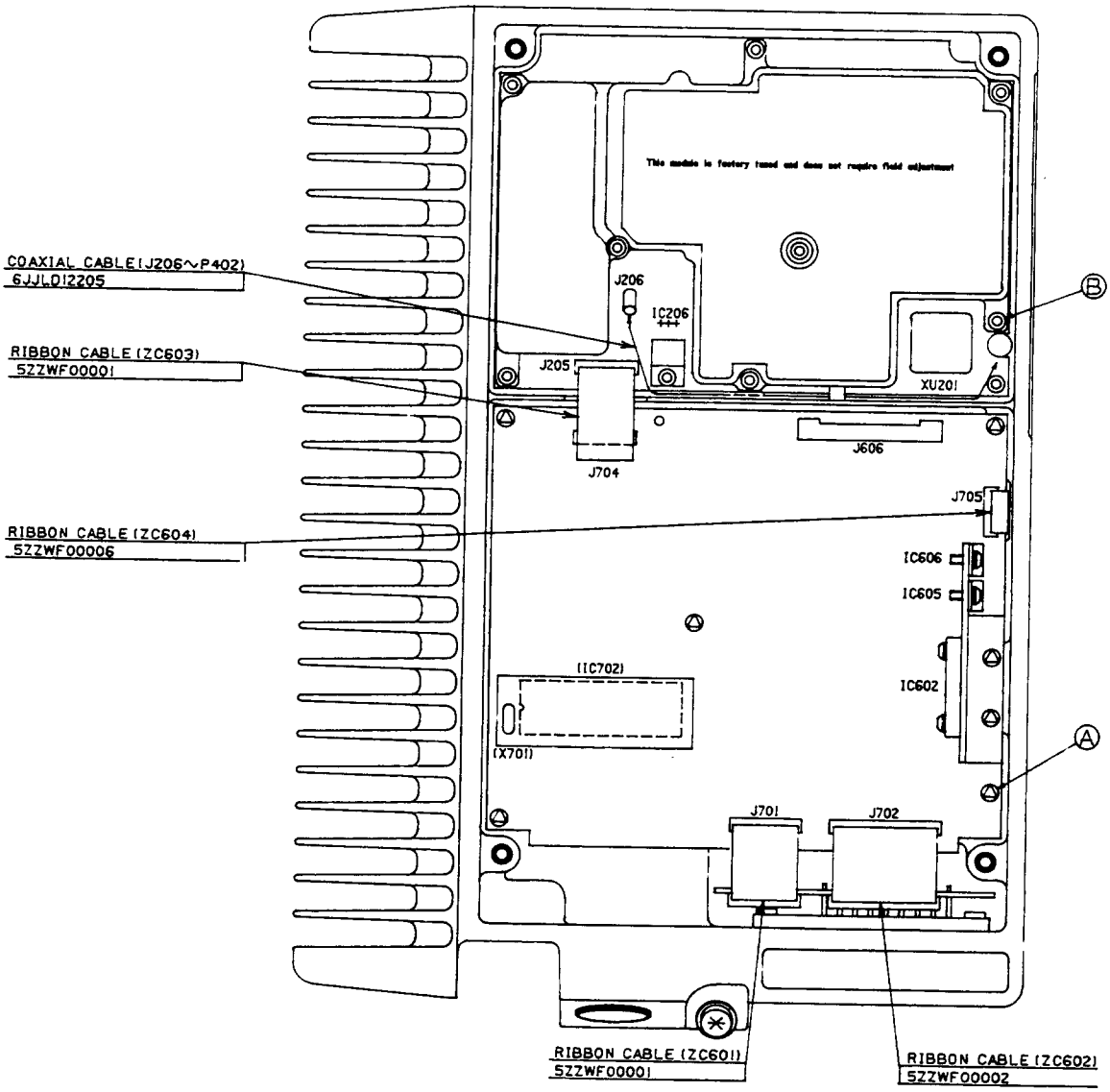
To gain access to the unit for servicing:

1. Remove the lock screw on the front of the radio using No. 30 TORX ® driver.
2. Pull the radio forward and remove from the mounting bracket.

To remove the printed wire boards:

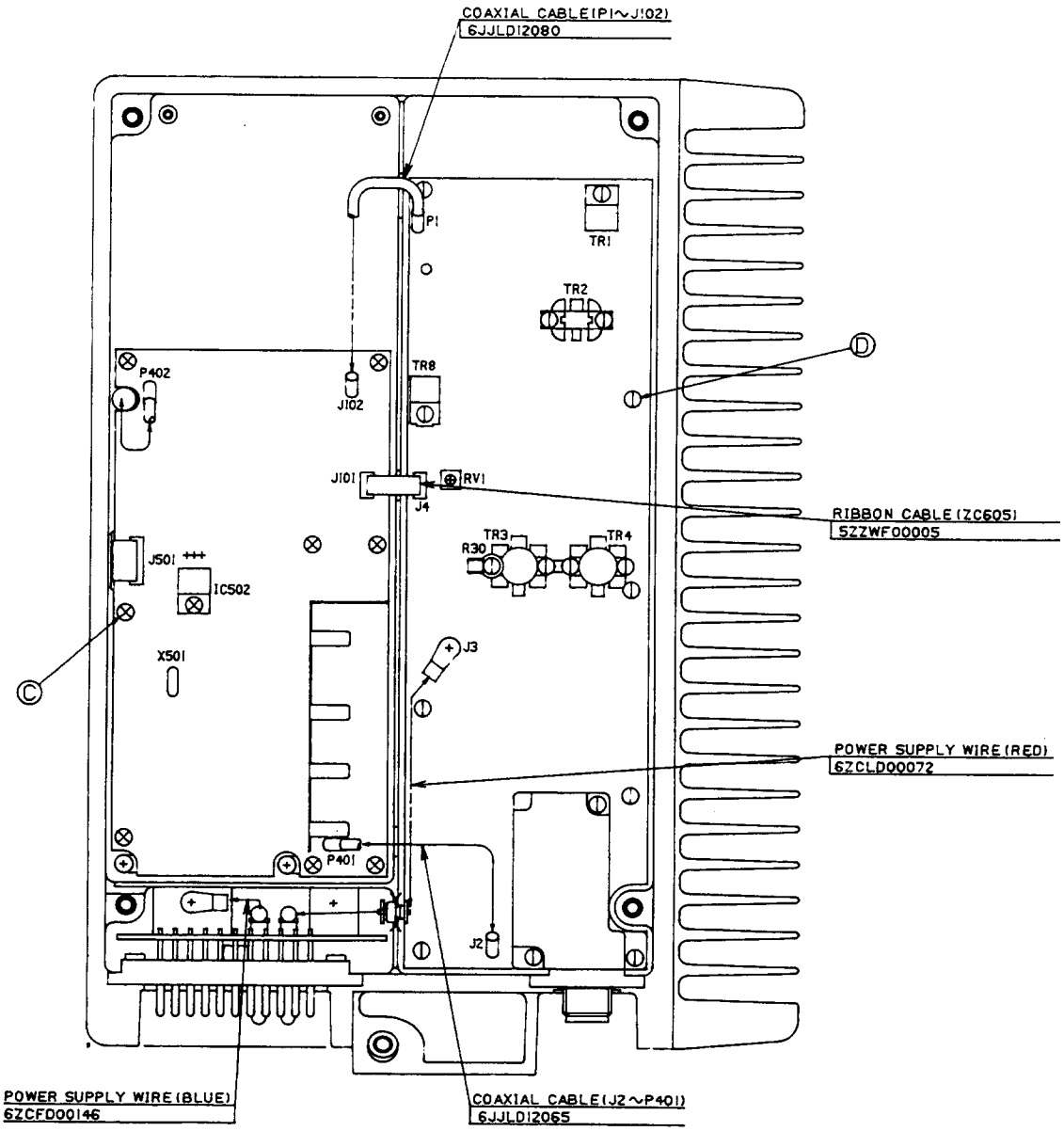
1. Each of the boards may be removed after removing the radio cover, the cables and the retaining screws securing the board to the main frame.
2. The cables and the screws to be removed are listed in Table 2.

TORX ® Trademark of CAMCAR Division TEXTRON, Inc.



Disassembly–Top View

Figure 1



Disassembly–Bottom View

Figure 2

Board name	Cables to be removed	Screws to be removed
System Control board	Four ribbon cables	Seven screws A (Figure 1)
Synthesizer board	One coaxial cable and one ribbon cable	Ten screws B (Figure 1)
PA board	Two power supply wires (red and blue), two coaxial cables, one ribbon cable	19 screws D (Figure 2)
Rx/Exciter board	Three coaxial cables and two ribbon cables	Nine screws C (Figure 2)

TABLE 2 - DISASSEMBLY PROCEDURE

To replace the printed wire boards.

1. Perform preceding procedures in reverse order.

CAUTION

After securing the radio, it is important that the screws securing the covers be fully secured. This ensures that the RF shielding gaskets make good contact and that the radio performance specifications are not compromised.

PA TRANSISTOR REPLACEMENT

WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

To replace the PA RF transistors:

1. Unsolder one lead at a time with a 50 watt soldering iron. Use a scribe or X-acto® knife to hold the lead away from the printed circuit board until the solder cools. Remove the mounting screws.

2. Lift out the transistor. Remove any old solder from the printed circuit board with a vacuum desoldering tool. Special care should be taken to prevent damage to the printed circuit board runs because part of the matching network is included in the base and collector runs.

3. Trim the new transistor leads (if required) to the lead length of the removed transistor.

4. Apply a coat of silicone grease to the transistor mounting surface. Place the transistor in the mounting hole. Align the leads as shown on the Outline Diagram. Then replace the transistor mounting screws using moderate torque (9.4 kg.cm).

5. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board. Take care not to use excessive heat that causes the printed wire board runs to separate from the board. Check for shorts and solder bridges before applying power.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

REMOVING IC's

Removing IC's (and most other soldered-in components) can be easily accomplished by using a vacuum desoldering tool such as SOLDA-PULLT® or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the desoldering tool.

An alternate method is to heat all pins simultaneously using a special soldering tip.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

REPLACING CHIP COMPONENTS

Replacement of chip components should always be done with a temperature-controlled soldering iron such as Weller EC2000 or EC1000, using a controlled temperature not exceeding 536°F (280°C). However, do not touch the black metal film of the resistors or the ceramic body of capacitors with the soldering iron.

NOTE

The metalized end terminations of the parts may be touched with the soldering iron without causing damage.

REMOVING CHIP COMPONENTS

1. Using two soldering irons heat both ends of the chip at the same time until solder flows, and then remove and discard the chip.

2. Remove excess solder with a vacuum solder extractor.

3. Carefully remove the epoxy adhesive and excess flux to prevent damage to the printed board.

REPLACING CHIP COMPONENTS

1. Using as little solder as possible, "tin" one end of the component and one of the pads on the printed wiring board.

2. Place the "tinned" end of the component on the "tinned" pad on the board and simultaneously touch the component and the pad with a well "tinned" soldering iron while pressing the component down on the board.

3. Place the "tinned" soldering iron on the other end of the component and the pad simultaneously. Apply solder to the top of the end of the component until the solder starts to flow. Use as little solder as possible while getting a good joint.

4. After the component has cooled, remove all flux from the component and printed wiring board area with alcohol.

TEST AND TROUBLESHOOTING PROCEDURES

Maintenance of the radio is facilitated by using the servicing techniques unique to this radio. Typical voltage readings are provided on the Schematic Diagram for reference when troubleshooting.

CAUTION

Before bench testing the radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed:	16.5 Volts
Transmitter keyed (50 ohms resistive load):	16.3 Volts
Transmitter keyed (no load or non-resistive load):	14 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limits shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 16.3 Volt figure.

Routine transmitter tests should be performed at EIA Standard Test Voltages (13.6 VDC for loads of 6 to 16 amperes; 13.4 VDC for loads of 16 to 36 amperes). Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering (such as Lapp Model 73) may be usable when operated in parallel with a 12 Volt automotive storage battery.

MICROPHONICS

Synthesized radios tend to be sensitive to shock and vibration, creating microphonics. The construction of the RANGR radio with its die-cast aluminum frame, cast shield, and multiple board-mounting screws, provides a high degree of immunity. When removing printed circuit boards or shields, note the location of all mounting hardware.

When servicing the radio be sure that no solder build-up has occurred on the chassis or shield.

To assure a high degree of resistance to microphonics be sure to replace exactly, all hardware removed.

Be sure that all mounting screws are properly torqued and shields are in place. Refer to the Mechanical Layout Diagram.

NOTE

Loose or rubbing parts, especially in the VCO area are particularly sensitive and can cause microphonics. Again, be certain all hardware is properly installed and torqued.

TEST FREQUENCIES

If the EEPROM is not custom programmed to the customer specified personality, then a standard test program is provided. The EEPROM is programmed on several channels including tone and digital Channel Guard and carrier control timer. The test program is given in Table 3.

FREQ SPLIT	CHANNEL	TX Frequency RX Frequency (MHz)	Channel Guard	Carrier control Timer
29 - 42 MHz	1	29.025 29.075	71.9 Hz	
	2	32.025 32.075	023	
	3	35.025 35.075		30 sec
	4	38.075 39.025		
	5	41.025 41.975		
35 - 50 MHz	1	35.025 35.075	71.9 Hz	
	2	38.075 39.025	023	
	3	41.025 41.075		30 sec
	4	45.025 45.075		
	5	49.025 49.075		

TABLE 3 - TEST PROGRAM

PA TROUBLESHOOTING PROCEDURE

DC VOLTAGE CHECK

First, Check the meter readings for power supply voltage and various stabilized DC voltages, at TP608.
The typical readings for the test points are given in the chart below.

TEST POINT	FUNCTION MEASURED	SCALE	TYPICAL READING
TP608-3	9V-RX	0-15V	9V
TP608-4	5V	0-15V	5V
TP608-8	EX9V	0-15V	9V
TP608-9	+8V	0-15V	8V
TP608-11	9V	0-15V	9V
TP608-12	A+	0-15V	13.6V

TABLE 4 - READINGS AT TP608

EXCITER QUICK CHECK

When troubleshooting the transmitter check for typical readings for the DC voltages across Exciter resistor R143, the Synthesizer output (J206), and the Exciter output (J102) as listed in Table 5.

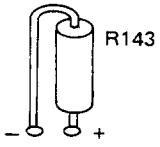
SYMPTOM	PROCEDURE	ANALYSIS
Little or No RF Output	Key transmitter and monitor EXCITER DC voltages across R143 for 0.7 VDC. The voltage should increase. 	If voltage does not increase, check TR104 and associated components.
	Disconnect the coaxial cable plug P402 from the Synthesizer board and measure RX/EX synthesizer output, J206. Should be +1 to +7 dBm.	If synthesizer output is low, check IC208 and associated circuitry.
	Disconnect the coaxial cable plug P401 from the PA board and measure EXCITER OUTPUT, J102. Should be 0.4 watts or more.	If EXCITER OUTPUT is low, check TR104 and associated components.

TABLE 5 - EXCITER QUICK CHECK

TYPICAL PERFORMANCE INFORMATION

SIGNAL LEVELS

SIGNAL	INDICATION	VOLTAGE LEVEL
CAS	High Level	9.0 VDC
	Low Level	0.15 VDC
RUS	High Level (Rx Un-sq)	9.0 VDC
	Low Level (Rx Squelched)	0.15 VDC
	Low Level (Rx Mute/PTT pulled low, Rx unsquelched)	0.6 VDC
$\overline{\text{SQ DSBL}}$, Input	Logic Low (Sq. Dis)	0 VDC
	Logic High(Sq)	2.4 VDC
	Rx Un-Sq	0.14 VDC
$\overline{\text{CCT PA ENBL}}$	Logic Low	0.35 VDC
	Logic High	5.5 VDC
$\overline{\text{TX ENB}}$	Logic Low	2.0 VDC
	Logic High	9.0 VDC
PTT, Input	Logic Low	0 VDC
	Logic High	13 VDC

TABLE 6 - SIGNAL LEVELS

Front Connector	J801
RX RF	P401
RX/EX INJ	P402
EX Output	J102

TABLE 7 RADIO CONNECTOR IDENTIFICATION

TEST PROCEDURES

These Test Procedures are designed to assist you in servicing a transmitter that is operating, but not properly. Once a defect is pinpointed, refer to the Transmitter Troubleshooting Procedure. Before starting, be sure that transmitter is tuned and aligned properly.

CAUTION

Before bench testing the radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed:	16.5 Volts
Transmitter keyed (50 ohms resistive load):	16.3 Volts
Transmitter keyed (no load or non-resistive load):	14.0 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limits shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 16.3 Volt figure.

Routine transmitter tests should be performed at EIA Standard Test Voltages (13.6 VDC for loads of 6 to 16 amperes; 13.4 VDC for loads of 16 to 36 amperes). Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering (such as Lapp Model 73) may be usable when operated in parallel with a 12 Volt automotive storage battery.

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST controls are adjusted to the proper setting before shipment and normally do not require readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction with the de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing over-modulation while preserving intelligibility.

TEST EQUIPMENT

1. An audio oscillator (GE Model 4EX6A10)
2. Deviation Monitor

PROCEDURE FOR SETTING THE SYNTHESIZER TRANSMIT DEVIATION

NOTE

The transmit deviation has been properly set by the factory and should require no readjustement. Should it become necessary to adjust the deviation, please refer to the Maintenance Manual LBI-38186 and the section TX AUDIO PROCESSOR in SYSTEM CONTROL BOARD and MODULATION LEVEL CONTROL in FREQUENCY SYNTHESIZER BOARD. These will familiarize you with the modulation deviation and make the Alignment Procedure more understandable.

1. Select a center frequency channel. Remove P604

2. Rotate RV201 and RV604 fully counterclockwise.

3. Apply a 1 kHz tone at 1 Vrms through a 100μF capacitor to MIC HI at J701-6 (+ lead of capacitor).

   Connect the deviation monitor to the antenna connector J1 via a 30-dB coupler, whose output is terminated in a 50-ohm load. Key the radio.

4. Set VCO MOD ADJUST, RV202 for ±3.75 kHz deviation.

5. Adjust DEVIATION SYMMETRY ADJUST RV603 for a difference between plus and minus peak frequency deviation of less than ±0.1 kHz.

6. Repeat procedures 4 and 5 until the specified frequency deviation is obtained in both directions.

7. Set RV604 fully clockwise. Apply a 400 Hz tone to J604-2 and with the radio keyed, vary its amplitude until the Deviation Monitor reads 1 kHz. Note the level.

8. Change the signal generator frequency to 10 Hz at the same level and set LOOP MOD ADJUST, RV201 for a deviation of 1 kHz. Unkey the radio.

9. Disconnect the signal generator and replace P604 in position 1-2.

10. Select a frequency with Tone Channel Guard (preferably close to the center frequency).

    Key the radio and set CG DEVIATION ADJUST, RV604 for a deviation reading of ±0.75 kHz.

    NOTE: If channel Guard is not used on any frequency, the VCO MOD ADJUST RV202 may be set for a deviation of ±4.5 kHz instead of ±3.75 kHz.

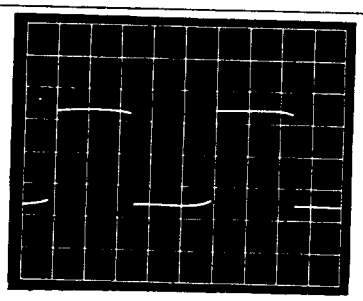
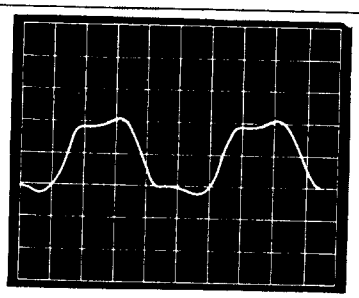
AUDIO CHECKS

TEST EQUIPMENT REQUIRED

- Audio Oscillator
- Voltmeter
- Oscilloscope
- Deviation Monitor

AUDIO AC VOLTAGE

1. Connect audio oscillator output across J701-6 (or J801-9) and J701-5 (or J801-5).

		IC607-1	IC607-7
SCOPE SETTING	HORIZONTAL	200 µSEC/DIV	200 µSEC/DIV
	VERTICAL	2 VOLTS/DIV	2 VOLTS/DIV
SET AUDIO OSCILLATOR at 1000 Hz WITH OUTPUT OF 1.0 VRMS. MODULATION ADJUSTED FOR 4.5 kHz DEVIATION. NOTE: AN RMS OR PEAK READING VOLTMETER WILL READ 1/2 TO 1/3 OF PEAK-TO-PEAK READINGS.			

AUDIO SENSITIVITY

1. Connect audio oscillator output across J701-6 (or J801-9) and J701-5 (or J801-5). Adjust output for 1000 Hz at 1.0 VRMS.

2. Reduce generator output until deviation falls to 3.0 kHz for radios without Channel Guard or to 2.25 kHz for radios with Channel Guard. Voltage should be less than 120 millivolts.

SYNTHESIZER AND TRANSMITTER ALIGNMENT

TEST EQUIPMENT REQUIRED

1. Wattmeter, 50 ohm (capable of measuring 150 Watts & 1 Watt)
2. DC Voltmeter, 20,000 ohms per volt
3. Digital Voltmeter
   Power supply, 13.8 VDC regulated
4. An output meter or a VTVM

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

Refer to Figure 3 for location of tuning and adjustment controls.

1. Apply DC power to radio.

NOTE

Before alignment or making any adjustments to the transmitter, be sure that power supply voltage (A+) and various stabilized DC voltages are proper. Refer to Table 4.

- SYNTHESIZER -

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
				NOTE The synthesizer is factory aligned and should not require further adjustment. Should it become necessary to adjust the synthesizer please refer to the Maintenance Manual LBI-38186 and the "Frequency Synthesizer" section. These will familiarize you with the operation of the VCO's and make the Alignment Procedure more understandable.
				NOTE The label on the cover of the Synthesizer must be removed, or holes made in it to gain access to the adjustable components, through the existing holes in the shield. These hole locations are shown in Figure 3.
				NOTE Should it become necessary to adjust the synthesizer, program a PROM to the highest frequency of the split (42 MHz for A board or 50 MHz for B board) for proper alignment.
1.	TP201 (Control Voltage Monitor)	CV202	7 VDC	Select highest frequency transmit channel in the split (42 MHz - A, 50 MHz - B). With a 50 ohm load on the antenna connector J1, key the radio. Adjust CV202 until the lock detector indicator CD711 goes out. Monitor TP201 with a digital voltmeter and adjust CV202 for a reading of 7.0 $\pm$0.1 VDC. Check that CD711 remains out. Unkey the radio.

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
2.	TP201 (Control Voltage Monitor)	CV201	7.5VDC	Select highest receive channel in the split as in Step 1 (release PTT switch). Adjust CV201 until lock detector indicator CD711 goes out. Monitor TP201 with a digital voltmeter and adjust CV201 for a reading of 7.5±0.1VDC. Check that CD711 remains out.
3.	TP201 (Control Voltage Monitor)		3.5 to 7.5VDC	Select each receive and transmit channel. Voltage at TP201 should be between 3.5 and 7.5 VDC.
4.	J206		+1 to +7 dBm	Rx/Ex injection level at J206 should be between +1 and +7 dBm.

- REFERENCE OSCILLATOR FREQUENCY -

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
5.	J206	FREQ TRIM Control on TCXO	Channel Operating Frequency	NOTE This step assumes the frequency is measured when the transmitter is first keyed. If delayed, the rapidly rising ambient temperature must be taken into consideration. The oscillator frequency should be set at 25°C ambient temperature. Press the PTT switch while monitoring the Rx/Ex injection frequency at J206. Adjust FREQ TRIM Control on TCXO for the assigned channel frquency within ±0.5 ppm. Note: The receiver injection frequency will automatically be correct.

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
				NOTE The Exciter requires no adjustment. If it becomes necessary to check the Exciter, proceed as follows. **NOTE** The Exciter can be isolated from the rest of the radio for checking purposes, if desired. To isolate and set up for alignment, remove coaxial cable connector P402. Connect a (0-1 watt) wattmeter to J102. Apply a +3 dBm on-frequency signal to P402 using adapter coaxial cable B19/CFQ-3234.
6.			100 mW	Check output power on the wattmeter. It should be greater than 100 milliwatts. **NOTE** Disconnect wattmeter from J102. Reinstall P402 if removed. Connect a (0-150 watts) wattmeter and 50-ohm load to antenna jack J1.
7.	J1		RV1	Monitor the transmitter output power on each channel. Select the channel with the lowest output power and set RV1 for rated output power.

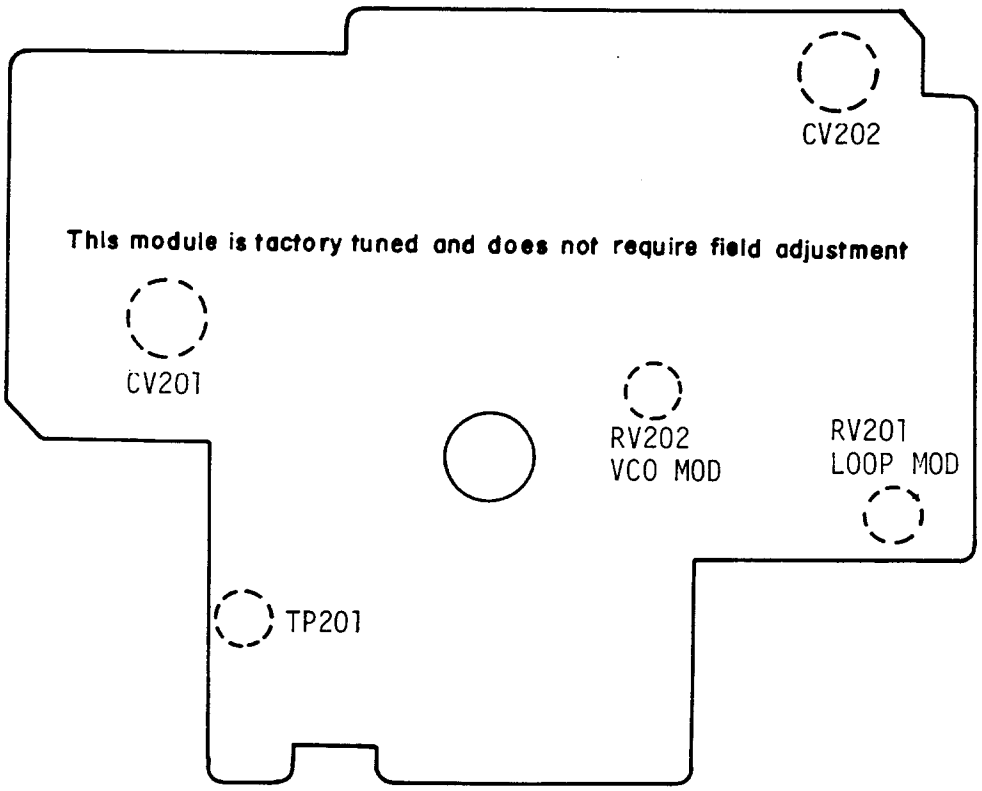


Figure 3 - Hole locations for synthesizer tuning and transmitter deviation adjustment

RECEIVER ALIGNMENT

TEST EQUIPMENT REQUIRED

- 20,000 ohms-per-volt multimeter.
- AC Voltmeter
- RF Signal Generator
- Frequency Counter
- 4-ohm 15 watt resistor
- Audio Isolation Transformer (1:1) 19A116736P1 or equivalent

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

Before aligning the receiver or making any adjustments to the radio be sure that the output of 9 Volt Regulator is 9.0 ±0.2 VDC

NOTE

If installing the Noise Blanker option board, cut jumper W501 and plug option board into J502 (be sure plug is installed on J503-2, 3 in receiver unit, and P706 is installed on J706-2, 3 in system control unit). Set the output signal level of the RF signal generator so as to obtain 12 dB SINAD at audio output. Adjust coils L505 and L506 to obtain best SINAD sensitivity reading.

IF/FM DETECTOR ALIGNMENT

Apply a 1000 microvolt, on-frequency test signal modulated by 1,000 Hz with ±3.0 kHz deviation to antenna jack J1.

Connect a 4-ohm, 15-watt resistor in place of the speaker. Connect the isolation transformer input across the resistor. Connect the isolation transformer output to the Distortion Analyzer (See figure 5).

Adjust the VOLUME control for 5 Watts output (4.47 VRMS) using the Distortion Analyzer as a voltmeter.

Set the output signal level of the RF signal generator so as to obtain 12dB SINAD at audio output.

Adjust coils L505 through L509 to obtain maximum SINAD SENSITIVITY.

Set the output signal level of the RF signal generator to 1000 microvolt.

Adjust L510 for maximum audio output.

FRONT-END ALIGNMENT

Select the lowest frequency channel. Set the frequency of the RF signal generator to the lowest channel frequency + 10.4 MHz. (= f_R +1/2IF spurious frequency). Adjust CV401 to obtain worst SINAD SENSITIVITY (maximum spurious rejection in this condition).

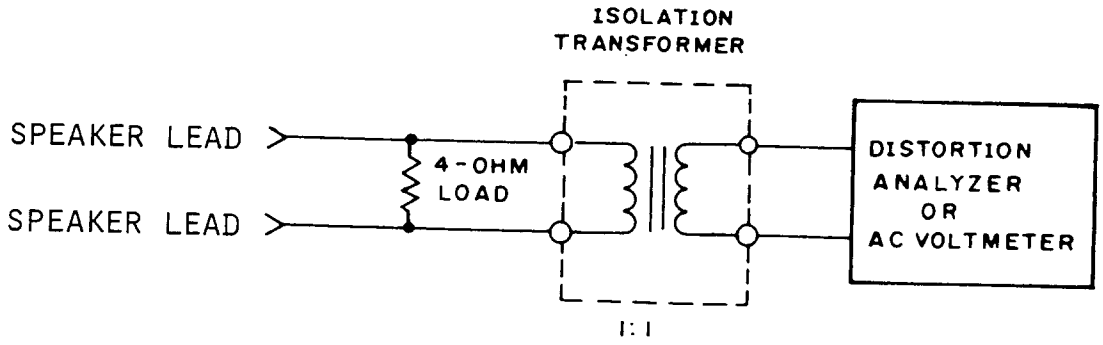


Figure 5 - Audio Isolation Transformer

RV601 ADJUSTMENT PROCEDURE

RV601 is used to set squelch amplifier gain to correct for noise variations between various bands of RANGR. This control does not require adjustment unless the squelch hybrid HC601 is changed or the systems board is exchanged between radios of different frequency bands.

1) Connect a signal generator to the antenna connector.

2) Set the squelch control on the Control Head fully clockwise.

3) Set RV601 on the System Control board fully clockwise.

4) Set the signal generator to the level to produce 20dB quieting.

5) Raise the generator level by 2dB.

6) Set the squelch control on the Control Head fully counterclockwise.

7) Adjust RV601 until the squelch just closes.

8) Set the modulation frequency to 1kHz with 3kHz deviation.

9) Check the signal generator level required to just open the squelch. It should be greater than the 20dB level and less than 1μV.

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RECEIVER AUDIO AND SQUELCH CHECKS

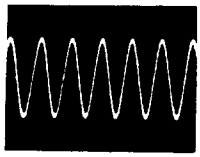
SQUELCH CIRCUIT TEST WITH 6kHz SIGNAL

PRELIMINARY STEPS

1. Set the squelch on the control head to close at 8 dB SINAD level.
2. Quiet receiver with 1000 uV modulated signal applied to antenna jack J1.
3. Set modulation frequency to 6 kHz.
4. Set deviation to 3 kHz.
5. Use 10 megohm probe.

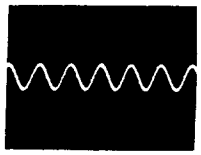
(A)

HOR .1 MSEC/DIV
VERT 0.1 V/DIV
(0.3 ∿ 0.6 V p-p)



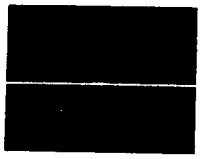
(B)

HOR .1 MSEC/DIV
VERT 0.1 V/DIV
(0.5 V p-p)



(C)

HOR .1 MSEC/DIV
VERT 2 V/DIV
(7.5 ∿8.0 VDC)
BASE LINE 0 VDC



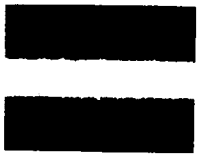
SQUELCH CIRCUIT CHECKS WITH NOISE

PRELIMINARY STEPS

1. Set the squelch on the control head to close at 8 dB SINAD level.
2. Remove input signal.
3. Use 10 megohm probe.

(A)

HOR .5 MSEC/DIV
VERT 1 V/DIV
(3.5 ∿4.0V P-P)



(B)

HOR .5 MSEC/DIV
VERT 1 V/DIV
(2 V P-P)

(C)

HOR .5 MSEC/DIV
VERT 2 V/DIV
(7.5 ∿8.0 VDC)

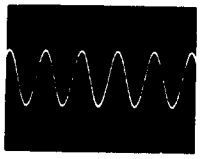
AUDIO CIRCUIT

PRELIMINARY STEPS

1. Apply 1000 uV on frequency signal with 1000 Hz modulation and 3 kHz deviation to antenna jack J1.
2. Output set to 10 Watts (6.3 VRMS) into 4-ohm load.
3. Use 1 megohm probe.

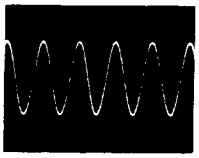
(D)

HOR .5 MSEC/DIV
VERT 50 mV/DIV
(160 mV P-P)



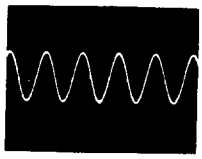
(E)

HOR .5 MSEC/DIV
VERT .2 V/DIV
(.84 V P-P)



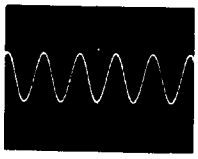
(F)

HOR .5 MSEC/DIV
VERT .1 V/DIV
(.28 V P-P)



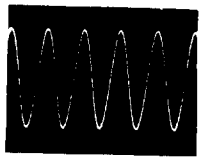
(G)

HOR .5 MSEC/DIV
VERT .1 V/DIV
(.28 V P-P)



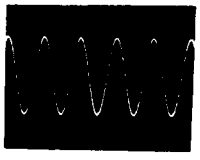
(H)

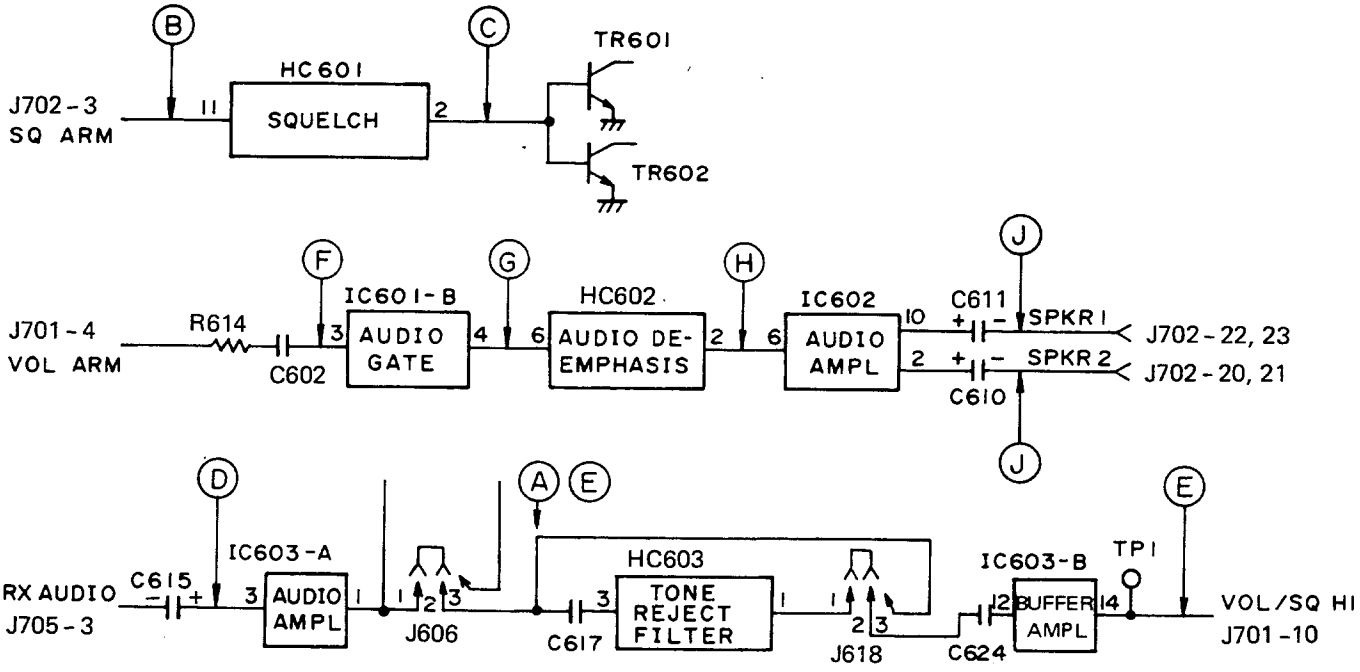
HOR .5 MSEC/DIV
VERT 50 mV/DIV
(280 mV P-P)



(J)

HOR .5 MSEC/DIV
VERT 2 V/DIV
(8.8 V P-P)




B
C
TR601
HC601
J702-3
SQ ARM
11
SQUELCH
2
TR602
F
G
H
J
IC601-B
HC602
IC602
C611
J701-4
VOL ARM
R614
3
AUDIO
GATE
4
6
AUDIO DE-
EMPHASIS
2
6
AUDIO
AMPL
10
SPKR 1
J702-22, 23
2
SPKR 2
J702-20, 21
C602
C610
D
A
E
IC603-A
HC603
IC603-B
TP1
RX AUDIO
J705-3
C615
3
AUDIO
AMPL
1
J606
C617
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FILTER
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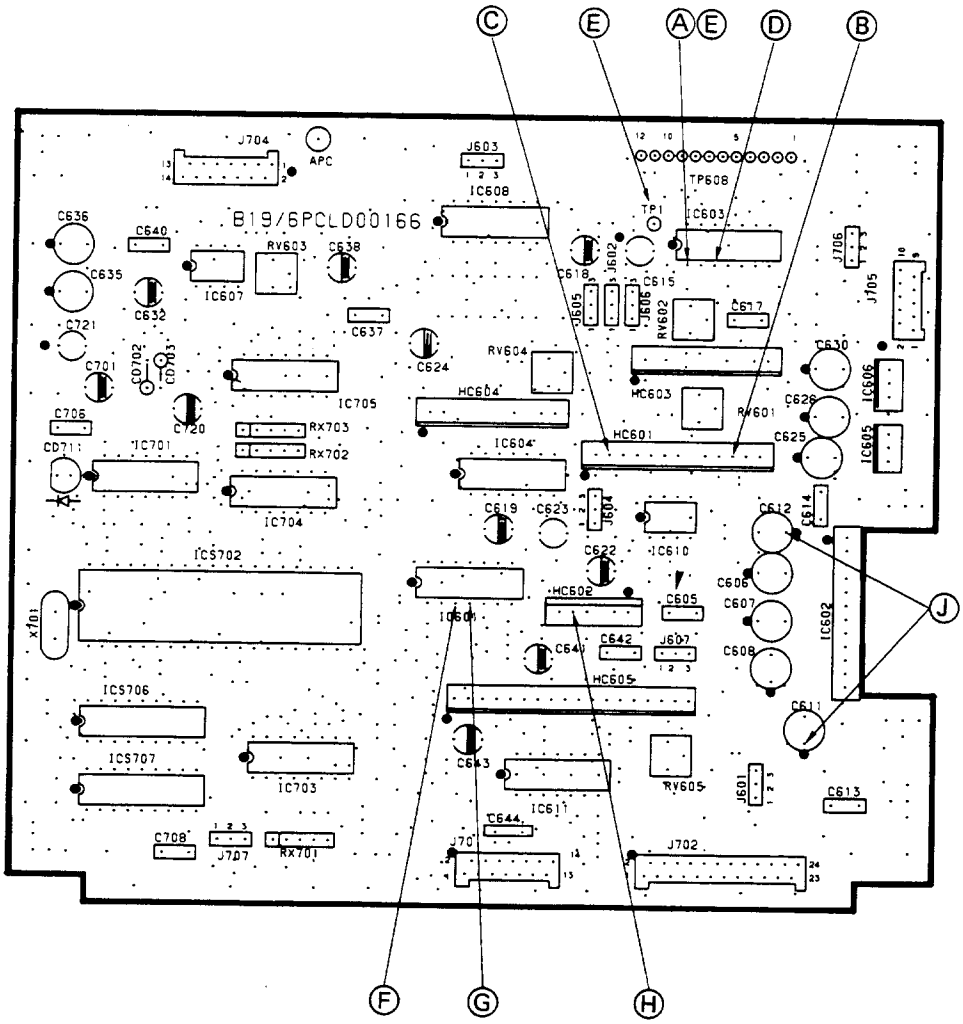
BUFFER
AMPL
14
C624
VOL/SQ HI
J701-10


C
E
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J704
APC
J603
IC608
TP608
TP1
IC603
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C635
C632
RV603
C638
IC607
C637
C721
C624
RV604
HC604
HC603
C630
C626
RV601
C625
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C701
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IC705
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IC704
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C623
C622
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C612
C606
C607
C608
HC602
C605
C642
J607
C641
HC605
IC702
X701
IC706
IC707
IC703
C643
IC611
C644
RV605
C613
C708
J707
RX701
J701
J702
F
G
H
J

TEST PROCEDURE

These Test Procedures are designed to help you to service a receiver that is operating, but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pinpointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6 dB attenuation pad
- Audio Isolation Transformer
- 4-ohm resistor (15-watt minimum)

PRELIMINARY ADJUSTMENT

NOTE

These procedures are written around the Heathkit Distortion Analyzer. If a Distortion Analyzer other than the Heath IM-12 is used, measure the sensitivity and modulation acceptance bandwidth in accordance with manufacturer's instructions.

1. Unsquelch the receiver.

STEP 1
AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1000 microvolt, on-frequency test signal modulated by 1,000 Hz with 3.0 kHz deviation to antenna jack J1.

B. With 10 Watt Speaker

Disconnect the speaker. Connect a 4-ohm, 15-watt load resistor in its place.

Connect the isolation transformer input across the resistor. Connect the isolation transformer output to the Distortion Analyzer (See Figure 5).

C. Adjust the VOLUME control for 10-watt output (6.32 VRMS) using the Distortion Analyzer as a voltmeter.

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 3%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 3%, or maximum audio output is less than 10-watt, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. FM Detector alignment (Refer to Receiver Alignment).

STEP 2
USABLE SENSITIVITY
(12 DB SINAD)

TEST PROCEDURE

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000 microvolt, on-frequency signal modulated by 1000 Hz with 3.0 kHz deviation to J1.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. Set signal generator output to 0.3 μV. Switch the RANGE control from SET LEVEL to the distortion range. Readjust Distortion Analyzer SET LEVEL as required until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 5 Watts (4.47 Volts RMS across the 4.0 ohm receiver load using the Distortion Analyzer as a Voltmeter).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the IF stages as directed in the Alignment Procedure.

STEP 3
MODULATION ACCEPTANCE
BANDWIDTH (IF BANDWIDTH)

TEST PROCEDURE

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Reduce audio output level to 10% of rated output.

B. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

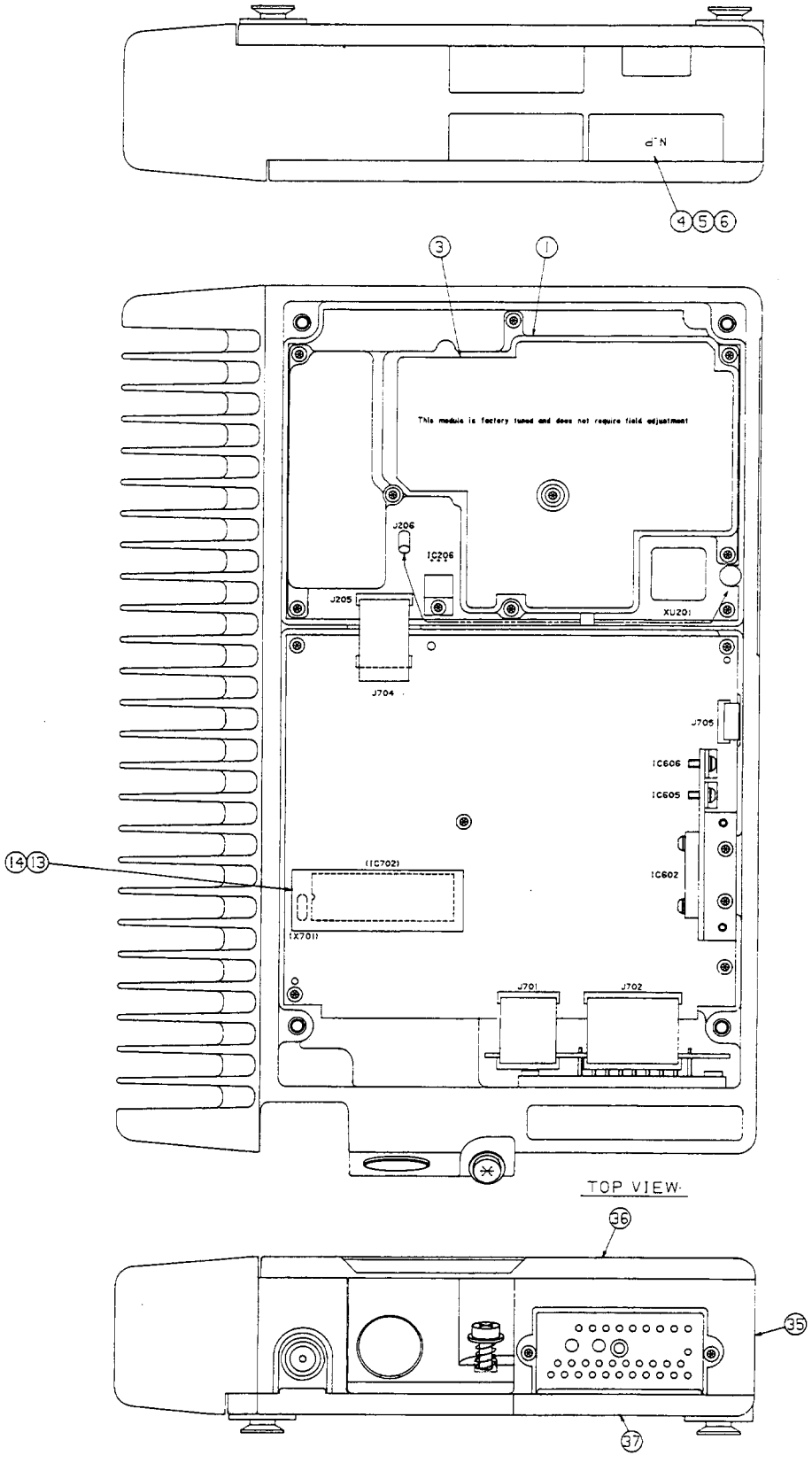
C. Set the RANGE control on the Distortion Analyzer to the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

D. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

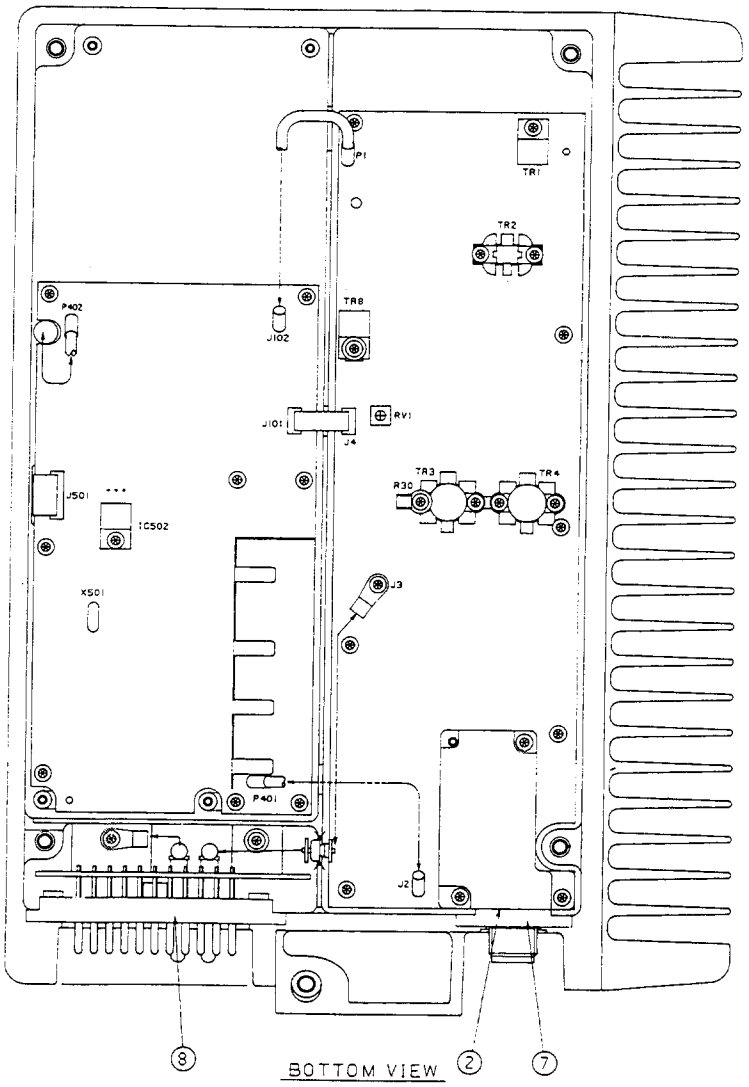
E. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than +7.0 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, check the synthesizer frequency and then refer to the alignment of IF stages.



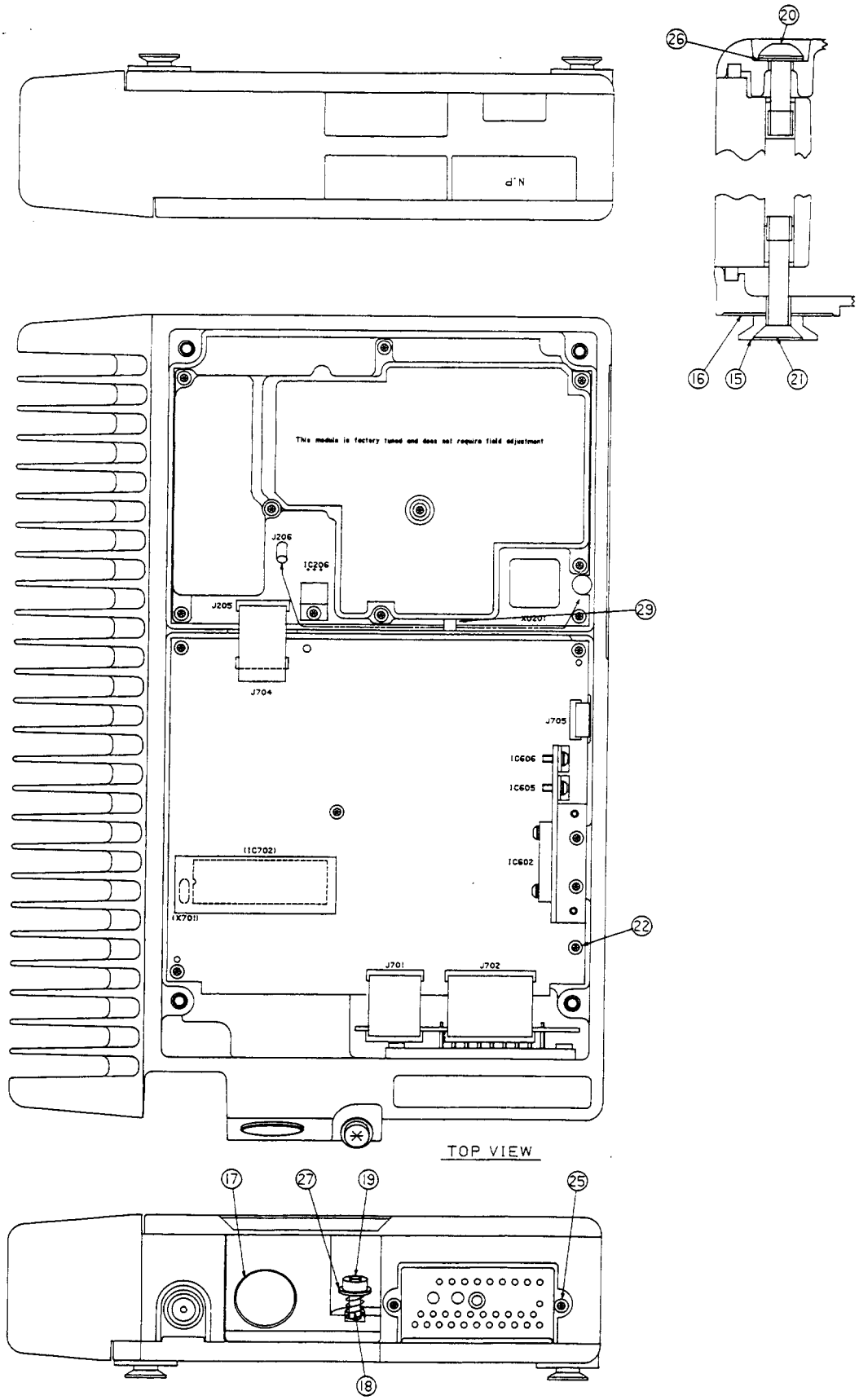
MECHANICAL LAYOUT DIAGRAM 1/2



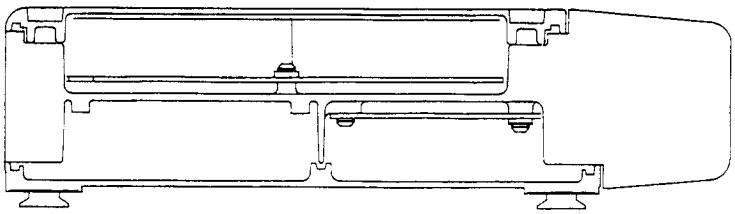
BOTTOM VIEW

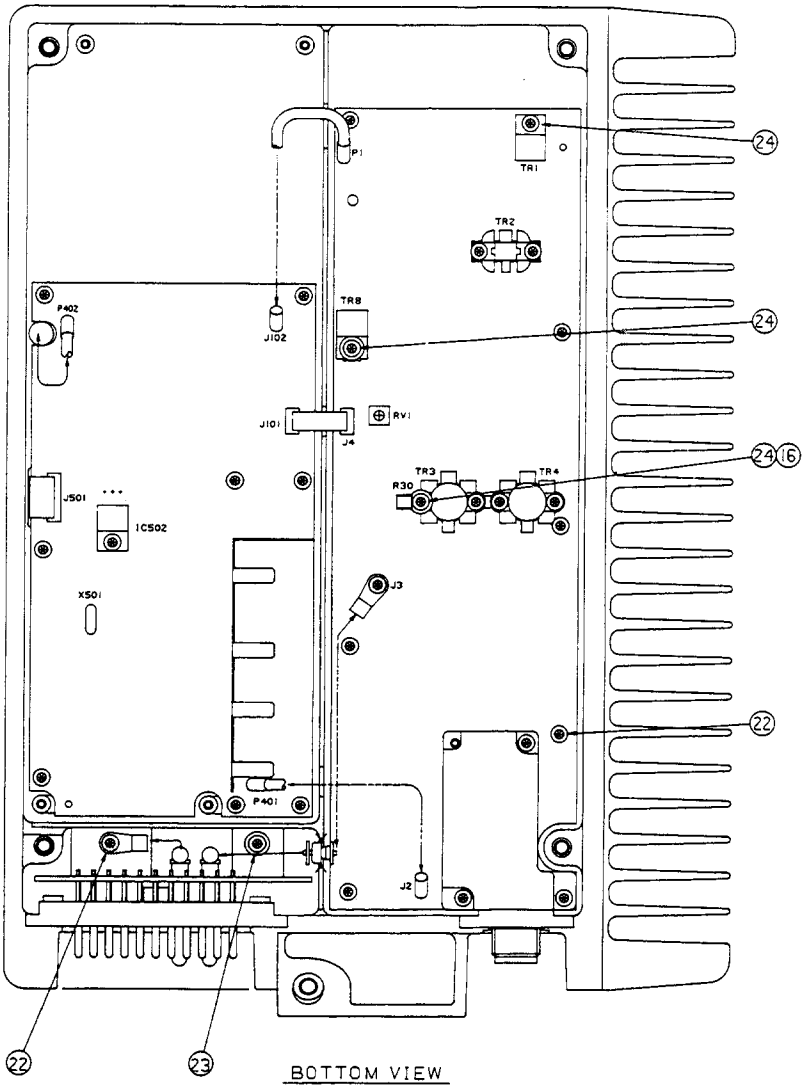
SYMBOL	GE PART NO.	NOMENCLATOR
1	B19/MTC002425B	CASE,SHIELD
2	B19/MTC002970	CASE,SHIELD
3	B19/MTT021172B	SEAL
4	B19/MPNN22140A	PLATE,SERIAL NO.
5	B19/MPNN19349	OVER LAY
6	B19/MTZ002812	ADHESIVE TAPE
7	B19/MPPK01415	GASKET,ANTENNA CONNECTOR
8	B19/MPPK01416	GASKET,INTERFASE CONNECTOR
10	B19/MPPK01286	GASKET,SHIELD
11	B19/MPPK01161	GASKET,SHIELD
12	B19/MPPK01163	GASKET,SHIELD
13	B19/MTB153924	CASE,SHIELD
14	B19/MTB153925A	COVER,SHIELD
31	B19/MPPK01162	GASKET,SHIELD
35	B19/MPBC08459	FRAME ASM (COMPLETE ASM)
36	B19/MPBC08554	TOP COVER ASM (COMPLETE ASM)
37	B19/MPBC08461	BOTTOM COVER ASM (COMPLETE ASM)
38	B19/MPBX18126	MOUNTING BRACKET
39	B19/MPXP01744A	MOUNTING HARDWARE

MECHANICAL LAYOUT DIAGRAM 2/2



HARDWARE (SECREW) KIT 1/2
KIT CODE: B19/MPXP01954A

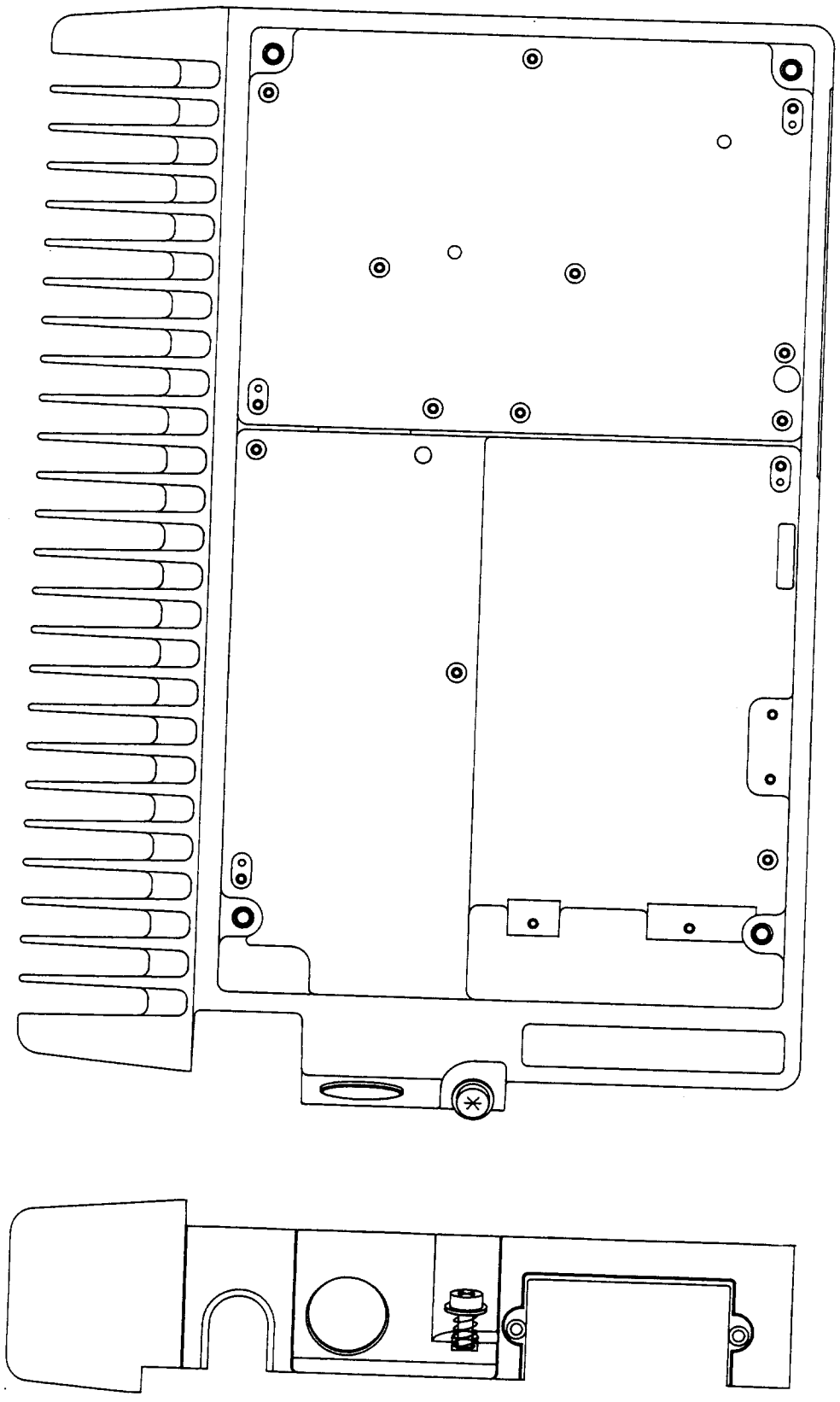




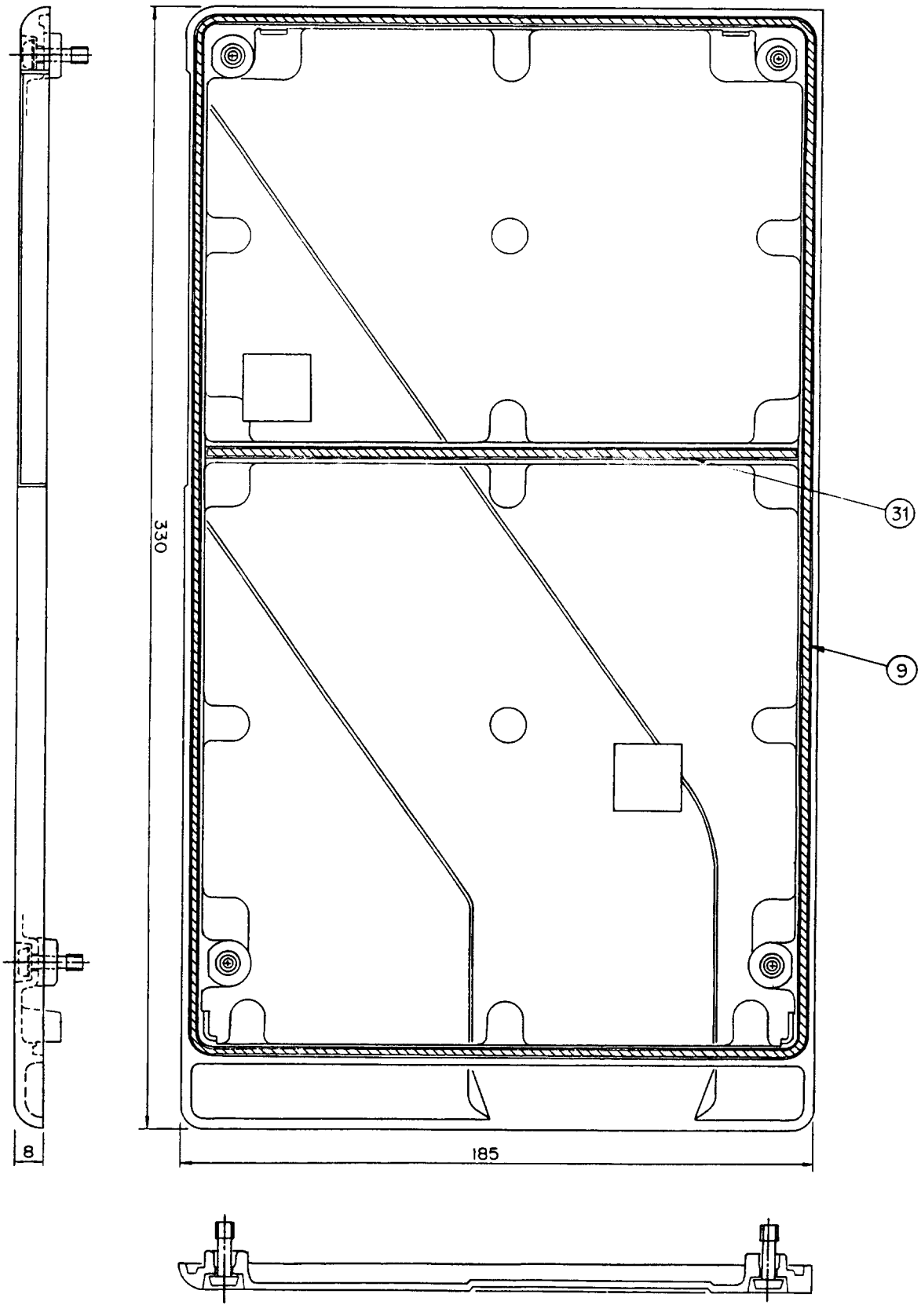
BOTTOM VIEW

SYMBOL	GE PART NO.	DESCRIPTION	QTY PER KIT
15	B19/MTL032906B	FOOT	4
16	B19/MTT021134A	SPACER	4
17	B19/MTV002836	COVER	1
18	B19/MPSR021598	SPRING	1
19	B19/MPTG02014A	SCREW	1
20	B19/MPTG02015	SCREW	4
21	B19/MPTG02016	SCREW	4
22	B19/BRTG03830	SCREW,PAN HEAD M3x8	56
23	B19/BRTG03942	SCREW,PAN HEAD M3x8	3
24	B19/BRTG03943	SCREW,PAN HEAD M3x12	3
25	B19/BRTG03293	SCREW,FLAT HEAD M3x10	6
26	B19/BRTG01781	WASHER,THRUST	4
27	B19/BRTG03301	WASHER	1
28	B19/MTL035255	SPACER	1
29	B19/MTT021147	CLAMP,CABLE	1

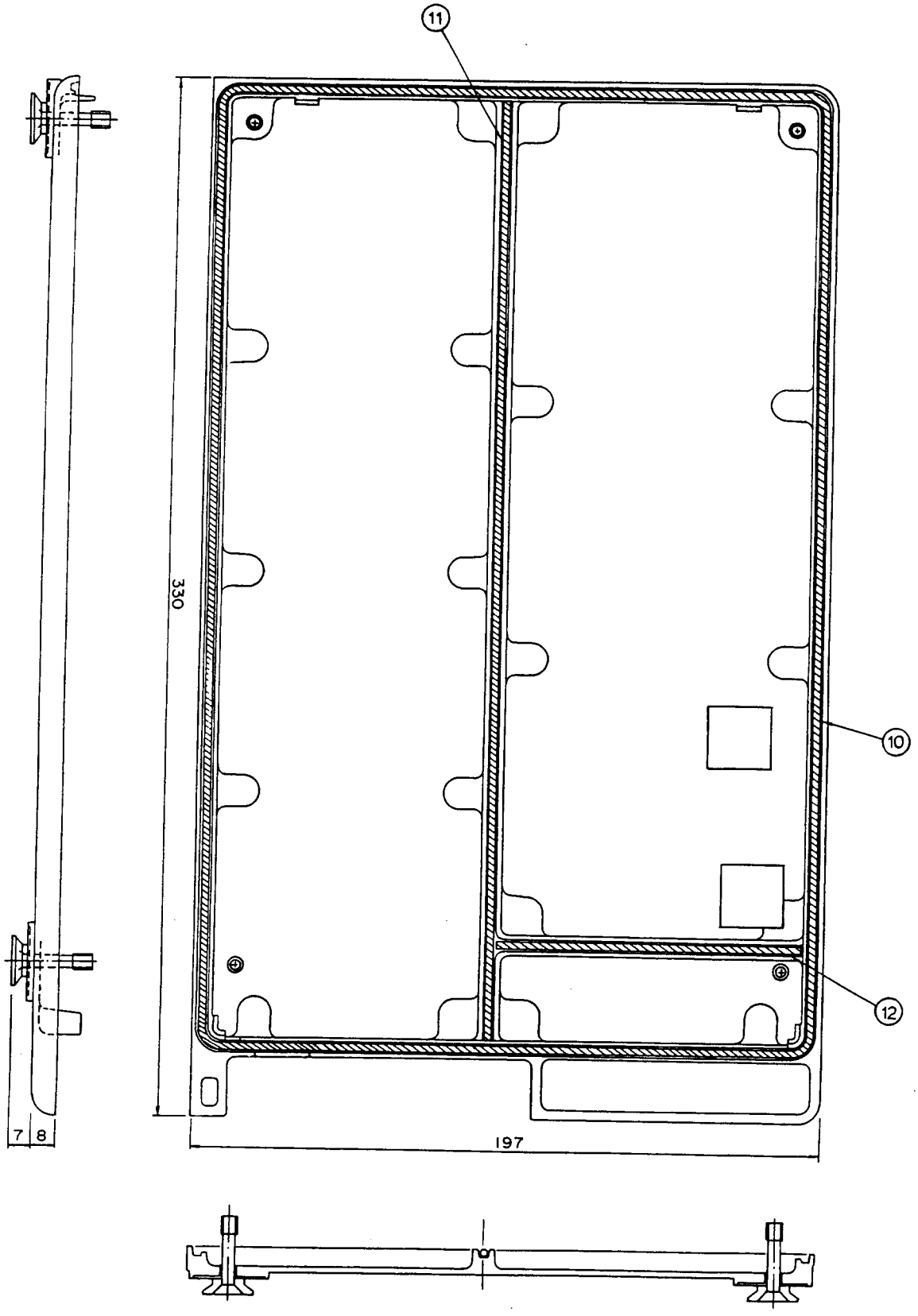
HARDWARE (SCREW) KIT 2/2
KIT CODE: B19/MPXP01954A



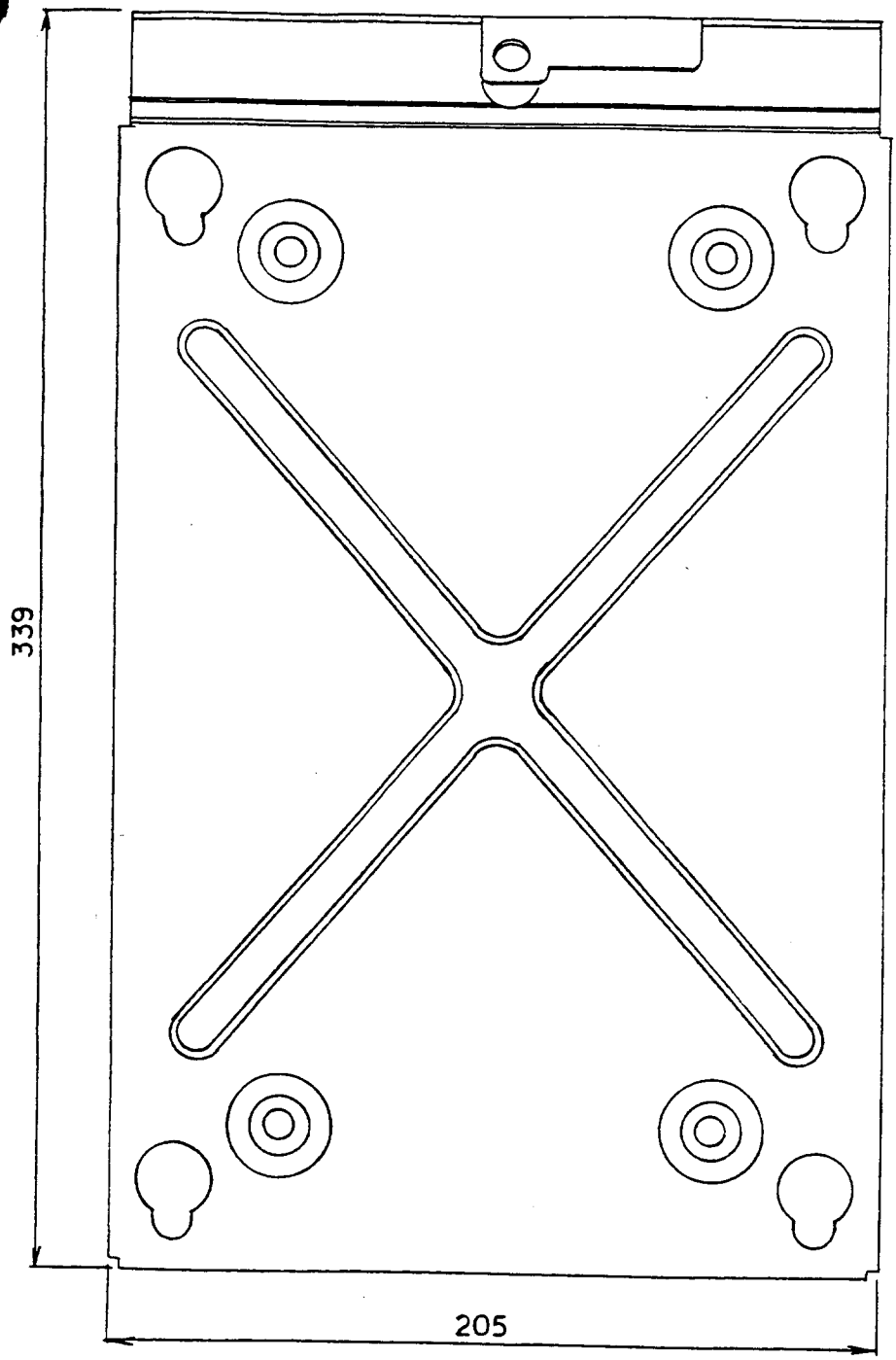
(35)
FRAME ASSEMBLY
ASM CODE : B19/MPBC08459

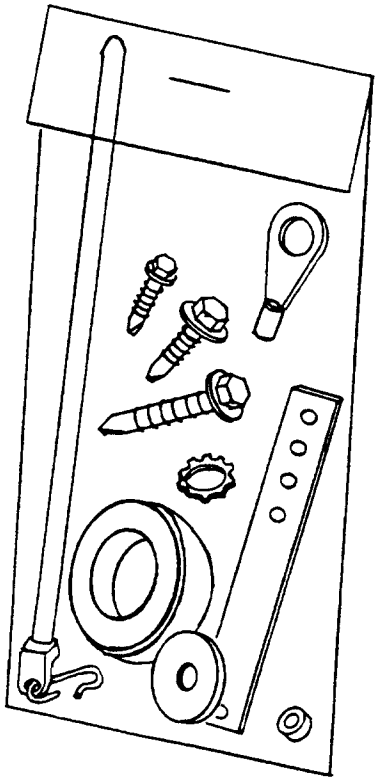


(36)
TOP COVER ASSEMBLY
ASM CODE:B19/MPBC08554



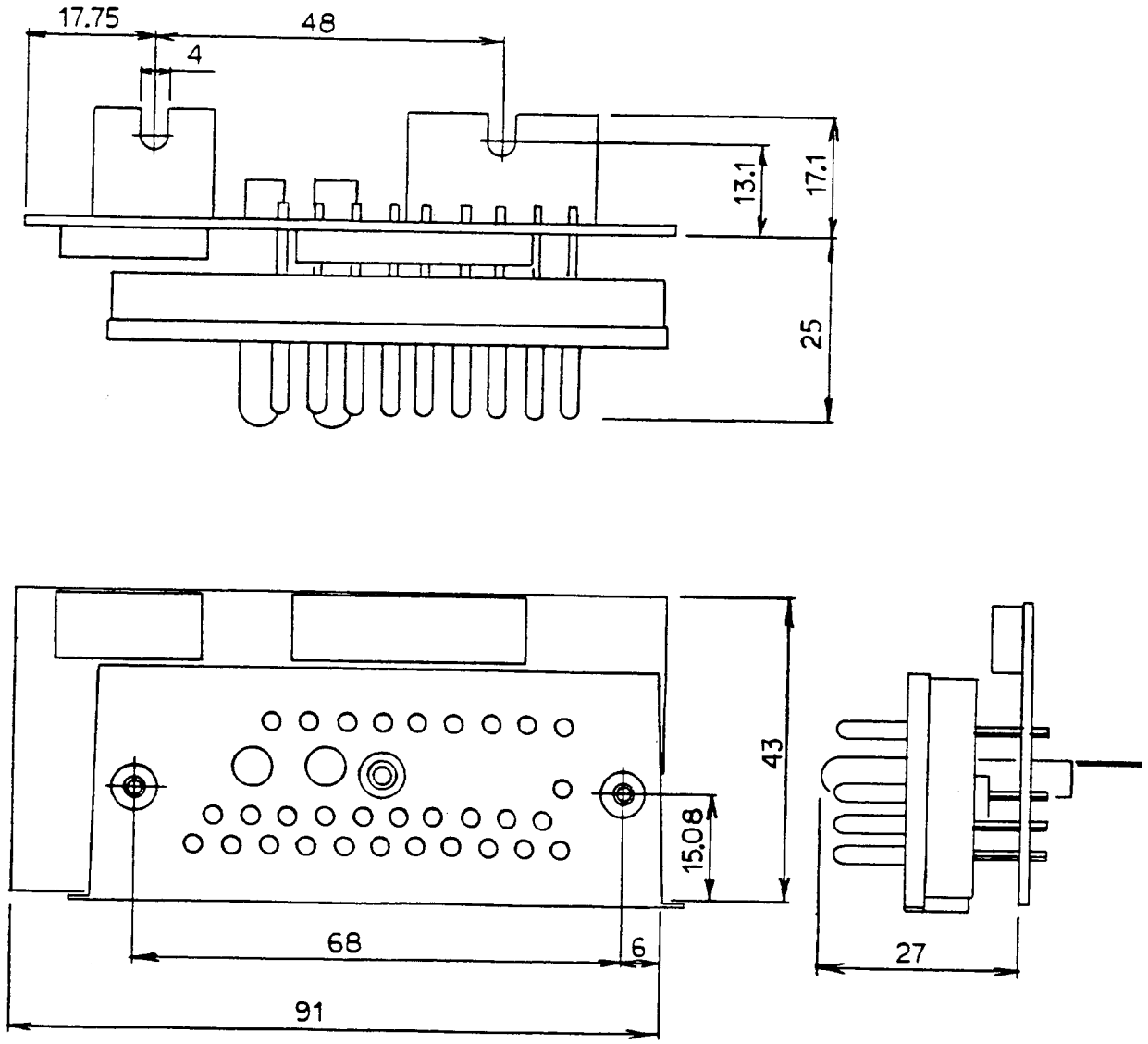
(37)
BOTTOM COVER ASSEMBLY
ASM CODE:B19/MPBC08461





(38)
MOUNTING BRACKET
CODE:B19/MPBX18126

(39)
MOUNTING HARDWARE KIT
KIT CODE:B19/MPXP01744A



INTERFACE BOARD ASSEMBLY
ASM CODE:B19/CMH-813

(End of "B" Section)

MAINTENANCE MANUAL

29-50 MHz BOARD ASSEMBLIES

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DESCRIPTION

The System Control board for RANGR provides all functions necessary for two-way communications. This board is controlled by the control unit.

The System Control board interconnects with the power/control cable from the control unit.

The System Control board contains the audio circuitry, microcomputer, EEPROM and voltage regulators. The micro-computer controls all system functions, supplies frequency data to the frequency synthesizer, and tone/code data to the Channel Guard.

In addition to the normal radio functions, the microcomputer contains self-diagnostic maintenance routines to aid in troubleshooting the radio. Included are an internal test of the microcomputer and input/output tests to assure proper operation of the data port and data bus. Details and procedures are included in the Service Section of this manual.

The system control and interface circuits consist of the microcomputer, electrically eraseable PROM, interface circuits for voltage shifting and protection, and a watchdog timer. The EEPROM gives the user the capability to program the radio's personality as desired. The EEPROM contains the receive and transmit frequency data, Channel Guard tone frequencies/digital codes and the CCT delay on a per-channel basis.

NOTE

The EEPROM may be programmed serially through the front connector using the General Electric Universal Radio Programmer Model TQ2310.

CIRCUIT ANALYSIS

SYSTEM CONTROL BOARD

MICROCOMPUTER AND CONTROL

The microcomputer interfaces with the control unit through J701/J702 and responds to all user commands and control functions originating from the control unit. It provides the transmit and receive data to the frequency synthesizer, switching information for tone and digital Channel Guard, and provides the carrier control timer (CCT) function when the radio is in the transmit mode.

When the microphone is keyed, the $\overline{\text{PTT}}$ line from the control unit goes low. This low is applied to the microcomputer through buffer TR702 and inverter TR703. TR702 is controlled by ignition switch A+. The ignition switch must be on and A+ applied to the base of TR702. TR702 must be turned on to permit keying of the transmitter. When Channel Guard is present, the release of the PTT signal is delayed by the microcomputer for approximately 160 milliseconds to eliminate any squelch tail.

The microcomputer immediately closes the antenna relay switch by applying a low level to $\overline{\text{DPTT}}$ at IC702-28. The microcomputer then delays 15 milliseconds before transmit 9V is switched on by applying a low level to TX ENB at IC702-32. This is done to guarantee that the antenna relay contacts are closed before the transmitter is energized. Once $\overline{\text{DPTT}}$ is low, the receive audio is muted. Buffers TR705 and TR704 provide $\overline{\text{DPTT}}$ to the audio control circuits, and antenna relay. IC704-B provides the DPTT signal to the Tx/Rx VCO's and the audio processor.

The $\overline{\text{TX ENB}}$ line is controlled by microcomputer port 1, bit 5 (IC702-32) through inverter TR712 and buffer TR711. A low level on IC702-32 turns TR712 off, allowing the base of TR711 to rise. TR711 turns on, and applies A- to the $\overline{\text{TX ENB}}$ line. Inverter TR710 is also turned on during this time to inhibit the alert tone PTT.

CHANNEL SELECTION

The microcomputer and EEPROM provide the radio with up to 16 independent transmit and receive frequencies. Each time the PTT switch is operated the microcomputer transfers channel data from the EEPROM and converts it to frequency data assigned to the selected channel. The frequency data is then loaded serially into the frequency synthesizer.

The microcomputer continually monitors the status of tri-state buffers IC703A-D. These buffers are periodically turned off by a positive 5 volt, one millisecond pulse from IC702-36. At the same time PROM power switch TR708 is turned on and applies +5 VDC to the EEPROM. When the buffers are turned on, channel select data is loaded into input/output ports of the microcomputer through ports P20-P23. Power is then applied to the EEPROM and the tri-state buffers are turned off. The microcomputer converts the channel select data into address information, accesses the EEPROM, and receives the frequency data stored in the addressed location. This data then passes through the I/O ports of the EEPROM and P20-P23 of the microcomputer. The conversion process is repeated eight times in rapid succession (eight locations are required for each channel) and the data loaded serially into the frequency synthesizer over the clock and data lines. This data also includes Channel Guard information, if present, and carrier control timer information on a per-channel basis. A 4-millisecond channel change pulse from port P16 of the microcomputer is also sent to the frequency synthesizer to speed up channel acquisition.

WATCHDOG TIMER

The watchdog timer, consisting of a digital counter IC701-A and TR701, monitors the operation of the microcomputer. IC701-A generates a reset pulse in the unlikely condition that the microcomputer goes awry and does not execute the software properly.

A 6 MHz crystal X701 steps the microcomputer through the software. As programmed in software a random pulse appears at IC702-35 and is applied to the base of inverter TR701 momentarily turning it on and inhibiting any reset pulse from timer IC701-A. A discharging circuit consisting of R710 and C705 forces the microcomputer to toggle IC702-A. If the timer does not receive any inputs for a specified period of time, TR701 turns off and IC701-A times out and applies a reset pulse to pin 4 of the microcomputer. The watchdog reset will normally restore the microcomputer to normal operation so that only one pulse will occur. In the event the microcomputer is not restored to normal operation, a 6 Hz square wave will appear on the reset line and the indicator CD711 (normally unlit) will turn on.

ADVANCE CHANGE PULSE

The advance change pulse is received from connector J702 and applied to the microcomputer interrupt port IC702-6 through inverter TR707. The advance change pulse is important in radios equipped with PSLM. When a call is received on a priority channel the advance change pulse interrupts the microcomputer, forcing it to service immediately the I/O circuits. The tri-state buffers are turned on and new channel select information read in.

CARRIER CONTROL TIMER

The carrier control timer function is executed by the microcomputer under software control on a per-channel basis. When the programmed time has elapsed an alert tone is generated from P13 (IC702-30) on the microcomputer, applied to the audio PA and heard on the speaker. The CCT may be programmed for 1 or 2 minutes or disabled (programmed for no CCT).

VOLTAGE TRANSLATION

Inverter buffers IC704D-G, translate the 5 VDC levels required by the microcomputer to the +9 VDC level used by the frequency synthesizer. Inverter TR709 restores the proper polarity to the clock.

FREQUENCY SEGMENT CONTROL

To achieve rapid wideband VCO tuning extending over the 29-42 MHz range or the 35-50 MHz range, each Bandsplit is divided into four frequency segments.

By selecting one segment the operating frequency spread of the VCO is limited and frequency lock time reduced. Each segment is identified by two bits on a per-channel basis and programmed into the EEPROM. Capacitors are switched in and out of the VCO tank circuit to set the VCO tuning range to cover the correct frequency segment.

The frequency segment control circuit consists of a dual "D"-type flipflop operating under control of the microcomputer. The four frequency segment identification bits appear on the channel change and data lines and fed to dual "D" FF IC705. At the appropriate time the microcomputer applies the enable signal to clock the new segment data change through the FF. The output of the FF's is a binary expression identifying the frequency segment selected. Table 1 identifies the binary expression and the selected frequency segment.

The output of the frequency segment control circuit is applied to the modulation level control and the frequency segment selector circuits.

	SEGMENT	FREQUENCY SPLIT (MHz)	FF OUTPUT				GROUNDED MODULATION RESISTOR
			IC705-1 (INPUT TR216)	IC705-2 (INPUT TR217)	IC705-13 (INPUT TR218)	IC705-12 (INPUT TR219)	
29-42MHz	1	29-32	0	1	0	1	NONE
	2	32-35	0	1	1	0	R275
	3	35-38.5	1	0	0	1	R276, R296
	4	38.5-42	1	0	1	0	R275, R276 R281, R296
35-50MHz	1	35-38.5	0	1	0	1	NONE
	2	38.5-42	0	1	1	0	R275
	3	42-46	1	0	0	1	R276, R296
	4	46-50	1	0	1	0	R275, R276 R281, R296

TABLE 1 - Frequency Segment Selection

TX AUDIO PROCESSOR

The audio processor provides audio pre-emphasis with amplitude limiting and post limter filtering and a total gain of approximately 24 dB. Approximately 27 dB gain is provided by IC607A, 4 dB by IC607B and -7 dB by R666, R667.

The 9 Volt regulator IC606 powers the audio processor and applies regulated 9 volts to a voltage divider consisting of R665, R668 and symmetry control, RV603. The +4.5 V output from the voltage divider establishes the operating reference point for operational amplifiers IC607A and IC607B. C636 provides an AC ground at the summing input of both operational amplifiers.

When the input signal to IC607A-2 is of a magnitude such that the amplifier output at IC607A-1 does not exceed 5 volts P-P, the amplifier provides a nominal 27 dB gain. When the audio signal level at IC607A-1 exceeds 5 volts P-P, the amplifier gain is reduced to 1. This limits the audio amplitude at IC607A-1 to 6 volts P-P.

Resistors R662, R663 and C633 comprise the audio pre-emphasis network that enhances the signal-to-noise ratio. R663 and C633 control the pre-emphasis curve below limiting. R662 and C663 control the cut-off point for high frequency pre-emphasis. As high frequencies are attenuated, the gain of IC607 is increased.

Audio from the microphone is coupled to the audio processor through R662 and C633.

The amplified output of IC607A is coupled through R666, C633, R669, R670, R671 and bilateral switch IC608C to a second operational amplifier IC607B. The bilateral switch is controlled by the DPTT line so that Tx audio is transmitted only when the PTT switch is pressed. IC607B provides a signal gain of approximately 4 dB.

The Channel Guard tone input is applied to bilateral switch IC608C controlled by the DPTT line. The CG tone then modulates the reference oscillator and VCO on the synthesizer board.

A post-limiter filter consisting of IC607B, R669-R671, R687, C689 and C640 provides 12 dB per octave roll-off. R666 and C637 provide an additional 6 dB per octave roll-off for a total of 18 dB. The output of the post-limiter filter is coupled through the VG (Voice Guard) unit or directly to the synthesizer Tx MOD.

TX enable switch IC608-D shorts out operational amplifier IC607-B when the radio is in the receive mode. The TX ENABLE signal is generated by the microcomputer when the PTT switch is operated and is less than 2.7 VDC in the receive mode.

RX AUDIO

Received audio from the FM detector is applied to the input of audio pre-amplifier IC603-A. The audio output level of the audio preamplifier is adjusted by Volume/Squelch HI level control RV602 for 300 millivolts RMS. The audio of 300 millivolts RMS is applied to the audio preamplifier (IC603-B) through the Tone Reject filter (HC603). When VG is opptionally added, this audio is applied to VG (Voice Guard) circuit (IC611, HC603). Audio output from the VG circuit is applied to Tone Reject filter (HC605) through pins J606-2 & 3. The audio is then applied to the volume and squelch controls in the control unit through connector J701-10.

Audio is returned on the VOL ARM through J701-18 and applied to audio gate (bilateral switch) IC601-B. The audio gate is controlled by DPTT (delayed Push-To-Talk) and PA KEY/CCT PA ENB and is turned on when the control input (pin 5) exceeds 7 VDC. The gate is turned off when the control input is less than 2 volts. Receipt of an on-frequency signal (if present) with

sufficient signal-to-noise level and the correct Channel Guard frequency will cause the audio control circuit to apply +9 volts to IC601-B turning the audio gate on.

Audio from the audio gate is applied to the de-emphasis network consisting of a low-pass filter and a high-pass filter.

The low-pass filter provides a 6 dB per octave roll-off between 300 and 3000 Hz. The high-pass filter attenuates frequencies below 300 Hz.

The audio output from the de-emphasis network is applied to the non-inverting input of the audio power amplifier. The audio power amplifier consists of IC602, and associated circuitry, and provides 10-watts (6.3 VRMS across a 4 ohm load) of audio output power at terminals J702-20 and 22. The gain of IC602 is determined by the value of R622.

SQUELCH CIRCUITS

The squelch circuit(HC601)monitors noise on the SQ ARM output line and allows the receiver to be unmuted when an on-frequency signal reduces the noise level below the squelch threshold setting.

The 300 millivolt output of the audio preamplifier is applied to the squelch circuit through the variable squelch control in the control unit. The squelch control sets the noise threshold level required to operate the squelch circuit. When the noise falls below the threshold level, the receiver is unmuted.

The squelch circuit(HC601) consists of a high-pass filter, an averaging detector, DC amplifier, and a Schmitt trigger shown in Figure 1. The high-pass filter consisting of HC601-A, removes all voice signals from the SQ ARM output and couples noise to HC601-B.

Noise in the 6-8 kHz range is applied to the averaging detector consisting of HC601-B. The noise is rectified and filtered to provide an average DC output level proportional to the noise input. The DC output level is adjusted by RV601.

The average DC level is amplified by HC601-C to a level ranging from 0 to 6.0 VDC, and applied to the non-inverting input of the Schmitt trigger, HC601-D. The inverting input of HC601-D is referenced to 4.5 VDC. IC603-C provides the stable 4.5 VDC reference voltage.

When the DC level exceeds 4.5 VDC, Schmitt trigger HC601-D switches and provides a positive voltage to the CAS (Carrier Activity Sensor) and RUS (Receiver Unsquelched Sensor) control transistors in the audio control circuits. The Schmitt trigger will remain on until the threshold level falls below approximately 4.3 VDC. This difference in voltage between the firing point and turn-off point provides sufficient hysterisis to eliminate "bubbling" -- i.e., noise popping in the speaker. The "bubbling" would normally be caused by transitional changes in the DC level around the reference point which allows the receiver to be unmuted.

When an on-frequency signal is received, there will be little or no noise present at the squelch input. This results in an absence of voltage at the output of the squelch circuit Schmitt trigger, allowing the receiver to be unmuted.

AUDIO CONTROL

The audio control circuits shown by Figure 2 control the operation of the audio gate (IC601-B) and the final audio PA and consist of TR601-605, inverter IC601-A and associated circuitry. The audio control circuit inputs consist of $\overline{\text{DPTT}}$ (Delayed Push-To-Talk), $\overline{\text{RX MUTE}}$ (Receiver Mute), $\overline{\text{PA KEY/CCT}}$ PA ENB (Public Address Key/Carrier Control Timer Public Address Enable), and the output of the squelch circuit.

When an on-frequency signal with the correct Channel Guard Tone is received, CAS control transistor TR601 and RUS control transistor TR602 are turned off by the absence of a positive voltage at their bases. The CAS line from the collector of TR601 rises to +9 VDC and is supplied to J701-14.

The collector of RUS Transistor TR602 also rises to +9 VDC and turns on inverter IC601-A. A- is then applied to the base of inverter TR603, turning it off and allowing its collector to go high. The positive voltage on the collector is applied to audio gate IC601-B, turning it on. TR604 is biased on but has no effect on audio switches TR605. The base of the transistor is connected to the output of audio control switch IC601A-2 which is at A-. Therefore TR605 turns off, allowing input audio to the PA which feed audio power to the speaker.

When the microphone is keyed, the $\overline{\text{DPTT}}$ input is low. This low is applied to audio gate IC601-B through CD603B, turning IC601-B off. It is also applied to audio control switch IC601-A (through CD603A) turning it off. TR603 is also off and TR604, TR605 are on. TR605 shorts out the audio input to the audio PA IC602.

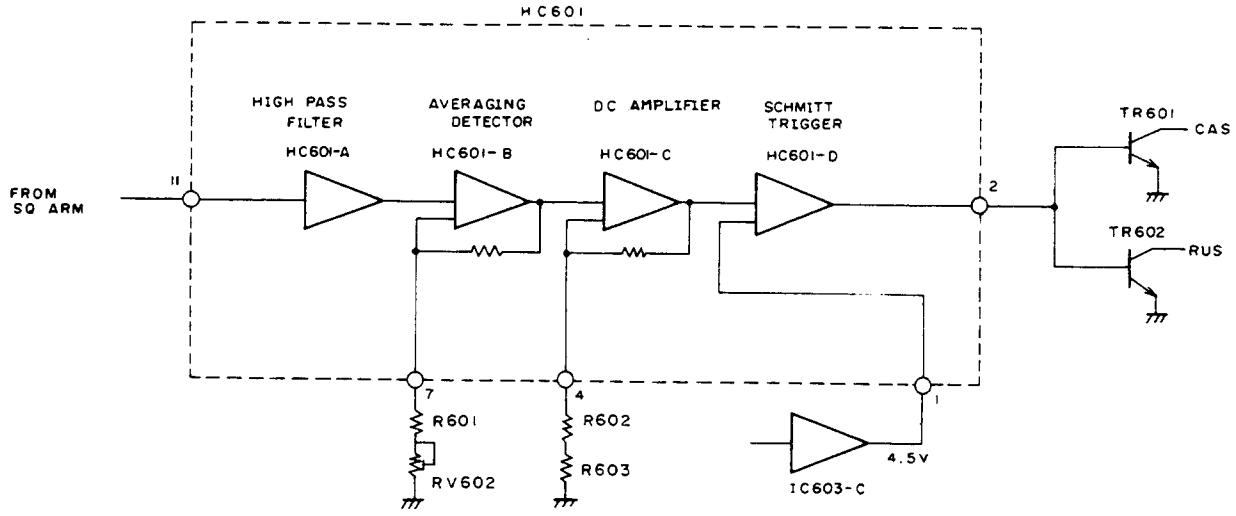

Figure 1 - Squelch circuits (HC601)

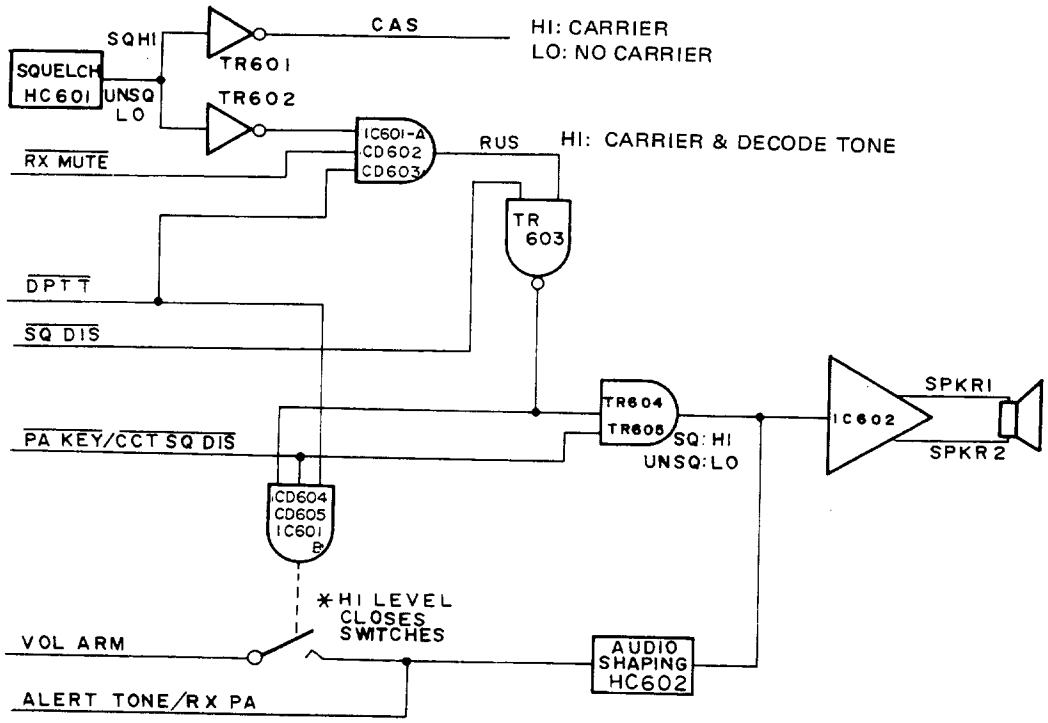

Figure 2 - Audio Control Circuit

POWER DISTRIBUTION

Battery supply A+ enters the radio through the front connector at J801-19. A- enters through J801. Figure 3 is a block diagram of the power distribution system. Two heavy connections are provided for transmit A+ and transmit A- and connect to two busses. The busses are connected to the PA through a special feedthrough arrangement. A second set of wires is routed through the control unit and supplies power to the audio amplifier and all other radio circuitry.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

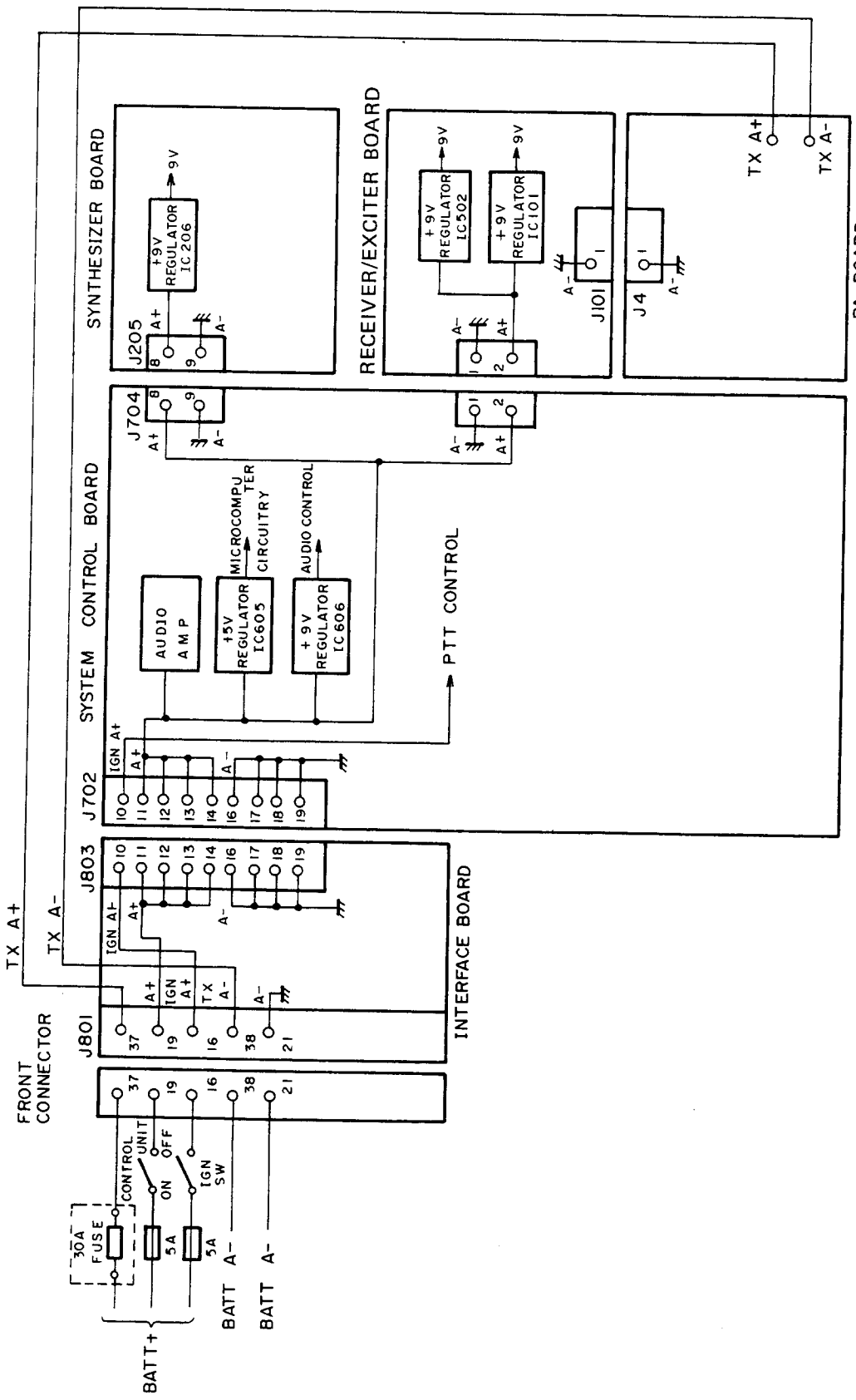

Figure 3- Power Distribution

CHANNEL GUARD

Channel Guard provides a means of restricting calls to specific radios through the use of a continuous-tone or digitally-coded squelch system (CTCSS or CDCSS). Tone frequencies range from 67 Hz to 210.7 Hz, 33 standard tones and 83 unique digital codes are available. These tones/codes are identified in Tables 2 and 3.

STANDARD TONE FREQUENCIES Hz				
67.0	88.5	107.2	131.8	167.9
71.9	91.5	110.9	136.5	173.8
74.4	94.8	114.8	141.3	179.9
77.0	97.4	118.8	146.2	186.2
79.7	100.0	123.0	151.4	192.8
82.5	103.5	127.3	156.7	203.5
85.4			162.2	210.7

TABLE 2 - Channel Guard Tone Frequencies

★

PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE	PRIMARY CODE	EQUIVALENT CODE
023	340, 766	205	135, 610	464	237,642, 772
025		223	350, 475, 750	465	056, 656
026	566	226	104, 557	466	144, 666
031	374, 643	243	267, 342	503	157, 312
032		244	176, 417	506	224, 313, 574
043	355	245	370, 554	516	067, 720
047	375, 707	251	236, 704, 742	532	161, 345
051	520, 771	261	227, 567	546	317, 614, 751
054	405, 675	263	213, 136	565	307, 362
065	301	265	171, 426	606	153, 630
071	603, 717, 746	271	427, 510, 762	612	254, 314, 706
072	470, 701	306	147, 303, 761	624	075, 501
073	640	311	330, 456, 561	627	037, 560
074	360, 721	315	321, 673	631 745	231, 504, 636
114	327, 615	331	372, 507	632	123, 657
115	534, 674	343	324, 570	654	163, 460, 607
116	060, 737	346	616, 635, 724	662 444	363, 436, 443,
125	172	351	353, 435	664	344, 471, 715
131	572, 702	364	130, 641	703	150, 256
132	605, 634, 714	365	107	712	136, 502
134	273	371	217, 453, 530	723	235, 611, 671
143	333	411	117, 756	731	447, 473, 474
152	366, 415	412	127, 411, 711		744
155	233, 660	413	133, 620	732	164, 207
156	517, 741	423 713	234, 563, 621	734	066
162	416, 553	431	262, 316, 730	743	312, 515, 663
165	354	432	276, 326	754	076, 203
172	057	445	222, 457, 575		
174	142, 270				

TABLE 3 - Primary and Equivalent Digital Codes (Octal)

The Channel Guard encode and decode functions are implemented in the microcomputer under software control. The microcomputer provides digital and/or tone Channel Guard with Squelch Tail Elimination (STE).

If the radio is in the receive mode, the Channel Guard tone/code is hard limited and inputted into the microcomputer through IC702-29 (LIM CG Tone Decode). If the correct tone code is present, the receiver is opened by the RX MUTE line. If the radio is in the transmit mode, the microcomputer generates the Channel Guard tone using WALSH BIT 1 and WALSH BIT 2. Those outputs are summed together and filtered on the System Control board to generate a smooth sinewave for tone Channel Guard or a digital waveform for digital Channel Guard.

The Channel Guard contains a summing amplifier IC604-A 8-pole active voice reject filter HC604 limiter IC604-C and tone/code reject filter HC603. A Channel Guard disable circuit TR606 allows the Channel Guard encode to be disabled. The Channel Guard decoder can be disabled at the microcomputer.

The microcomputer selects the assigned Channel Guard encode code/tone information from the EEPROM memory for each channel, transmit and receive, and generates the Channel Guard signal.

The output of audio preamplifier IC603-A is applied to the summing amplifier through bilateral switches IC601-C and D. In the encode mode DPTT is high applying A- from IC601-D to the control input of IC601-C turning it off and preventing any input from the output of audio preamplifier IC603-A from interfering with the encoding signal.

The output of summing amplifier IC604-A is applied to buffer/amplifier IC604-B through a two-pole active voice reject filter HC604. The active filter shunts all frequencies above 300 Hz to ground, thereby preventing those frequencies from interfering with the encoded signal. The output of IC604-B is the assigned CG tone or digital signal. This signal is applied to the REF MOD line through CG deviation control RV604 and IC609. Channel Guard deviation is set for 0.75 kHz.

In the decode mode DPTT is low, turning bilateral switch IC601-D off, allowing the 9 V filtered supply to turn IC601-C on. The output of audio preamplifier IC603-A is then applied to the summing amplifier IC604-A through bilateral switch IC601-C. This signal is amplified and filtered by IC604A,B and HC604, so that only the CG signal (if present) is applied to hard limiter IC604-C. The CG signal is squared up for comparison by the microcomputer to determine if the CG signal is correct. If the microcomputer determines the CG signal to be correct, RX Mute transistor TR713, is turned off, applying +9 VDC to the RX MUTE line to open the receiver.

The Channel Guard Disable(CG DSBL) line has a double function. It can disable the encode or the decode CG function. The encode function is disabled by applying +19 V or more to J701-2. This will turn on TR606 and shunt the Channel Guard tone/code to ground while the decode function is disabled within the microcomputer software. To disable the decoder, ground the CG DSBL line at J701-2. The microcomputer will detect that the line is low, turn off TR713 and force the RX MUTE line high. The decode filter/limiter circuit is not affected, it continues to operate. The detection software also does not stop working. This allows the off-hook STE to function. When the CG DSBL line is pulled high (9.0 VDC) the microcomputer does not sense any changes. It is buffered by protection diode CD710. Channel Guard disable transistor TR606 will turn on when the CG DSBL line goes above 17 V and shorts the output of the filter to ground. This will prevent any signal from going out on CG HI and will also disable the decoder since no limited CG tone will

go to the microcomputer. The receiver will be muted since no CG is decoded. Disabling the decoder this way will never allow the audio to open up, while taking the radio off hook (pulling $\overline{\text{CG DSBL}}$ low) will always make the radio open up. Turning CG Disable transistor TR606 on causes the DC bias to change. It will take 2 or 3 seconds for the bias to restore itself after the encoder is disabled.

The Squelch Tail Elimination (STE) eliminates squelch tails when the radio is on-hook or off-hook. When Channel Guard is disabled (off-hook), the decoder is still looking at the received signal. The $\overline{\text{RX MUTE}}$ line is high, as would normally be expected. The Channel Guard decoder is looking for the STE burst (phase reversal in tone Channel Guard, STE tone in Digital Channel Guard). If an STE burst is detected, the $\overline{\text{RX MUTE}}$ line will go low for about 200 ms. This will prevent the squelch tail from being heard. After 200 ms, the $\overline{\text{RX MUTE}}$ line will go high again; by now the transmission has ended and the squelch will hold the audio closed. The off-hook STE does not affect the operation of the Channel Guard while on-hook. Another way of looking at it: the radio will go quiet for 200 ms any time STE is detected. If it was on-hook it will stay quiet after the 200 ms, if it was off-hook it will revert to noise squelch operation.

In some instances it is necesssary to invert the polarity of the digital Channel Guard signal to enhance system compatability. Inverted polarity normally results in a wrong code or one that cannot be used. When this occurs, move P603 connected between J604-2, 3 to J603-2,3. The encode DCG codes may be inverted by reprogramming the EEPROM.

FREQUENCY SYNTHESIZER BOARD

The frequency synthesizer receives clock, data, and control information from the microcomputer and from this generates the Tx/Rx RF frequencies. It also provides frequency lock status to the microcomputer. It consists of synthesizer chip IC201, low- and high-current buffers, loop filter, Tx & Rx voltage-controlled oscillators (VCO's), feedback amplifiers, the dual- modulus prescaler, and the reference oscillator. The VCO's are locked to the reference oscillator by a single direct-divide synthesis loop consisting of the feedback buffer, prescaler, and synthesizer. The TX VCO operates over a frequency range of 29 MHz to 50 MHz. The RX VCO operates over the range 49.8 to 70.8 MHz.

REFERENCE OSCILLATOR

The TCXO is enclosed in an RF of a 5 PPM TCXO (Temperature Compensated Crystal Oscillator). The standard reference oscillator frequency is 13.2 MHz.

The TCXO is enclosed in an RF shielded can. Access to the oscillator trimmer is made through a hole in the top of the can. The TCXO is compensated by an internal temperature-compensator circuit for both low and high temperatures. With no additional compensation the oscillators will provide 5 PPM stability from -30°C to +60°C.

CAUTION

TCXOs are individually compensated at the factory and cannot be repaired in the field. Any attempt to repair or change the frequency of a TCXO will void the warranty.

SYNTHESIZER

Synthesizer IC201 contains a programmable reference oscillator divider (÷ R), phase detector, and programmable VCO dividers (÷N, A). The reference frequency, 13.2 MHz from the reference oscillator is divided by a fixed integer number to obtain a 5 kHz channel reference for the synthesizer.
This divide value can be changed by PROM programming. The internal phase detector compares the output of the reference divider with the output of the internal ÷N, A counter. The ÷N, A counter receives as its input the VCO frequency divided by the dual-modulus prescaler and programmed by the microcomputer. This comparison results in a ± error voltage when the phases differ and a constant output voltage when the phase-detector inputs compare in frequency and phase.

If a phase error is detected an error voltage is developed and applied to the VCO DC offset and high current buffers and loop-filter to reset the VCO frequency. The count of the ÷N, A counters is controlled by the frequency data received on the clock and data lines from the microcomputer. Thus, when a different channel is selected or when changing to the transmit or receive mode an error voltage is generated and appears at the phase-detector output, APD OUT causing the phase-locked loop to acquire the new frequency.

The enable pulse from the microcomputer enables the synthesizer and allows frequency data to be internally stored.

EQUALIZER

The equalizer consisting of IC209-A, R216, R219 and C2120 receives transmit audio from Loop Mod adjuster RV201. The output of the equalizer is summed with the output signal from the phase detector by adder IC209-B.

DC OFFSET AND HIGH CURRENT BUFFERS

DC offset buffer TR201, TR205 and diode CD202 receive the error voltage from the synthesizer and increase this level by 1.8 VDC to extend the operating range of the high-current buffers. When the PLL is off-frequency due to a channel change or frequency drift, the error voltage from the synthesizer(APD) rises or falls, turning TR201 either on or off. This transistor TR201 controls the DC offset buffer TR205. R207, CD202 and TR205 complete a high-current rapid-charge or -discharge path for C207-C209.

As the error voltage decreases, TR201, TR205 and CD202 turn on completing a discharge path for C207 to C209. When the error voltage goes positive TR201, TR205 and CD202 are turned off, allowing C207 to C209 to charge through R207. IC204 is turned on for four milliseconds when a channel is changed in receive. The time is 20 milliseconds when in transmit and when changing from transmit to receive.

LOOP FILTER

The loop-filter consists of R209-R211, and C207-209. This filter controls the bandwidth and stability of the synthesizer loop. Bilateral switch IC204 is controlled by the 4 millisecond, 9 volt channel-change pulse. When the channel-change pulse is present, the bilateral switch shorts out the low-pass filter, greatly increasing the loop bandwidth to achieve the 4-millisecond channel acquisition time required for dual priority scan. The low-pass filter removes noise and other extraneous signals internal to the synthesizer chip.

The output of the filter is applied to the varicaps in the transmit and receive VCO's to adjust and maintain the VCO frequency.

The use of two VCO's allows rapid independent selection of transmit and receive frequencies across the frequency split.

RECEIVER VOLTAGE CONTROLLED OSCILLATOR

The receiver VCO consists of a low-noise JFET oscillator, TR210, followed by high-gain buffer TR211. TR211 prevents external loading and provides power gain. The VCO is a Colpitts oscillator with the various varactors, capacitors and coil forming the tank circuit.

The VCO is switched on and off under control of the DPTT line. When the DPTT line is low, the Receiver VCO is turned on (TR213 is off, TR212 is on). Oscillator output is typically +10 dBm. The output is applied to the feedback buffer for VCO frequency control and as the Rx/Ex injection frequency to the receiver 1st mixer through L.O. buffers TR402, TR403 on the RX board. The Rx VCO also uses a high-Q resonator coil to achieve superior noise performance. The VCO operates over a frequency range of 49.8 to 70.8 MHz. The VCO voltage need only be set once at the highest frequency of the band split, after which it will operate over the entire split with no more tuning.

TRANMITTER VOLTAGE CONTROLLED OSCILLATOR

The transmit VCO is basically the same as the receiver VCO. The wideband VCO allows frequency separation of 13 MHz or 15 MHz as determined by the bandsplit the radio is operating on, 29-42 MHz or 35-50 MHz. The varactors in conjunction with the frequency segment selector circuitry (TR216 - TR219, TR227, TR228, TR230 and pin diodes CD217, CD218 and CD221) provide a voltage-controlled adjustment range that extends across the entire frequency split.

VCO control switch TR222 turns the Transmit VCO on when DPTT is high.

FEEDBACK BUFFER

The buffered outputs of the Rx VCO and Tx VCO, from TR211 and TR221 respectively, are supplied to the feedback buffer amplifiers TR206 and TR207. This, in turn drives the dual-modulus prescaler IC202. The buffered VCO outputs also drive the synthesizer output buffer IC208, which provides the common Receiver/Exciter Injection drive.

DUAL-MODULUS PRESCALER

The dual-modulus prescaler completes the PLL feedback path from the synthesizer to loop filter, to the VCO's and feedback buffers and then back to the synthesizer through the prescaler. The prescaler divides the VCO frequency by 64 or 65 under control of M CONT from the synthesizer. The output of the prescaler is applied to the synthesizer where it is divided down to 5 kHz by an internal ÷ N, A counter and compared in frequency and phase with the divided-down frequency from the reference oscillator. The result of this comparison is the error voltage used to maintain frequency lock. The ÷ N, a counter is controlled by data received from the microcomputer. Depending on the operating frequency, the DC voltage at TP201 should be within the range 3.5 to 7.5 VDC when the PLL is locked.

LOCK DETECT

The lock-detect circuit consists of comparator IC203, diodes CD203 and CD204, and reference oscillator mute switch TR208 and TR209. It is used to quickly synchronize the phase relation of the divided-down VCO frequency and the reference oscillator if the loop loses lock. It also provides a fast lock-detect signal to the microcomputer to turn on the out-of-lock indicator. If a large change in frequency is required, the ramp capacitor output (C_R) of the synthesizer may increase to near 7.5 VDC and cause the comparator output to decrease. This decrease in voltage turns TR209 off and allows TR208 to be turned on by the

positive LD line from the synthesizer. Thus TR208 disables the reference oscillator and allows the PLL loop to be brought back to synchronization rapidly.

If a large frequency error exists, the LD positive lead from the synthesizer will carry negative spikes to the microcomputer through CD204 to activate the lock indicator circuit. Pulse shaper IC701 is a one-shot multivibrator which increases the pulse width to span 1 computer cycle. TR209 is turned on, keeping TR208 off thereby preventing TR208 from muting the reference oscillator.

MODULATION LEVEL CONTROL

The modulation level control circuit automatically sets the Tx audio level applied to the transmit VCO modulator CD212 through VCO deviation adjust control RV202. The modulation level control circuit consists of IC205, R274 - R282, varactor CD212, C245 and bypass capacitors C247 and C248. The modulation level is controlled by turning bilateral switches IC205 on or off (under control of IC705) to include attenuators R275, R276 and R281 in the circuit. R274, R275, R276 and R281 form an adjustable voltage divider to change the modulation level as required. Table 1 also identifies the resistor (if applicable) used for each frequency segment.

FREQUENCY SEGMENT SELECTOR

The frequency-segment selector switches capacitance in and out of the Tx and Rx VCO tank circuits to select the frequency segment containing the selected channel. The frequency segment selector consists of TR216 - TR219, TR227, TR228, TR230, CD209, CD210, CD217, CD218, CD220 and CD221 and operates under control of the microcomputer through FF's IC705A & B. Capacitors (C224, C227, C252, C255, C291 and C294) are selected or deselected for operation in a given segment. Table 4 identifies the circuit conditions existing for selection of each segment and the capacitors used.

Reverse bias to turn off the pin-diodes is provided by the +8 V filtered supply through R232, R234 and R286. Forward bias for the diodes and current for the switching transistors are provided by the +8 V supply though R231, R233 and R285. When segment 3 is selected, TR216, TR219 and TR227 are turned on. In the Tx VCO diodes CD217 and CD221 are reverse biased and CD218 is turned on. Capacitors C251 and C293 are effectively isolated from ground by L218 and L225 respectively and C254 is connected to ground via CD218 and TR219.

Similarly in the RX VCO C223 and C290 are isolated from ground, and C226 is grounded via CD210 and TR219.

Operation of the radio over the frequency ranges 29-42 MHz or 35-50 MHz is determined by the group number of the synthesizer board. Each frequency split is divided into four operating segments varying from 3 to 4 MHz wide.

SEGMENT	TRANSISTOR SWITCH*							PIN DIOES						GROUNDED CAPACITORS
	TR216	TR217	TR218	TR219	TR227	TR228	TR230	CD209	CD210	CD217	CD218	CD220	CD221	
1	0	1	0	1	0	1	1	ON	ON	ON	ON	ON	ON	ALL
2	0	1	1	0	1	0	0	ON	OFF	ON	OFF	OFF	OFF	C223 C251
3	1	0	0	1	1	0	0	OFF	ON	OFF	ON	OFF	OFF	C226 C254
4	1	0	1	0	1	0	0	OFF	OFF	OFF	OFF	OFF	OFF	NONE

* '1' indicates transistor is turned on.

TABLE 4 - Capacitor Selection

PA BOARD

The four power amplifiers covering the frequency ranges of 29-42 MHz and 35-50 MHz and power levels of 60 W and 110 W, are very similar in construction and operation. The only differeces are in the transistor types and some component values. The following description applies to all four versions.

The PA assembly uses a driver and three RF power transistors to provide rated output power. The output power is adjustable over a range of 55 to 110 watts and 30 to 60 watts for the two power versions. Five transistors are used in the power control circuit.

Supply voltage for the PA is provided by power leads from the System Interface Board to J3 (A+) and (A-) on the PA board. Diode CD11 will cause the main fuse in the fuse assembly to blow if the polarity of the power leads is reversed. CD10 is a surge protector to suppress voltage surges on the power leads.

RF AMPLIFIERS

The Exciter output is coupled through coaxial cable P1 to the PA input. The RF is coupled through an attenuator pad (R1-R3), impedance matching transformer T1 and frequency compensator C2 and R4 to the base of pre-driver TR1. L1, CD1, and R6 set the bias voltage for TR1. C3, R6 and R36 provide negative feedback to improve the stability of TR1. Collector voltage on pre-driver TR1 is controlled by the Power Control Circuit and is applied trough a decoupling network which consists of C5, C6 and C58.

The output of TR1 is coupled to the base of amplifier TR2 through impedance-matching transformer T2 and frequency compensator C8, R34 and R35. C7 provide matching between T2 and the base of TR2. C11 and R9 provide negative feedback and R8 improves the stability of TR2.

Collector voltage to driver TR2 is supplied through a decoupling network consisting of C13 to C15 and L13.

The RF output from TR2 passes through impedance-matching transformer T3 and matching element C12. (Note: This is a 50 ohm point and may be used for checking power levels). From C16, RF passes through stabilizing resistors R10 and R11 and matching element C17 to input of 4:1 transformer T4.

The Power Amplifier, consisting of TR3, TR4, T4 and T5 is a class-C push-pull power amplifier. T4 provides impedance-matching and power splitting to the bases of TR3 and TR4. C18 and C19 provide matching elements to T4. R12 and R13 provide the base loading to TR3 and TR4. C21, C24, R14 and R15 are negative feedback elements to improve the stability of TR3 and TR4, T5 provides impedance-matching and power combining for the collectors of TR3 and TR4. C26 and C27 provide matching elements to T4. C22 and C23 provide matching elements to the collector of TR3 and TR4.

Operating voltage for the power amplifier is supplied from the DC input through T5 and decoupling network consisting of C28 to C30 and L2.

The output of the power amplifier passes through T5 to the LPF network consisting of C31 to C33 and L4. (Note: This is a 50 ohm point and may be used for checking power levels.) The RF power passes through 50 ohm microstrip Z2 and Z3, directional coupler T6 and associated components and transmit/receive relay K1 to the low-pass filter.

The relay is energized by D9V from the System Control Receiver/Exciter Board.

POWER CONTROL CIRCUIT

The power control circuit provides closed-loop RF power leveling and power turndown when it senses high VSWR load conditions.

When the transmitter is keyed, TX9V turns on and supplies current to DC Amplifier, which provides a constant control reference voltage.

TR5 to TR8 serve as DC amplifiers to supply voltage to the collector of TR1. The setting of RV1 determines the current supplied to the base of TR5. As the detected RF power increases, the current to the base of TR5 increases causing TR5 to pull current away from the base of TR8. This cuts back the drive to TR8 and in turn TR7, which reduces the voltage at the collector of TR1, decreasing RF output power.

RF power is sensed by directional coupler T6 and its associated elements. Forward power is sensed by CD3 and reflected power by CD2. Forward power is determined by the setting of RV1. CD4 to CD7 set the level of reflected RF power at which the control circuit reduces the RF output.

Thermal protection is provided by R30 (posistor) and its associated elements. R30 is thermally connected to the body of TR4. As the temperature of TR4 rises above 90°C, the resistance of R30 increases, and TR6 turns ON. This diverts emitter current from TR5 to R25, which lowers the voltage at the collector of TR1, reducing the power output.

CAUTION

Do not operate the transmitter at levels higher than rated output. Operating at higher than rated output will shorten the life of the RF power transistors.

RECEIVER/EXCITER BOARD

EXCITER CIRCUIT

The Exciter consists of a broadband negative feedback amplifier stage operating over a frequency range of 29-50 MHz.

An attenuator pad R138 and R139 at the input of the exciter provides a constant load for the injection amplifier and attenuates the signal from the injection amplifier to approximately +13 dBm. The exciter amplifies the +13 dBm signal from the injection amplifier to provide 100 mW to the power amplifier.

The Tx injection signal input from the injection amplifier is applied to the base of amplifier TR104 through an attenuator pad and impedance matching components L117 and C169. The impedance matching network matches the injection amplifier output to the base of TR104. R140, R141 and CD105 set the bias voltage for the TR104. C172 provides noise decoupling. L117 consists of broadband transformer (4:1 impedance ratio). R142 and C170 provide negative feedback to improve the stability of TR104.

The 100 mW output of TR104 is coupled to the power amplifier board through low-pass filter consisting of C174, C175, C176, L119 and output connector J102. Collector voltage for TR104 is supplied by Tx 9 V through Tx switch TR107. +9 V is regulated from the A+ to 9 VDC by IC502. When $\overline{\text{TX ENBL}}$ goes high (receive mode) TR107 is turned off.

Service Note

The output RF level can be measured by connecting a 50-ohm dummy load to J102, feeding a +3 dBm signal to P402 (135-174 MHz) and grounding the $\overline{\text{TX ENBL}}$ line.

RECEIVER CIRCUIT

The FM dual-conversion, superheterodyne receiver is designed for operation in the 29-42/35-50 MHz frequency ranges. A regulated 9.0 volts is provided to all receiver stages except the audio PA IC, which operates from the switched A+ supply.

The receiver has intermediate frequencies of 20.8 MHz and 455 kHz. Adjacent channel selectivity is obtained by using two band-pass filters: a 20.8 MHz crystal filter and a 455 kHz ceramic filter.

All of the receiver circuitry except the synthesizer, audio preamp, audio PA, and squelch circuit is mounted on the Receiver/Exciter board. The receiver consists of:

- Front End and Mixer
- 20.8 MHz 1st IF, 455 kHz 2nd IF and FM Detector
- Audio PA
- Squelch

RECEIVER FRONT END

An RF signal from the antenna is coupled through the low-pass filter, antenna relay, and band-pass filter to the input of RF amplifier TR401. The output of TR401 is coupled through low-pass filter and high-pass filters to the input of 1st mixer HC401. Front-end selectivity is provided by these band-pass, low-pass and high-pass filters.

RECEIVER INJECTION

Receiver RF injection (49.8-62.8 or 55.8-70.8 MHz) from the synthesizer VCO is applied to amplifier TR402 through P402. The input level at P402 will be between 0.5 and 1.0 milliwatts. The output of amplifier TR402 is coupled to the input of amplifier TR403. The output of amplifier TR403 is filtered by a band pass filter. This filter is tuned to pass frequencies in the 49.8-70.8 MHz passband.

1st MIXER

The first mixer is a double-balanced diode mixer (HC401) that converts a signal in 29-42 or 35-50 MHz range to the 20.8 MHz first IF frequency.

In the mixer stage, RF from the front-end RF filter is applied to one input of the mixer. Injection voltage from the amplifier stages is applied to the other input of the mixer. The 20.8 MHz 1st IF output signal is coupled from the output of HC401 through C501 to the source input of IF AMPL TR501. TR501 are a JFET amplifier/buffer stage. The output of the JFET buffer is coupled through C502 to the optional noise blanker (W402 removed) or through impedance matching networks L505, L506 and associated circuitry (bypassing IF blanking FETs TR502 and TR503) to a 4-pole XTAL band-pass filter.

1st IF

The highly-selective Crystal filter consisting of FL501-1 and FL501-2 provides the first portion of the receiver IF selectivity. The output of the filter is coupled through impedance-matching network L507, C514 and C515 to the 1st IF amplifier TR504. The amplifier provides approximately 20 dB of IF gain. The output of TR504 is coupled through an impedance-matching network L508 to a 2-pole XTAL bnad-pass filter. The output of the XTAL band-pass filter is coupled through an impedance matching network L509 to the input of IC501. Diodes CD501 provides limiting for the 20.8 MHz IF signal (1.4Vp-p) to prevent high level overload of IC501.

2nd IF and DETECTOR

IC501 and associated circuitry comprise the 2nd oscillator/mixer, IF amplifier and FM detector. The 20.8 MHz IF input is applied to pin 18 of IC501 and mixed with a 20.345 MHz frequency supplied by crystal oscillator X501. Low-side injection is used. The output of the internal mixer is amplified and applied to a 6-pole ceramic filter, FL503 which provides the 455 kHz selectivity. The output of the 455 kHz filter is reapplied to IC501-5. The 2nd IF signal is amplified and limited. L510 shifts the IF signal by 90° and reapplies it to the internal FM detector. The FM detector compares the shifted IF signal to the internal IF signal to recover the audio modulation. The audio output of IC501 is applied to the System Control board.

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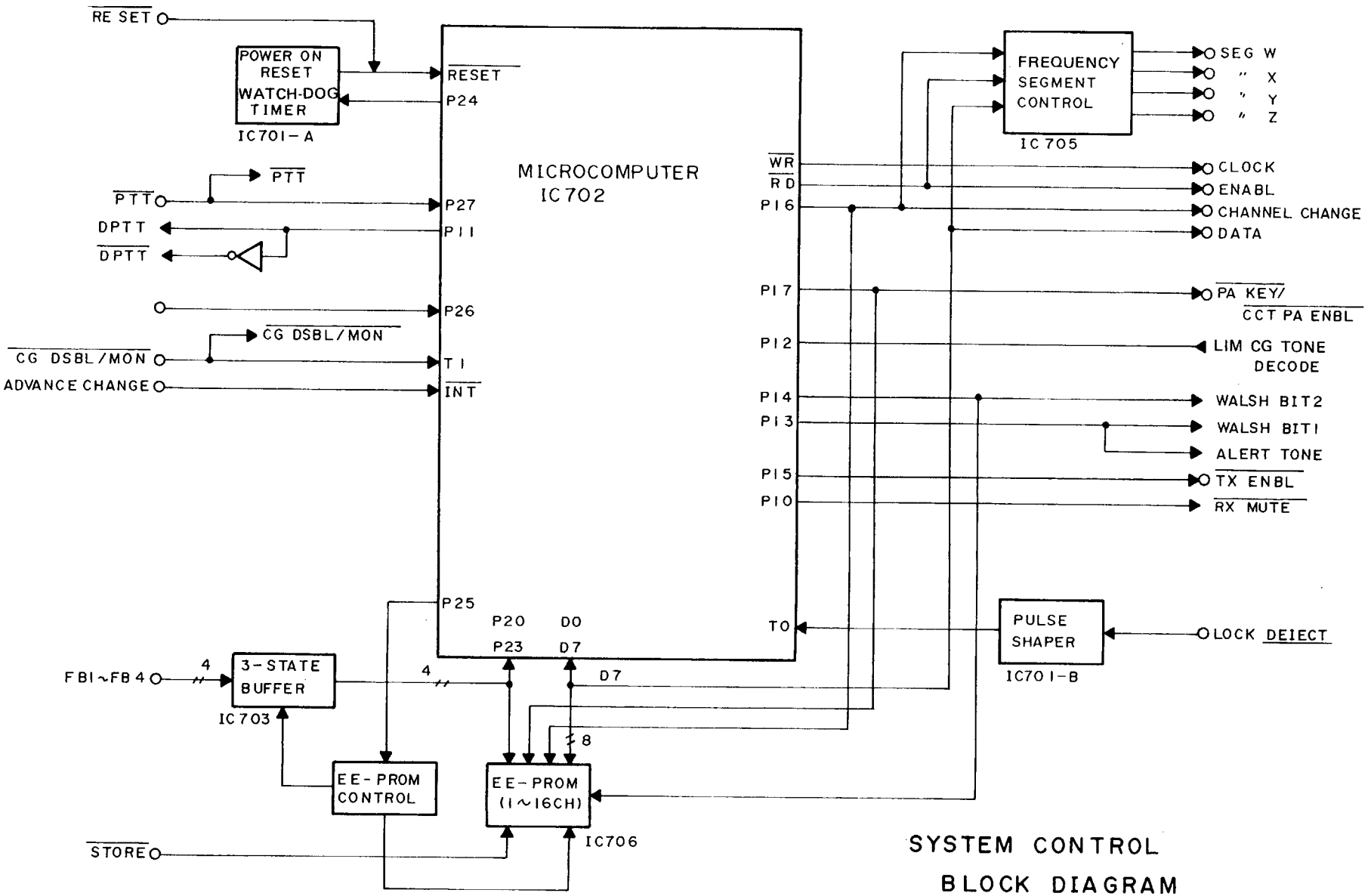
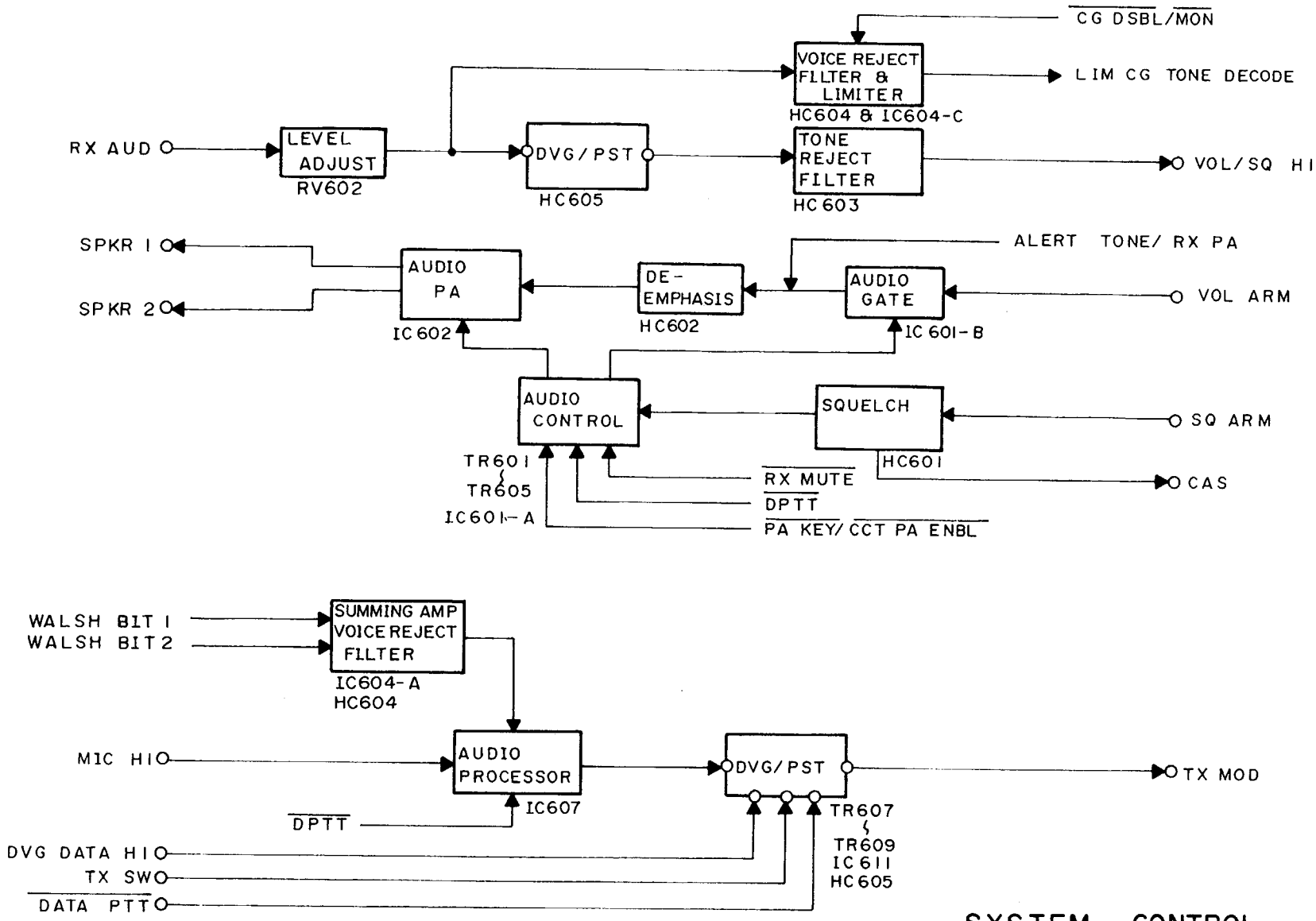
SECTION	BLOCK DIAGRAM
SYSTEM CONTROL	DA00–CMC–486
SYNTHESIZER	DA00–CMG–170
POWER AMPLIFIER	DA00–CAH–705
RECEIVER/EXCITER	DA00–CMN–203
INTERCONNECTION	DD00–JHM–155

SECTION	SCHEMATIC DIAGRAM			
	A BAND 29 – 42 MHz		B BAND 35 – 50 MHz	
	60 W	110 W	60 W	100 W
SYSTEM CONTROL	DD00–CMC–486			
SYNTHESIZER	DD00–CMG–170			
POWER AMPLIFIER	DD00–CAH–705			
RECEIVER/EXCITER	DD00–CMN–203			
INTERFACE	DD00–CMH–813			



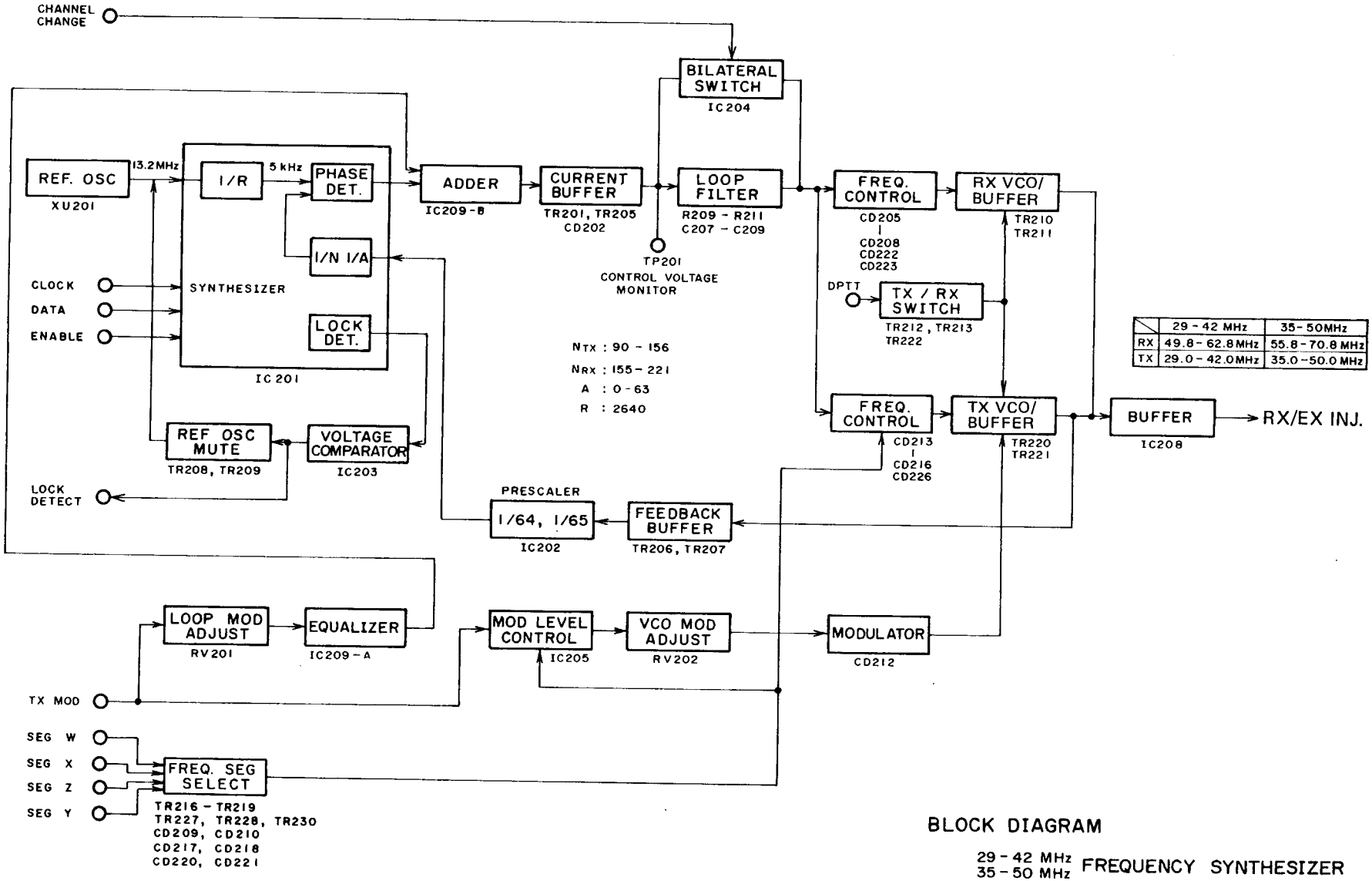
SYSTEM CONTROL
BLOCK DIAGRAM

DA00-CMC-486 1/2



SYSTEM CONTROL
BLOCK DIAGRAM

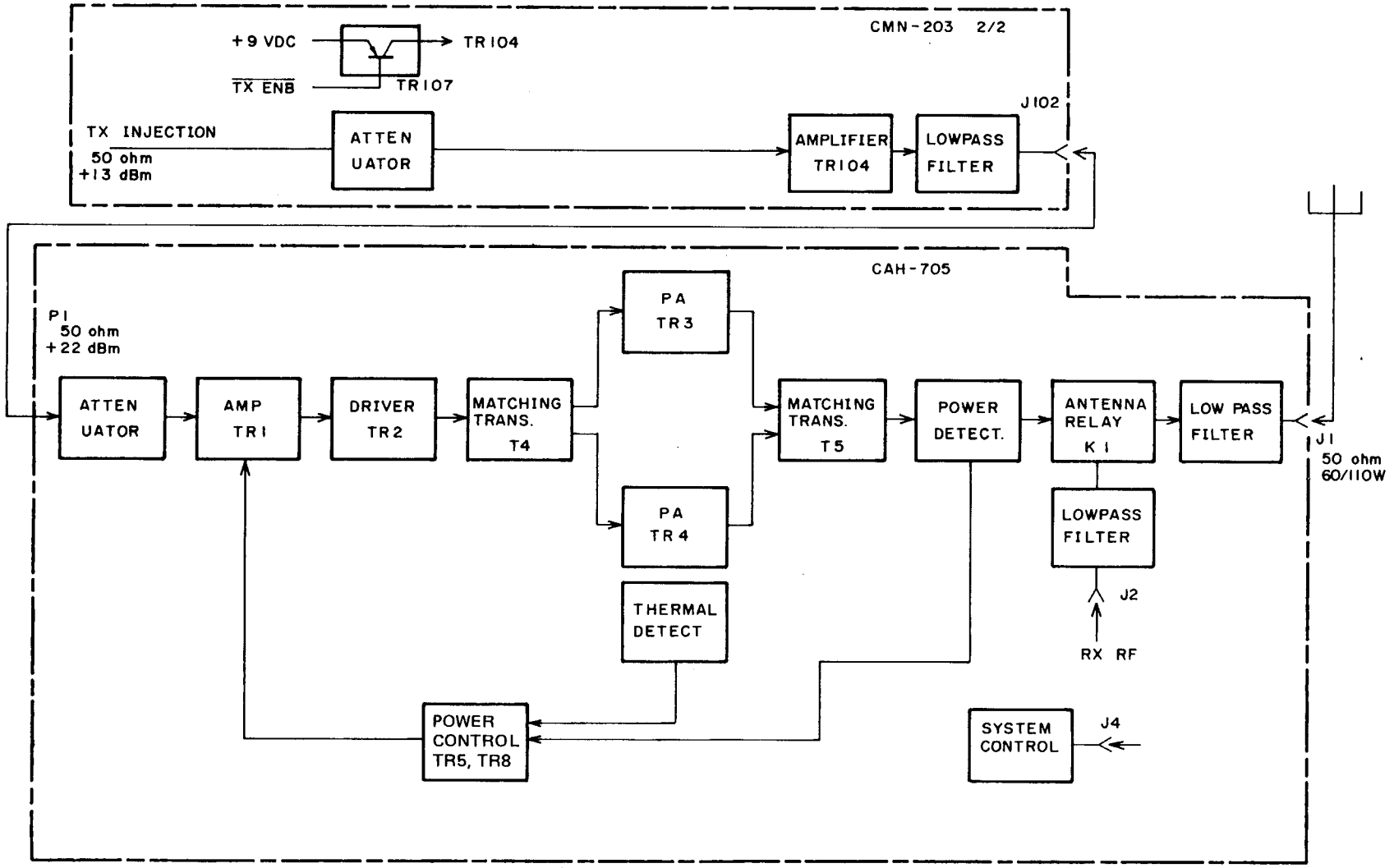
DA00-CMC-486 2/2



BLOCK DIAGRAM

29 - 42 MHz
35 - 50 MHz FREQUENCY SYNTHESIZER

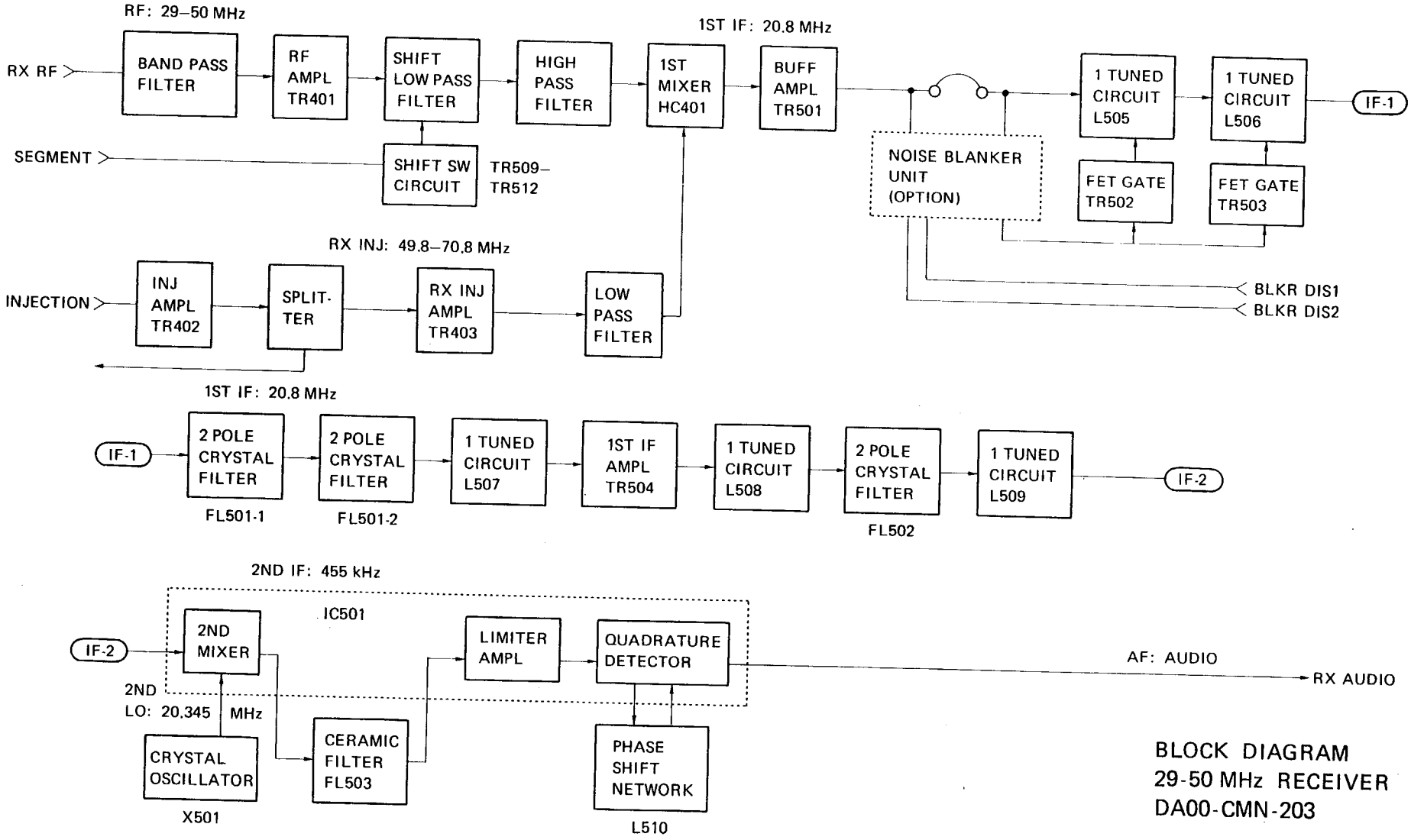
DAOO - CMG - 170



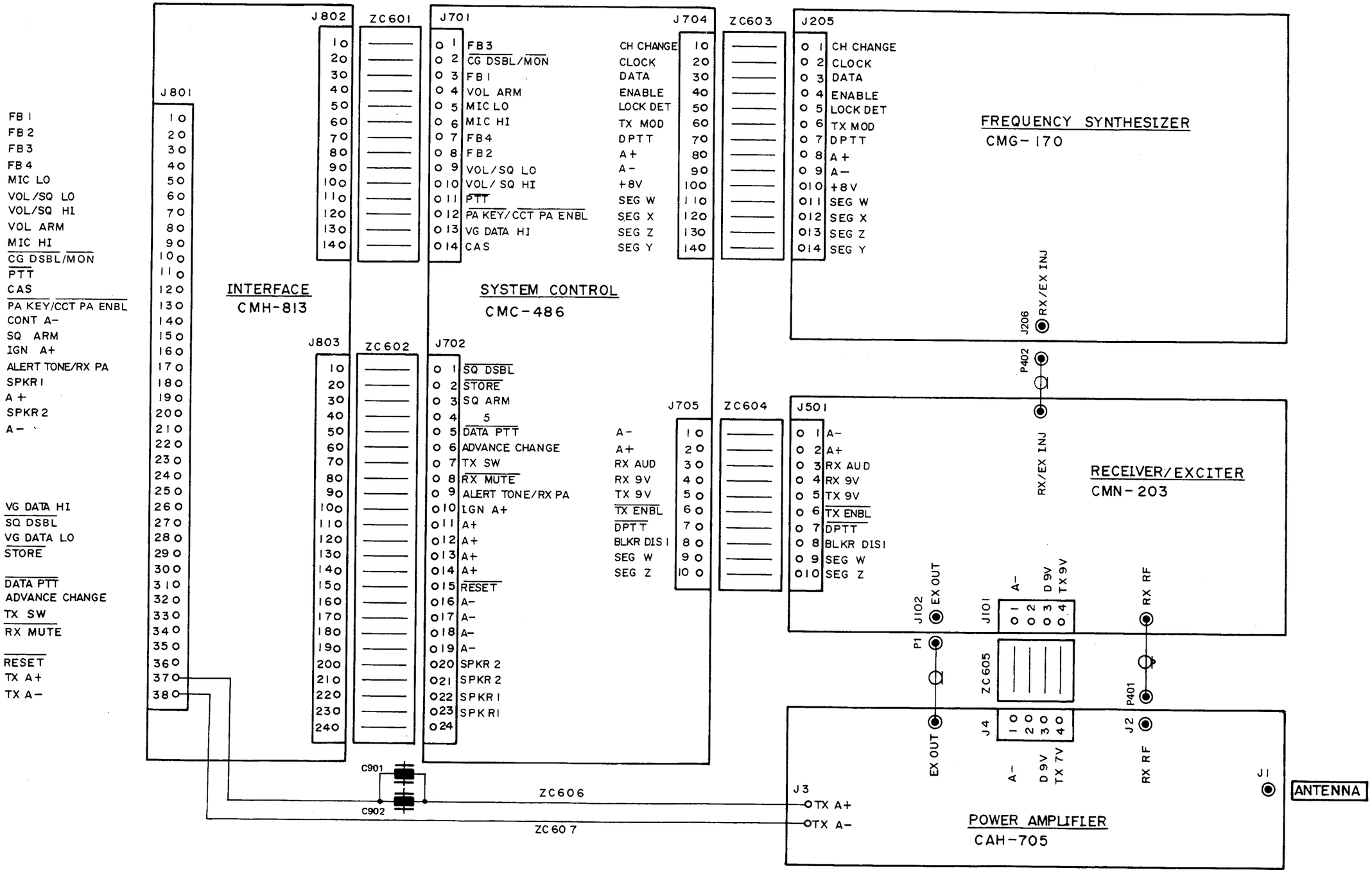
Low-Band Exciter and Power Amplifier Block Diagram

POWER AMPLIFIER CAH–705
(including EXCITER CMN–203)

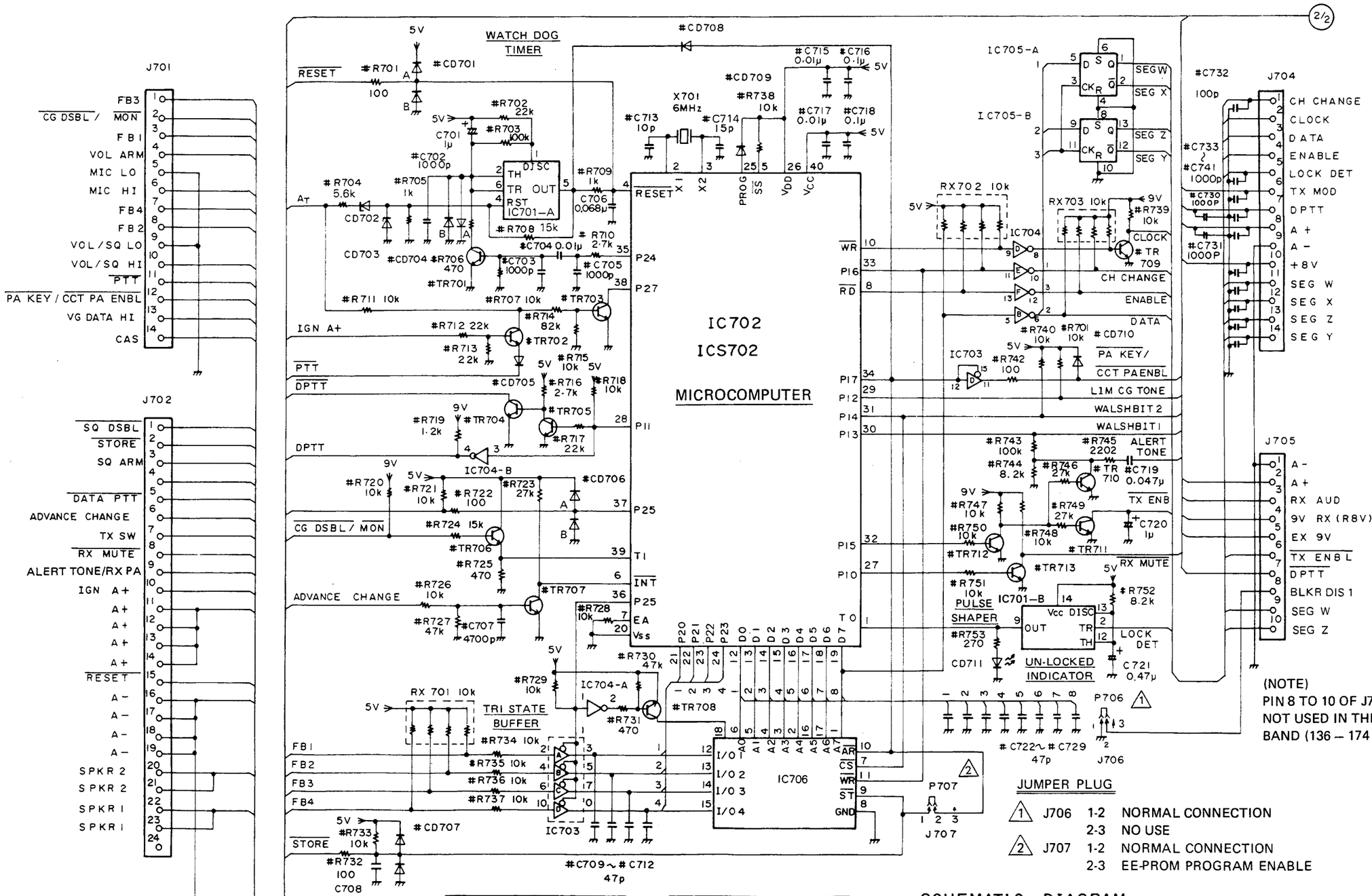
DA00–CAH–705



BLOCK DIAGRAM
29-50 MHz RECEIVER
DA00-CMN-203



INTERCONNECTION DIAGRAM
DD00-JHM-155



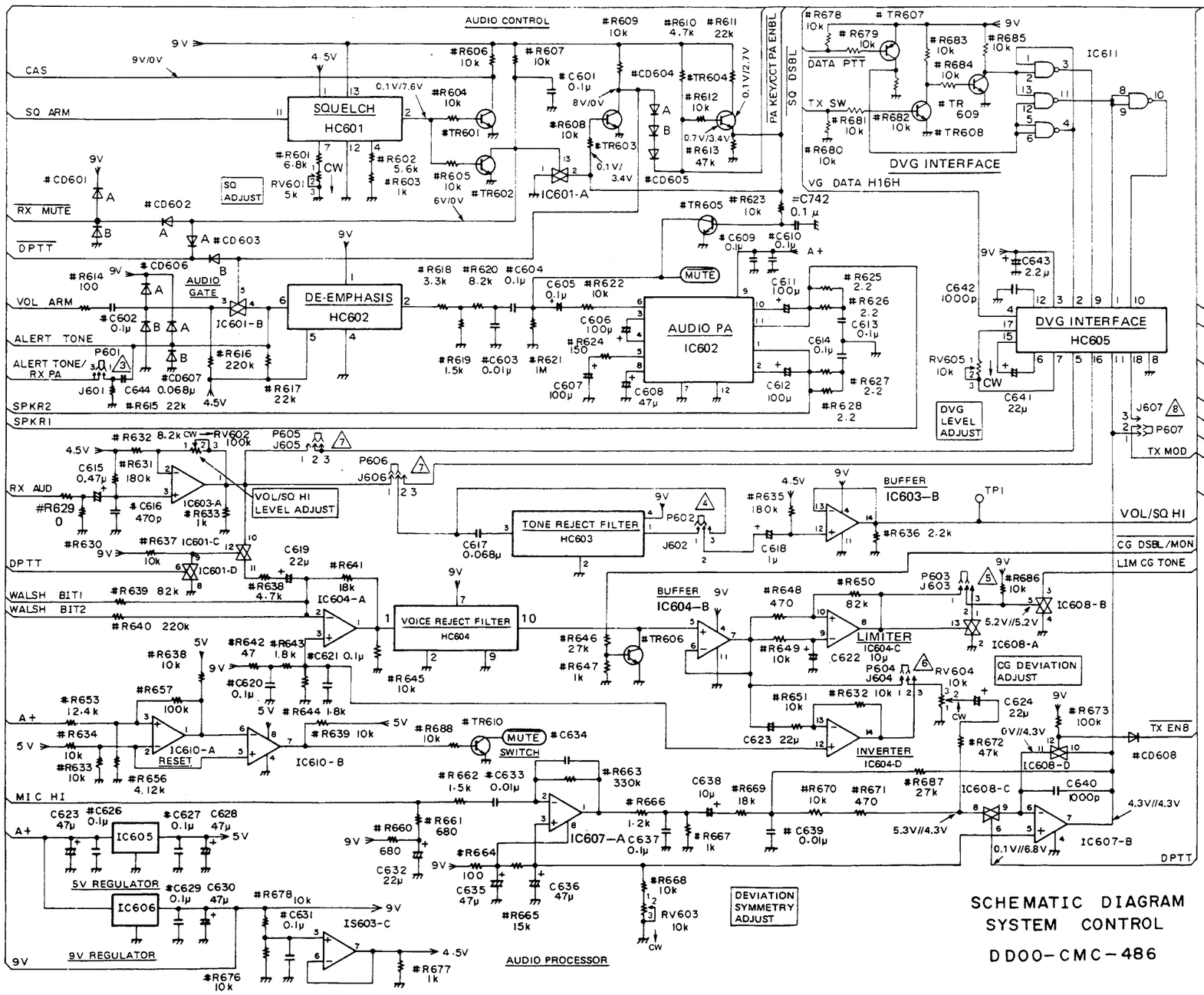
POW		GND
5 V	9 V	
IC701-14	–	IC701-7
IC703-16	–	IC703-8
IC704-14	–	IC704-7
–	IC705-14	IC705-7

SPARE GATE		
DEVICE	INPUT	OUTPUT
IC703	14	13

JUMPER PLUG

1	J706	1-2	NORMAL CONNECTION
		2-3	NO USE
2	J707	1-2	NORMAL CONNECTION
		2-3	EE-PROM PROGRAM ENABLE

SCHEMATIC DIAGRAM
SYSTEM CONTROL
DD00-CMC-486 1/2



19 V	GND
IC601-14	IC601-7
IC603-4	IC603-11
IC604-4	IC604-11
–	IC607-4
IC608-14	IC608-7
IC609-14	IC609-7

SPARE GATE			
DEVICE	INPUT	OUTPUT	CONTROL
IC609	3	4	5
	8	9	6
	10	11	12

JUMPER PLUG

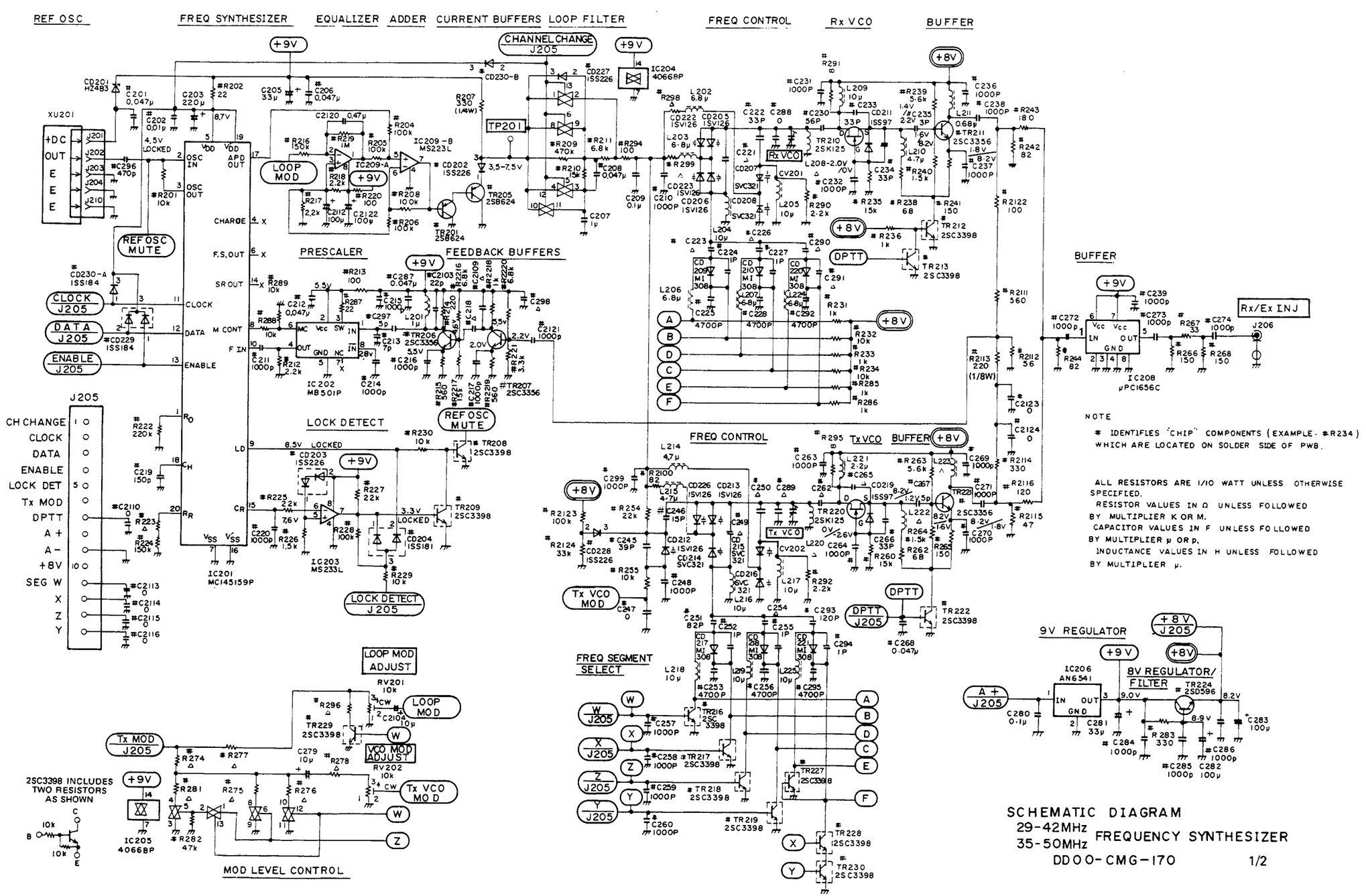
3	P601	1-2	NORMAL CONNECTION
		2-3	ALERT TONE/Rx PA DISABLE
4	P602	1-2	CG TONE REJECT FILTER USED
		2-3	CG TONE REJECT FILTER NOT USED
5	P603	1-2	RECEIVE CG POLARITY NORMAL
		2-3	RECEIVE CG POLARITY INVERTED
6	P604	1-2	TRANSMIT CG POLARITY NORMAL
		2-3	TRANSMIT CG POLARITY INVERTED
	P605	2-3	NORMAL
		1-2	WITH VOICE GUARD
7	P606	1-2	NORMAL
		2-3	WITH VOICE GUARD
8	P607	1-2	NORMAL
		2-3	WITH VOICE GUARD

DC VOLTAGE CHECK

SQUELCH CIRCUIT SHOWN FOR UNSQUELCHED/SQUELCHED
AUDIO PROCESSOR CIRCUIT SHOWN FOR DPTT LOW/DPTT HIGH

SCHEMATIC DIAGRAM
SYSTEM CONTROL
DDOO-CMC-486

2/2



NOTE

* IDENTIFIES "CHIP" COMPONENTS (EXAMPLE: *R234) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.

ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER μ OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER μ.

SCHEMATIC DIAGRAM
29-42MHz
35-50MHz FREQUENCY SYNTHESIZER
DDOO-CMG-170 1/2

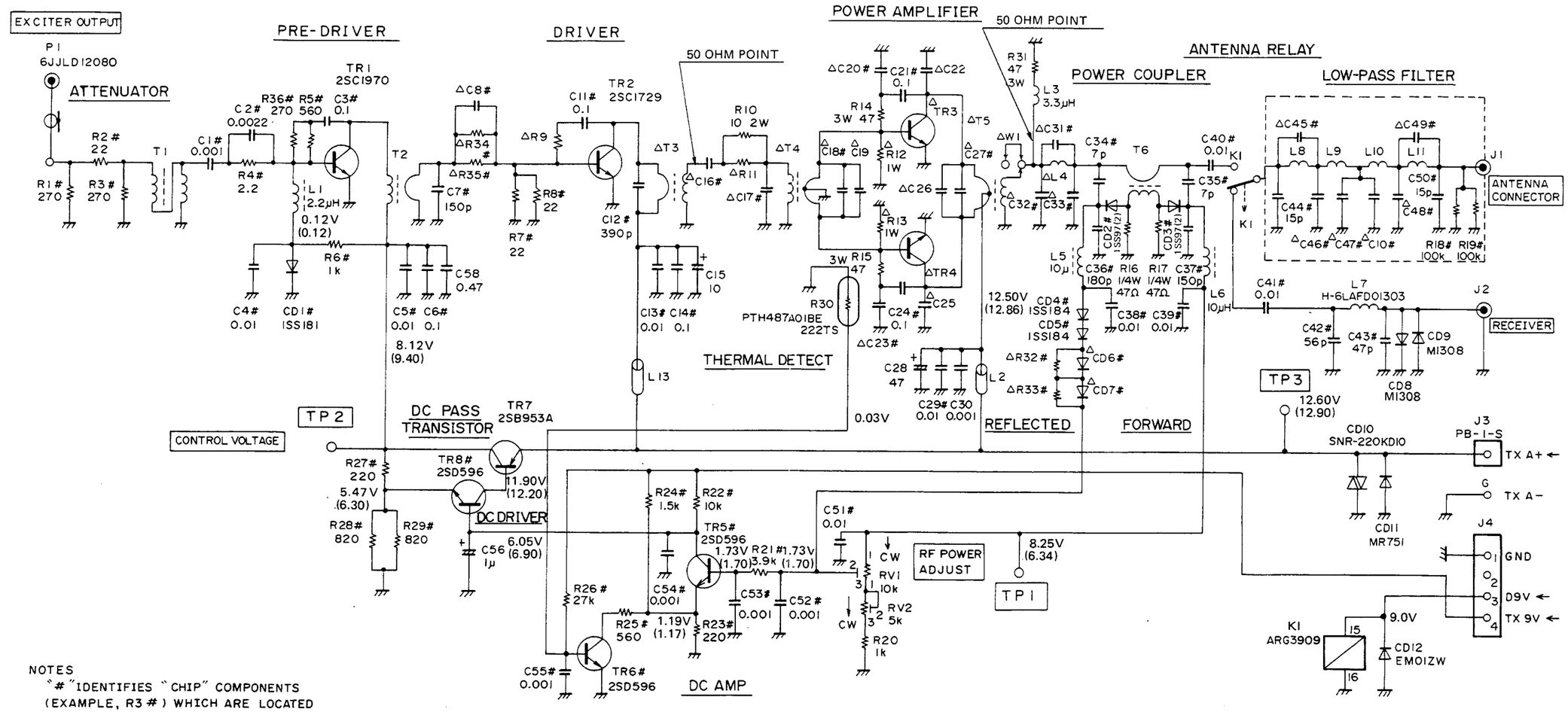
Δ COMPONENT IDENTIFICATION CHART

SYMBOL	CMG-170A (29–42 MHz)	CMG-170B (35–50 MHz)
C218	47pF	22pF
C221	18pF	27pF
C223	56pF	68pF
C226	18pF	22pF
C249	100pF	68pF
C250	120pF	100pF
C254	27pF	22pF
C262	150pF	100pF
C265	56pF	47pF
C289	18pF	4pF
C290	100pF	120pF
C291	1pF	10pF
C298	0.01μF	1000pF
C2109	100pF	0
L208	JR-NB-7561	JR-NB-7560
L220	JR-NB-7563	JR-NB-7562
L222	4.7μH	2.2μH
L223	1.5μH	1μH
R223	22kΩ	1kΩ
R270	47kΩ	33kΩ
R272	2.2kΩ	1kΩ
R274	4.7kΩ	6.8kΩ
R275	10kΩ	22kΩ
R276	4.7kΩ	6.8kΩ
R277	4.7kΩ	2.7kΩ
R278	8.2kΩ	18kΩ
R281	27kΩ	47kΩ
R296	56kΩ	33kΩ
R298	100Ω	82Ω
R299	100Ω	82Ω

SCHEMATIC DIAGRAM

29–42 MHz
35–50 MHz FREQUENCY SYNTHESIZER

DDOO–CMG–170 2/2



NOTES
"#" IDENTIFIES "CHIP" COMPONENTS (EXAMPLE, R3 #) WHICH ARE LOCATED ON THE COMPONENT SIDE OF THE BOARD.
W1 USED ONLY IN 60 W AMPLIFIER.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN μF UNLESS FOLLOWED BY MULTIPLIER n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

TRANSMITTER VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS AT 110 WATTS MEASURED TO SYSTEM NEGATIVE WITH HIGH INPUT IMPEDANCE (10 MΩ) DIGITAL MULTIMETER. READING TAKEN WITH TRANSMITTER KEYED. VALUE WITHIN ( ) INDICATES THE VOLTAGE READINGS AT 60 WATTS.

POWER CONTROL

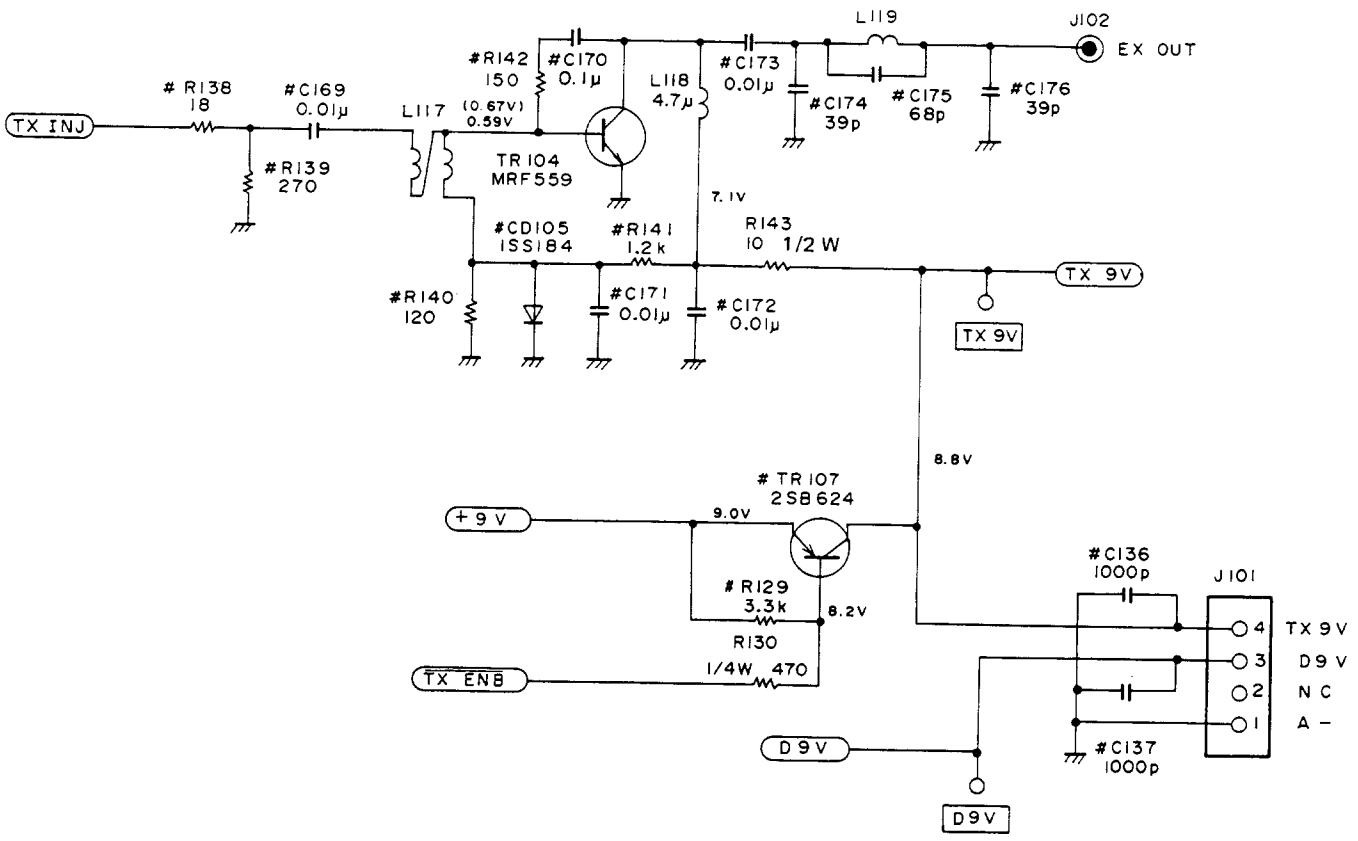
*RV2 is factory set and does not require further adjustment.

SCHEMATIC DIAGRAM
29.0-50MHz 60/110 WATT
POWER AMPLIFIER
DD00-CAH-705

△ COMPONENT IDENTIFICATION CHART

PART	CAH-705AL	CAH-705AH	CAH-705BL	CAH-705BH
	29~42MHz 60W	29~42MHz 110W	35~50MHz 60W	35~50MHz 110W
C8	——	0.0022μ	——	0.0022μ
C10	10P	10P	——	——
C16	0.1μ	0.1μ	0.1μ	120P
C17	47P	220P	39P	22P
C18	——	820P	——	820P
C19	330P	470P	330P	330P
C20	——	180P	120P	——
C22	220P	270P	220P	180P
C23	——	180P	120P	——
C25	220P	270P	220P	180P
C26	330P	390P	270P	330P
C27	390P	470P	390P	820P
C31	68P	68P	56P	56P
C32	39P	56P	30P	39P
C33	18P	18P	15P	15P
C45	75P	75P	56P	56P
C46	130P	130P	100P	100P
C47	180P	180P	130P	130P
C48	130P	130P	100P	100P
C49	56P	56P	47P	47P
CD6	——	1SS184	——	1SS184
CD7	——	1SS184	——	1SS184
L4	B19/6LAFD01132	B19/6LAFD01132	B19/6LAFD01285	B19/6LAFD01285
R34	5.6Ω 1/8W	——	5.6Ω 1/8W	——
R35	6.8Ω 1/8W	2.2Ω 1/8W	6.8Ω 1/8W	2.2Ω 1/8W
R9	56Ω 2W	47Ω 2W	56Ω 2W	47Ω 2W
R11	——	10Ω 2W	——	10Ω 2W
R12	4.7Ω 1W	2.2Ω 1W	4.7Ω 1W	2.2Ω 1W
R13	4.7Ω 1W	2.2Ω 1W	4.7Ω 1W	2.2Ω 1W
R32	0Ω 1/10W	——	0Ω 1/10W	——
R33	0Ω 1/10W	——	0Ω 1/10W	——
T3	B19/6LHFD00004	B19/6LHFD00009	B19/6LHFD00004	B19/6LHFD00004
T4	B19/6LHFD00011	B19/6LHFD00012	B19/6LHFD00011	B19/6LHFD00013
T5	B19/6LHLD00001	B19/6LHFD00010	B19/6LHLD00001	B19/6LHFD00010
TR3	2SC2540	2SC2782	2SC2540	2SC2782
TR4	2SC2540	2SC2782	2SC2540	2SC2782
W1	B19/6ZCLD00058	——	B19/6ZCLD00058	——

EXCITER AMP

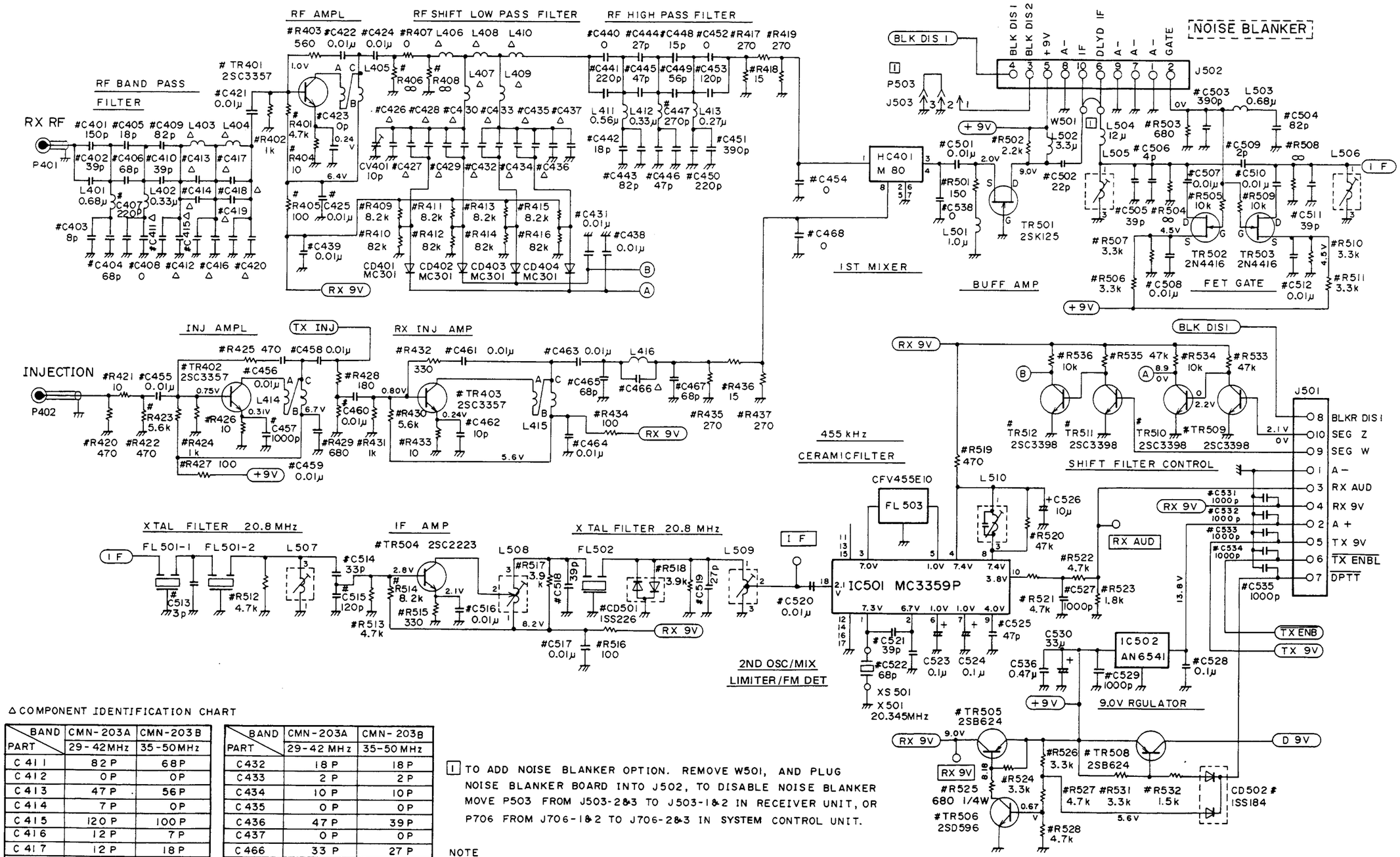


NOTE

"#" IDENTIFIES CHIP COMPONENTS (EXAMPLE #C171) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.

ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR u.

SCHEMATIC DIAGRAM
29-50MHz EXCITER
DDOO-CMN-203



△ COMPONENT IDENTIFICATION CHART

PART \ BAND	CMN-203A 29-42MHz	CMN-203B 35-50MHz
C411	82P	68P
C412	0P	0P
C413	47P	56P
C414	7P	0P
C415	120P	100P
C416	12P	7P
C417	12P	18P
C418	4P	2P
C419	100P	82P
C420	0P	0P
C426	5P	0P
C427	5P	3P
C428	0P	0P
C429	8P	8P
C430	0P	0P

PART \ BAND	CMN-203A 29-42 MHz	CMN-203B 35-50 MHz
C432	18P	18P
C433	2P	2P
C434	10P	10P
C435	0P	0P
C436	47P	39P
C437	0P	0P
C466	33P	27P
L403	LD 10012	LD 10010
L404	LD 10018	LD 10015
L406	LD 10012	LD 10010
L407	0.68µ	0.56µ
L408	LD 10020	LD 10018
L409	LD 10012	LD 10010
L410	LD10012	LD 10010

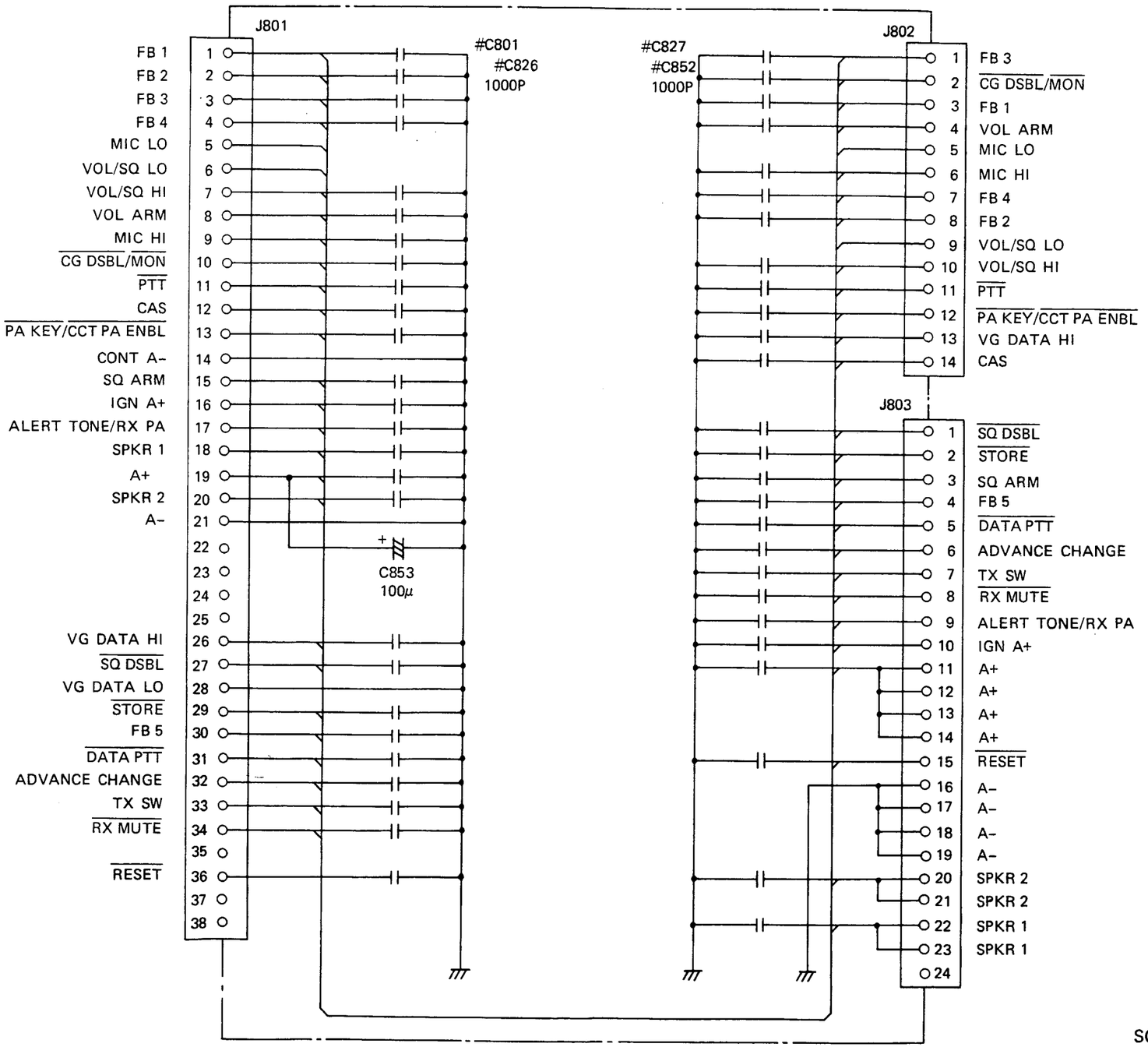
[1] TO ADD NOISE BLANKER OPTION. REMOVE W501, AND PLUG NOISE BLANKER BOARD INTO J502, TO DISABLE NOISE BLANKER MOVE P503 FROM J503-2&3 TO J503-1&2 IN RECEIVER UNIT, OR P706 FROM J706-1&2 TO J706-2&3 IN SYSTEM CONTROL UNIT.

NOTE

"#" IDENTIFIES CHIP COMPONENTS (EXAMPLE #C401) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.

ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER µ, n OR p.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR µ.

SCHEMATIC DIAGRAM
29-50MHz RECEIVER
DDOO-CMN-203



SCHEMATIC DIAGRAM
INTERFACE
DDOO-CMH-813

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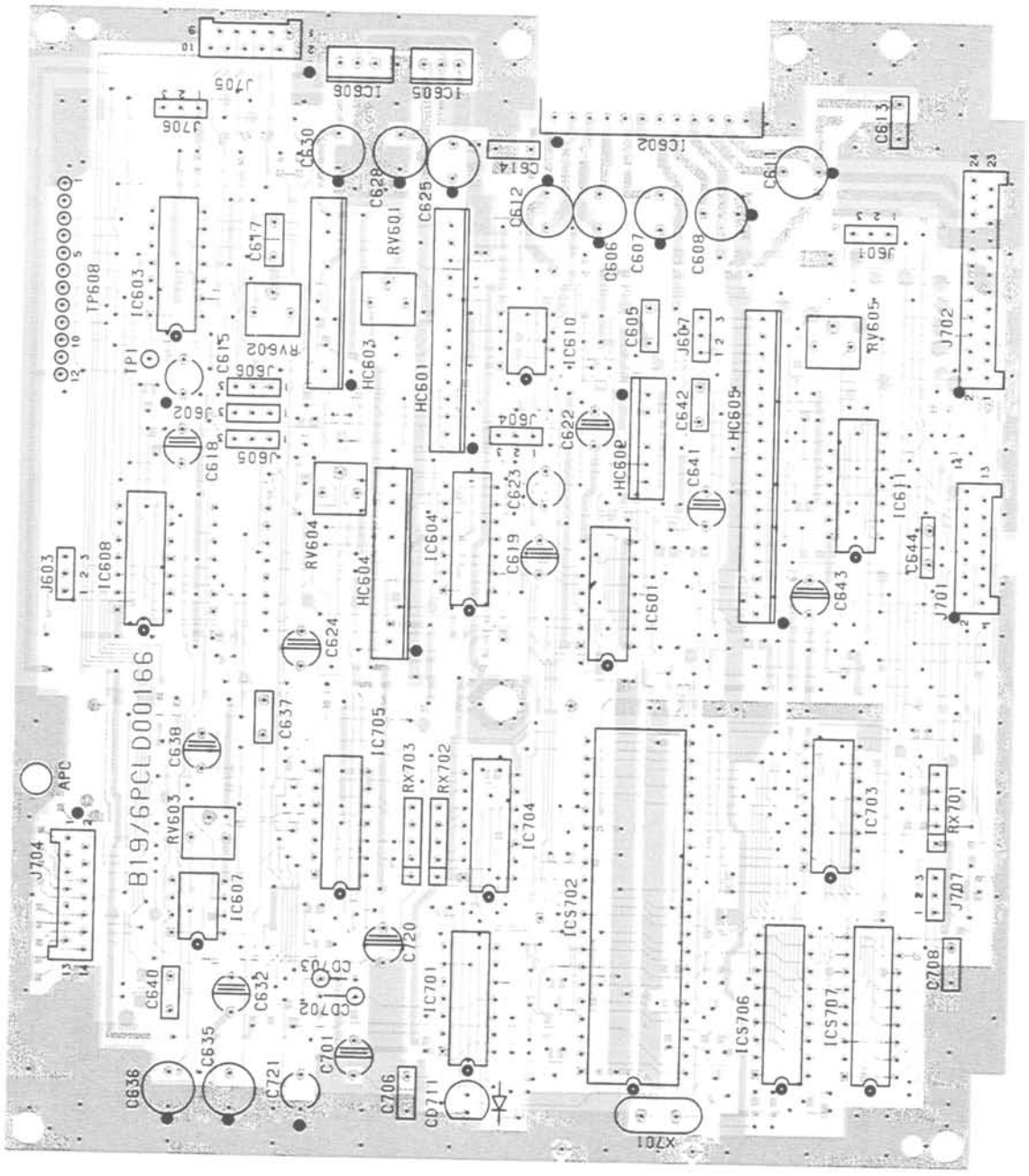
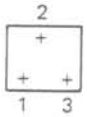
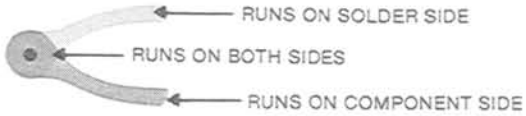


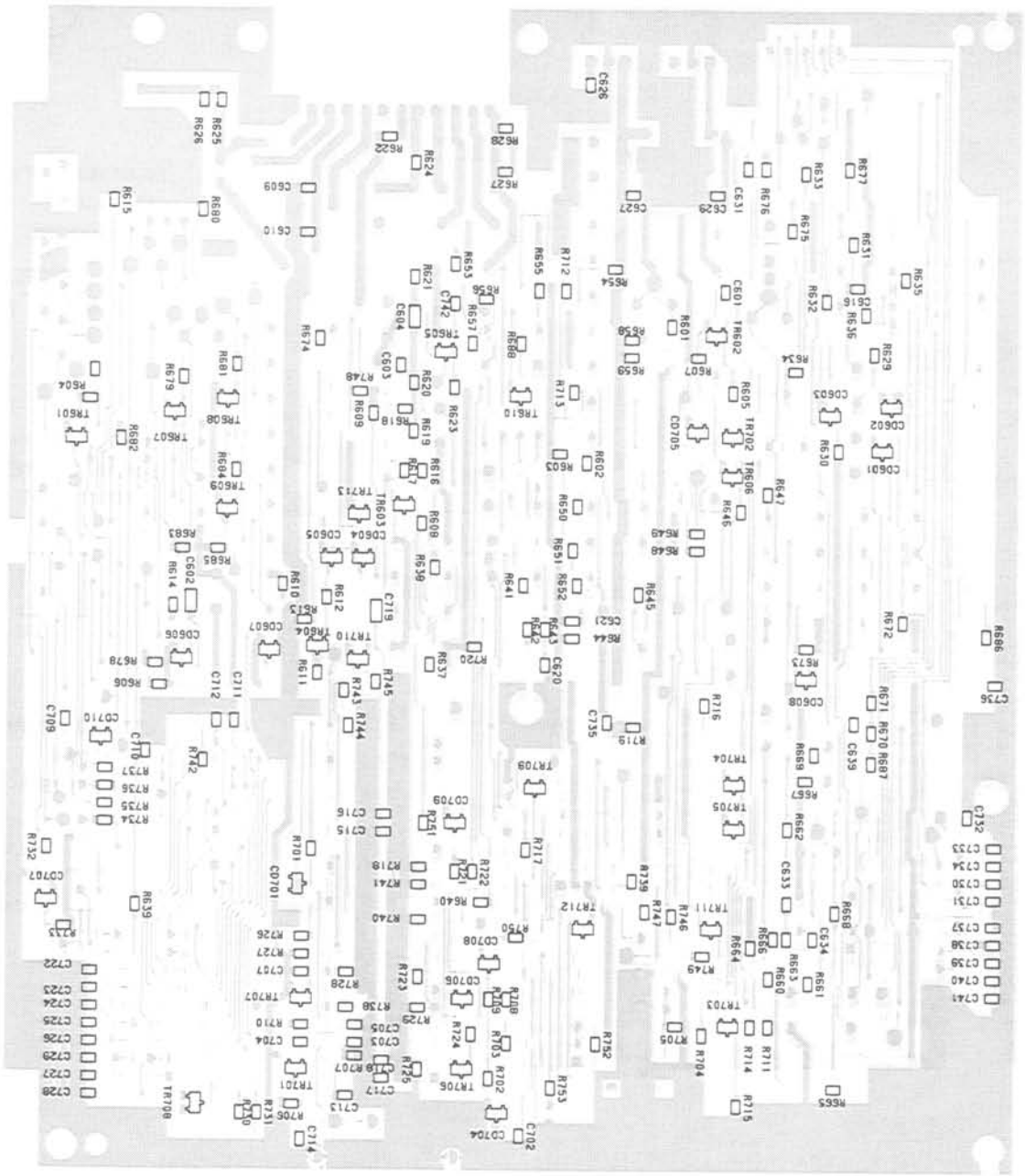
LEAD IDENTIFICATION
FOR VOLUME



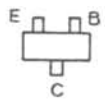
(TOP VIEW)



SYSTEM CONTROL BOARD
(COMPONENT SIDE)

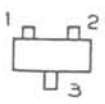


LEAD IDENTIFICATION FOR TRANSISTOR



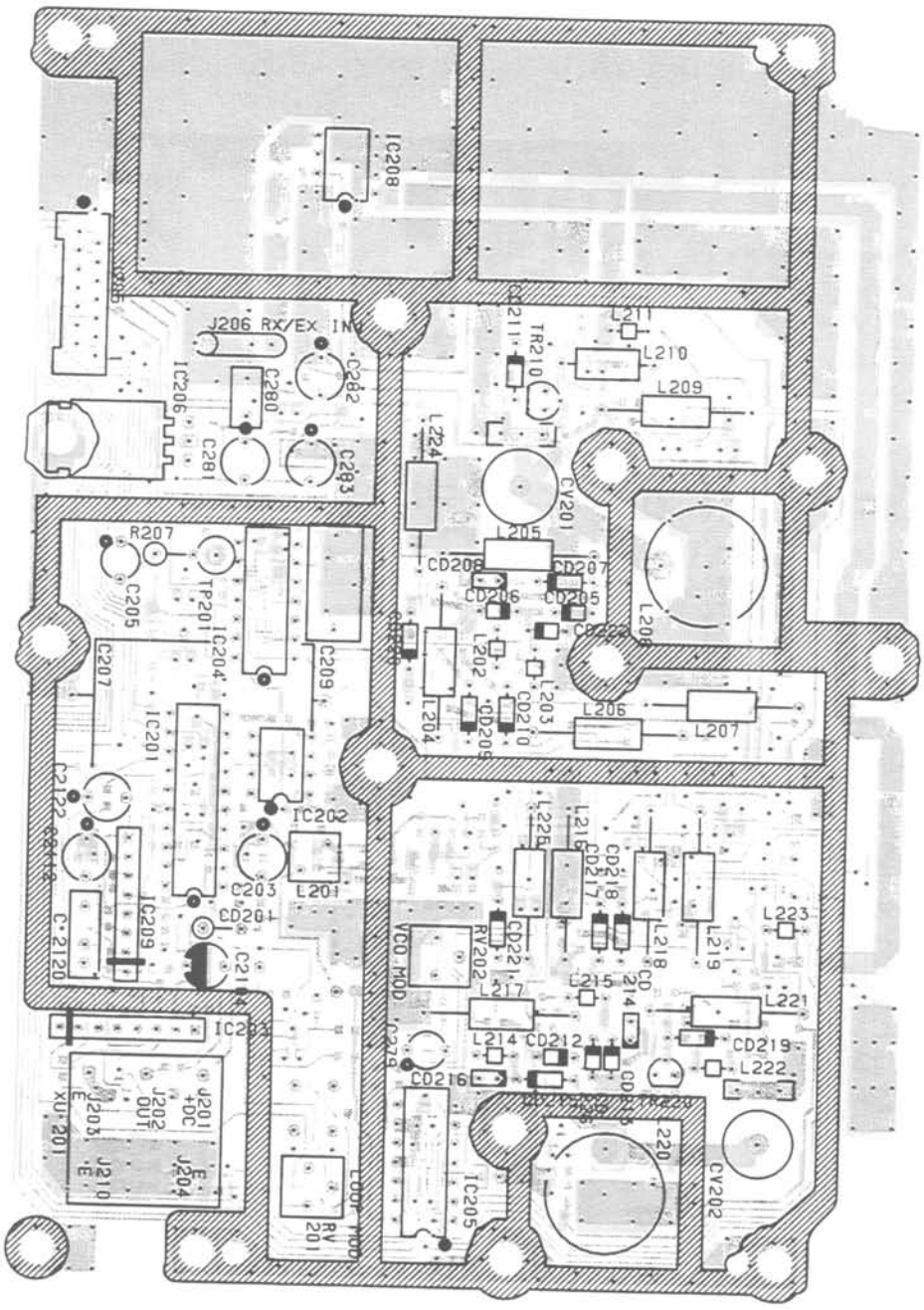
(TOP VIEW)

LEAD IDENTIFICATION FOR DIODES



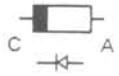
(TOP VIEW)

SYSTEM CONTROL BOARD
(SOLDER SIDE)

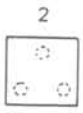


LEAD IDENTIFICATION
FOR TR210, TR220
(TOP VIEW)

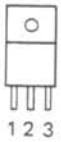
LEAD IDENTIFICATION
FOR DIODES
(TOP VIEW)

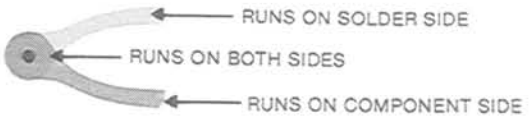


LEAD IDENTIFICATION
FOR RV201, RV202
(TOP VIEW)

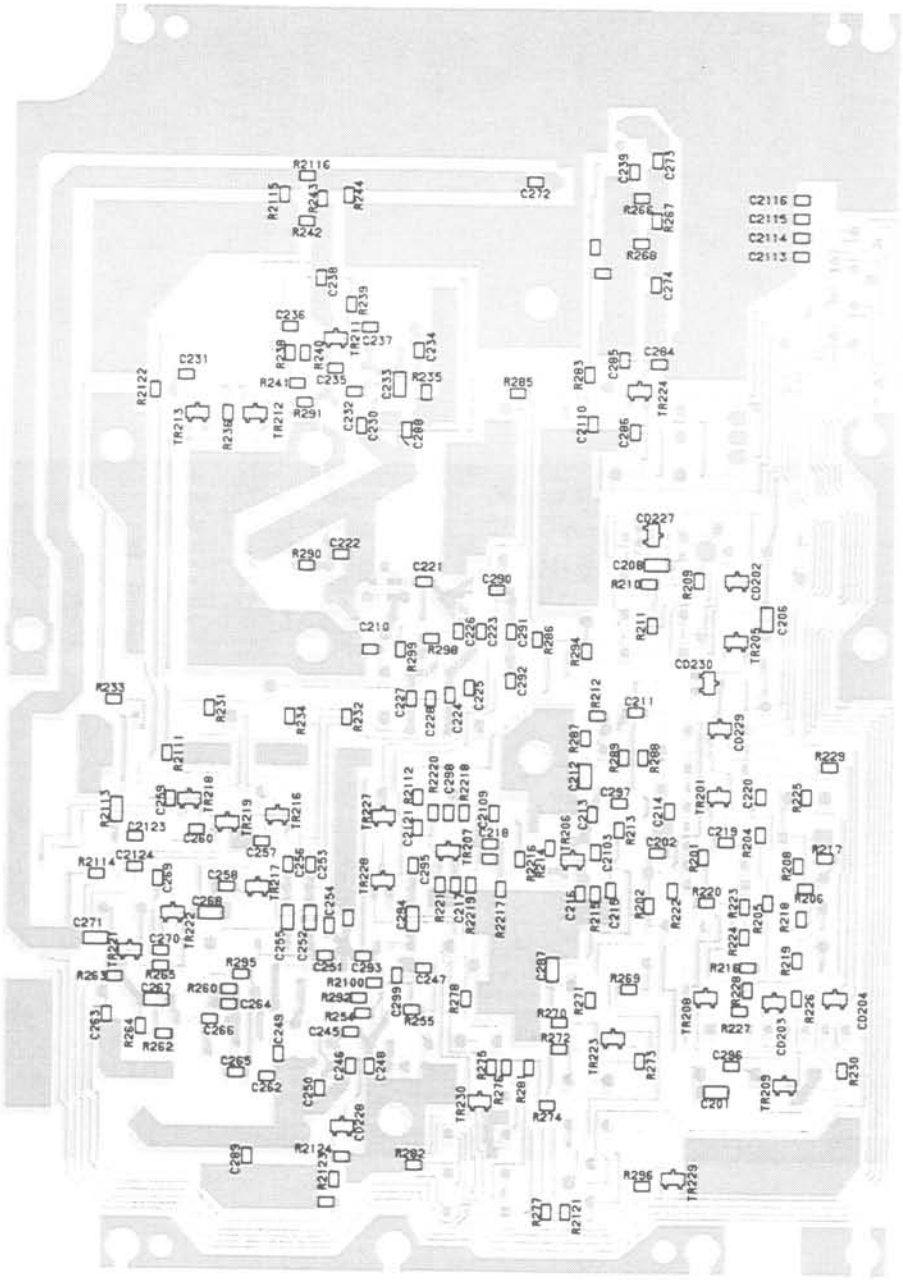


LEAD IDENTIFICATION
FOR IC206
(TOP VIEW)

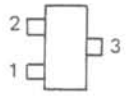




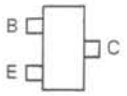
FREQUENCY SYNTHESIZER BOARD
(COMPONENT SIDE)



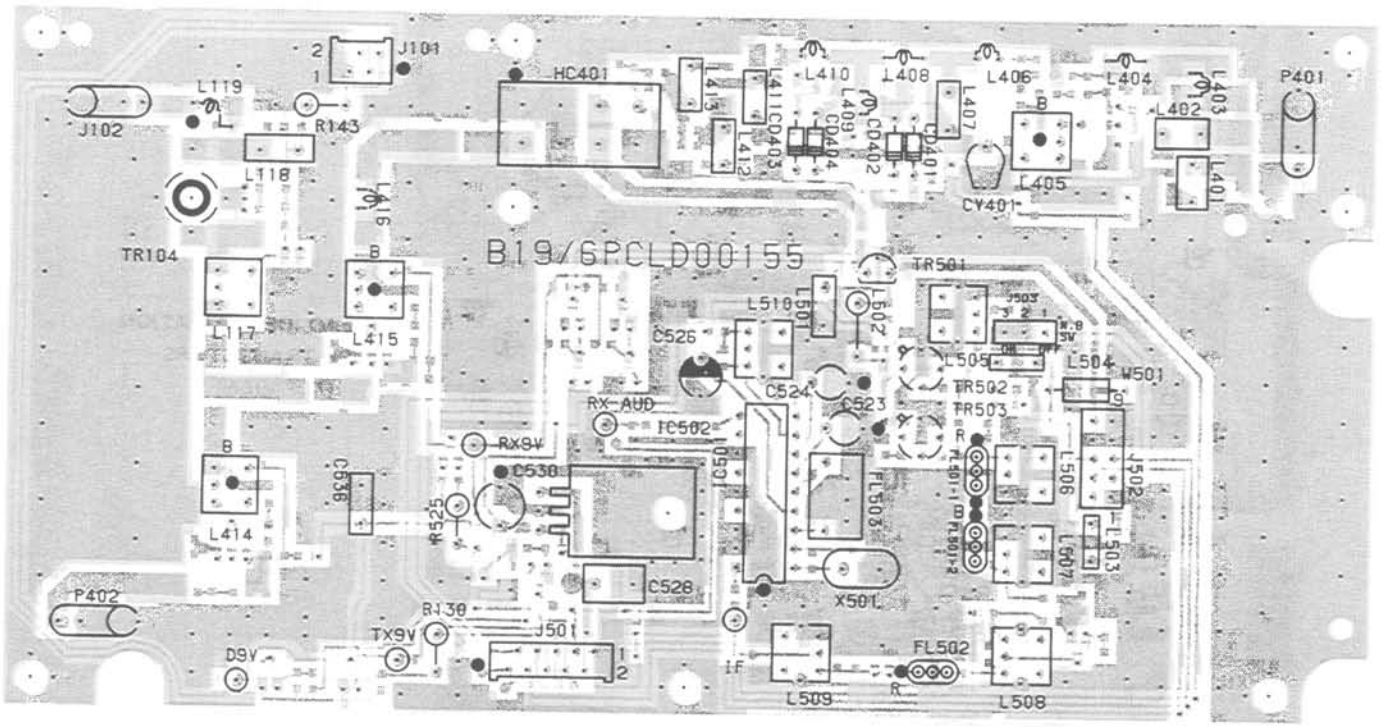
LEAD IDENTIFICATION
FOR DIODES
(TOP VIEW)



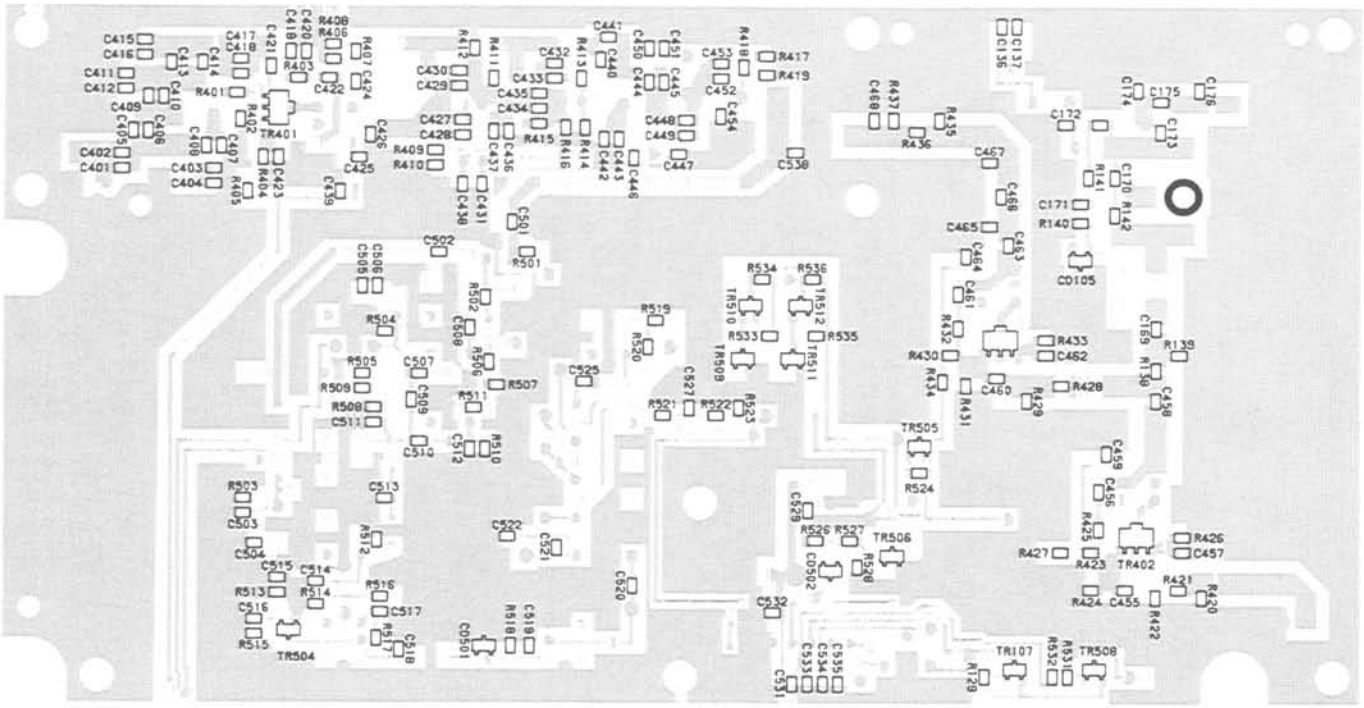
LEAD IDENTIFICATION
FOR TRANSISTORS
(TOP VIEW)



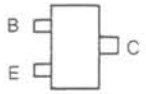
FREQUENCY SYNTHESIZER
(SOLDER SIDE)



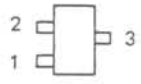
RECEIVER/EXCITER BOARD
(COMPONENT SIDE)



LEAD IDENTIFICATION
FOR CD 501
(TOP VIEW)



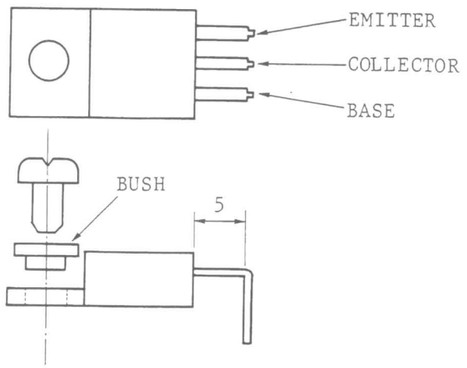
LEAD IDENTIFICATIN
FOR TRANSISTORS
(TOP VIEW)



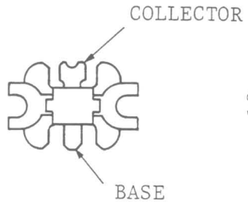
RECEIVER/EXCITER BOARD
(SOLDER SIDE)

(Page D24 is blank)

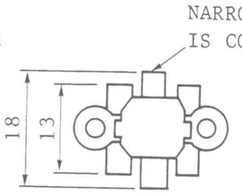
LEAD IDENTIFICATION FOR TR1



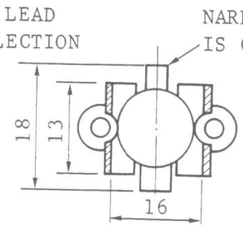
MOUNTING FOR TR1



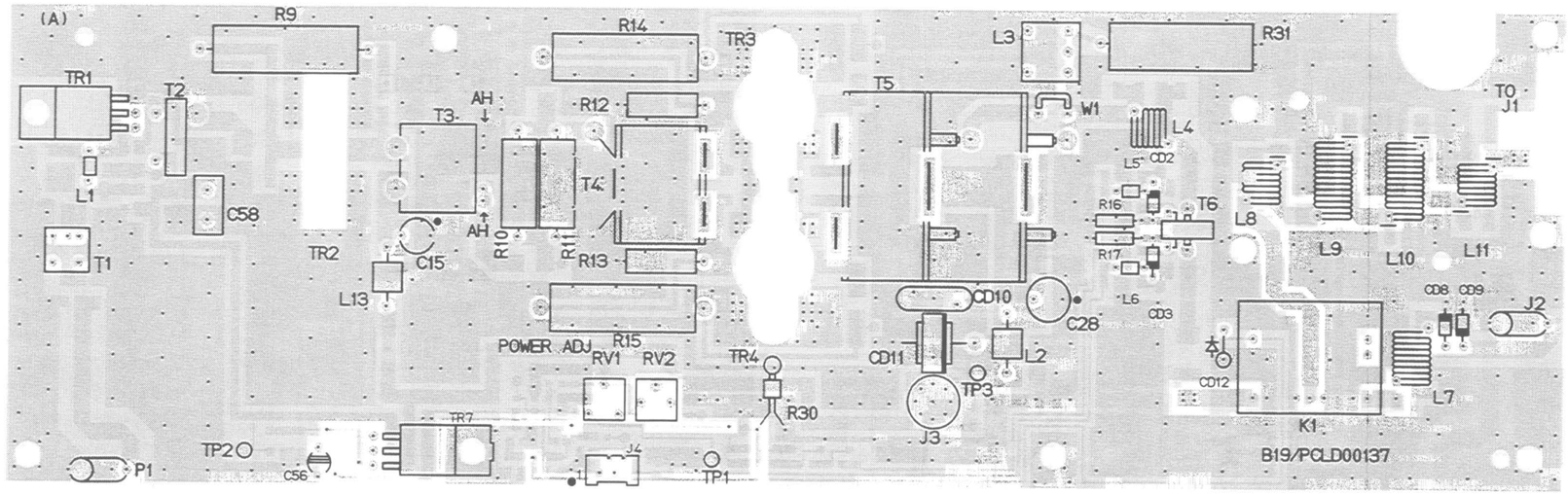
LEAD IDENTIFICATION
FOR TR 2



TYP LEAD TRIMMING
FOR TR 3 AND TR 4
(Used in AL and BL)



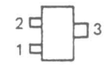
TYP LEAD TRIMMING INCLUDING MARK
FOR TR 3 AND TR 4
(Used in AH and BH)



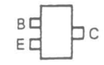
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

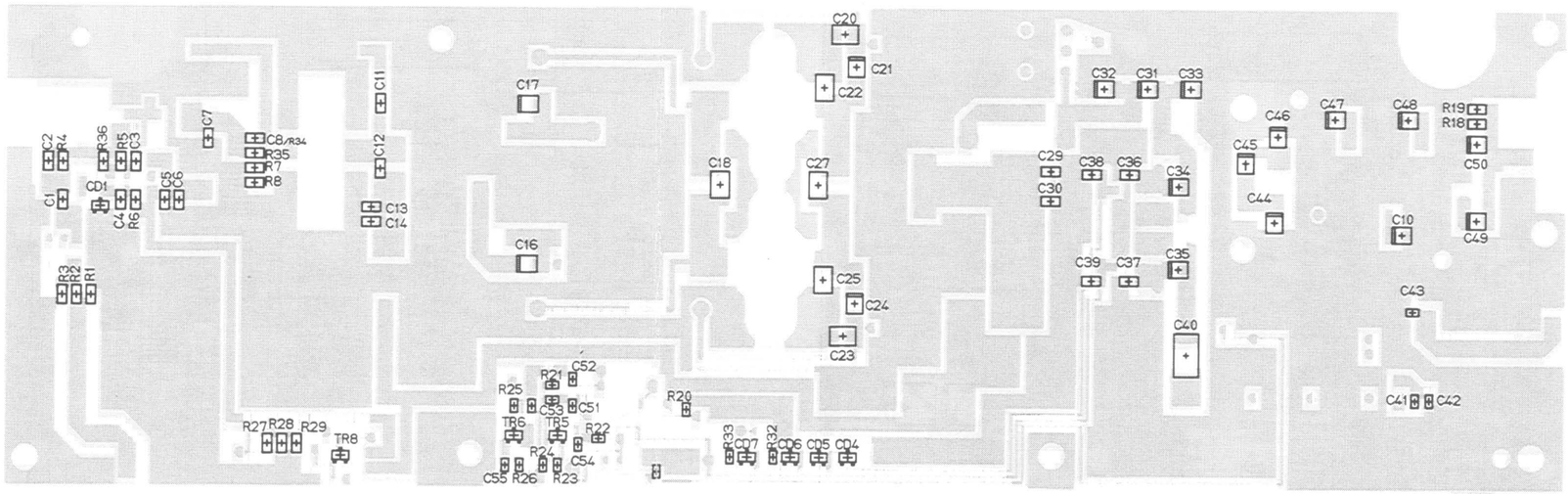
POWER AMPLIFIER BOARD
(COMPONENT SIDE)

LEAD IDENTIFICATION
FOR CD1, CD8, CD13, CD14 and CD15
(TOP VIEW)



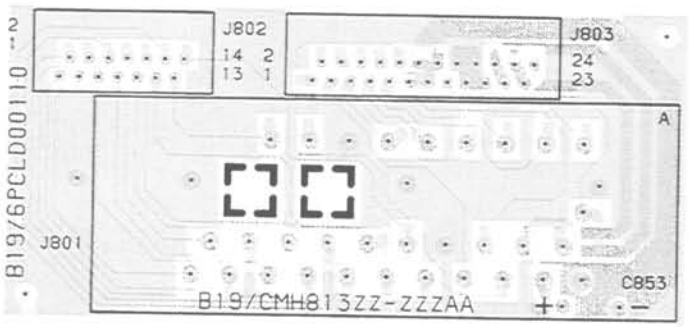
LEAD IDENTIFICATION
FOR TRANSISTORS
(TOP VIEW)

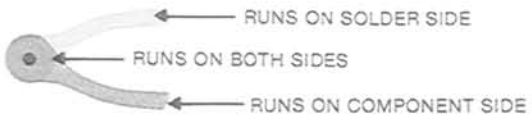




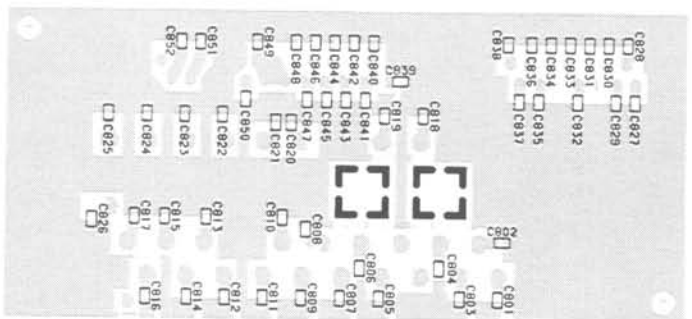
NO COMPONENTS ARE MOUNTED
ON THE BACK OF COMPONENT SIDE

POWER AMPLIFIER BOARD
(CHIP COMPONENT ALLOCATION)



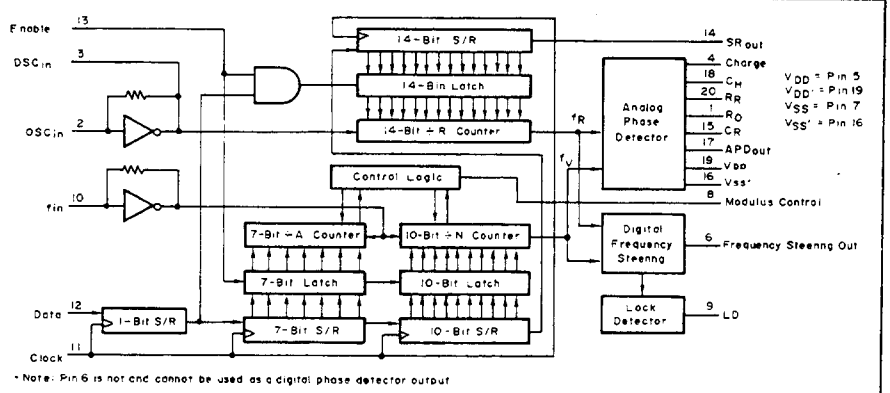
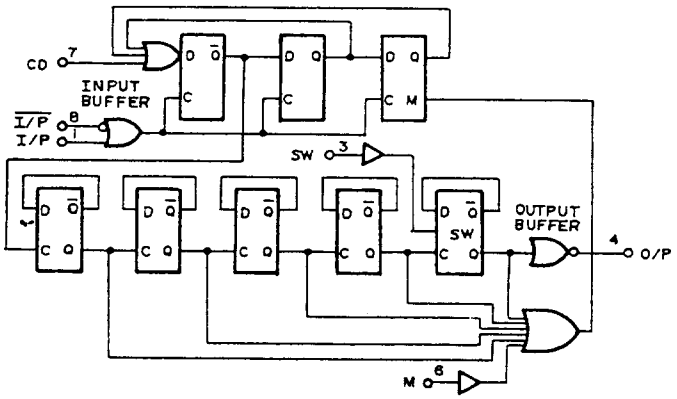
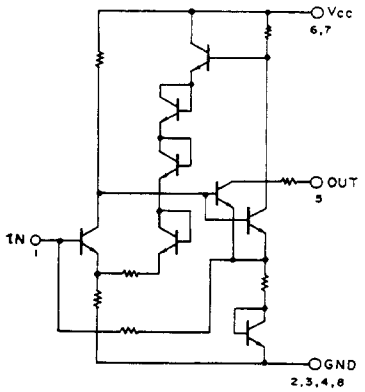
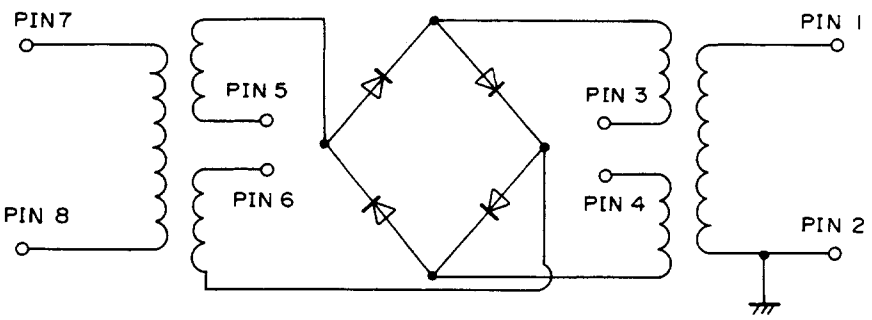


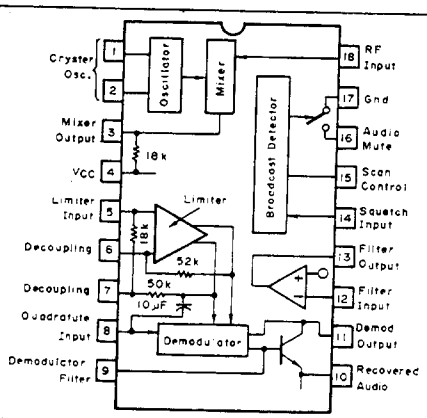
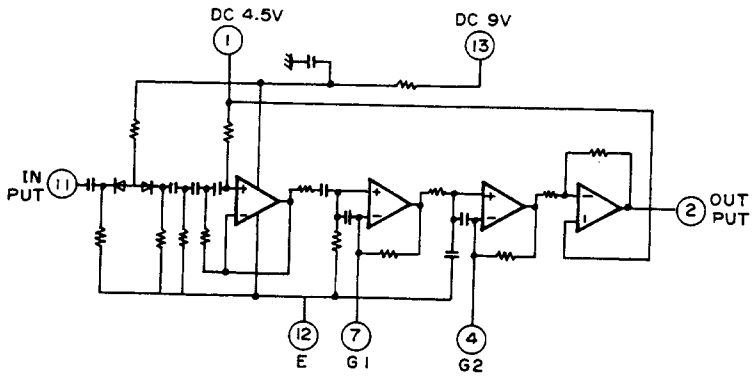
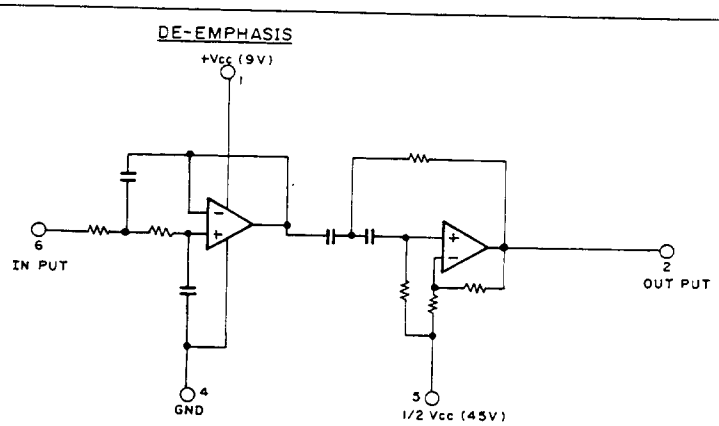
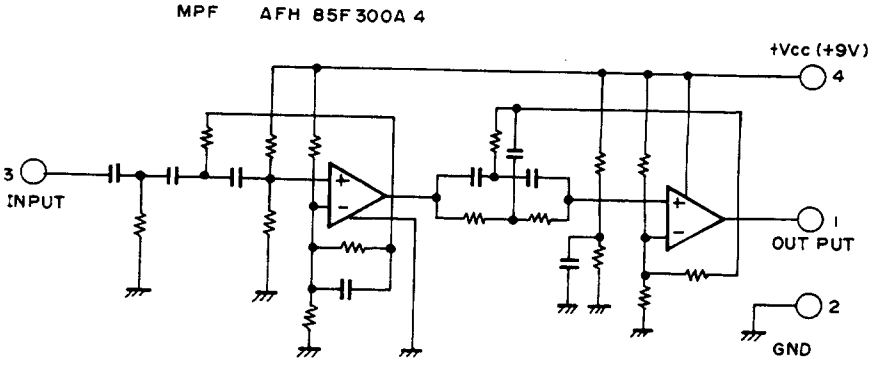
INTERFACE BOARD
(COMPONENT SIDE)

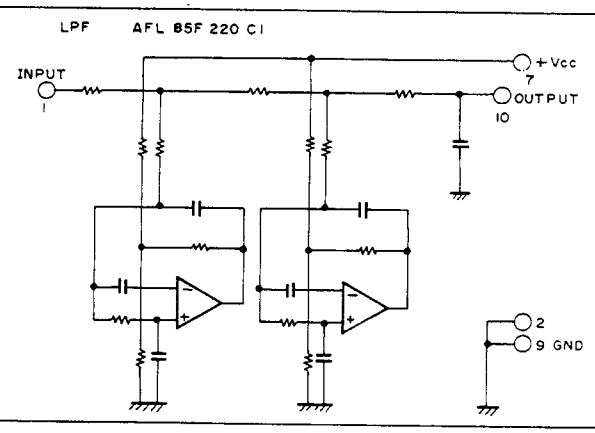
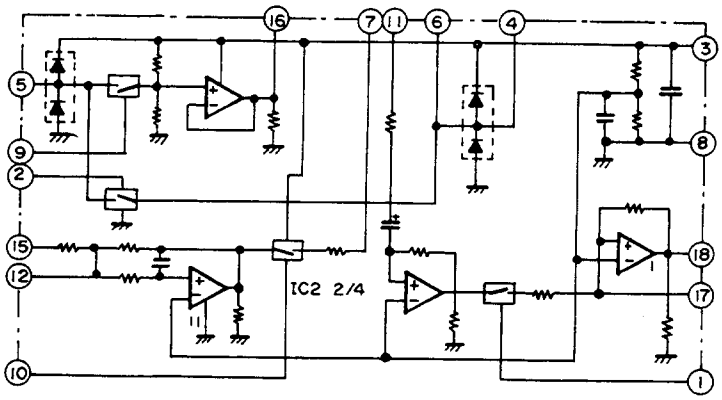
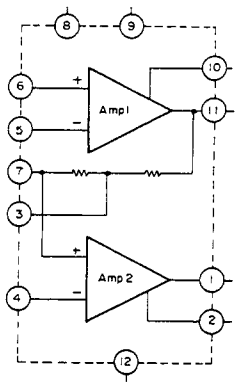
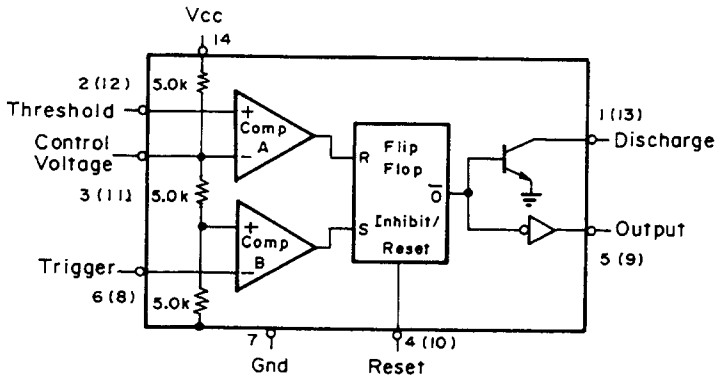


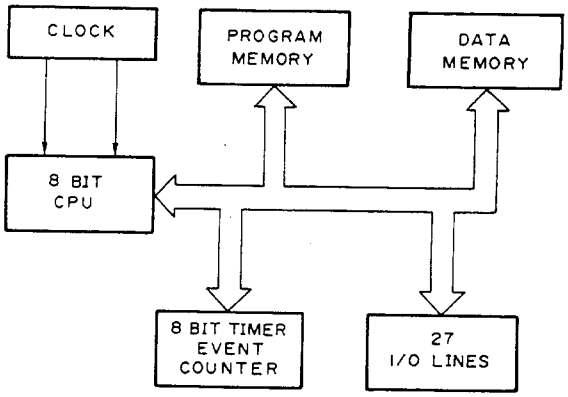
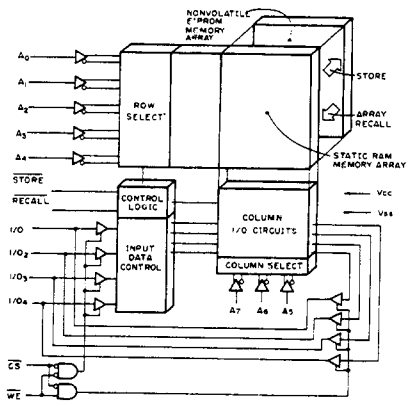
INTERFACE BOARD
(SOLDER SIDE)

(Page D28 is blank)

SYMBOL	GE PART NO	EQUIVALENT CIRCUIT
IC201	B19/ 5CAAJ00328	
IC202	B19/ 5DDAT00206	
IC208	B19/ 5DAAA00183	
HC401	B19/ 5NZBH00002	

SYMBOL	GE PART NO	EQUIVALENT CIRCUIT
IC501	B19/ 5DAAR00074	
HC601	B19/ 6DHFD00160	
HC602	B19/ 6DHFD00167	
HC603	B19/ 6DHFD00168	

SYMBOL	GE PART NO	EQUIVALENT CIRCUIT
HC604	B19/ 6DHFD00169	
HC605	B19/ 6DHFD00164	
IC602	B19/ 5DAAA00233	
IC701	B19/ 5DAAJ00646	

SYMBOL	GE PART NO	EQUIVALENT CIRCUIT
IC702	B19/ 6DLLD00008	
IC706	B19/ 5DDBY00026	

SYMBOL	GE PART NO.	DESCRIPTION
	B19/CAH-705AL B19/CAH-705AH B19/CAH-705BL B19/CAH-705BH	POWER AMPLIFIER BOARD A BAND (29 to 42 MHz), 60W: AL A BAND , 110W: AH B BAND (35 to 50 MHz), 60W: BL B BAND , 110W: BH
		---------- CAPACITORS ----------
C1	B19/5CAAD01105	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C2	B19/5CAAD01509	Ceramic: 2200 pF ±10%, 50 VDCW, temp coef ±15%.
C3	B19/5CAAD01268	Ceramic: 0.1 uF +80-20%, 50 VDCW.
C4 and C5	B19/5CAAD01597	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C6	B19/5CAAD01268	Ceramic: 0.1 uF +80-20%, 50 VDCW.
C7	B19/5CAAD00870	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C8	B19/5CAAA01509	Ceramic: 2200 pF ±10%, 50 VDCW, temp coef ±15%. (Used in AH and BH).
C10	B19/5CAAA03094	Ceramic: 10 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C11	B19/5CAAD01268	Ceramic: 0.1 uF +80-20%, 50 VDCW.
C12	B19/5CAAD00786	Ceramic: 390 pF ±5%, 50 VDCW, temp coef ±15%.
C13	B19/5CAAD01597	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C14	B19/5CAAD01268	Ceramic: 0.1 uF +80-20%, 50 VDCW.
C15	B19/5CEAA02283	Electrolytic: 33 uF ±20%, 25 VDCW.
C16	B19/5CAAA03083	Ceramic: 0.1 uF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in AL, BL and AH).
C16	B19/5CAAA03078	Ceramic: 120 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BH).
C17	B19/5CAAA03097	Ceramic: 220 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AH).
C17	B19/5CAAA03086	Ceramic: 22 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BH).
C17	B19/5CAAA03080	Ceramic: 47 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL).
C17	B19/5CAAA03100	Ceramic: 39 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL).
C18	B19/5CMAB01437	Mica: 820 pF ±5%, 100 VDCW. (Used in AH and BH).
C19	B19/5CMAB00141	Mica: 470 pF ±5%, 100 VDCW. (Used in AH).
C19	B19/5CMAB00139	Mica: 330 pF ±5%, 100 VDCW. (Used in AL, BL and BH).
C20	B19/5CAAA03098	Ceramic: 180 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AH).
C20	B19/5CAAA03078	Ceramic: 120 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL).
C21	B19/5CAAA03083	Ceramic: 0.1 uF ±10%, 50 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C22	B19/5CAAA03092	Ceramic: 270 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AH).
C22	B19/5CAAA03098	Ceramic: 180 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BH).
C22	B19/5CAAA03097	Ceramic: 220 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and BL).
C23	B19/5CAAA03098	Ceramic: 180 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AH).
C23	B19/5CAAA03078	Ceramic: 120 pF ±5%, 500 VDCW, temp coef ±60 PPM. (Used in BL).
C24	B19/5CAAA03083	Ceramic: 0.1 uF ±10%, 50 VDCW.
C25	B19/5CAAA03092	Ceramic: 270 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AH).
C25	B19/5CAAA03098	Ceramic: 180 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BH).
C25	B19/5CAAA03097	Ceramic: 220 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and BL).
C26	B19/5CMAB00140	Mica: 390 pF ±5%, 500 VDCW. (Used in AH).
C26	B19/5CMAB00139	Mica: 330 pF ±5%, 500 VDCW. (Used in AL and BH).
C26	B19/5CMAB00138	Mica: 270 pF ±5%, 500 VDCW. (Used in BL).
C27	B19/5CMAB01478	Mica: 470 pF ±5%, 100 VDCW. (Used in AH).
C27	B19/5CMAB01437	Mica: 820 pF ±5%, 100 VDCW. (Used in BH).
C27	B19/5CMAB01469	Mica: 390 pF ±5%, 100 VDCW. (Used in AL and BL).
C28	B19/5CEAA01817	Electrolytic: 47 uF ±20%, 50 VDCW.
C29	B19/5CAAD01597	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C30	B19/5CAAD01105	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C31	B19/5CAAA03090	Ceramic: 68 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C31	B19/5CAAA03095	Ceramic: 56 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C32	B19/5CAAA03095	Ceramic: 56 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AH).
C32	B19/5CAAA03100	Ceramic: 39 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and BH).
C33	B19/5CAAA03085	Ceramic: 18 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C33	B19/5CAAA03101	Ceramic: 15 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C34 and C35	B19/5CAAA00102	Ceramic: 7 pF ±0.5 pF, 500 VDCW, temp coef 0±60 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C36	B19/5CAAD01065	Ceramic: 180 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C37	B19/5CAAA00870	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C38 and C39	B19/5CAAD01597	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C40	B19/5CBAB02003	Ceramic: 0.01 uF ±5%, 50 VDCW.
C41	B19/5CAAD01385	Ceramic: 10000 pF ±10%, 50 VDCW, temp coef 0±60 PPM.
C42	B19/5CAAD00969	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0±30%.
C43	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0±30%.
C44	B19/5CAAA03101	Ceramic: 15 pF ±5%, 500 VDCW, temp coef 0±60 PPM.
C45	B19/5CAAA00123	Ceramic: 75 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C45	B19/5CAAD03095	Ceramic: 56 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C46	B19/5CAAA03120	Ceramic: 130 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C46	B19/5CAAA03091	Ceramic: 100 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C47	B19/5CAAA03098	Ceramic: 180 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C47	B19/5CAAA03120	Ceramic: 130 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C48	B19/5CAAA03120	Ceramic: 130 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C48	B19/5CAAA03091	Ceramic: 100 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C49	B19/5CAAA03095	Ceramic: 56 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in AL and AH).
C49	B19/5CAAA03080	Ceramic: 47 pF ±5%, 500 VDCW, temp coef 0±60 PPM. (Used in BL and BH).
C50	B19/5CAAA03101	Ceramic: 15 pF ±5%, 500 VDCW, temp coef 0±60 PPM.
C51	B19/5CAAA01115	Ceramic: 0.01 uF ±10%, 50 VDCW.
C52 thru C55	B19/5CAAAD0838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±5%,
C58	B19/5CRAA00838	Polyester: 0.047 uF ±5%, 50 VDCW.
		---------- DIODE ----------
CD1	B19/5TXAD00452	Silicon: sim to TOSHIBA 1SS181.
CD2 and CD3	B19/5TXAA00313	Silicon, Schottkey Barrier: sim to 1SS97(2).
CD4 and CD5	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD6 and CD6	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184. (Used in AH and BH).
CD8 and CD9	B19/5TXAR00041	PIN Diode: MI308
CD10	B19/5TZAA00104	Ceramic Varistor: sim to SANKEN SNR-220KD10.
CD11	B19/5TXAM00019	Silicon: sim to MOTOLORA MR751.
CD12	B19/5TXAM00068	Silicon: sim to SANKEN EM01ZW.
		---------- JACKS ----------
J1	B19/6JALD00001	Connector.
J2	B19/5JWCL00045	Connector.
J3	B19/5JTCW00060	Connector.
J4	B19/5JWBS00176	Connector.
P1	B19/6JJLD12080	Connector.
		---------- RELAYS ----------
K1	B19/5KLAD00657	RF Relay: sim to ARG3909.
		---------- COIL ----------
L1	B19/5LCAA00224	Coil: RF 2.2 uH ±20%.
L2	B19/6LAFD01129	Coil: RF.
L3	B19/5LZNL00004	Coil: RF 3.3 uH ±10%.
L4	B19/6LAFD01132	Coil: RF (Used in AL and AH).
L4	B19/6LAFD01285	Coil: RF (Used in BL and BH).
L5 and L6	B19/5LCAA00232	Coil: RF 10 uH ±10%.
L7	B19/6LAFD01303	Coil: RF.
L8	B19/6LAFD01132	Coil: RF.
L9 and L10	B19/6LAF001133	Coil: RF.
L11	B19/6LAFD01132	Coil: RF.
L13	B19/6LAFD01129	Coil: RF.
		---------- RESISTORS ----------
R1	B19/5RDAC02163	Metal film: 270 ohms ±5%, 200 VDCW, 1/8W.
R2	B19/5RDAC02210	Metal film: 22 ohms ±5%, 200 VDCW, 1/8W.
R3	B19/5RDAC02163	Metal film: 270 ohms ±5%, 200 VDCW, 1/8W.
R4	B19/5RDAC02223	Metal film: 2.2 ohms ±5%, 200 VDCW, 1/8W.
R5	B19/5RDAC02515	Metal film: 560 ohms ±5%, 200 VDCW, 1/8W.
R6	B19/5RDAC02132	Metal film: 1K ohms ±5%, 200 VDCW, 1/8W.
R7 and R8	B19/5RDAC02210	Metal film: 22 ohms ±5%, 200 VDCW, 1/8W.
R9	B19/5REAG01461	Metal film: 47 ohms ±5%, 500 VDCW, 3W. (Used in AH and BH).
R9	B19/5REAG00247	Metal film: 56 ohms ±5%, 3W. (Used in AL and BL).

SYMBOL	GE PART NO.	DESCRIPTION
R10	B19/5REAG00048	Metal film: 10 ohms ±5%, 350 VDCW, 2W.
R11	B19/5REAG00048	Metal film: 10 ohms ±5%, 350 VDCW, 2W. (Used in AH and BH).
R12 and R13	B19/5REAG01120	Metal film: 2.2 ohms ±5%, 350 VDCW, 1W. (Used in AH and BH).
R12 and R13	B19/5REAG00412	Metal film: 4.7 ohms ±5%, 1W. (Used in AL and BL).
R14 and R15	B19/5REAG01464	Metal film: 47 ohms ±5%, 500 VDCW, 3W.
R16 and R17	B19/5RDAA01179	Metal film: 47 ohms ±5%, 300 VDCW, 1/4W.
R18 and R19	B19/5RDAC02138	Metal film: 100K ohms ±5%, 200 VDCW, 1/8W.
R20	B19/5RDAC02446	Metal film: 1K ohms ±5%, 200 VDCW, 1/10W.
R21	B19/5RDAC02477	Metal film: 3.9K ohms ±5%, 100 VDCW, 1/10W.
R22	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R23	B19/5RDAC02469	Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.
R24	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R25	B19/5RDAC02552	Carbon film: 560 ohms ±5%, 100 VDCW, 1/10W.
R26	B19/5RDAC02457	Metal film: 27K ohms ±5%, 100 VDCW, 1/10W.
R27	B19/5RDAC02159	Metal film: 220 ohms ±5%, 200 VDCW, 1/8W.
R28 and R29	B19/5RDAC02142	Metal film: 820 ohms ±5%, 100 VDCW, 1/8W.
R30	B19/5RXAE00028	Posistor: 2.2K ohms.
R31	B19/5REAG01464	Metal film: 47 ohms ±5%, 500 VDCW, 3W.
R36	B19/5RDAC02163	Metal film: 270 ohms ±5%, 200 VDCW, 1/8W.
RV1	B19/5RVAB00279	Variable: 10K ohms ±30%, 0.1W.
RV2	B19/5RVAB00400	Variable: 5K ohms ±30%, 0.1W.
		---------- TRANSISTORS ----------
T1	B19/6LHFD00006	RF Transformer.
T2	B19/6LHFD00005	RF Transformer.
T3	B19/6LHFD00009	RF Transformer. (Used in AH).
T3	B19/6LHFD00004	RF Transformer. (Used in AL, BL and BH).
T4	B19/6LHFD00011	RF Transformer. (Used in AL and BL).
T4	B19/6LHFD00013	RF Transformer. (Used in BH).
T4	B19/6LHFD00012	RF Transformer. (Used in AH).
T5	B19/6LHFD00010	RF Transformer. (Used in AH and BH).

SYMBOL	GE PART NO.	DESCRIPTION
T5	B19/6LHLD00001	RF Transformer. (Used in AL and BL).
T6	B19/5LZN100007	RF Transformer.
TR1	B19/5TCAD00115	Silicon, NPN: sim to MITSUBISHI 2SC1970.
TR2	B19/5TCAD00097	Silicon, NPN: sim to MITSUBISHI 2SC1729.
TR3 and TR4	B19/5TCAF00510	Silicon, NPN: sim to TOSHIBA 2SC2782. (Used in AH and BH).
TR3 and TR4	B19/5TCAD00073	Silicon, NPN: sim to MITSUBISHI 2SC2540. (Used in AL and BL).
TR5	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR6	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SC596.
TR7	B19/5TDAB00001	Silicon, PNP: sim to MATSUSHITA 2SB953A.
TR8	B19/5TDAR00054	Silicon, NPN: sim to NEC 2SD596.
		---------- WIRES ----------
W1	B19/6ZCLD00058	(Used in AL and BL).

SYMBOL	GE PART NO.	DESCRIPTION
	B19/CMN-203	RECEIVER/EXCITER BOARD
		---------- CAPACITORS ----------
C136 and C137	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C169	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C170	B19/5CAAD01078	Ceramic: 0.1 uF +80%, -20%, 50 VDCW, temp coef +30%, -20%.
C171 thru C173	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C174	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C175	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C176	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C401	B19/5CAAD00958	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C402	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C403	B19/5CAAD00964	Ceramic: 8 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM.
C404	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C405	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C406	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C407	B19/5CAAD00954	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C409	B19/5CAAD00960	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C410	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C411	B19/5CAAD00960	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C411	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C413	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C413	B19/5CAAD00969	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C414	B19/5CAAD00951	Ceramic: 7 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C415	B19/5CAAD00970	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C415	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C416	B19/5CAAD00968	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C416	B19/5CAAD00951	Ceramic: 7 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).

SYMBOL	GE PART NO.	DESCRIPTION
C417	B19/5CAAD00968	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C417	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C418	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef ±30 PPM. (Used in CMN-203A).
C418	B19/5CAAD00946	Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C419	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C419	B19/5CAAD00960	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C421 and C422	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C424 and C425	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C426 and C427	B19/5CAAD00956	Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C427	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C429	B19/5CAAD00964	Ceramic: 8 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A/B).
C431	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C432	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A/B).
C433	B19/5CAAD00946	Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A/B).
C434	B19/5CAAD00953	Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A/B).
C436	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A/B).
C436	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A/B).
C438 and C439	B19/5CAAD00959	Ceramic: 0.01 pF ±10%, 50 VDCW, temp coef ±15%.
C441	B19/5CAAD00954	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C442	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C443	B19/5CAAD00960	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C444	B19/5CAAD00952	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C445 and C446	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C447	B19/5CAAD00972	Ceramic: 270 pF ±5%, 50 VDCW, temp coef 0±30 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C448	B19/5CAAD00950	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C449	B19/5CAAD00969	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C450	B19/5CAAD00954	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C451	B19/5CAAD00974	Ceramic: 390 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C453	B19/5CAAD00970	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C455 and C456	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C457	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C458 and C461	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C462	B19/5CAAD00953	Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef ±30 PPM.
C463 and C464	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C465	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C467	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C466	B19/5CAAD00948	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203A).
C466	B19/5CAAD00952	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMN-203B).
C501	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C502	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C503	B19/5CAAD00974	Ceramic: 390 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C504	B19/5CAAD00960	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C505	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C506	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C507 and C508	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C509	B19/5CAAD00949	Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C510	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C511	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C512	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C513	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C514	B19/5CAAD00948	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C515	B19/5CAAD00970	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±30 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C516 and C517	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C518	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C519	B19/5CAAD00952	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C520	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C521	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef ±15%.
C522	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C523 and C524	B19/5CZAY00004	Electrolytic: 0.1 uF ±10%, 16 VDCW.
C525	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C526	B19/5CSAC00932	Tantalum: 10 uF ±20%, 16 VDCW.
C527	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C528	B19/5CRAA00617	Polyester: 0.1 uF ±5%, 50 VDCW.
C529	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C530	B19/5CEAA02283	Electrolytic: 33 uF ±20%, 25 VDCW.
C531 thru C535	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C536	B19/5CRAA00838	Polyester: 0.47 uF ±5%, 50 VDCW.
		---------- DIODES ----------
CD105	B19/5TXAD00291	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD401 thru CD404	B19/5TXAR00023	Silicon, Fast Recovery (RF switch): sim to Mitsubishi MC301
CD501	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS226.
CD502	B19/5TXAD00291	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CV401	B19/5CVAC00005	Variable, max 10 pF.
		---------- FILTERS ----------
FL501	B19/5XHAA00784	Crystal filter: 20.8 MHz 4 poles.
FL502	B19/5XHAA00785	Crystal filter: 20.8 MHz 2 poles.
FL503	B19/5NRAA00144	Ceramic filter: 455 KHz; sim to Mulata CFV455E10.
		---------- HYBRID CIRCUITS ----------
HC401	B19/5NZBH00002	Double Balance Mixer.
		--------- INTEGRATED CIRCUITS ---------
IC501	B19/5DDAD00074	Linear, IF Amplifier & Detector: sim to MOTOROLA MC3359P.
IC502	B19/5DAAR00021	Linear, Positive voltage Regulator: sim to MATSUHITA AN6541.
		---------- CONNECTORS ----------
J101	B19/5JWCL00176	Connector: 4 pins.
J102	B19/5JWCL00045	Connector: RF.
J501	B19/5JWBS00178	Connector: 10 pins.

SYMBOL	GE PART NO.	DESCRIPTION
J502	B19/5JFAL00007	Connector: 10 pins.
J503	B19/5JTCA00137	Connector: 3 pins.
P401	B19/6JJLD12065	Connector: RF.
P402	B19/6JJLD12205	Connector: RF.
P503	B19/5JDAN00012	Connector: 2 pins.
		---------- COILS ----------
L117	B19/6LHFD00004	Coil: RF.
L118	B19/5LCAA00556	Choke coil: 4.7 uH.
L119	B19/6LALD00082	Coil: RF.
L401	B19/5LAAA00059	Coil: RF 0.68 uH ±10%.
L402	B19/5LAAA00060	Coil: RF 0.33 uH ±10%.
L403	B19/6LALD10012	Coil: RF 0.12 uH ±5% (Used in CMN-204A).
L403	B19/6LALD10010	Coil: RF 0.1 uH ±10% (Used in CMN-204B).
L404	B19/6LALD10018	Coil: RF 0.18 uH ±5% (Used in CMN-204A).
L404	B19/6LALD10015	Coil: RF 0.15 uH ±5% (Used in CMN-204B).
L405	B19/6LHLD00003	Coil: RF.
L406	B19/6LALD10012	Coil: RF 0.12 uH ±5% (Used in CMN-204A).
L406	B19/6LALD10010	Coil: RF 0.1 uH ±5%. (Used in CMN-204B).
L407	B19/5LAAA00059	Coil: RF 0.68 uH ±10% (Used in CMN-204A).
L407	B19/5LAAA00061	Coil: RF 0.56 uH ±10% (Used in CMN-204B).
L408	B19/6LALD10020	Coil: RF 0.2 uH ±5%. (Used in CMN-204A).
L408	B19/6LALD10018	Coil: RF 0.18 uH ±5%. (Used in CMN-204B).
L409 and L410	B19/6LALD10012	Coil: RF 0.12 uH ±5%. (Used in CMN-204A).
L409 and L410	B19/6LALD10010	Coil: RF 0.1 uH ±5%. (Used in CMN-204B).
L411	B19/5LAAA00061	Coil: RF 0.56 uH ±10%.
L412	B19/5LAAA00060	Coil: RF 0.33 uH ±10%.
L413	B19/6LAAA00063	Coil: RF 0.27 uH ±10%.
L414 and L415	B19/6LHLD00003	Coil: RF.
L416	B19/6LALD10007	Coil: RF 0.07uH ±5%.
L501	B19/5LCAA00557	Coil: RF 1 uH ±10%.
L502	B19/5LCAC00160	Coil: RF 3.3 uH ±10%.
L503	B19/5LCAA00558	Coil: RF 0.68 uH ±10%.
L504	B19/5LCAA00559	Coil: RF 12 uH ±10%.
L505 thru L508	B19/6LALD00085	Coil: RF.
L509	B19/6LALD00086	Coil: RF.
L510	B19/5LAAL00004	Coil: RF.

SYMBOL	GE PART NO.	DESCRIPTION
		---------- RESISTORS ----------
R129	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R130	B19/5RDAA01541	Carbon film: 470 ohms ±5%, 500 VDCW, 1/4W.
R138	B19/5RDAC02545	Metal film: 18 ohms ±5%, 100 VDCW, 1/10W.
R139	B19/5RDAC02555	Metal film: 270 ohms ±5%, 100 VDCW, 1/10W.
R140	B19/5RDAC02554	Metal film: 120 ohms ±5%, 100 VDCW, 1/10W.
R141	B19/5RDAC02473	Metal film: 1.2K ohms ±5%, 100 VDCW, 1/10W.
R142	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R143	B19/5RDAC01712	Carbon film: 10 ohms ±5%, 500 VDCW, 1/2W.
R401	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R402	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R403	B19/5RDAC02552	Metal film: 560 ohms ±5%, 100 VDCW, 1/10W.
R404	B19/5RDAC02450	Metal film: 10 ohms ±5%, 100 VDCW, 1/10W.
R405	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R407	B19/5RDAC02581	Metal film: 0 ohms.
R409	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R410	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R411	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R412	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R413	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R414	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R415	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R416	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R417	B19/5RDAC02555	Metal film: 270 ohms ±5%, 100 VDCW, 1/10W.
R418	B19/5RDAC02464	Metal film: 15 ohms ±5%, 100 VDCW, 1/10W.
R419	B19/5RDAC02555	Metal film: 270 ohms ±5%, 100 VDCW, 1/10W.
R420	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R421	B19/5RDAC02450	Metal film: 10 ohms ±5%, 100 VDCW, 1/10W.
R422	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R423	B19/5RDAC02452	Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R424	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R425	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R426	B19/5RDAC02450	Metal film: 10 ohms ±5%, 100 VDCW, 1/10W.
R427	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R428	B19/5RDAC02578	Metal film: 180 ohms ±5%, 100 VDCW, 1/10W.
R429	B19/5RDAC02472	Metal film: 680 ohms ±5%, 100 VDCW, 1/10W.
R430	B19/5RDAC02452	Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10W.
R431	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R432	B19/5RDAC02470	Metal film: 330 ohms ±5%, 100 VDCW, 1/10W.
R433	B19/5RDAC02450	Metal film: 10 ohms ±5%, 100 VDCW, 1/10W.
R434	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R435	B19/5RDAA02555	Carbon film: 270 ohms ±5%, 100 VDCW, 1/10W.
R436	B19/5RDAC02464	Metal film: 15 ohms ±5%, 100 VDCW, 1/10W.
R437	B19/5RDAC02555	Metal film: 270 ohms ±5%, 100 VDCW, 1/10W.
R501	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R502	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R503	B19/5RDAC02472	Metal film: 680 ohms ±5%, 100 VDCW, 1/10W.
R505	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R506 and R507	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R509	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R510 and R511	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R512 and R513	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R514	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R515	B19/5RDAC02470	Metal film: 330 ohms ±5%, 100 VDCW, 1/10W.
R516	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R517 and R518	B19/5RDAC02477	Metal film: 3.9K ohms ±5%, 100 VDCW, 1/10W.
R519	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R520	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R521 and R522	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R523	B19/5RDAC02475	Metal film: 1.8K ohms ±5%, 100 VDCW, 1/10W.
R524	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R525	B19/5RDAA01627	Carbon film: 680 ohms ±5%, 100 VDCW, 1/4W.
R526	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R527 and R528	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R531	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R532	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R533	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R534	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R535	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R536	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
		---------- TRANSISTOR ----------
TR104	B19/5TBAB00019	Silicon, NPN: sim to MOTOROLA MRF559.
TR107	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624.
TR401 thru TR403	B19/5TCAB00287	Silicon, NPN: sim to NEC 2SC3357.
TR501	B19/5TKAH00006	N-channel, Field Effect: sim to SONY 2SK125.
TR502 and TR503	B19/5TZAR00015	N-channel, Field Effect: sim to Motorola 2N4416.
TR504	B19/5TCAB00239	Silicon, NPN: sim to NEC 2SC2223.
TR505	B19/5TDAB00055	Silicon, PNP: sim to NEC 2SB624.
TR506	B19/5TBAB00054	Silicon, NPN: sim to NEC 2SD596.
TR508	B19/5TDAB00055	Silicon, PNP: sim to NEC 2SB624.
TR509 thru TR512	B19/5TCAZ00011	Silicon, NPN: sim to NEC 2SC3398.
		---------- WIRE ----------
W501	B19/5ZCBJ00001	Jumper-wire
		---------- CRYSTAL ----------
X501	B19/5XHAA00786	Quartz Crystal: 20.345 MHz.
XS501-1 and XS501-2	B19/5ZJDF00001	Crystal Socket:

SYMBOL	GE PART NO.	DESCRIPTION
	B19/CMG-170A B19/CMG-170B	29-42 MHz SYNTHESIZER BOARD 35-50 MHz SYNTHESIZER BOARD
		---------- CAPACITORS ----------
C201	B19/5CAAD01131	Ceramic: 0.047 uF ±10%, 25 VDCW.
C202	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C203	B19/5CEAA02119	Electrolytic: 220 uF ±20%, 10 VDCW.
C205	B19/5CEAA02283	Electrolytic: 33 uF ±20%, 25 VDCW,
C206	B19/5CAAD01131	Ceramic: 0.047 uF ±10%, 25 VDCW.
C207	B19/5CRAH00066	Metallized Plastic: 1 uF ±10%, 200 VDCW
C208	B19/5CAAD01131	Ceramic: 0.047 uF ±10%, 25 VDCW.
C209	B19/5CAAD00680	Polypropylene: 0.1 uF ±5%, 50 VDCW,
C210 and C211	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C212	B19/5CAAD01131	Ceramic: 0.047 uF ±10%, 25 VDCW.
C213	B19/5CAAD00951	Ceramic: 7 pF ±0.5 pF, 50 VDCW. temp coef 0±30 PPM.
C214 thru C217	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C218	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0±30% PPM. (Used in CMG-170A).
C218	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C219	B19/5CAAD00958	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C220	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C221	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C221	B19/5CAAD00952	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C222	B19/5CAAD00948	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C223	B19/5CAAD00969	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C223	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C224	B19/5CAAD00852	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C225	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.
C226	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C226	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C227	B19/5CAAD00852	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C228	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.

SYMBOL	GE PART NO.	DESCRIPTION
C230	B19/5CAAD00969	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C231 and C232	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C233	B19/5CAAD00794	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C234	B19/5CAAD00948	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C235	B19/5CAAD00853	Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C236 thru C239	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C245	B19/5CAAD00955	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C246	B19/5CAAD00950	Ceramic: 15 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM.
C248	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C249	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C249	B19/5CAAD00947	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C250	B19/5CAAD00970	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C250	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C251	B19/5CAAD00960	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C252	B19/5CAAD00795	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C253	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.
C254	B19/5CAAD00952	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C254	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C255	B19/5CAAD00795	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C256	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.
C257 thru C260	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C262	B19/5CAAD00958	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C262	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C263 and C264	B19/5CAAD00838	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef ±15%.
C265	B19/5CAAD00969	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).

SYMBOL	GE PART NO.	DESCRIPTION
C265	B19/5CAAD00854	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0+30 PPM. (Used in CMG-170B).
C266	B19/5CAAD00948	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C267	B19/5CAAD00800	Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C268	B19/5CAAD01131	Ceramic: 0.047 uF ±10%, 25 VDCW.
C269 and C270	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C271	B19/5CAAD00782	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef ±350-1000 PPM.
C272 thru C274	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C279	B19/5CEAA01826	Electrolytic: 10 uF ±20%, 16 VDCW.
C280	B19/5CRAA00617	Polyester: 0.1 uF ±5%, 50 VDCW.
C281	B19/5CEAA02283	Electrolytic: 33 uF ±20%, 25 VDCW.
C282 and C283	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16 VDCW.
C284 thru C286	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C287	B19/5CAAD01131	Electrolytic: 0.047 uF ±10%, 25 VDCW.
C289	B19/5CAAD00963	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. (Used in CMG-170A).
C289	B19/5CAAD00961	Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM. (Used in CMG-170B).
C290	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C290	B19/5CAAD00970	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C291	B19/5CAAD00852	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C291	B19/5CAAD00953	Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170B).
C292	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.
C293	B19/5CAAD00970	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C294	B19/5CAAD00795	Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C295	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.
C296	B19/5CAAD01051	Ceramic: 470 pF ±5%, 50 VDCW, temp coef +350-1000 PPM.
C297	B19/5CAAD00956	Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±30 PPM.
C298	B19/5CAAD00959	Ceramic: 10000 pF ±10%, 50 VDCW, temp coef ±15%. (Used in CMG-170A).
C298	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%. (Used in CMG-170B).

SYMBOL	GE PART NO.	DESCRIPTION
C299	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef +15%.
C2103	B19/5CAAD00840	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±30 PPM.
C2104	B19/5CSAC00932	Tantalum: 10 uF ±20%, 16 VDCW.
C2109	B19/5CAAD00839	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0±30 PPM. (Used in CMG-170A).
C2112	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16 VDCW.
C2120	B19/5CRAA00419	Polyester: 0.47 uF ±5%, 50 VDCW.
C2121	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C2122	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16 VDCW.
CV201 and CV202	B19/5CVAV00003	Variable: 9 pF max.
		---------- DIODES ----------
CD201	B19/5TXAE00587	Zener, 4.0V: sim to HITACHI HZ4B3.
CD202 and CD203	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD204	B19/5TXAD00356	Silicon, Fast Recovery (2 diodes with anode common): sim to TOSHIBA 1SS181.
CD205	B19/5TXAE00691	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD206	B19/5TXAE00692	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD207 and CD208	B19/5TXAT00004	Silicon, Variable Capacitance Diode: sim to Sanyo SVC321B.
CD209 and CD210	B19/5TXAR00041	Silicon, Fast Recovery, (RF Switch): sim to Mitsubishi MI308.
CD211	B19/5TXAA00326	Silicon, Schottky Barrier: sim to NEC 1SS97.
CD212	B19/5TXAE00692	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD213	B19/5TXAE00691	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD214 thru CD216	B19/5TXAT00003	Silicon, Variable Capacitance Diode: sim to Sanyo SVC321B.
CD217 and CD218	B19/5TXAR00041	Silicon, Fast Recovery, (RF Switch): sim to Mitsubishi MI308
CD219	B19/5TXAA00326	Silicon, Schottky Barrier: sim to NEC 1SS97.
CD220 and CD221	B19/5TXAR00041	Silicon, Fast Recovery, (RF Switch): sim to Mitsubishi MI308
CD222	B19/5TXAE00691	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD223	B19/5TXAE00604	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD226	B19/5TXAE00691	Silicon, Variable Capacitance Diode: sim to HITACHI 1SV126.
CD227 and CD228	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.

SYMBOL	GE PART NO.	DESCRIPTION
CD229 and CD230	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
		---------- INTEGRATED CIRCUITS ----------
IC201	B19/5DAAJ00328	Synthesizer, C MOS serial input: sim to MOTOROLA MC145159P.
IC202	B19/5DDAT00206	Prescaler: sim to FUJITSU MB501P
IC203	B19/5DDAB00328	Linear, Dual Comparator: sim to MITSUBISHI M5233L.
IC204 and IC205	B19/5DAAJ00359	Digital, Bilateral switch: sim to MOTOROLA MC14066BCP.
IC206	B19/5DAAR00021	Linear, Positive Voltage Regulator: sim to MATSUSHITA AN6541.
IC208	B19/5DAAA00183	RF wide band amplifier: sim to NEC UPC1656C.
IC209	B19/5DDAB00164	Linear, Dual OP Amp: sim to MITSUBISHI M5223L.
		---------- JACKS ----------
J201 thru J204	B19/5ZJDF00001	Crystal socket: sim to HAKUTO 75315-001.
J205	B19/5JWBS00239	Connector: 14 pins.
J206	B19/5JWCL00045	Connector: RF.
J210	B19/5ZJDF00001	Crystal socket: sim to HAKUTO 75315-001.
		---------- COILS ----------
L201	B19/5LCAA00471	Coil RF.
L202 and L203	B19/5LCAC00543	Choke Coil: 6.8 uH ±10%.
L204 and L205	B19/5LCAC00018	Choke Coil: 10 uH ±10%.
L206 and L207	B19/5LCAC00151	Choke Coil: 6.8 uH ±10%.
L208	B19/5LAAC00055	Coil RF. (Used in CMG-170A).
L208	B19/5LAAC00057	Coil RF. (Used in CMG-170B).
L209	B19/5LCAC00018	Choke Coil: 10 uH ±10%.
L210	B19/5LCAA00317	Choke Coil: 4.7 uH ±10%.
L211	B19/5LAAA00480	Choke RF.
L214 and L215	B19/5LCAA00510	Choke Coil: 4.7 uH ±10%.
L216 thru L219	B19/5LCAC00018	Choke Coil: 10 uH ±10%.
L220	B19/5LAAC00056	Coil RF. (Used in CMG-170A).
L220	B19/5LAAC00058	Coil RF. (Used in CMG-170B).
L221	B19/5LCAC00154	Choke Coil: 2.2 uH ±10%.
L222	B19/5LCAA00510	Choke Coil: 4.7 uH ±10%. (Used in CMG-170A).
L222	B19/5LCAA00504	Choke Coil: 2.2 uH ±10%. (Used in CMG-170B).

SYMBOL	GE PART NO.	DESCRIPTION
L223	B19/5LCAA00502	Coil RF. (Used in CMG-170A).
L223	B19/5LCAA00471	Coil RF. (Used in CMG-170B).
L224	B19/5LCAC00151	Choke Coil: 6.8 uH ±10%.
L225	B19/5LCAA00018	Choke Coil: 10 uH ±10%.
		---------- RESISTORS ----------
R201	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R202	B19/5RDAC02465	Metal film: 22 ohms ±5%, 100 VDCW, 1/10W.
R204 thru R206	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R207	B19/5RDAA01480	Carbon film: 330 ohms ±5%, 300 VDCW, 1/4W.
R208	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R209	B19/5RDAC02490	Metal film: 470K ohms ±5%, 100 VDCW, 1/10W.
R210	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R211	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W.
R212	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R213	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R214	B19/5RDAC02469	Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.
R215	B19/5RDAC02552	Metal film: 560 ohms ±5%, 100 VDCW, 1/10W.
R216	B19/5RDAC02455	Metal film: 150K ohms ±5%, 100 VDCW, 1/10W.
R217 and R218	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R219	B19/5RDAC02461	Metal film: 1M ohms ±5%, 100 VDCW, 1/10W.
R220	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R221	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R222	B19/5RDAC02453	Metal film: 220K ohms ±5%, 100 VDCW, 1/10W.
R223	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R223	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R224	B19/5RDAC02455	Metal film: 150K ohms ±5%, 100 VDCW, 1/10W.
R225	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R226	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R227	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R228	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R229 and R230	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R231	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R232	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R233	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R234	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R235	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R236	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R238	B19/5RDAC02467	Metal film: 68 ohms ±5%, 100 VDCW, 1/10W.
R239	B19/5RDAC02452	Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10W.
R240	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R241	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R242	B19/5RDAC02582	Metal film: 82 ohms ±5%, 100 VDCW, 1/10W.
R243	B19/5RDAC02578	Metal film: 180 ohms ±5%, 100 VDCW, 1/10W.
R244	B19/5RDAC02582	Metal film: 82 ohms ±5%, 100 VDCW, 1/10W.
R254	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R255	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R260	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R262	B19/5RDAC02467	Metal film: 68 ohms ±5%, 100 VDCW, 1/10W.
R263	B19/5RDAC02452	Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10W.
R264	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R265 and R266	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R267	B19/5RDAC02466	Metal film: 33 ohms ±5%, 100 VDCW, 1/10W.
R268	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R274	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R274	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R275	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R275	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).

SYMBOL	GE PART NO.	DESCRIPTION
R276	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R276	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R277	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R277	B19/5RDAC02476	Metal film: 2.7K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R278	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R278	B19/5RDAC02482	Metal film: 18K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R281	B19/5RDAC02457	Metal film: 27K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R281	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R282	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R283	B19/5RDAC02470	Metal film: 330 ohms ±5%, 100 VDCW, 1/10W.
R285 and R286	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R287	B19/5RDAC02465	Metal film: 22 ohms ±5%, 100 VDCW, 1/10W.
R288 and R289	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R290	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R292	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R294	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R296	B19/5RDAC02444	Metal film: 56K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R296	B19/5RDAC02483	Metal film: 33K ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R298 and R299	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170A).
R298 and R299	B19/5RDAC02582	Metal film: 82 ohms ±5%, 100 VDCW, 1/10W. (Used in CMG-170B).
R2100	B19/5RDAC02582	Metal film: 82 ohms ±5%, 100 VDCW, 1/10W.
R2111	B19/5RDAC02552	Metal film: 560 ohms ±5%, 100 VDCW, 1/10W.
R2112	B19/5RDAC02579	Metal film: 56 ohms ±5%, 100 VDCW, 1/10W.
R2113	B19/5REAG01730	Metal film: 220 ohms ±5%, 100 VDCW, 1/8W.
R2114	B19/5RDAC02470	Metal film: 330 ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R2115	B19/5RDAC02460	Metal film: 47 ohms ±5%, 100 VDCW, 1/10W.
R2116	B19/5RDAC02554	Metal film: 120 ohms ±5%, 100 VDCW, 1/10W.
R2122	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R2123	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R2124	B19/5RDAC02483	Metal film: 33K ohms ±5%, 100 VDCW, 1/10W.
R2216	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W.
R2217	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R2218	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R2219	B19/5RDAC02552	Metal film: 560 ohms ±5%, 100 VDCW, 1/10W.
R2220	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W.
RV201 and RV202	B19/5RVAB00399	Vairable: 10K ohms ±30%, 0.1 W.
		---------- TRANSISTORS ----------
TR201	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624(BV3).
TR205	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624(BV3).
TR206 and TR207	B19/5TCAB00288	Silicon, NPN: sim to NEC 2SC3356.
TR208 and TR209	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR210	B19/5TKAH00006	N-Channel, Field Effect, Junction Single Gate: sim to SONY 2SK125.
TR211	B19/5TCAB00288	Silicon, NPN: sim to NEC 2SC3356.
TR212 and TR213	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR216 thru TR219	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR220	B19/5TKAH00006	N-Channel, Field Effect, Junction Single Gate: sim to SONY 2SK125.
TR221	B19/5TCAB00288	Silicon, NPN: sim to NEC 2SC3356.
TR222	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
TR224	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596 (DV3).
TR227 thru TR230	B19/5TCAZ00011	Silicon, NPN: sim to SANYO 2SC3398.
		---------- CRYSTALS ----------
XU201	B19/6XNLD00005	Reference Oscillator unit. (standard 5 PPM).

SYMBOL	GE PART NO.	DESCRIPTION

SYMBOL	GE PART NO.	DESCRIPTION
	B19/CMC-486A	SYSTEM CONTROL BOARD
		---------- CAPACITORS ----------
C601	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C602	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25 VDCW, temp coef ±15%.
C603	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C604	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25 VDCW, temp coef ±15%.
C605	B19/5CRAA00617	Polyester: 0.1 uF ±5%, 50 VDCW.
C606 and C607	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16 VDCW.
C608	B19/5CEAA01982	Electrolytic: 47 uF ±20%, 16 VDCW.
C609 and C610	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C611 and C612	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16 VDCW.
C613 and C614	B19/5CRAA00617	Polyester: 0.1 uF ±5%, 50 VDCW.
C615	B19/5CZAY00002	Electrolytic: 0.47 uF ±10%, 16 VDCW.
C616	B19/5CAAD01051	Ceramic: 470 pF ±5%, 50 VDCW, temp coef ±30%.
C617	B19/5CRAA00881	Polyester: 0.068 uF ±5%, 50 VDCW.
C618	B19/5CSAC00982	Tantalum: 1 uF ±10%, 35 VDCW.
C619	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16 VDCW.
C620 and C621	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C622	B19/5CSAC00912	Tantalum: 10 uF ±20%, 35 VDCW.
C623	B19/5CEAA02695	Electrolytic: 22 uF ±20%, 16 VDCW.
C624	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16 VDCW.
C625	B19/5CEAA01816	Electrolytic: 47 uF ±20%, 25 VDCW.
C626 and C627	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C628	B19/5CEAA01816	Electrolytic: 47 uF ±20%, 25 VDCW.
C629	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C630	B19/5CEAA01816	Electrolytic: 47 uF ±20%, 25 VDCW.
C631	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C632	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16 VDCW.
C633	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C635 and C636	B19/5CEAA01982	Electrolytic: 47 uF ±20%, 16 VDCW.
C637	B19/5CRAA00617	Polyester: 0.1 uF ±5%, 50 VDCW.
C638	B19/5CSAC00912	Tantalum: 10 uF ±20%, 35 VDCW.
C639	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C640	B19/5CRAA00585	Polyester: 1000 pF ±5%, 50 VDCW.
C641	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16 VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C642	B19/5CRAA00585	Polyester: 1000 uF ±5%, 50 VDCW.
C643	B19/5CSAC01069	Tantalum: 2.2 uF ±20%, 35 VDCW.
C644	B19/5CRAA00881	Polyester: 0.068 uF ±5%, 50 VDCW.
C701	B19/5CSAC00982	Tantalum: 1 uF ±20%, 35 VDCW.
C702 and C703	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C704	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C705	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C706	B19/5CRAA00881	Polyester: 0.068 uF ±5%, 50 VDCW.
C707	B19/5CAAD00957	Ceramic: 4700 pF ±10%, 50 VDCW, temp coef ±15%.
C708	B19/5CRAA00881	Polyester: 0.068 uF ±5%, 50 VDCW.
C709 thru C712	B19/5CAAD00854	Ceramic: 47 pF ±10%, 50 VDCW, temp coef ±15%.
C713	B19/5CAAD00953	Ceramic: 10 pF ±10%, 50 VDCW, temp coef ±15%.
C714	B19/5CAAD00950	Ceramic: 15 pF ±10%, 50 VDCW, temp coef ±15%.
C715	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C716	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C717	B19/5CAAD00959	Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C718	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
C719	B19/5CAAD01131	Ceramic: 0.047 uF ±10%, 25 VDCW, temp coef ±15%.
C720	B19/5CSAC00982	Tantalum: 1 uF ±10%, 35 VDCW.
C721	B19/5CZAY00002	Electrolytic: 0.47 uF ±10%, 16 VDCW.
C722 thru C729	B19/5CAAD00854	Ceramic: 47 pF ±10%, 50 VDCW, temp coef ±15%.
C730 thru C741	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C742	B19/5CAAD01586	Ceramic: 0.1 uF +80%, 25 VDCW.
		---------- DIODES ----------
CD601	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD602 and CD603	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD604	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD605	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD606 and CD607	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD608	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD701	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD702	B19/5TXAE00688	Zener, 500 mW, 6.5 V: sim to Hitachi HZ7A2.

SYMBOL	GE PART NO.	DESCRIPTION
CD703	B19/5TXAE00689	Zener, 500 mW, 3.8 V: sim to Hitachi HZ4A1.
CD704 and CD705	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD706 and CD707	B19/5TXAD00320	Silicon, Fast Recovery (2 diodes in series): sim to TOSHIBA 1SS226.
CD708 thru CD710	B19/5TXAD00290	Silicon, Fast Recovery (2 diodes in cathode common): sim to TOSHIBA 1SS184.
CD711	B19/5TZAD00242	Diode, optoelectronic, red: sim to TOSHIBA TLR143.
		---------- HYBRID CIRCUIT ----------
HC601	B19/6DHFD00160	Squelch: sim to JRC DHFD160.
HC602	B19/6DHFD00167	Filter: sim to MURATA DHFD167.
HC603	B19/6DHFD00168	Filter: sim to MURATA DHFD168.
HC604	B19/6DHFD00169	Filter: sim to MURATA DHFD169.
HC605	B19/6DHFD00164	Filter: sim to MURATA DHFD164.
		-------- INTEGRATED CIRCUITS --------
IC601	B19/5DAAJ00359	Digital, Bilateral Switch: sim to MOTOROLA MC14066BP.
IC602	B19/5DAAA00233	Linear, Audio Amplifier: sim to NEC PC1230H2.
IC603 and IC604	B19/5DAAJ00615	Linear, Quad OP AMP: sim to MOTOROLA LM2902N.
IC605	B19/5DAAJ00305	Linear, Positive Voltage Regulator: sim to MOTOROLA MC7805CT.
IC606	B19/5DAAR00021	Linear, Positive Voltage Regulator: sim to MATSUSHITA AN6541.
IC607	B19/5DAAF00027	Linear, Dual OP AMP: sim to 4558 type.
IC608	B19/5DAAJ00359	Digital, Bilateral Switch: sim to MOTOROLA MC14066BP.
IC610	B19/5DAAJ00645	Linear, Dual Comparator: sim to MOTOROLA LM2903N.
IC611	B19/5DAAJ00578	Digital, Quad 2-Input NAND Gate: sim to MOTOROLA MC14011BCP.
IC701	B19/5DAAJ00646	Linear, Dual Timer: sim to MOTOROLA MC3456P.
IC702	B19/5DDAB0038	Microcomputer: M5L8049H1-059P
IC703	B19/5DAAJ00390	Digital, Hex 3-state Buffer: sim to MOTOROLA MC14503BCP.
IC704	B19/5DDAF00216	Digital, Hex Inverter Buffer/Driver: sim to HITACHI HD7416.
IC705	B19/5DDAS00142	Digital, Dual D Flip-Flop: sim to MOTOROLA MC14013BCP.
IC706	B19/5DDBY00026	Digital, EEPROM: sim to Xicor X2212AP.
ICS702	B19/5ZJAB00029	IC Sockets: 40 pin.
ICS706	B19/5ZJAB00030	IC Sockets: 18 pin.
		---------- JACKS ----------
J601 thru J607	B19/5JTCA00137	Contact: electrical.
J701	B19/5JWBS00239	Connector: 14 pins.
J702	B19/5JWBS00182	Connector: 24 pins.
J704	B19/5JWBS00239	Connector: 14 pins.
J705	B19/5JWBS00237	Connector: 7 pins.
J706 and J707	B19/5JWBS00137	Contact: electrical.
P601 thru P607	B19/5JDAN00012	Receptacle: 2 position.
P706 and P707	B19/5JDAN00012	Receptacle: 2 position.
		---------- RESISTORS ----------
R601	B19/5RDAC02458	Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10W.
R602	B19/5RDAC02452	Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10W.
R603	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R604 thru R609	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R610	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R611	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R612	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R613	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R614	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R615	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R616	B19/5RDAC02453	Metal film: 220K ohms ±5%, 100 VDCW, 1/10W.
R617	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R618	B19/5RDAC02462	Metal film: 3.3K ohms ±5%, 100 VDCW, 1/10W.
R619	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R620	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R621	B19/5RDAC02461	Metal film: 1M ohms ±5%, 100 VDCW, 1/10W.
R622 and R623	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R624	B19/5RDAC02468	Metal film: 150 ohms ±5%, 100 VDCW, 1/10W.
R625 thru R628	B19/5RDAC02614	Metal film: 2.2 ohms ±5%, 100 VDCW, 1/10W.
R629	B19/5RDAC02581	Metal film: 0 ohms.
R631	B19/5RDAC02459	Metal film: 180K ohms ±5%, 100 VDCW, 1/10W.
R632	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R633	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R635	B19/5RDAC02459	Metal film: 180K ohms ±5%, 100 VDCW, 1/10W.
R636	B19/5RDAC02451	Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10W.
R637	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R638	B19/5RDAC02478	Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10W.
R639	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R640	B19/5RDAC02453	Metal film: 220K ohms ±5%, 100 VDCW, 1/10W.
R641	B19/5RDAC02482	Metal film: 18K ohms ±5%, 100 VDCW, 1/10W.
R642	B19/5RDAC02460	Metal film: 47 ohms ±5%, 100 VDCW, 1/10W.
R643 and R644	B19/5RDAC02475	Metal film: 1.8K ohms ±5%, 100 VDCW, 1/10W.
R645	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R646	B19/5RDAC02457	Metal film: 27K ohms ±5%, 100 VDCW, 1/10W.
R647	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R648	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R649	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R650	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R651 and R652	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R653	B19/5RDAC02590	Metal film: 12.4K ohms ±1%, 100 VDCW, 1/10W.
R654 and R655	B19/5RDAC02589	Metal film: 10K ohms ±1%, 100 VDCW, 1/10W.
R656	B19/5REAG02959	Metal film: 4.12K ohms ±1%, 100 VDCW, 1/10W.
R657	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R658 and R659	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R660 and R661	B19/5RDAC02472	Metal film: 680 ohms ±5%, 100 VDCW, 1/10W.
R662	B19/5RDAC02474	Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10W.
R663	B19/5RDAC02456	Metal film: 330K ohms ±5%, 100 VDCW, 1/10W.
R664	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R665	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R666	B19/5RDAC02473	Metal film: 1.2K ohms ±5%, 100 VDCW, 1/10W.
R667	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R668	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R669	B19/5RDAC02482	Metal film: 18K ohms ±5%, 100 VDCW, 1/10W.
R670	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R671	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R672	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R673	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R675 and R676	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R677	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R678 thru R686	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R687	B19/5RDAC02457	Metal film: 27K ohms ±5%, 100 VDCW, 1/10W.
R688	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R701	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R702	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R703	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R704	B19/5RDAC02452	Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10W.
R705	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R706	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R707	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R708	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R709	B19/5RDAC02446	Metal film: 1K ohms ±5%, 100 VDCW, 1/10W.
R710	B19/5RDAC02476	Metal film: 2.7K ohms ±5%, 100 VDCW, 1/10W.
R711	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R712 and R713	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R714	B19/5RDAC02486	Metal film: 82K ohms ±5%, 100 VDCW, 1/10W.
R715	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R716	B19/5RDAC02476	Metal film: 2.7K ohms ±5%, 100 VDCW, 1/10W.
R717	B19/5RDAC02454	Metal film: 22K ohms ±5%, 100 VDCW, 1/10W.
R718	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R719	B19/5RDAC02473	Metal film: 1.2K ohms ±5%, 100 VDCW, 1/10W.

SYMBOL	GE PART NO.	DESCRIPTION
R720 and R721	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R722	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R723	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R724	B19/5RDAC02481	Metal film: 15K ohms ±5%, 100 VDCW, 1/10W.
R725	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R726	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R727	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R728 and R729	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R730	B19/5RDAC02439	Metal film: 47K ohms ±5%, 100 VDCW, 1/10W.
R731	B19/5RDAC02471	Metal film: 470 ohms ±5%, 100 VDCW, 1/10W.
R732	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R733 thru R741	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R742	B19/5RDAC02447	Metal film: 100 ohms ±5%, 100 VDCW, 1/10W.
R743	B19/5RDAC02449	Metal film: 100K ohms ±5%, 100 VDCW, 1/10W.
R744	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R745	B19/5RDAC02453	Metal film: 220K ohms ±5%, 100 VDCW, 1/10W.
R746	B19/5RDAC02457	Metal film: 27K ohms ±5%, 100 VDCW, 1/10W.
R747 and R748	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R749	B19/5RDAC02457	Metal film: 27K ohms ±5%, 100 VDCW, 1/10W.
R750 and R751	B19/5RDAC02445	Metal film: 10K ohms ±5%, 100 VDCW, 1/10W.
R752	B19/5RDAC02479	Metal film: 8.2K ohms ±5%, 100 VDCW, 1/10W.
R753	B19/5RDAC02555	Metal film: 270 ohms ±5%, 100 VDCW, 1/10W.
RX701 thru RX703	B19/5RZAB00043	Resister array: 10K ohms.
RV601	B19/5RVAB00400	Variable: 5K ohms ±30%, 0.1W.
RV602	B19/5RVAB00401	Variable: 100K ohms ±30%, 0.1W.
RV603 thru RV605	B19/5RVAB00399	Variable: 10K ohms ±30%, 0.1W.
		---------- TRANSISTORS ----------
TR601 thru TR606	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596 (DV3).
TR607	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624 (BV3).
TR608 thru TR610	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596 (DV3).
TR701 thru TR707	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596 (DV3).
TR708	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624 (BV3).
TR709 thru TR713	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596 (DV3).
		---------- CRYSTALS ----------
X701	B19/5XHAA00778	Quartz crystal.
X701-A and X701-B	B19/5ZJDF00001	Crystal Socket.
	B19/CMH-813	INTERFACE BOARD
		---------- CAPACITORS ----------
C801 and C852	B19/5CAAD00838	Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C853	B19/5CEAA01813	Electrolytic: 100 uF ±20%, 50 VDCW.
		---------- JACKS ----------
J801	B19/5JCAP00006	Connector.
J802	B19/5JWBS00241	Connector.
J803	B19/5JWBS00242	Connector.
		INTERCONNECTION
		---------- CAPACITORS ----------
C901 and C902	B19/5CBAB00838	Ceramic: 1000 pF ±200%, 50 VDCW, temp coef +20.
		---------- CABLES ----------
ZC601	B19/5ZZWF00001	Flexible cable.
ZC602	B19/5ZZWF00002	Flexible cable.
ZC603	B19/5ZZWF00001	Flexible cable.
ZC604	B19/5ZZWF00006	Flexible cable.
ZC605	B19/5ZZWF00004	Flexible cable.
ZC606	B19/6ZCLD00072	Power cable include C901 and C902
ZC607	B19/6ZCFD00146	Power cable
		---------- MISCELLANEOUS ----------
	B19/MPDM01167	Radio Key
	19A704978P1	Keylock Assembly
	19A705158P4	Noise Blanker Kit
	19B216021G3	Tx Fuse, 20 A-low power.
	19B216021G6	Tx Fuse, 30 A-high power.

(End of "D" Secion)