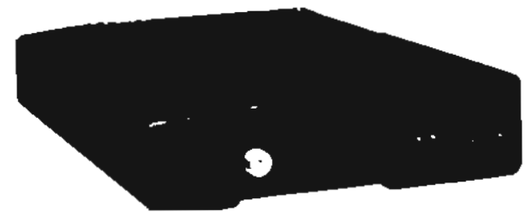
LBI

31621

GE Mobile Communications

RANGR™
403-512 MHz



INCLUDES

TABLE OF CONTENTS

ILLUSTRATIONS

FCC FILING NUMBER

PART #	FCC ID #	FREQUENCY SPLIT (MHz)	TX POWER OUT (W)	OSCILLATOR STABILITY (ppm)
1	AXA9HHTR-142-B2	450-470	35	2
2	AXA9HHTR-143-B2	450-470	100	2
3	AXA9HHTR-142-C2	470-488	30	2
4	AXA9HHTR-143-C2	470-488	80	2
5	AXA9HHTR-142-D2	482-500	30	2
6	AXA9HHTR-143-D2	482-500	80	2
7	AXA9HHTR-142-E2	494-512	30	2
8	AXA9HHTR-143-E2	494-512	80	2
9	AXA9HHTR-142-B	450-470	35	5
10	AXA9HHTR-143-B	450-470	100	5

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	403-423 MHz, 410-430 MHz, 420-440 MHz MHz 440-460 MHz, 450-470 MHz, 470-488 MHz MHz 482-500 MHz, and 494-512 MHz
BATTERY DRAIN	
Receive	
Squelched	0.7 Amperes at 13.8 Volts
Unsquelched	2.2 Amperes at 13.8 Volts
Transmit	
30W/35W Watts	13 Amperes at 13.6 Volts
80W/100W Watts	29.5 Amperes at 13.4 Volts
FREQUENCY STABILITY	0.0005%/0.0002% depending on model.
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 14% Transmit
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	30W/35W/80W/100W
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	403-470 MHz ---- 20 MHz 470-512 MHz ---- 18 MHz
MICROPHONE LOAD IMPEDANCE	600 ohms
POWER ADJUST RANGE	100% to 50% of rated power
RF OUTPUT IMPEDANCE	50 ohms
FM NOISE	-50 dB
CARRIER ATTACK TIME	20 milliseconds

AUDIO ATTACK TIME	20 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 (25 kHz channels)	-80 dB
SPURIOUS RESPONSE	-85 dB
INTERMODULATION 25 kHz	-80 dB
MODULATION ACCEPTANCE	±7 kHz
MAXIMUM FREQUENCY SEPARATION	403-470 MHz --- 20 MHz 470-512 MHz --- 18 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	-45 dB
SQUELCHED	-70 dB
RECEIVER RECOVERY TIME	200 milliseconds
RECEIVER ATTACK TIME	150 milliseconds
CHANNEL SPACING	25 kHz

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

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter" which is stamped on the label containing the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

Rev. A - UHF Radio 19C852450 P1-P36

A 10 pF capacitor (19A700219P26) was added from TR503-B to ground on Receiver Board to prevent receiver 1st IF (82.2 MHz) parasitic oscillation.

Rev. B - UHF Radio 19C852450 P1-P36

A 5 pF capacitor (B19/5CAAD00800) and a 7 pF capacitor (B19/5CAAD00977) was added in series from TR503-B to ground on Receiver Board to prevent receiver 1st IF (82.2 MHz) parasitic oscillation.

Rev. C - UHF Radio 19C852450 P1-P36

System Control Board CMC383

A 0.1 uF capacitor (B19/5CAAD01237) was added from $\overline{\text{SQ DSBL}}$ (J701-1) to eliminate S550 scan noise in speaker with radio squelched.

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 be equipped with:

- Microcomputer Controlled Frequency Synthesizer
- Up to 16 channels
- .0005% 1.0002% 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.

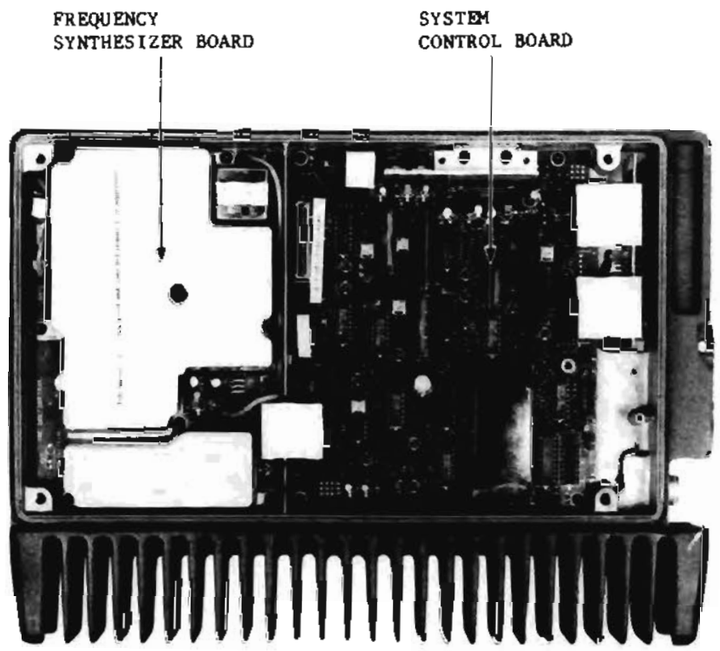
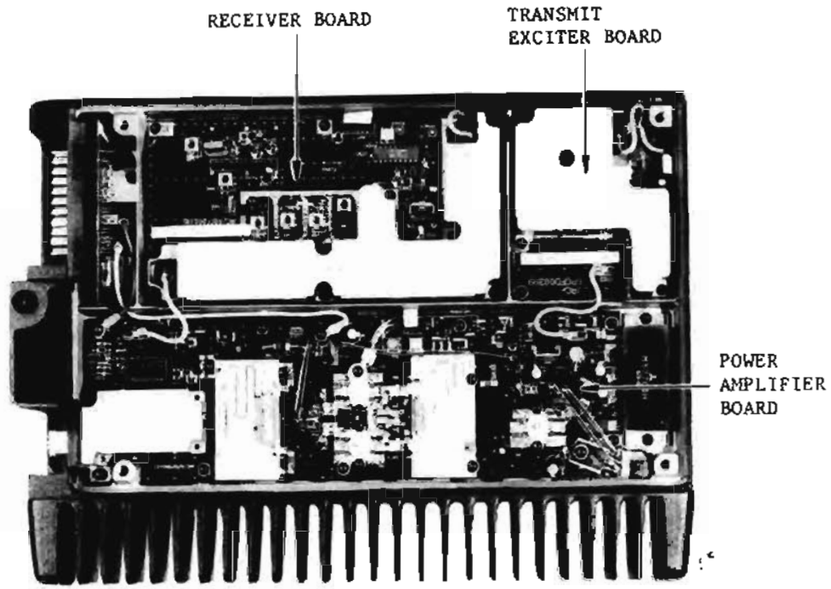
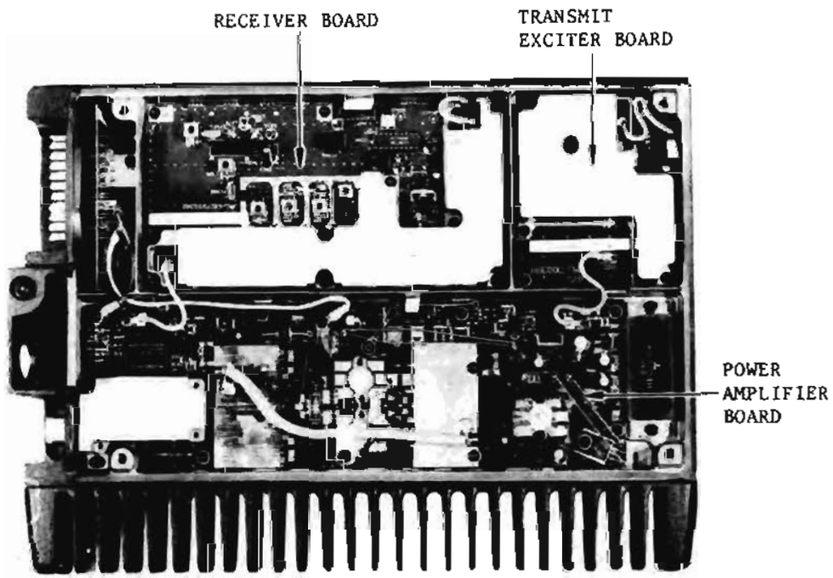


Figure 1 - Typical Module Layout (Top View)



- 80/100 W TYPE -



- 30/35 W TYPE -

Figure 2 - Typical Module Layout (Bottom View)

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

A centralized metering jack for the transmitter, receiver and system functions is provided for simplified alignment and troubleshooting.

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 12.5 kHz. Also insure that P706 is connected to J706-2 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 in 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, a jack for central metering 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 detail 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 use of microcomputer technology allows self-diagnostic maintenance routines to be incorporated in the microcomputer software. These routines are easy to run and provide a quick analysis of microcomputer and frequency synthesizer operation.

The service section of this manual contains the diagnostic routines and other maintenance information to service this radio. The service section includes:

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

GE Mobile Communications
General Electric Company
Lynchburg, Virginia 24502

Printed in Japan

MAINTENANCE MANUAL

403-512 MHz SYNTHESIZED RANGR

TWO WAY FM RADIO

SERVICE SECTION

TABLE OF CONTENTS

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 22 CONDUCTOR	B19/6JJFD00057
EXTENSION CABLE 10 CONDUCTOR	B19/6JJFD00058
EXTENSION CABLE 10 CONDUCTOR	B19/6JJFD00059
EXTENSION CABLE 4 CONDUCTOR	B19/6JJFD00060
EXTENSION CABLE 6 CONDUCTOR	B19/6JJFD00061
COAXIAL CABLE	B19/6JJFD00062
COAXIAL CABLE	B19/6JJFD00063
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	INTERVAL 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.

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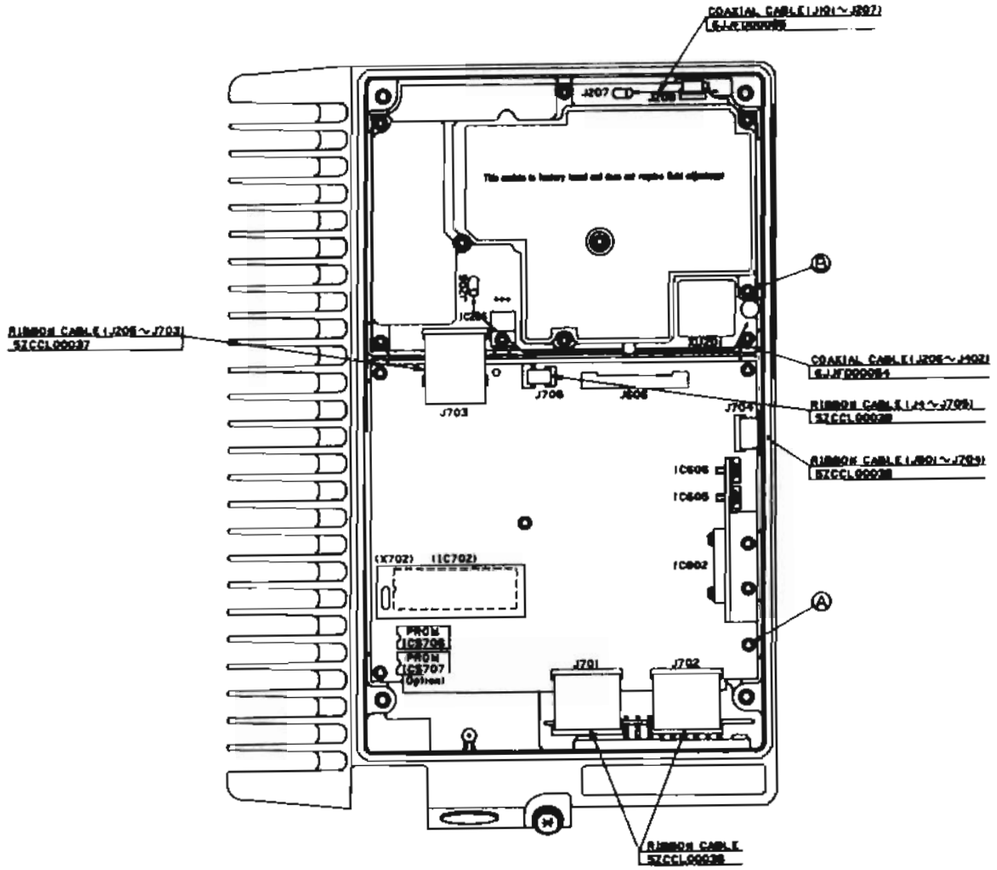
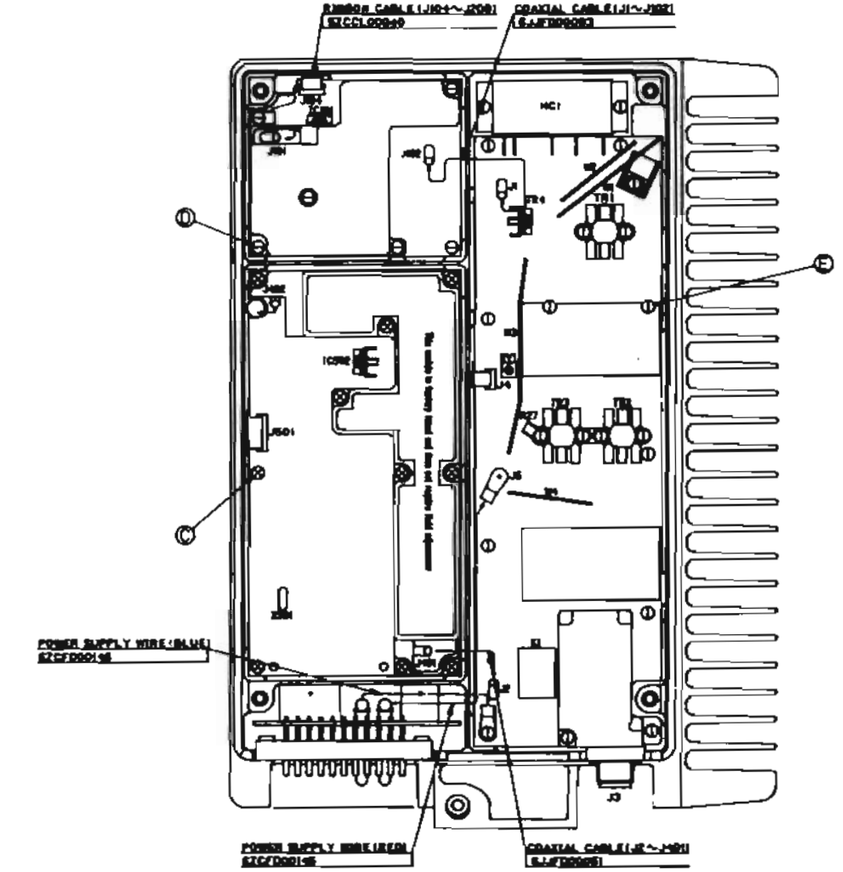


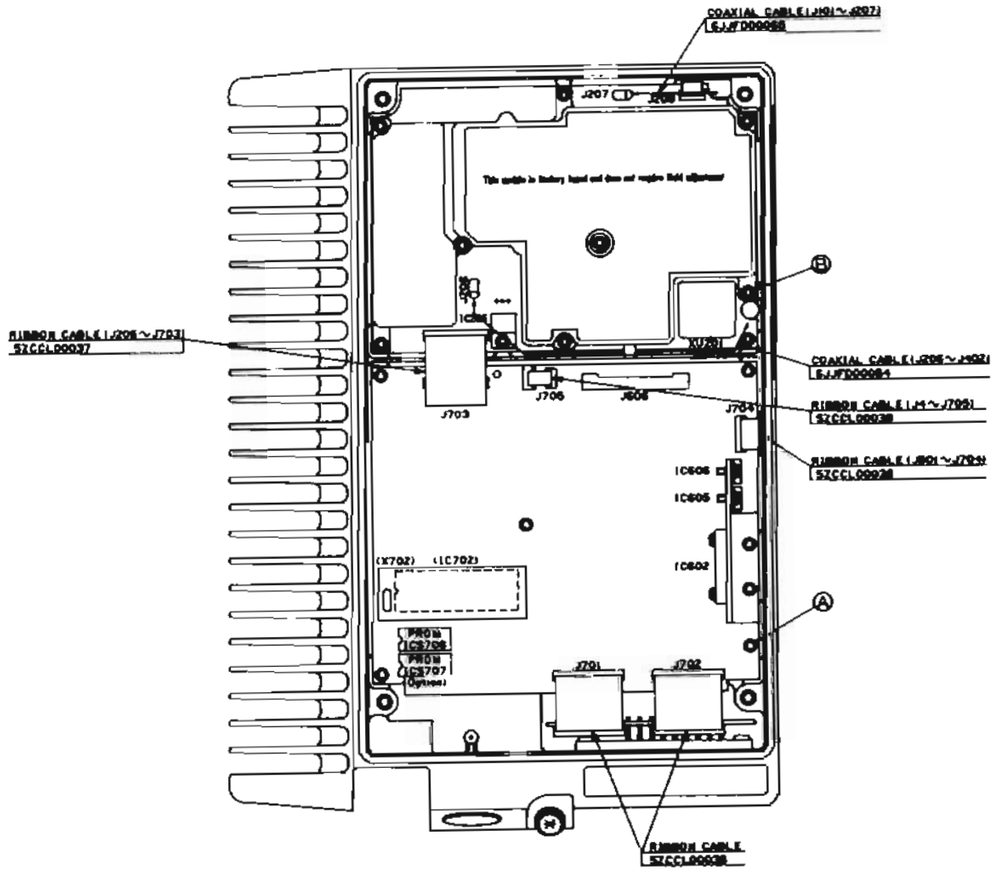
Disassembly-Top View

Figure 1



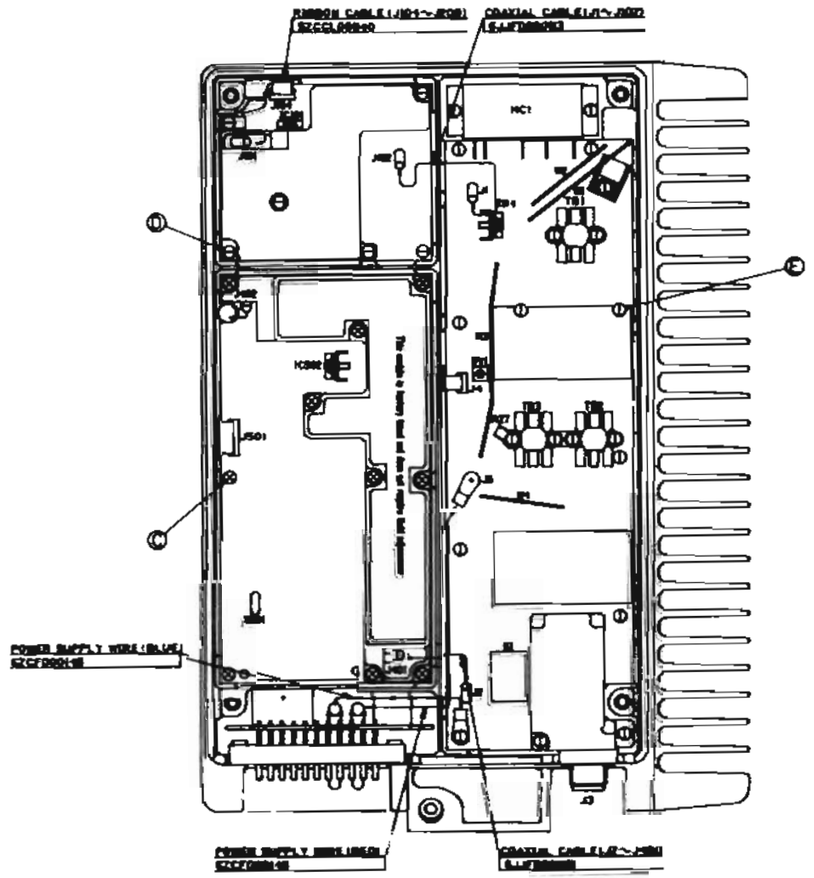
Disassembly-Bottom View

Figure 2



Disassembly-Top View

Figure 1



Disassembly-Bottom View

Figure 2

Board name	Cables to be removed	Screws to be removed
System control board	Five ribbon cables	Seven screws A (Figure 1)
Synthesizer board	Two coaxial cables and two ribbon cables	Ten screws B (Figure 1)
PA board	Two power supply wires (red and blue), two coaxial cables, one ribbon cable	20 screws E (Figure 2)
Tx Exciter board	Two coaxial cables, one ribbon cable	Six screws D (Figure 2)
Rx board	Two coaxial cables and one ribbon cable	Ten 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. Removed 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 silicon 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 (9.4kg·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. To remove an IC, heat each lead separately on the solder side and remove the old solder with the desoldering tool.

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 at 700°F (371°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 Self Test and Diagnostics routines and 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.

MICROCOMPUTER

When servicing the microcomputer/synthesizer circuitry it is sometimes desirable to force the microcomputer into specific operating modes. Following are tips that allow you to initiate these modes.

- Ground the lock-detect line at IC701-8 to force the microcomputer to continually try to reload the synthesizer. This mode will enable you to check the serial data, clock, channel change pulse and enable signals to the synthesizer.
- To stop the microcomputer from running, disable the watchdog timer by shorting the collector and emitter of TR701, and ground the single-step line at IC702-5.

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.

MICROCOMPUTER DIAGNOSTICS

The microcomputer, in addition to operational programming, contains software for self-diagnostic routines to aid in troubleshooting the radio. Since the radio can not function with a defective microcomputer, the self diagnostic routines include internal tests as well as input/output tests to verify proper operation.

The internal tests include a ROM test which verifies that the proper program is stored in the microcomputer and a RAM test which checks for proper data transfer to and from all memory locations.

The input/output tests include a test which grounds one pin at a time on Port 1 and the data bus, and a test which mirrors the inputs PTT, CG DISABLE, ADVANCE CHANGE, and FB4 - FB1 on to the data bus.

These tests assure proper operation of the ports and data bus, in addition to checking the input/output instructions of the microcomputer. When troubleshooting the radio, if problems are suspected on the system board, the diagnostic routines should be performed first before going on to the test procedures and alignment instructions.

TEST EQUIPMENT REQUIRED

- 13.8 VDC supply, 500 mA (unless being tested in radio)
- DC Voltmeter (Data Tech 30L or equivalent)
- Oscilloscope (Tektronix 404 or equivalent)

TEST PROCEDURE

1. Connect oscilloscope to J801-18 (SPKR 1) and ground.
2. Enter the self-diagnostic mode as follows:

CAUTION

When using the radio with the S550, S950 or S990 control head, the ADVANCE CHANGE line should be disconnected form the control head by removing connector P3. Instead of keying the microphone, ground J606-10.

Key the radio with the microphone on-hook. (Ground J801-11. Make sure that MONITOR Switch is OFF.)

- Apply A+ at J702-9 through a 10K resistor to J702-10.
- Turn radio on.

ROM AND RAM TESTS

Once power is supplied to the board, the microcomputer will jump to the self-diagnostic test and immediately begin execution of the ROM and RAM tests. Upon completion of the ROM and RAM test (less than a second) the display, data bus, or alert tone will indicate when the tests have been successfully completed. Test status is indicated as follows:

	D3	D2	D1	D0	ALERT TONE
ROM TEST FAILED	0	0	0	0	NONE
ROM TEST PASSED RAM TEST FAILED	0	0	0	1	NONE
ROM TEST PASSED RAM TEST PASSED	0	0	1	0	1 kHz

If the data bus is inaccessible then the alert tone can be used to indicate whether the radio passed the tests. If the tests are successfully completed there will be a 1 kHz tone on SPKR 1 and it will be heard on the speaker if the board is in radio. If no alert tone is present, then either the ROM or RAM test has failed.

If the radio fails these tests, the microcomputer function is defective. Before replacing the microcomputer, exhaust all other possibilities. Check associated circuits for shorted or open printed wire runs and components.

INPUT/OUTPUT TESTS

If the ROM and RAM tests are completed satisfactorily, release the PTT switch and remove A+ from J702-10. Note that the data bus will still indicate 02 (Hex), however, the 1 kHz tone should no longer be displayed on the scope or heard on the speaker.

The I/O test grounds one pin at a time on Port 1 and the data bus and is stepped through the test sequence by operating the PTT switch (momentarily grounding J801-11). Port 1 and the data bus can be monitored using a voltmeter. Port 1 consists of pins 27-34 on microcomputer IC702. The data bus includes pins 12-19 on IC702. Refer to schematic diagram for data bus and port identification for IC702. For example:

P17 = port 1 bit 7.

1. Momentarily press and release the PTT switch (J801-11) Port 1 and data bus lines all will go high.
2. Momentarily press and release the PTT switch (J801-11). IC702-34 and IC702-19 will go low. All other outputs should be high.
3. Momentarily press and release the PTT switch (J801-11). IC702-33 and IC702-18 will go low. All other outputs should be high.
4. Momentarily press and release the PTT switch (J801-11). IC702-17 will go low. All other outputs should be high. Note that IC702-32 will remain high. This is because this output switches the radio into the transmit mode when grounded. Thus the output is bypassed so that the radio will never go into the transmit mode during self test.
5. Momentarily press and release the PTT switch (J801-11). IC702-31 and IC702-16 will go low. All other outputs should be high.
6. Momentarily press and release the PTT switch (J801-11). IC702-30 and IC702-15 will go low. All other outputs should be high.
7. Momentarily press and release the PTT switch (J801-11). IC702-29 and IC702-14 will go low. All other outputs should be high.
8. Momentarily press and release the PTT switch (J801-11). IC702-28 and IC702-13 will go low. All other outputs should be high.
9. Momentarily press and release the PTT switch (J801-11). IC702-27 and IC702-12 will go low. All other outputs should be high.
10. Momentarily press and release the PTT switch (J801-11). Port 1 outputs will all be set high.

NOTE

At this point the program advances to mirror the outputs PTT, CG DISBL, ADVANCE CHANGE, and FB4-FB1 into the data bus IC702-12 throught IC702-19, respectively.

11. Momentarily apply ground to the following points while observing status of the associated data bus as indicated below. When ground is applied, the data bus should go low and then go high when ground is removed.

Momentarily Ground	Data Bus	Momentarily Ground	Data Bus
J801-30	IC702-18	J801-13	IC702-14
J801-10	IC702-17	J801-2	IC702-13
J801-32	IC702-16	J801-1	IC702-12
J801-4	IC702-15	J801-11	IC702-19

12. Exit the diagnostic routines by momentarily removing power from the radio.

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.

UHF TEST PROGRAM FREQUENCY

BAND (MHz)	CH	TX (MHz)	RX (MHz)	CG (Hz)	CCT
403.00 to 423.00	1	412.975	412.950	71.9	0.30
	2	403.500	403.025	023	
	3	422.975	422.950	71.9	
	4	412.975	412.950		
410.00 to 430.00	1	419.975	419.950	71.9	0.30
	2	410.500	410.025	023	
	3	429.975	429.950	71.9	
	4	419.975	419.950		
420.00 to 440.00	1	429.975	429.950	71.9	0.30
	2	420.500	420.025	023	
	3	439.975	439.950	71.9	
	4	429.975	429.950		
430.00 to 450.00	1	439.975	439.950	71.9	0.30
	2	430.500	430.025	023	
	3	449.975	449.950	71.9	
	4	439.975	439.950		
450.00 to 470.00	1	459.975	459.950	71.9	0.30
	2	450.500	450.025	023	
	3	469.975	469.950	71.9	
	4	459.975	459.950		
470.00 to 488.00	1	478.975	478.950	71.9	0.30
	2	470.500	470.025	023	
	3	487.975	487.950	71.9	
	4	478.975	478.950		
482.00 to 500.00	1	490.975	490.950	71.9	0.30
	2	482.500	482.025	023	
	3	499.975	499.950	71.9	
	4	490.975	490.950		
494.00 to 512.00	1	502.975	502.950	71.9	0.30
	2	494.500	494.025	023	
	3	511.975	511.950	71.9	
	4	502.975	502.950		

BAND: frequency band

CH : channel number

TX : transmit frequency

RX : receive frequency

CG : channel guard

CCT : carrier control timer

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 J606.
The typical readings for the test positions and test points are given in the chart below. The meter readings are typical using General Electric Test Set 4EX3A11 with Test Set Adapter 19C851532G1.

TEST POSITION	METERING POINT	FUNCTION MEASURED	SCALE	TYPICAL READING
B	J606-3	9V-RX	0-15V	9V
C	J606-4	5V	0-15V	5V
H	J606-8	EX9V	0-15V	9V
I	J606-9	+8V	0-15V	8V
J	J606-11	9V	0-15V	9V
K	J606-12	A+	0-15V	13.6V

TABLE 4 - READINGS AT J606

EXCITER QUICK CHECK

When troubleshooting the transmitter check for typical readings for the DC voltages across Exciter resistor R116, the Synthesizer output (J207), and the Exciter output (J102) as listed in Table 5.

SYMPTOM	PROCEDURE	ANALYSIS
Little or No RF Output	Unkey transmitter and check IC101-3 for +9.0 VDC	Verify +9.0 Volt supply. Check IC101.
	Key transmitter and Check DC voltages on TR101-TR106. (No RF Present)	If voltages are incorrect, check L101, L103, L105-L108, and all resistors for each stage. Check R106, R112, R123, R126, and R132. Check TR101-TR105. Replace components if defective.
	Key transmitter and check DC voltages on TR101-TR105. (RF Present)	Voltage should decrease when the transmitter is keyed. If not, check C101, C103, C107, C108, C112, C113, C116, C125, C140 and L109-L111.
	Disconnect the coaxial cable ZC601 from PA and measure RF input power from exciter. Should be 0.25 Watts or more.	If exciter output is low, check TR105 and associated circuitry. Check FL101-FL103. **If output power is correct, be sure** ZC601 is soldered securely and that it mates properly with the contact on the power amplifier.

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
$\overline{\text{Tx ENBL}}$	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
System Metering	J606
RX RF	J401
RX INJ	J206
TX INJ	J207
EX Output	J102

TABLE 7 - RADIO CONNECTOR IDENTIFICATION

TRANSMITTER ALIGNMENT

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 required 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
3. An output meter or a VTVM
4. GE Test Set Model 4EX3A11 with Test Set Adapter Cable 19C851532G1

PROCEDURE OF SYNTHESIZER TRANSMIT DEVIATION

NOTE

The transmit deviation has been properly set by the factory and should require no readjustment. Should it become necessary to adjust the deviation please refer to the Maintenance Manual LBI-31731 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 P605.

2. Rotate RV201 and RV603 fully counterclockwise.

3. Apply a 1 kHz tone at 1 Vrms through a 100μF capacitor to MIC HI at J701-16 (+ lead of capacitor).

   Connect the deviation monitor to the antenna connector J2 via a 30-dB coupler, whose output is terminated in a 50-ohm load. Key the radio.

   Set VCO DEVIATION ADJUST, RV202 for $\pm$3.75 kHz deviation.

4. Set RV603 fully clockwise. Apply a 400 Hz tone to J605-2 and with the radio keyed, vary its amplitude until the Deviation Monitor reads 2 kHz. Note the level.

5. Change the signal generator frequency to 10 Hz at the same level and set REF MOD ADJUST, RV201 for a deviation of 2 kHz. Unkey the radio.

6. Disconnect the signal generator and replace P605 in position 1-2.

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

   Key the radio and set CG DEVIATION ADJUST, RV603 for a deviation reading of $\pm$0.75 kHz.

   NOTE: If Channel Guard or Voice Guard is not used on any frequency, the VCO DEVIATION ADJUST RV202 may be set for a deviation of $\pm$4.5 kHz instead of $\pm$3.75 kHz.

AUDIO CHECKS

TEST EQUIPMENT REQUIRED

- Audio Oscillator
- AC Voltmeter
- Oscilloscope
- Deviation Monitor

AUDIO AC VOLTAGE

1. Connect audio oscillator output across J701-16 (or J801-9) and J701-3 (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.		[redacted]	[redacted]

AUDIO SENSITIVITY

1. Connect audio oscillator output across J701-16 (or J801-9) and J701-3 (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
4. Power supply, 13.8 VDC regulated
5. GE Test Set 4EX3A11 with Test Set Adapter Cable 19C851532G1

PRELIMINARY CHECKS AND ADJUSTMENTS

NOTE

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

1. Apply DC power to radio.

2. Connect plug of GE Test Set to Metering jack J606. Set polarity to "+" and voltage range to the 1 volt position (Test 1).

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.

ALIGNMENT PROCEDURE

- 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-31731 and "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 existing holes in the shield. These hole locations are shown in Figure 3.
				NOTE Should it become necesary to adjust the synthesizer, program a PROM to the highest frequency of the split (400 MHz for A board, 470 MHz for B board or 512 MHz for C board) for proper alignment.
1.	TP201 (Control Voltage Monitor)	CV202	7.0 VDC	Select highest frequency transmit channel in the split (440 MHz-A, 470 MHz-B, 512 MHz-C). With a 50 ohm load on the antenna connector J3, key the radio. Adjust CV202 until the lock detector indicator CD710 goes out. Monitor TP201 with a digital voltmeter and adjust CV202 for a reading of 7.0 ±0.1 VDC. Check that CD710 remains out. Unkey the radio.

- SYNTHESIZER -

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
2.	TP201 (Control Voltage Monitor)	CV201	7.0 VDC	Select highest receive channel in the split as in Step 1 (release PTT switch). Adjust CV201 until lock detector indicator CD710 goes out. Monitor TP201 with a digital voltmeter and adjust CV201 for a reading of 7.5±0.1VDC. Check that CD710 remains out.
3.	TP201 (Control Voltage Monitor)		3.5 to 7.5 VDC	Select each receive and transmit channel. Voltage at TP201 should be between 3.5 and 7.5 VDC.
4.	J207 J206		-3 to +6 dBm	Monitor TX injection at J207 and Rx injection at J206 Tx injection -3 to +6 dBm Rx injection -3 to +6 dBm

- REFERENCE OSCILLATOR FREQUENCY -

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
5.	J207	FREQ TRIM Control on VC-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 Tx injection frequency at J207. Adjust FREQ TRIM Control on VC-TCXO for the assigned channel frequency within ±0.5 ppm. Note: The receiver injection frequency will automatically be correct.

- EXCITER -

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.
6.	J102		250 mW	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 cables ZC608 and ZC610. Connect a (0-1 watt) wattmeter to J102. Apply a 0 dBm on-frequency signal to J101. Check output power on the wattmeter. It should be greater than 250 milliwatts.
7.	J3	RV1	Rated Output Power	NOTE Disconnect wattmeter from J102. Reinstall Z608 and Z610 if removed. Connect a (0-150 watts) wattmeter set to antenna jack J3. 80/100 WATT POWER AMPLIFIER Monitor the transmitter output power on each channel. Select the channel with the lowest output power and set RV1 for 80/100 watts output. 30/35 WATT POWER AMPLIFIER Monitor the transmitter output power on each channel. Select the channel with the lowest output power and set RV1 for 30/35 watts output.

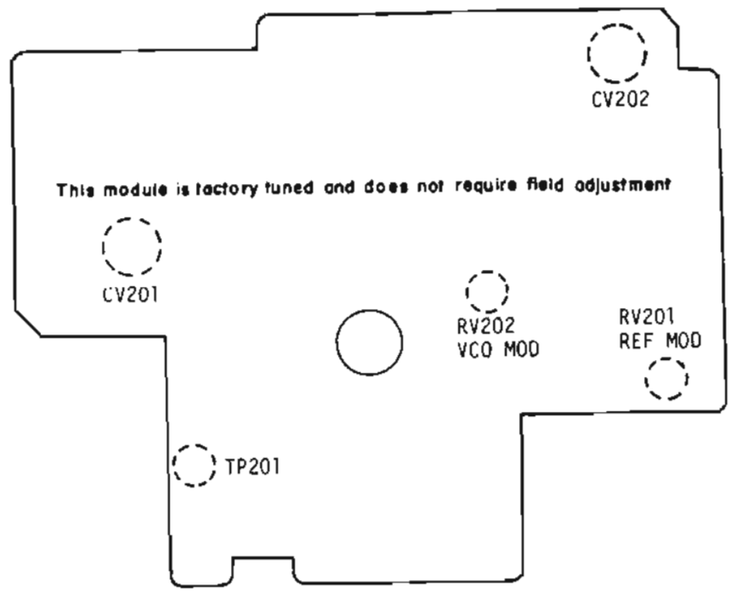


Figure 3 - Hole locations for synthesizer tuning and transmitter deviation adjustment

RECEIVER ALIGNMENT

Alignments for Front-End and Local Injection circuits are not required because a band-pass filter is employed in the RANGR wide band synthesized radio receiver.

TEST EQUIPMENT REQUIRED

- GE TEST Set 4EX3A11, 4EX8K12, or 20,000 ohms-per-volt multimeter.
- AC Voltmeter
- RF Signal Generator
- Frequency Counter (403 to 512 MHz)
- 4-ohm 15 watt resistor.
- Audio Isolation Transformer (1:1) 19A116736P1 or equivalent

> **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

ADJUSTMENT PROCEDURES

RECEIVER FREQUENCY ADJUSTMENT

No receiver frequency adjustment is required.

2nd RECEIVER OSCILLATOR

Using a frequency counter monitor 2nd Local Terminal. Set L509 for a frequency of 82.655 MHz ±200 Hz.

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 J3.

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 12 dB SINAD at audio output.

Adjust coils L504 to L508 to obtain minimum 12 dB SINAD.

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

Adjust L511 for maximum audio output.

Adjust RV602 for audio output level at TP1 of 300 mVrms.

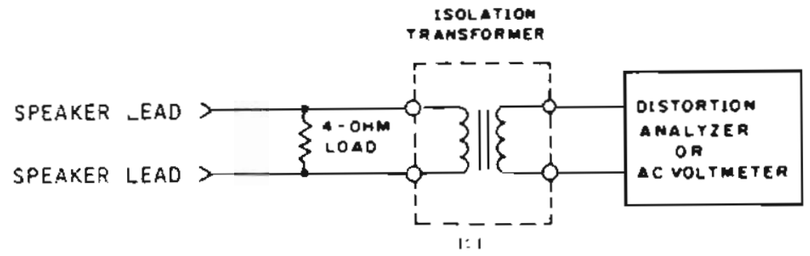


Figure 5 - Audio Isolation Transformer

RV605 ADJUSTMENT PROCEDURE

RV605 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 RV605 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 4dB.

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

7) Adjust RV605 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 1uV.

RECEIVER AUDIO AND SQUELCH CHECKS

SQUELCH CIRCUIT TEST WITH 6kHz SIGNAL

PRELIMINARY STEPS

1. Set the squelch volume on the control head to close at 8 dB SINAD level.
2. Quiet receiver with 1000 uV modulated signal applied to antenna jack J3.
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)

[redacted]

(B)

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

[redacted]

(C)

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

[redacted]

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)

[redacted]

(B)

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

[redacted]

(C)

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

[redacted]

AUDIO CIRCUIT

PRELIMINARY STEPS

1. Apply 1000 uV on frequency signal with 1000 Hz modulation and 3 kHz deviation to antenna jack J3.
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)

[redacted]

(E)

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

[redacted]

(F)

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

[redacted]

(G)

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

[redacted]

(H)

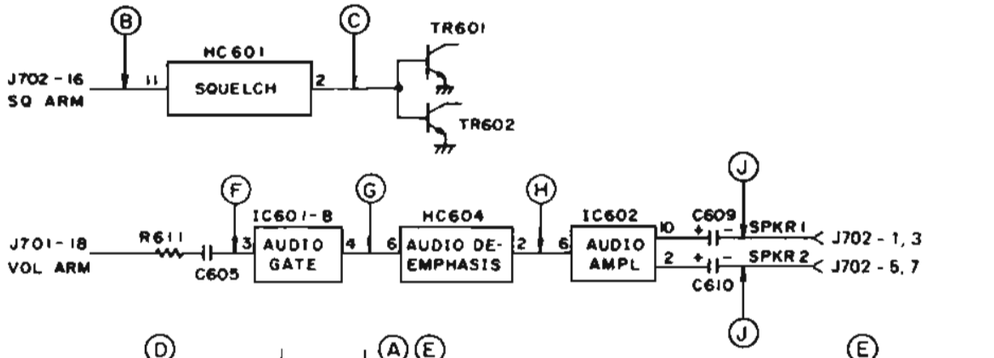
HOR .5 MSEC/DIV
VERT 50 mV/DIV
(280 mV P-P)

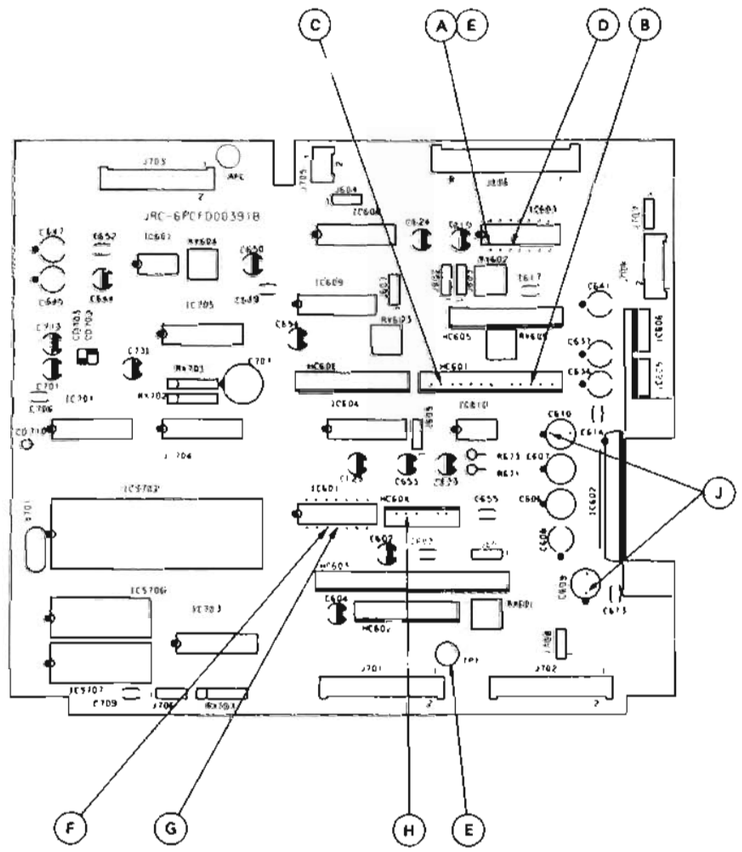
[redacted]

(J)

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

[redacted]





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 J3.

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 voltmenter.

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 J3.

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.

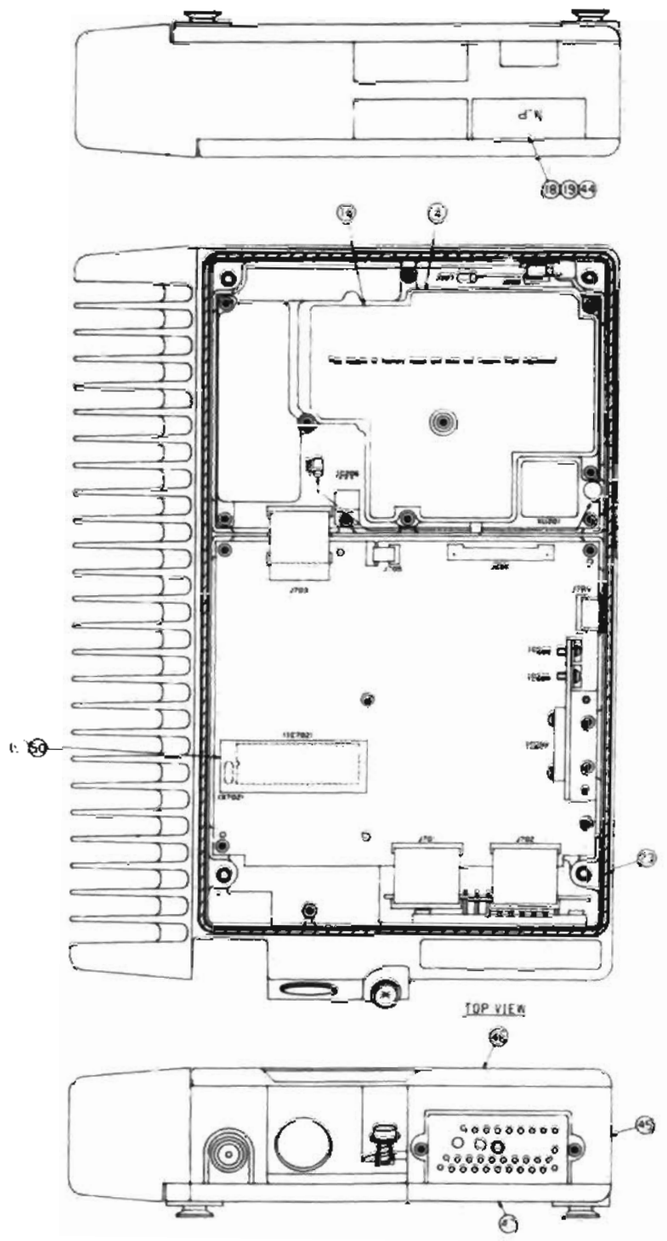
C. Set the RANGE control on the Distortion Analyzer to the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

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).

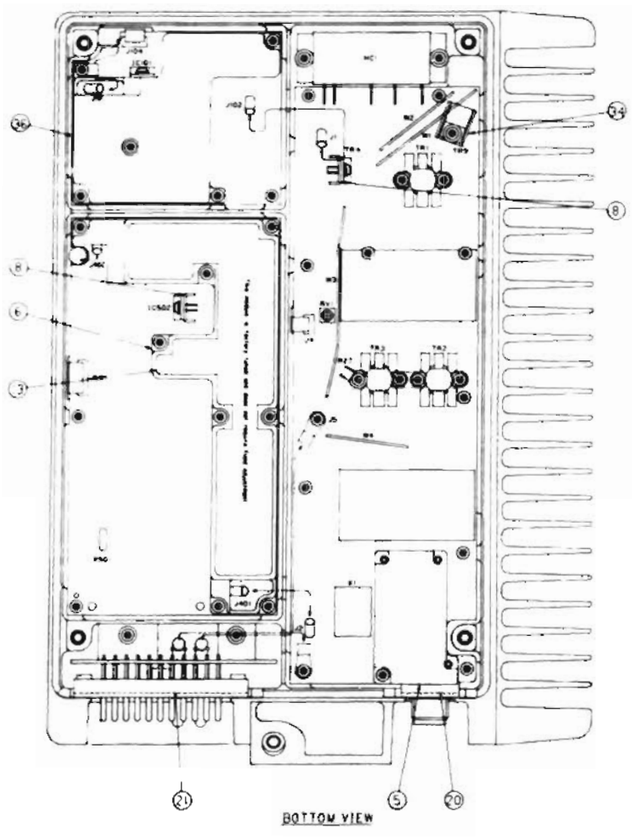
E. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than +7.0 kHz.

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.



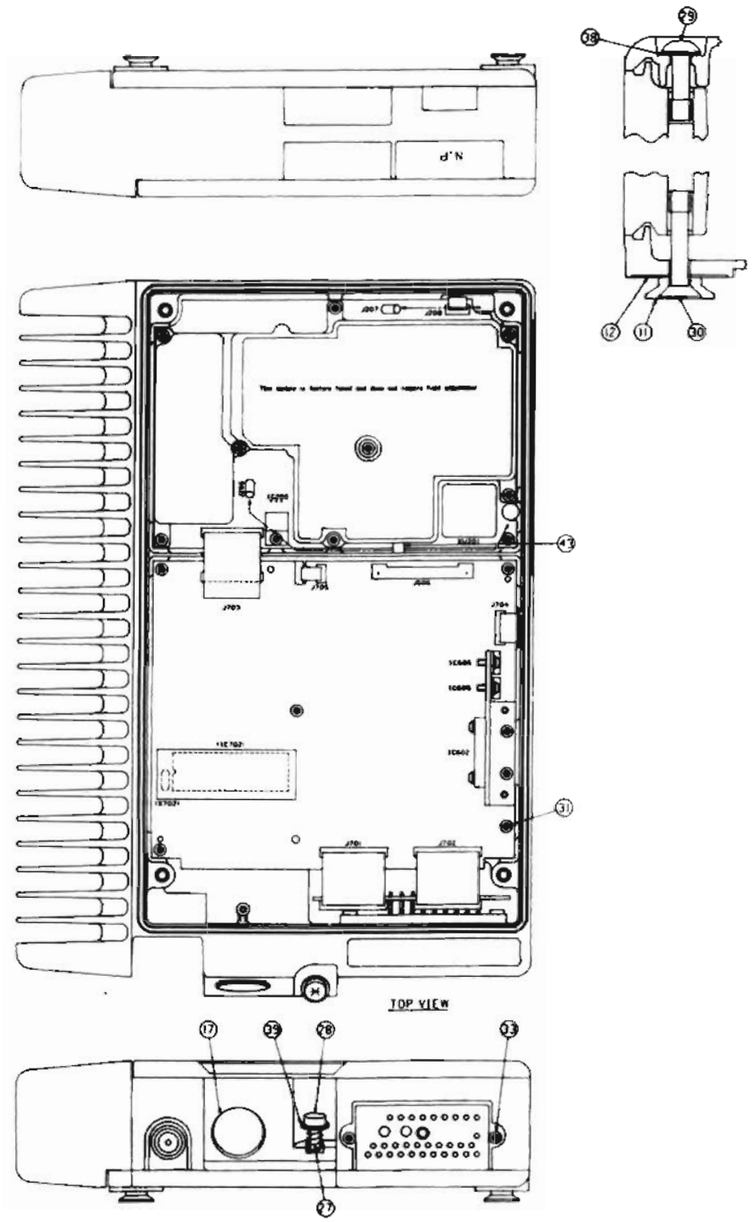
MECHANICAL LAYOUT DIAGRAM 1/2



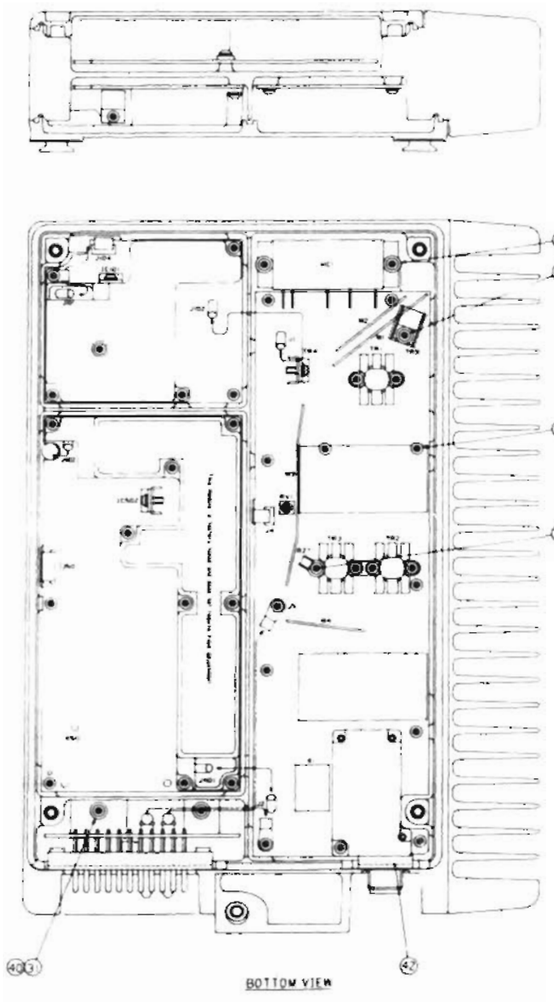
NO.	NOMENCLATOR	CODE
4	CASE,SHIELD	B19/MTC0024758
5	CASE,SHIELD	B19/MTC0024768
6	CASE,SHIELD	B19/MTC0024788
8	PLATE,HEAT SINK	B19/MTB147952A
13	SEAL	B19/MTT0211718
14	SEAL	B19/MTT0211728
18	PLATE,SERIAL NO.	B19/MPNN18119
19	OVERLAY	B19/MPNN19349
20	GASKET,ANTENNA CONNECTOR	B19/MPPX01254A
21	GASKET,INTERFASE CONNECTOR	B19/MPPX01255A
22	GASKET,SHIELD	B19/MPPX01286
23	GASKET,SHIELD	B19/MPPX01286
24	GASKET,SHIELD	B19/MPPX01161
25	GASKET,SHIELD	B19/MPPX01162
26	GASKET,SHIELD	B19/MPPX01163
34	PLATE,HEAT SINK	B19/MTB150008
36	CASE,SHIELD	B19/MTC002430A
44	ADHESIVE TAPE	B19/MTZ00281
45	FRAME ASM (COMPLETE ASM)	B19/MPBC07182
46	TOP COVER ASM (COMPLETE ASM)	B19/MPBC07110
47	BOTTOM COVER ASM (COMPLETE ASM)	B19/MPBC07112
48	MOUNTING BRACKET	B19/MPBX14964
49	MOUNTING HARDWARE	B19/MP3P01744A
50	CASE,SHIELD	B19/MTB153924
51	COVER,SHIELD	B19/MTB153925A

MECHANICAL LAYOUT DIAGRAM

MECHANICAL LAYOUT DIAGRAM 2/2

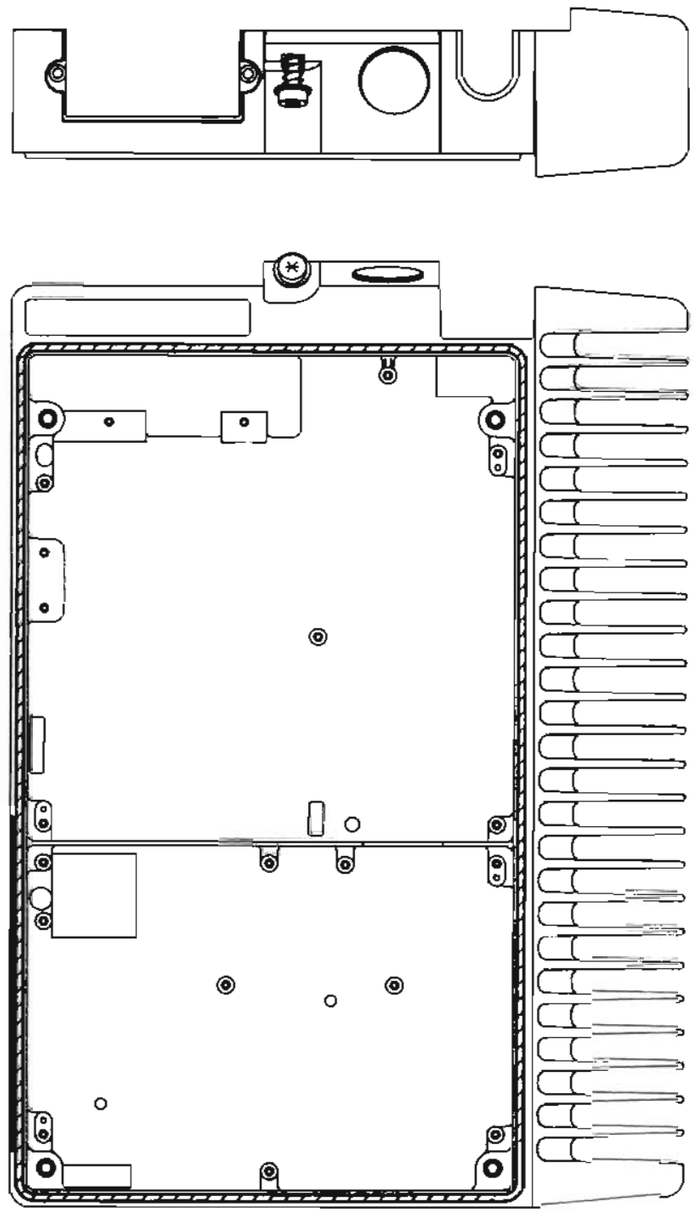


HARDWARE (SCREW) KIT
KIT CODE: B19/MPXP01954 1/2



NO	NOMENCLATOR	CODE	QTY PER ASY
11	FOOT	B19/MTL0329068	4
12	SPACER	B19/MTT021134A	4
17	COVER	B19/MTV002836	1
27	SPRING	B19/MPSR021594	1
28	SCREW	B19/MPTG02014A	1
29	SCREW	B19/MPTG02015	4
30	SCREW	B19/MPTG02016	4
31	SCREW,PAN HEAD M3x6	B19/BRTG03030	62
32	SCREW,PAN HEAD M3x12	B19/BRTG03291	3
33	SCREW,FLAT HEAD M3x10	B19/BRTG03293	6
37	SPACER	B19/MTL035255	1
38	WASHER THRUST	B19/BRTG01781	4
39	WASHER	B19/BRTG03301	1
40	WASHER	B19/BSFW030005	8
41	LOCK WASHER	B19/BRTG03492	3
42	SPACER	B19/MTB15007T	1
43	CLAMP CABLE	B19/MTT02114T	1
50	WASHER	B19/BSLW030005	2

HARDWARE (SCREW) KIT
KIT CODE: B19/MPXP01954 2/2



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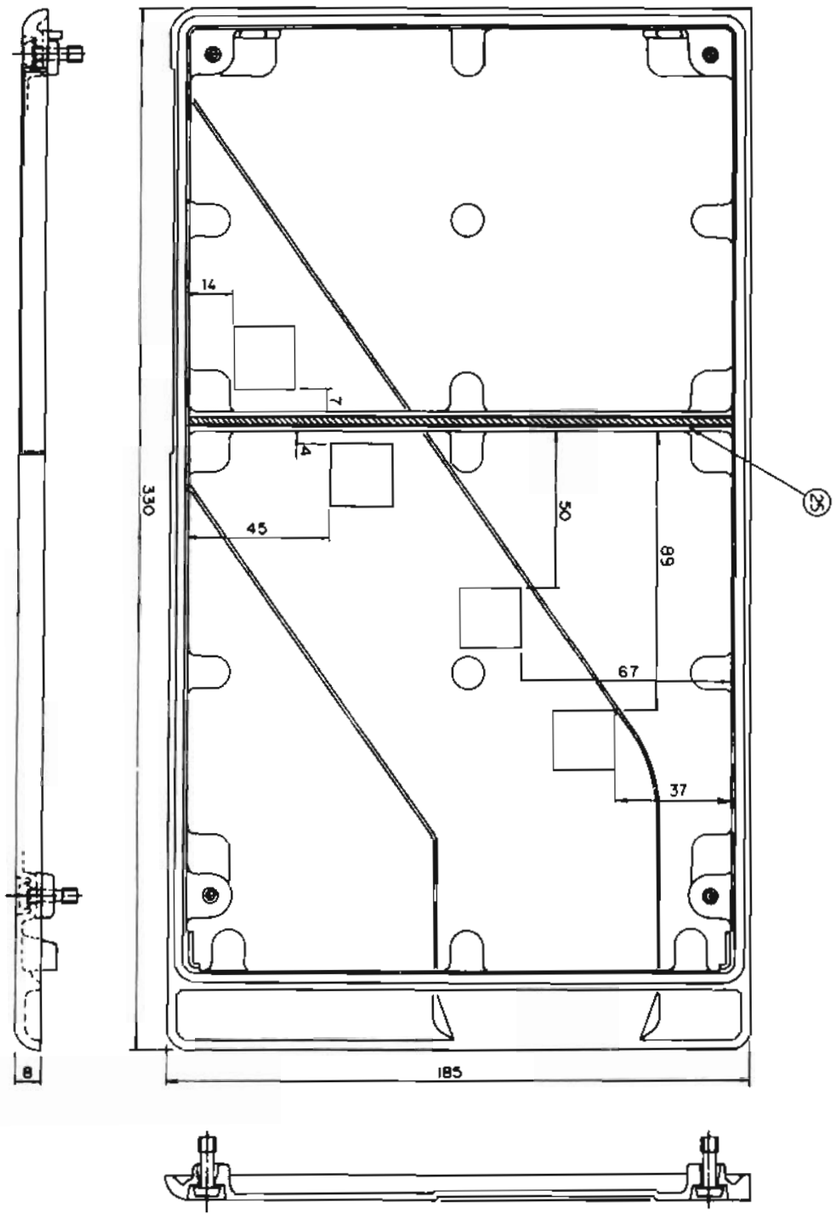

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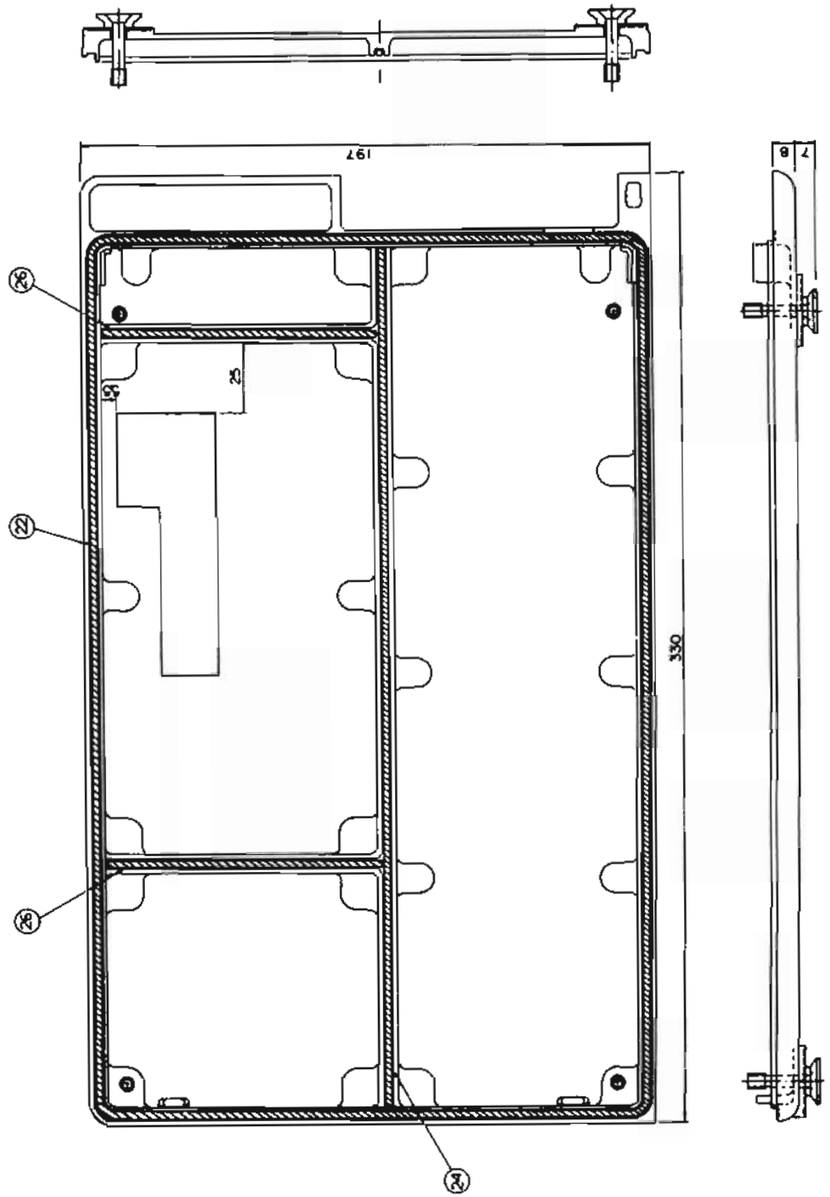

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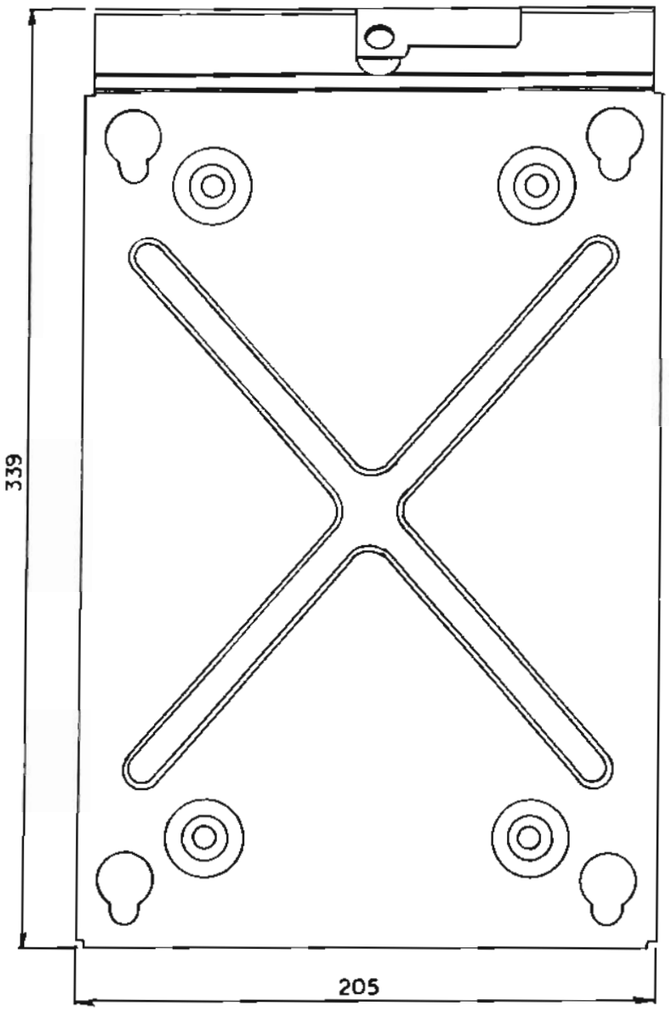
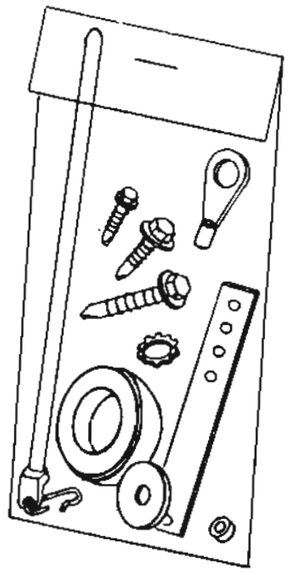
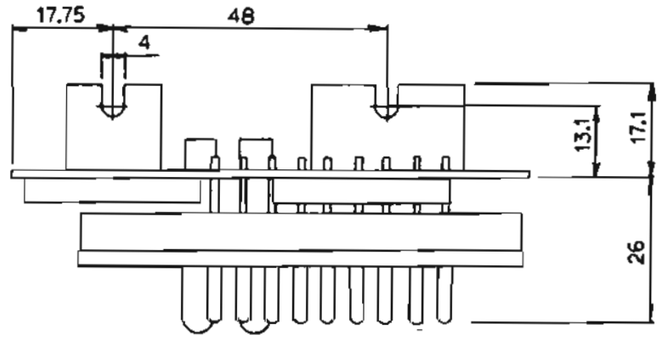
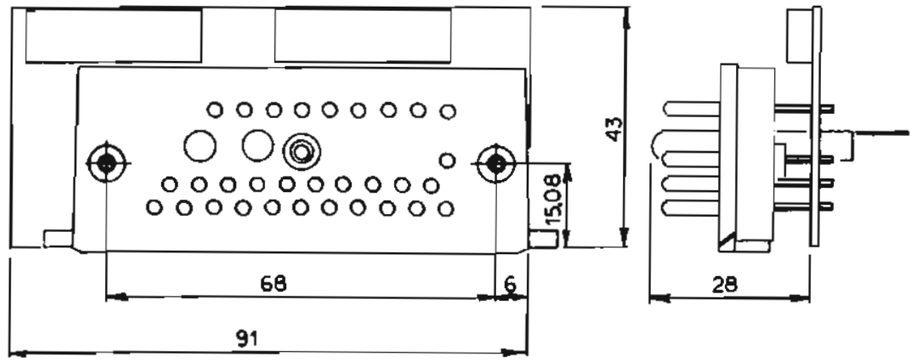




(48)
MOUNTING BRACKET
CODE:B19/MPBX14964

(49)
MOUNTING HARDWARE KIT
KIT CODE: B19/MPXP01744A





INTERFACE BOARD ASSEMBLY
ASM CODE:B19/CFQ-2223

MAINTENANCE MANUAL

403-512 MHz BOARD ASSEMBLIES

TABLE OF CONTENTS

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 for 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.

Centralized metering jacks for servicing are accessible from the top of the radio.

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 $\overline{\text{TX ENB}}$ 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 TR710 and buffer TR712. A low level on IC702-32 turns TR710 off, allowing the base of TR712 to rise. TR712 turns on, and applies A- to the $\overline{\text{TX ENB}}$ line. Inverter TR711 is also turned on during this time to inhibit the alert tone.

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 IC701-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 CD710 (normally unlit) will turn on. Refer to the self-diagnostic routine to determine the problem.

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 IC704B-F, TR713, and TR710 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 403-440 MHz range, the 440-470 MHz range, or 470-512 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 (IMPUT TR216)	IC705-2 (INPUT TR217)	IC705-13 (INPUT TR218)	IC705-12 (INPUT TR219)	
403-440MHz	1	403-412	0	1	0	1	NONE
	2	412-421	0	1	1	0	R275
	3	421-430	1	0	0	1	R276, R296
	4	430-440	1	0	1	0	R275, R276 R296
440-470MHz	1	440-447	0	1	0	1	NONE
	2	447-455	0	1	1	0	R275
	3	455-462	1	0	0	1	R276, R296
	4	462-470	1	0	1	0	R275, R276 R296
470-512MHz	1	470-480	0	1	0	1	NONE
	2	480-490.5	0	1	1	0	R275
	3	490.5-501	1	0	0	1	R276, R296
	4	501-512	1	0	1	0	R275, R276 R296

TABLE 1 - Frequency Segment Selection

TX AUDIO PROCESSOR

The audio processor provides audio pre-emphasis with amplitude limiting and post-limiter 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 R653, R654.

The 9 Volt regulator IC606 powers the audio processor and applies regulated 9 volts to a voltage divider consisting of R651, R655 and symmetry control, RV604. The +4.5 V output from the voltage divider establishes the operating reference point for operational amplifiers IC607A and IC607B. C647 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 R650, R652 and C646 comprise the audio pre-emphasis network that enhances the signal-to-noise ratio. R652 and C646 control the pre-emphasis curve below limiting. R650 and C646 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 R650 and C646.

The amplified output of IC607A is coupled through R653, C650, R656, R657, R658 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, and IC609 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, R656-R659, C651 and C652 provides 12 dB per octave roll-off. R653 and C649 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 $\overline{\text{TX ENABL}}$ 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 (HC605). When VG (VOICE GUARD) is optionally added, this audio is applied to the VG circuit (HC602, HC603). Audio output from the VG circuit is applied to Tone Reject filter (HC605) through pins J603-2 & 3. The audio is then applied to the volume and squelch controls in the control unit through connector J701-17.

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 $\overline{\text{DPTT}}$ (delayed Push-To-Talk) and $\overline{\text{PA KEY/CCT PA ENB}}$ 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 J702-1 and 5. The gain of IC602 is determined by the value of R615.

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 RV605.

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 J702-21.

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 in 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 switch 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 feeds audio power to the speaker.

$\overline{\text{DPTT}}$ When the microphone is keyed, the DPTT input is low. This low is applied to audio gate IC601-B through CD604B, turning IC601-B off. It is also applied to audio control switch IC601-A (through CD604A) turning it off. TR603 is also off and TR604, TR605 are on. TR605 shorts out the audio input to the audio PA IC 602.

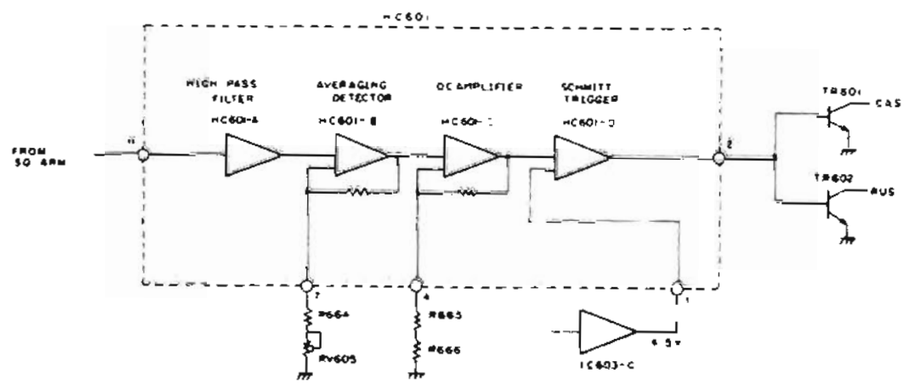


Figure 1 - Squelch circuits (HC601)

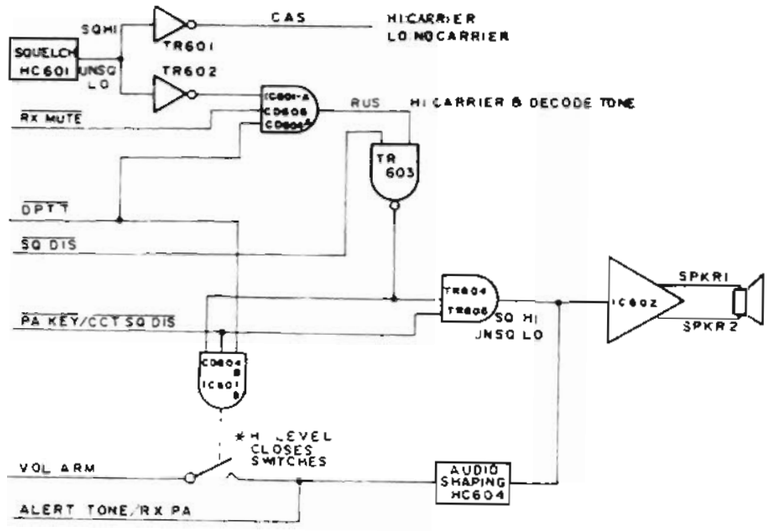


Figure 2 - Audio Control Circuit

POWER DISTRIBUTION

Battery supply A+ enters the radio through the front connector at J750-19. 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.

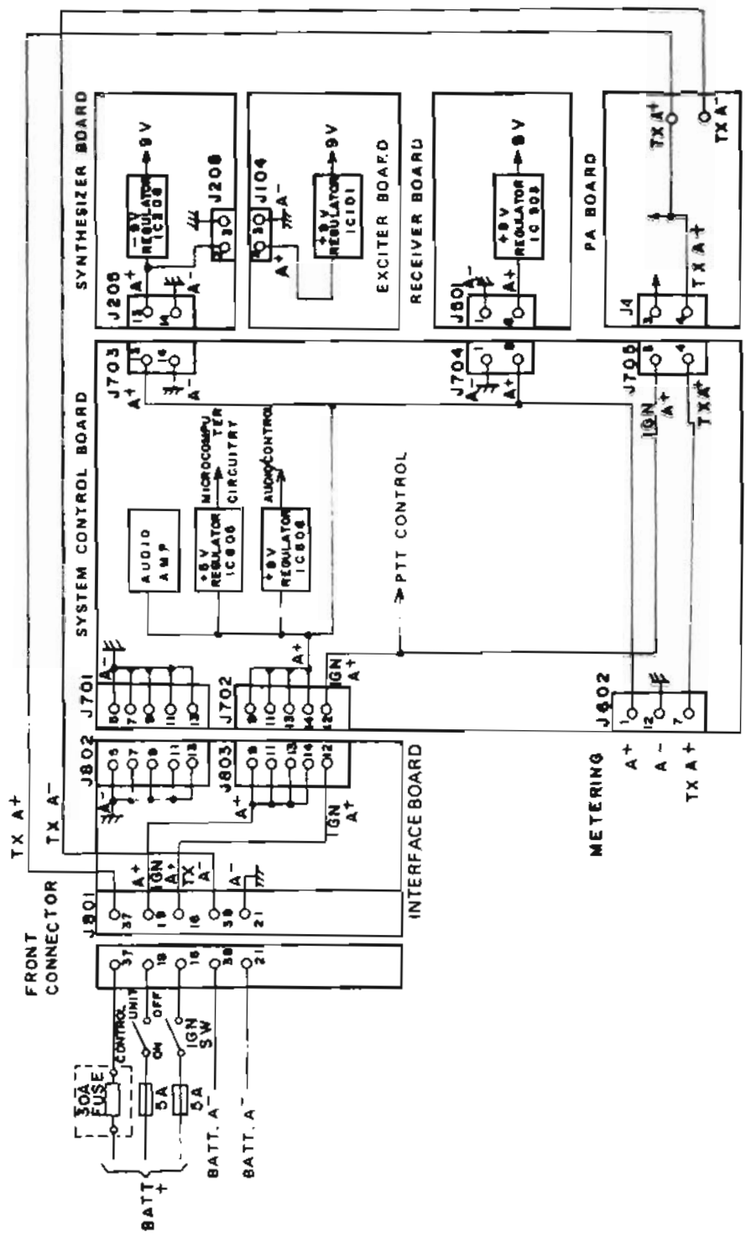


Figure 3 - Power Distribution

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 Chennel Guard tone/code is hard limited and fed 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 degital waveform for digital Channel Guard.

The Channel Guard contains a summing amplifier IC604-A, 8-pole active voice reject filter HC606, limiter IC604-C and tone/code reject filter HC605. 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 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 HC606. 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 TX MOD line throug. CG deviation control RV603, IC608C and TC607B. 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 HC606, 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 J701-15. 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 J701-15. 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 CD709. 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 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 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 RX MUTE line will go low for about 200 ms. This will prevent the squelch tail from being heard. After 200 ms, the 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 P604 connected between J604-1,2 to J604-2,3. 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 134.3 MHz to 170.6 MHz. The RX VCO operates over the range of 106.93 to 143.26 MHz.

REFERENCE OSCILLATOR

The reference oscillator consists of a 5 PPM VC-TCXO (Voltage Controlled-Temperature - Compensated Crystal Oscillator). The standard reference oscillator frequency is 13.2 MHz.

The 5 PPM* VC-TCXO receives transmit CG tone from REF MOD CONTROL RV201. RV201 provides the required tone level and phase to modulate the VC-TCXO. The VC-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 VC-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.

* 2 ppm on some models.

CAUTION

VC-TCXO are individually compensated at the factory and cannot be repaired in the field. Any attempt to repair or change the frequency of a VC-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 4.16 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, ADP 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.

DC OFFSET AND HIGH CURRENT BUFFERS

DC-offset buffer TR201 and diode CD201 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 either TR202 or TR203 on. These two transistors control high-current buffers TR204 and TR205. TR204 and TR205 complete a high-current rapid-charge or -discharge path for C207-C209.

If the error voltage decreases, TR203 is turned off and TR205 is turned on, completing a discharge path for C207-C209 through bilateral switches IC204. At the same time TR202 is turned on and TR204 is turned off, blocking the charge path. The opposite conditions exist when the error voltage goes positive. IC204 is turned on for 4 milliseconds when a channel is changed in the receive mode. The time is 20 milliseconds when in transmit mode and when changing form transmit to receive mode.

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 buffers for VCO frequency control and as the Rx injection frequency to the receiver 1st mixer through L.O. buffers TR404, TR405 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 106.93-143.26MHz. 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.

TRANSMITTER VOLTAGE CONTROLLED OSCILLATOR

The transmit VCO is basically the same as the receiver VCO. The wideband VCO allows frequency separation of 12 MHz, 10 MHz or 14 MHz as determined by the bandsplit the radio is operating on, 403-440 MHz, 440-470 MHz or 470-512 MHz. The varactors in condjunction 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. Buffer TR221 provides a typical output of +10 dBm to the feedback buffers for VCO frequency control and as the Tx Injection frequency to the exciter.

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

FEEDBACK BUFFERS

The Rx injection and Tx injection voltage output from the Rx VCO and Tx VCO are supplied to the receiver mixer and the exciter, respectively, and to the feedback buffers. Buffering is provided by TR207 and TR206 and the output applied to dual-modulus prescaler IC202.

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 4.16 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-R276, R278, 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 and R276 in the circuit. R274, R275 and R276 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 PF'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 +8V filtered supply through R232, R234 and R286. Forward bias for the diodes and current for the switching transistors are provided by the +8V supply through R231, R233 and R285. When segment 3 is selected TR216, TR219 and TR277 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 AC 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 403-440 MHz, 440-470 MHz or 470-512 MHz is determined by the group number of the synthesizer board. Each frequency split is divided into four operating segments varying from 7 MHz to 11 MHz wide.

SEGMENT	TRANSISTOR SWITCH*							PIN DIODES						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

EXCITER BOARD

The Exciter consists of four wide-band amplifier stages and a tripler stage, and operates over a frequency range of 403-512 MHz without any tuning. An attenuator pad (R101-R103) at the input of the Exciter provides a constant load for the VCO and attenuates the signal from the VCO to approximately 1 milliwatt.

The Exciter amplifies the 1 milliwatt signal from the VCO to provide 250 milliwatts drive to the power amplifier.

In addition to tripling the input signal and providing approximately 24 dB gain, the exciter contains the filter circuits that determine the bandwidth and spurious response characteristics of the transmitter.

The 134-171 MHz TX injection input from the TX VCO is applied to the base of amplifier TR101 through attenuator pad and C101. Collector voltage is supplied through L101 and R106. C103 matches the output of AMPL1 to TRIPLER.

The 8 to 10 milliwatt output of TR101 is coupled to the base of tripler TR102. C105 and L102 bypass the tripler signal at the input of TR102, and C106 and L104 bypass the input signal at the output of TR102. This improves the efficiency of tripler. The 8 to 10 milliwatt output from this stage is coupled through band-pass filter FL101 to AMPL2 input.

AMPL2 consists of class-A amplifier TR103. The 30 to 50 milliwatt output of this stage is coupled through C112 to the band-pass filter FL102.

Following the band-pass filter FL102 are class-A and class-B amplifiers. TR104 and TR105 respectively. The 300 milliwatt output of TR105 is coupled through impedance matching network C123 and L109 to the band-pass filter FL103 which provide the final selectivity in the exciter.

The output of band-pass filter FL103 is applied through coaxial connector J102 to the power amplifier board.

A+, supplied from the frequency Synthesizer board is stabilized to 9V by IC101 (3-terminal regulator), and +9V is applied to TR101-TR105 via TR106.

In the transmit mode, $\overline{\text{TX ENB}}$ is low, providing a path to ground for base current through TR106, which turns on. 9V from the regulator IC101 is then applied to the exciter.

Service Note

The output RF level can be measured by connecting a 50 ohm dummy load to J102 and feeding a 0 dBm signal to J101 (134-171 MHz) and grounding the $\overline{\text{TX ENB}}$ line.

The Exciter is energized by pressing the PTT switch.

Regulated 9 volts is present on all exciter stages when the transmitter is turned on.

PA BOARD

80/100 WATT POWER AMPLIFIER

The 250mW RF output from the exciter is applied to the PA input connector J1. It then passes through an attenuator consisting of resistors R1-R3, to the power module HC1. This unit consists of 3 class-C amplifiers to provide an output of 10 W. The first stage of the power module derives its collector voltage from the power control circuit.

The 10 W output of the power module drives amplifier TR1 via impedance-matching components C1, C6, C7 and stripline Z1. The low output impedance of TR1 is transformed to 50 ohms at the output end of C18 by C10-C14, C16, C18 and stripline Z2. L1 and L2 are the DC return and stabilizing network in the base of TR1.

The output of TR1 is coupled to a Wilkinson power splitter consisting of microstrip Z13.

The power amplifier stages consist of two identical paralleled class C power amplifiers (TR2, TR3). L3 and R34 are the DC return and stabilizing network in the base of TR2, while L5 and R35 make up the network in the base of TR3. Supply voltage (A+) for TR2 and TR3 coupled through collector feed network L17, L18, L19 and L20.

The output of TR2 and TR3 is applied to a Wilkinson power combiner (Z14).

The output of the combiner passes through the directional coupler. The rectified signals produced by CD1 and CD2 provide a measure of the forward and reflected power levels respectively.

After passing through the directional coupler the output is coupled to the low-pass filter consisting of L8-L10 and C62-C68 through antenna relay K1. In the RX mode, signals from the antenna are coupled via K1 the low-pass filter consisting of L11, L12 and C70-C73. CD3-CD6 provide receiver input protection against strong signals at the antenna connector in the receive mode.

30/35 W POWER AMPLIFIER

The circuit of the 30/35 W PA is the same as 80/100 W unit, except that the 50 ohm output of TR1 is fed directly to the directional coupler, and TR2 and TR3 are not used.

POWER CONTROL CIRCUIT

The power control circuit provides power leveling as well as thermal protection for the PA.

When the transmitter is keyed, RF is rectified by CD1. The resulting DC turns on RF switch TR4-TR7. Turning on TR5 applies collector voltage to the 1st RF driver transistor in the PA module.

If the power output should start to increase above the level set by RV1, TR5 will start to conduct. This causes TR7 to conduct less, reducing the collector voltage of TR5 to the 1st RF driver transistor in the PA module.

Thermal protection is provided by temperature compensating resistor R27.

When the heat sink temperature rises above 90 °C, the resistance of R27 increases and the power output is reduced to 60 W.

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 transistor.

RECEIVER BOARD

The FM dual-conversion, super-hetrerodyne receiver is designed for operation in the 403-512 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 82.2 MHz and 455 kHz. Adjacent channel selectivity is obtained by using two band-pass filters: a 82.2 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 Rx board. The receiver consists of:

- Front End and Mixer
- 82.2 MHz 1st IF, 455 kHz 2nd IF and FM Detctor
- 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 (FL401) to the input of RF amplifier TR401. The output of TR401 is coupled through band-pass filter (FL402) and band-pass filter (FL403) to the input of 1st mixer HC401. Front-end selectivity is provided by these band-pass filter.

RECEIVER INJECTION

Receiver RF injection (320.8-429.8 MHz) from the synthesizer VCO is applied to amplifier TR402 through J402. The input level at J402 will be between 1.0 and 2.0 milliwatts, 1.0 milliwatts minimum. 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 (FL404). This filter is tuned to pass frequencies in the 320.8-429.8 MHz passband.

1st MIXER

The first mixer is a double-balanced diode mixer (HC401) that converts a signal in 403-512 MHz range to the 82.2 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 82.2 MHz 1st IF output signal is coupled from the output of HC401 through C501 to the source input of IF AMPL TR501/504. TR501/504 are a JFET amplifier/buffer stage. The output of the JFET buffer is coupled through C504 to a 4-pole XTAL band-pass filter (FL501).

1st IF

The highly-selective crystal filters FL501-1 and FL501-2 provide the first portion of the receiver IF selectivity. The output of the filters is coupled through impedance matching network L506, C507 and C508 to the 1st IF amplifier TR503.

The crystal filter output of FL501 is applied to the base of the 1st IF amplifier TR503, and the amplified signal is taken from the collector. The amplifier provides approximately 20 dB of IF gain. The output is coupled through an impedance matching network, L507, C510 and R507 that matches the amplifier output to the input of FL502. The output of the filter is coupled through impedance-matching network L508, C511 and R508 to the 2nd mixer HC501.

2nd MIXER

HC501 and associated circuitry comprise the 2nd oscillator and 2nd mixer.

The 82.2 MHz IF input is applied to pin 7 and mixed with an 82.655 MHz frequency supplied by crystal oscillator X501. L509 sets the frequency of X501.

2nd IF AND DETECTOR

The output of the 2nd mixer is coupled to the 4-pole ceramic filter, which provides the 455 kHz selectivity. The output of the ceramic filter is coupled to the base of TR504. The transistor provides limiting for the 455 kHz IF signal (1.4Vp-p) to prevent high level overloading of IC501.

IC501 and associated circuitry function as the IF amplifier and FM detector.

The 455 kHz IF input is applied to pin 18.

The IF signal is amplified and applied to a 4-pole ceramic filter FL504 which provides the 455 kHz selectivity. The output of the 455 kHz filter is applied to IC501-5. The 2nd IF signal is amplified and limited. L511 shifts the IF signal by 90° and applies 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 unit via the level control, RV501.

GE Mobile Communications

General Electric Company
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DRAWING SHEET No.

A603 : FREQUENCY SYNTHESIZER BOARD

A604 : RECEIVER BOARD

A605 : EXCITER BOARD

A606 : POWER AMPLIFIER BOARD

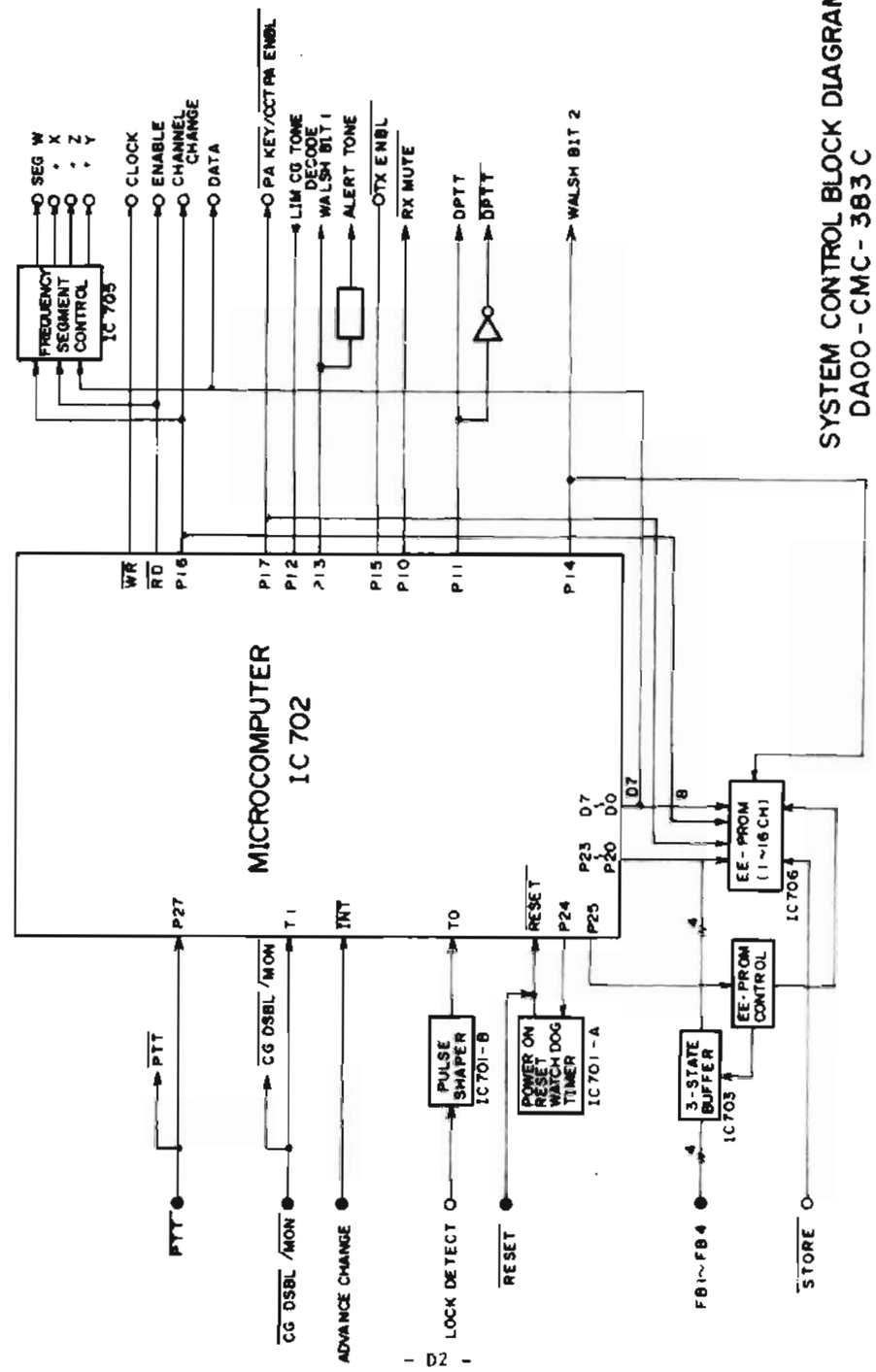
* A601 (INTERFACE: CFQ-2223) and A602 (SYSTEM CONTROL: CMC-383C) do not change in the table below.

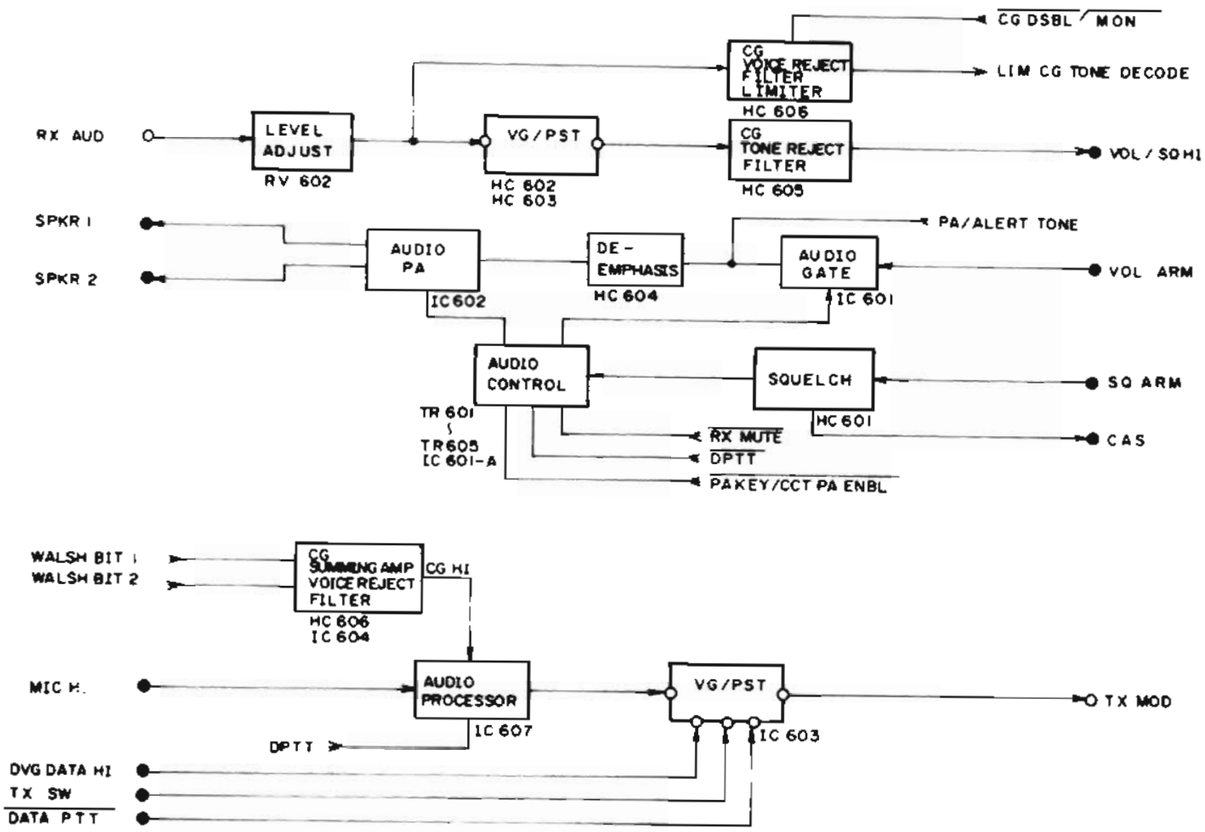
DRAWING SHEET No.

TYPE / PC BOARD	35A (403-423MHZ, 35W)	100A (403-423MHZ, 100W)	35B (410-430MHZ, 35W)	100B (410-430MHZ, 100W)	35C (420-440MHZ, 35W)	100C (420-440MHZ, 100W)
A603	CMG-132A					
A604	CMA-239A		CMA-239B		CMA-239C	
A605	CAF-256A					
A606	CAH-256L	CAH-256H	CAH-256L	CAH-256H	CAN-256L	CAH-256H

TYPE / PC BOARD	35D (440-460MHZ, 35W)	100D (440-460MHZ, 100W)	35E (450-470MHZ, 35W)	100E (450-470MHZ, 100W)
A603	CMG-132B			
A604	CMA-239D		CMA-239E	
A605	CAF-256B			
A606	CAH-256L	CAH-256H	CAH-256L	CAH-256H

TYPE / PC BOARD	30F (470-488MHZ, 30W)	80F (470-488MHZ, 80W)	30G (482-500MHZ, 30W)	80G (482-500MHZ, 80W)	30H (496-512MHZ, 30W)	80H (496-512MHZ, 80W)
A603	CMG-132C					
A604	CMA-239F		CMA-239G		CMA-239H	
A605	CAF-256C					
A606	CAH-256L	CAH-256H	CAH-256L	CAH-256H	CAH-256L	CAH-256H

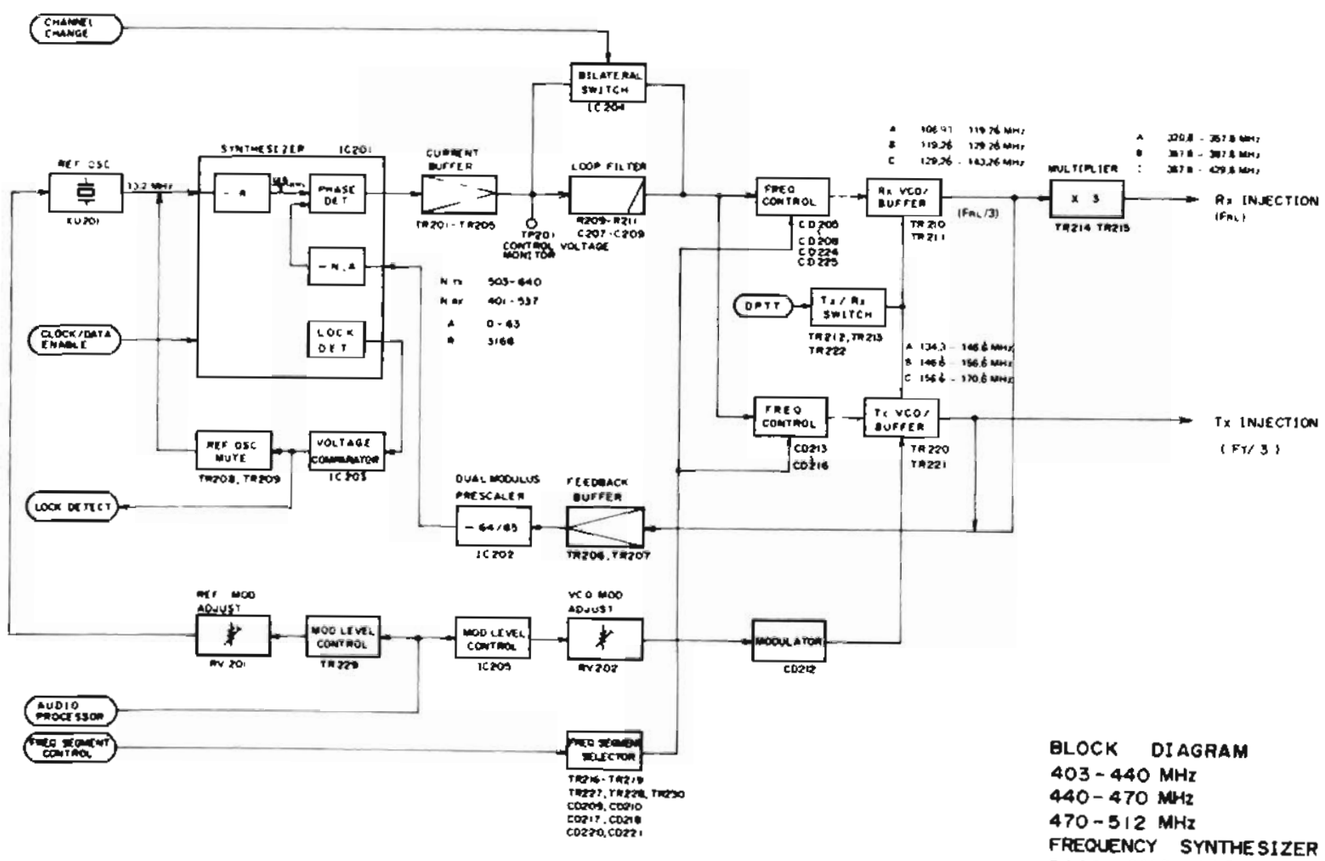




SYSTEM CONTROL BLOCK DIAGRAM
DA00-CMC-383C

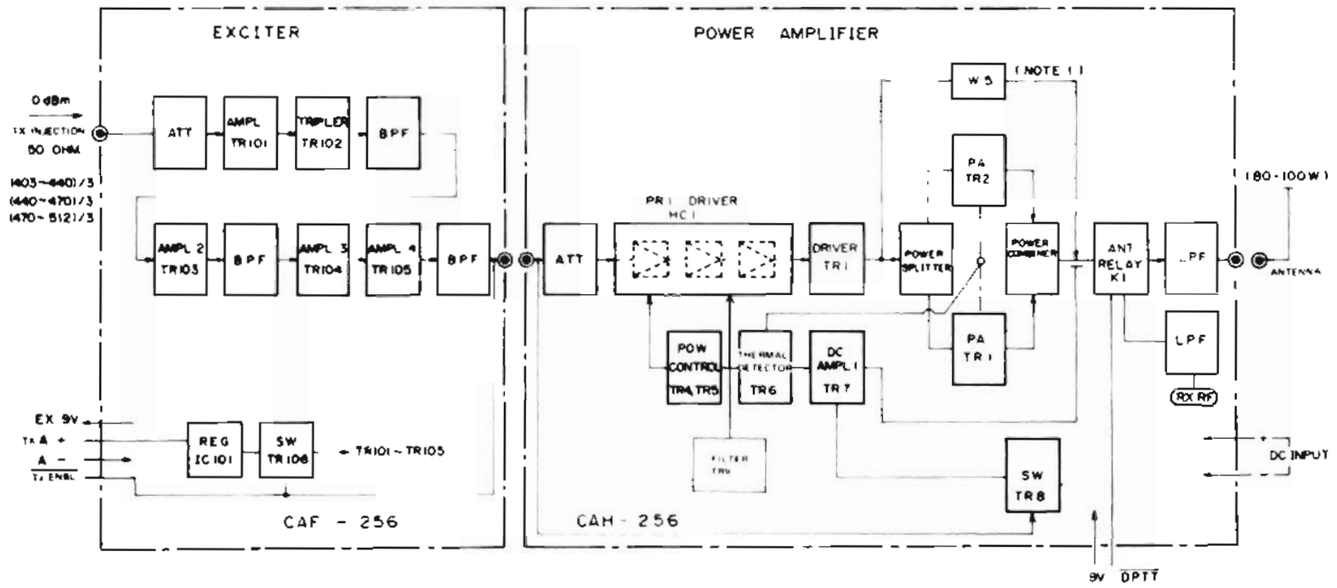
2/2

- D3 -



BLOCK DIAGRAM
403-440 MHz
440-470 MHz
470-512 MHz
FREQUENCY SYNTHESIZER
DA00-CMG-132

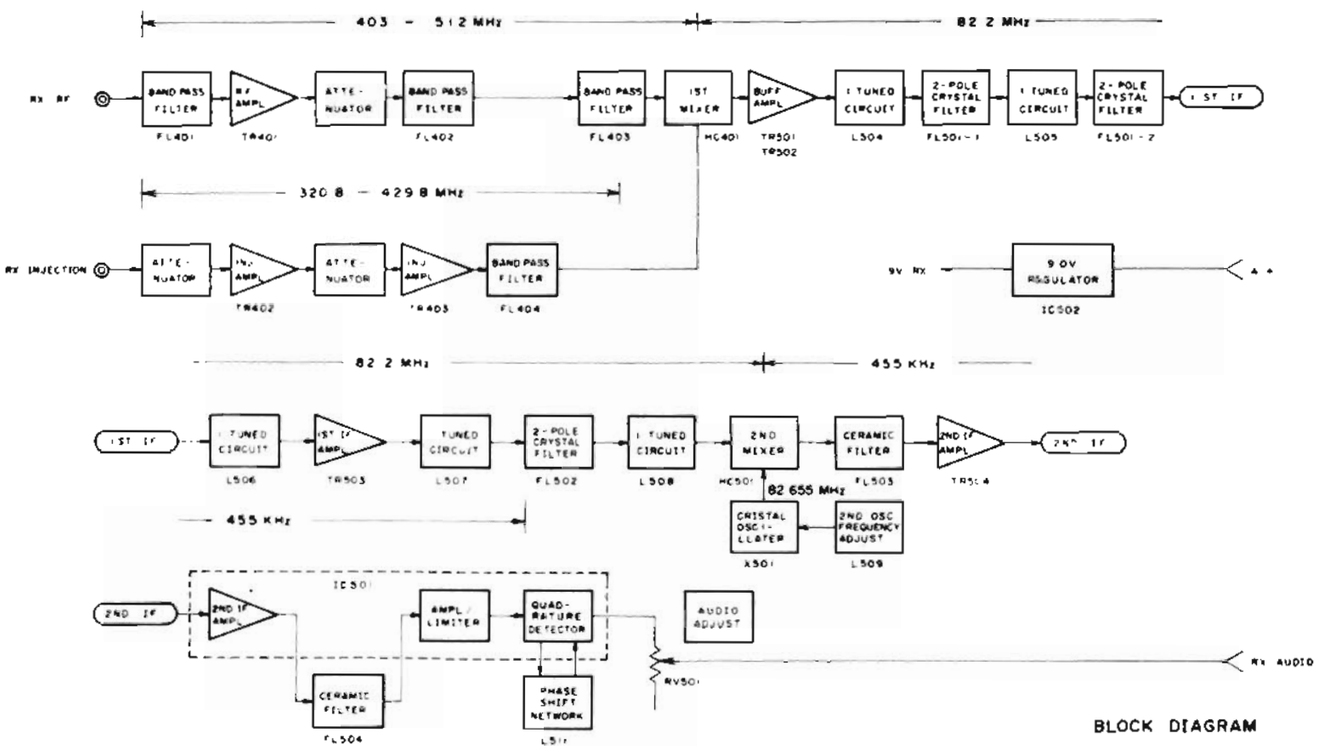
- D4 -



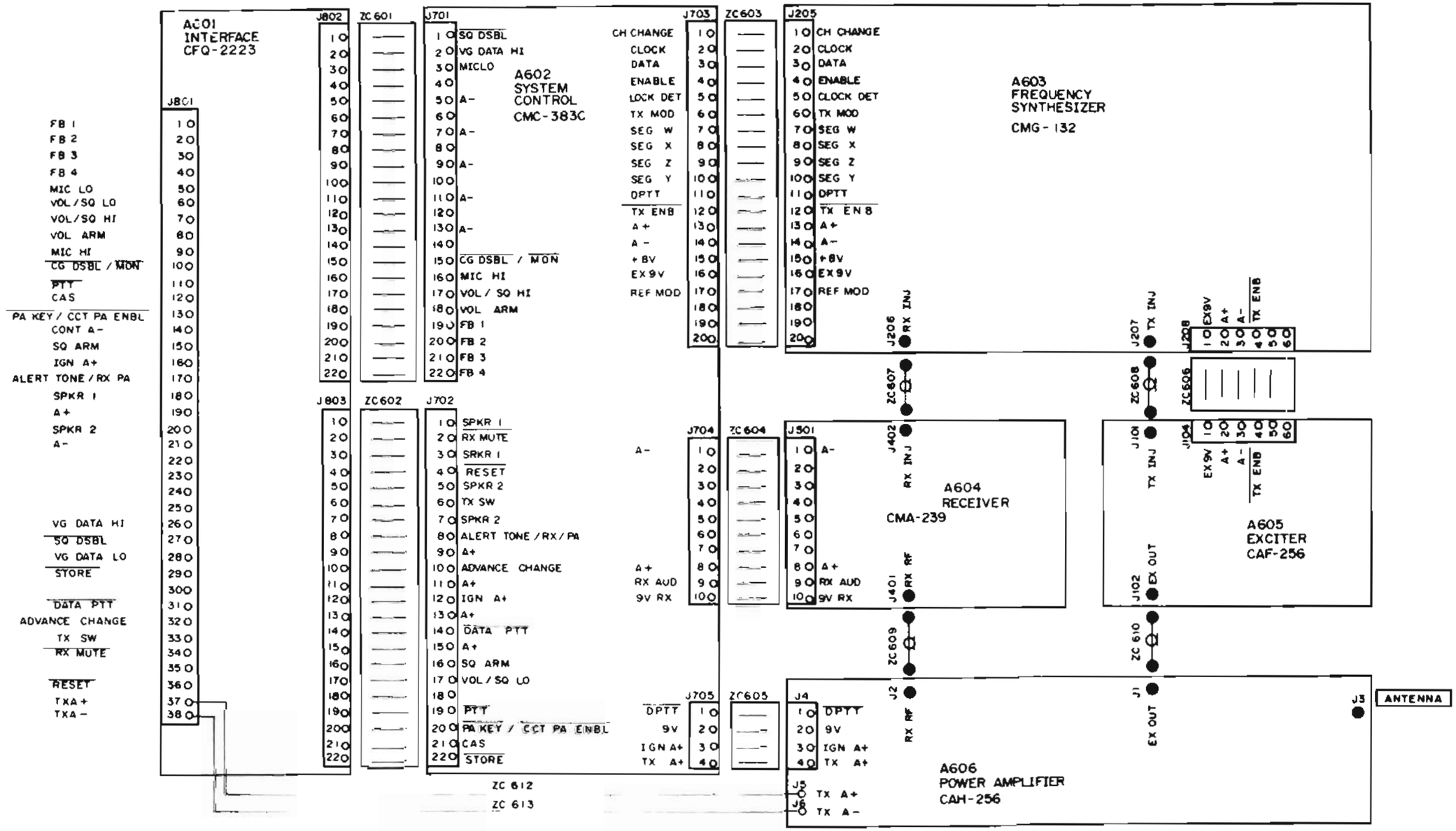
NOTE
1 W5 PRESENT IN 3C 35 WATT TRANSMITTERS ONLY

BLOCK DIAGRAM
403-512 MHz
EXCITER/POWER AMPLIFIER

DA00-CAF-256
DA00-CAH-256

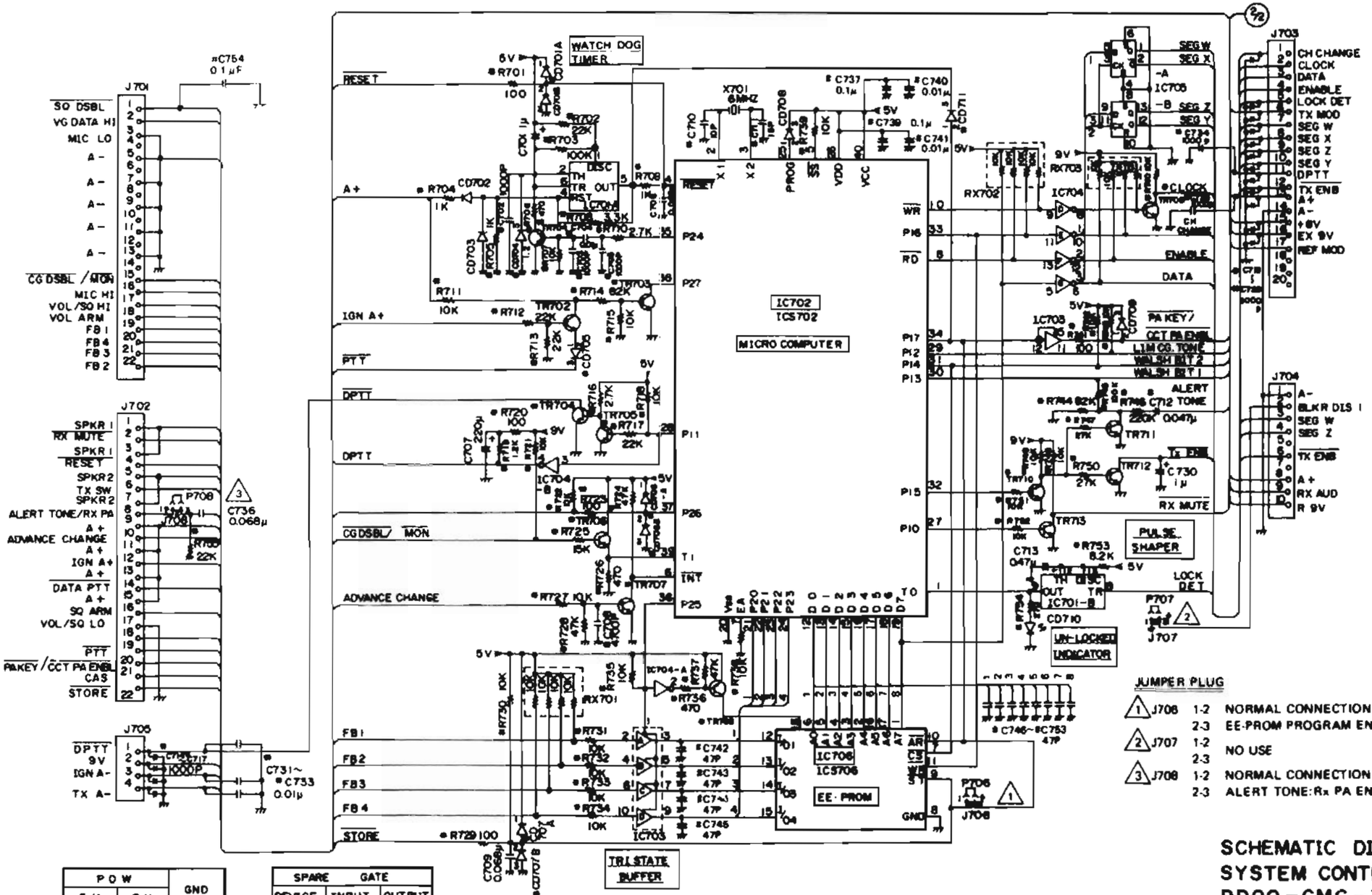


BLOCK DIAGRAM
403-512 MHz RECEIVER
DA00-CMA-239



TYPE JHM-451S	35A	100A	35B	100B	35C	100C	35D	100D	35F	100F	30F	80F	30G	80G	30H	80H
FREQUENCY (MHz)	403–423		410–430		420–440		440–460		450–470		470–488		482–500		488–512	
A603 SYNTHESIZER	CMG-132A						CMG-132B						CMG-132C			
A606 POWER AMPLIFIER	CAH-256AL	CAH-256AH	CAH-256AL	CAH-256AH	CAH-256AL	CAH-256AH	CAH-256BL	CAH-256BH	CAH-256BL	CAH-256BH	CAH-256CL	CAH-256CH	CAH-256CL	CAH-256CH	CAH-256CL	CAH-256CH
A604 RECEIVER	CMA-239A		CMA-239B		CMA-239C		CMA-239D		CMA-239E		CMA-239F		CMA-239G		CMA-239H	
A605 EXCITER	CAF-256A						CAF-256B						CAF-256C			

SCHEMATIC DIAGRAM
INTERCONNECTION
DDOO-JHM-451S

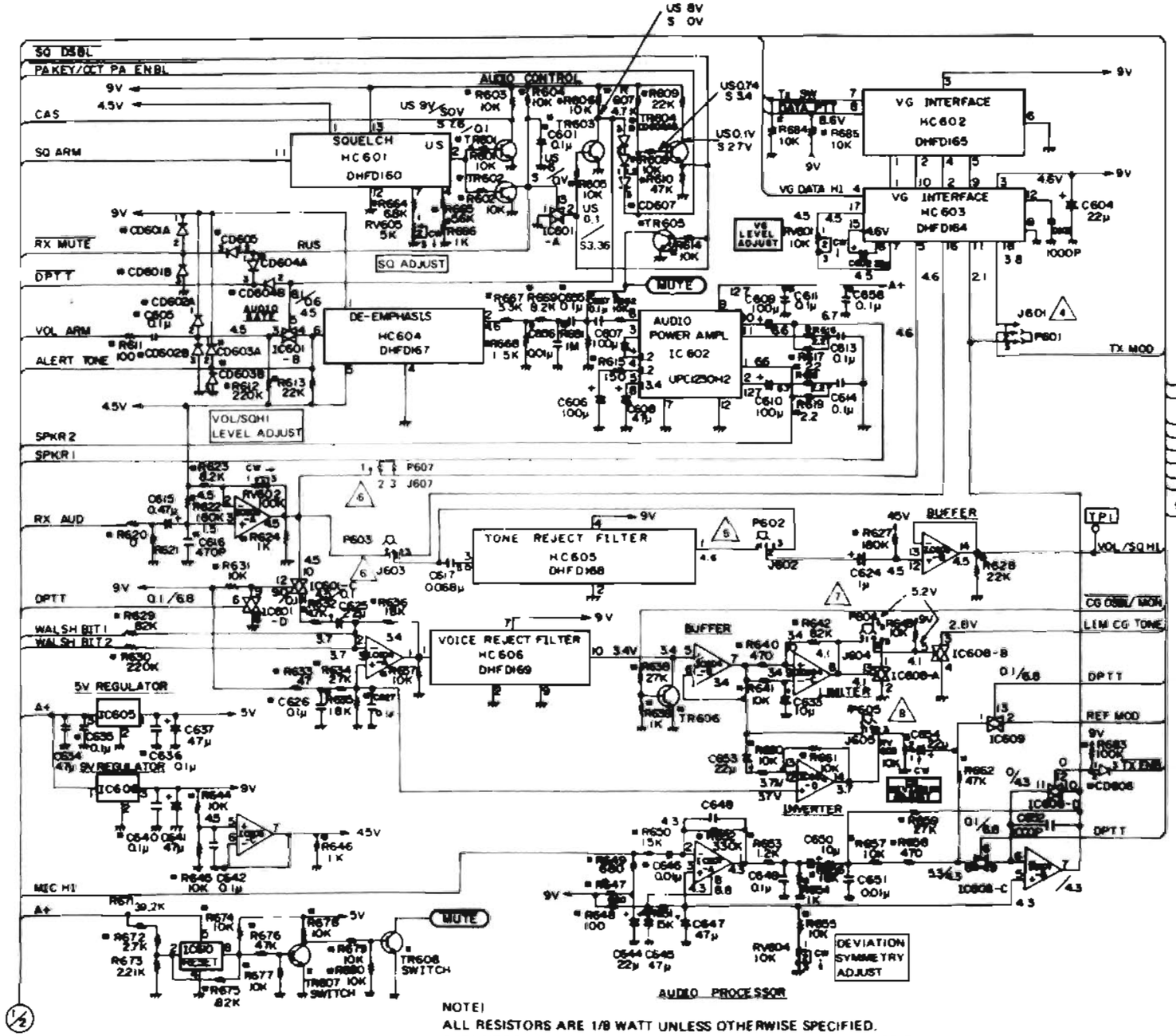


P O W		GND
5 V	9 V	
IC701-14	——	IC701-7
IC703-16	——	IC703-8
IC704-14	——	IC704-7
——	IC705-14	IC705-7

SPARE GATE		
DEVICE	INPUT	OUTPUT
IC703	14	13

NOTE)
ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED.
CAPACITOR VALUES IN F UNLESS FOLLOWD BY MULTIPLIER μ OR P.
"#" SYMBOL IS CHIP COMPONENT.

SCHEMATIC DIAGRAM
SYSTEM CONTROL 1/2
DDOO-CMC-383G



+9V	GND
IC601 - 14	IC601 - 7
IC603 - 4	IC603 - 11
IC604 - 4	IC604 - 11
———	IC607 - 4
IC608 - 14	IC608 - 7
IC609 - 14	IC609 - 7

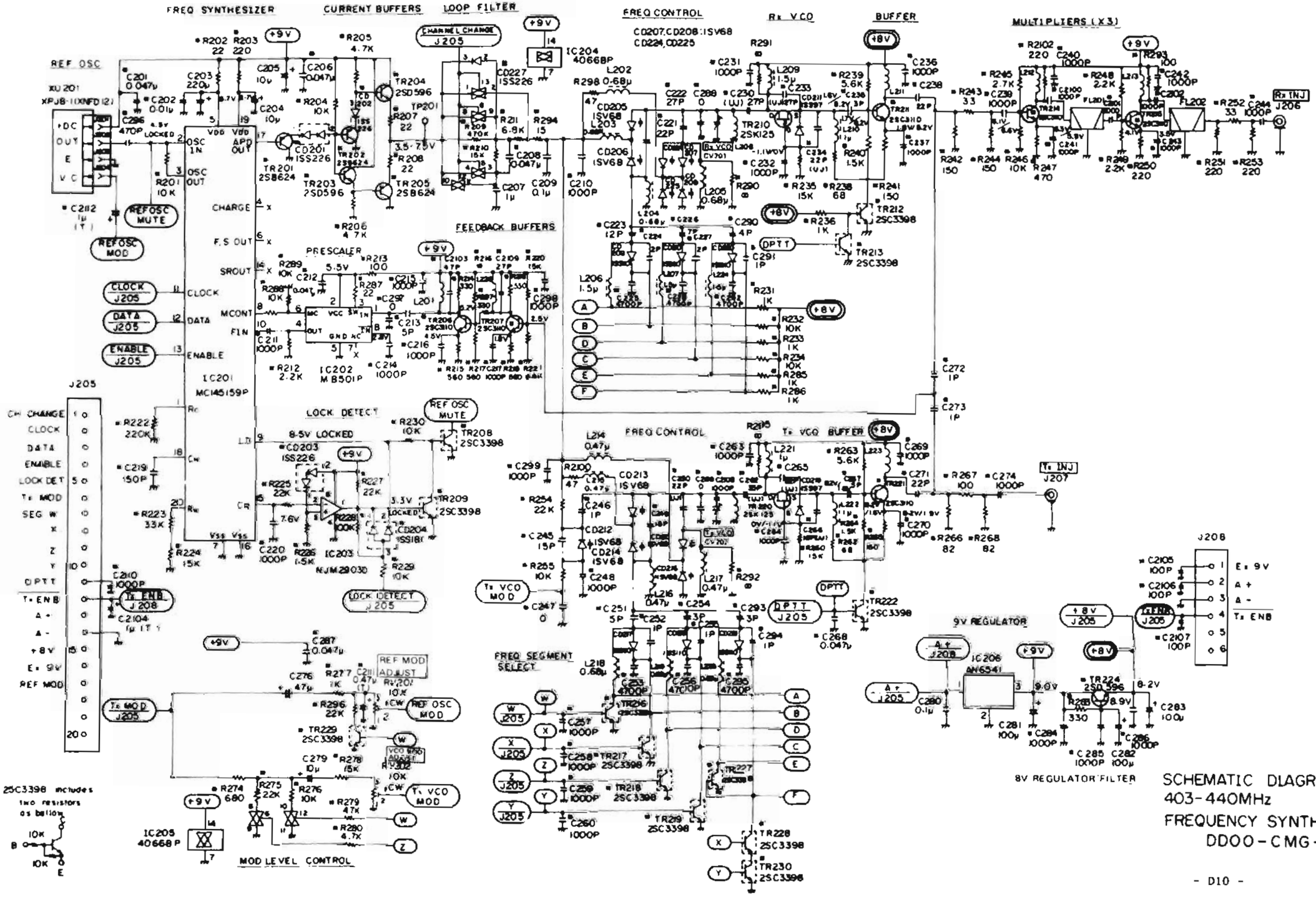
SPARE GATE			
DEVICE	INPUT	OUTPUT	CONTROL
IC609	3	4	5
	8	9	6
	10	11	12

JUMPER PLUG

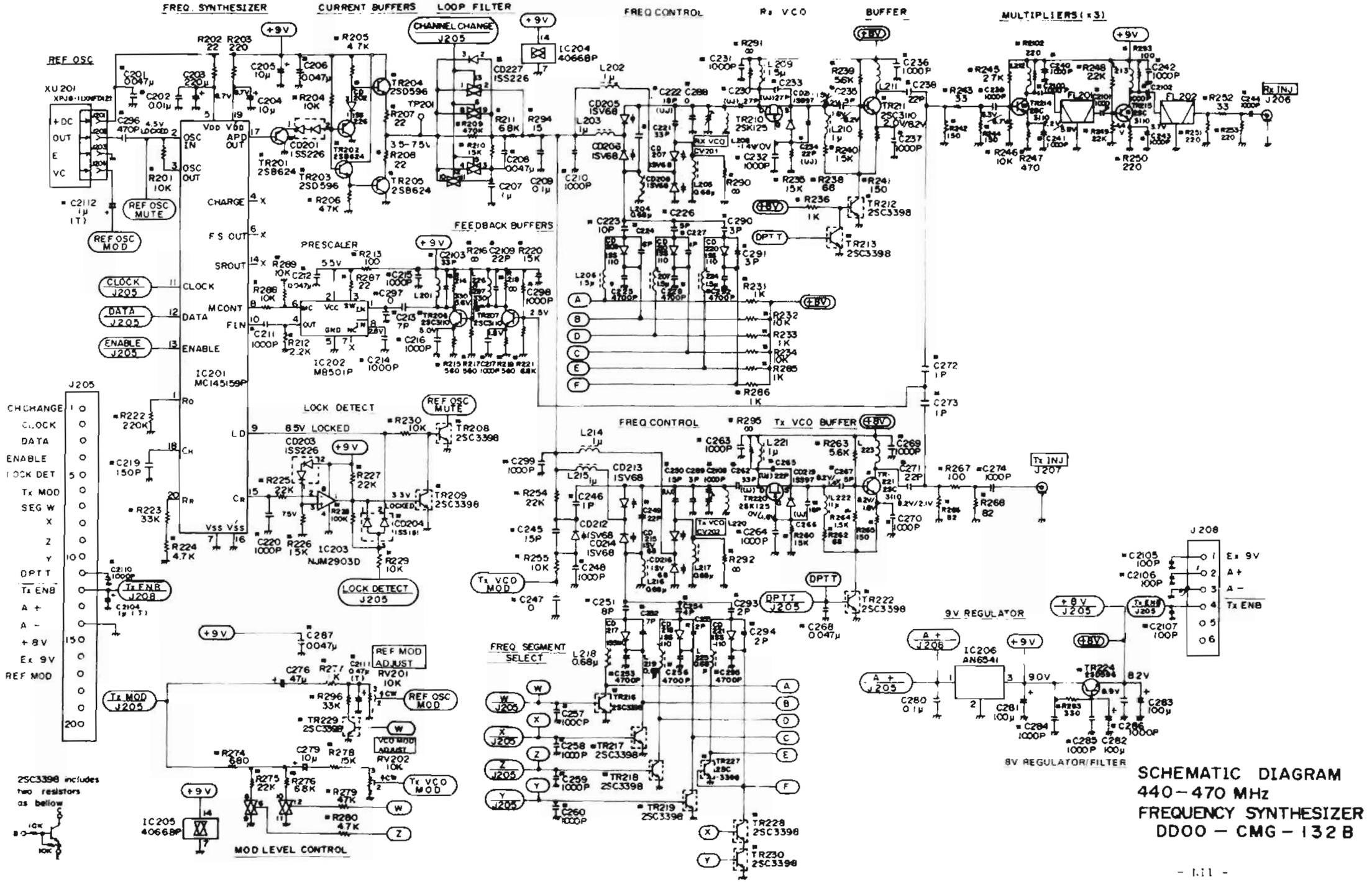
4	J601	1-2	TRANSMIT VG USE
		2-3	TRANSMIT VG NO USE
5	J602	1-2	CG TONE REJECT FILTER USE
		2-3	CG TONE REJECT FILTER NO USE
6	J603	1-2	RECEIVE VG NO USE
		2-3	RECEIVE VG USE
7	J604	1-2	RECEIVE CG POLARITY NORMAL
		2-3	RECEIVE CG POLARITY INVERT
8	J605	1-2	TRANSMIT CG POLARITY NORMAL
		2-3	TRANSMIT CG POLARITY INVERT

NOTE!
ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED.
CAPACITOR VALUES IN F UNLESS FOLLOWD BY MULTIPLIER μ OR P.
"#" SYMBOL IS CHIP COMPONENT.

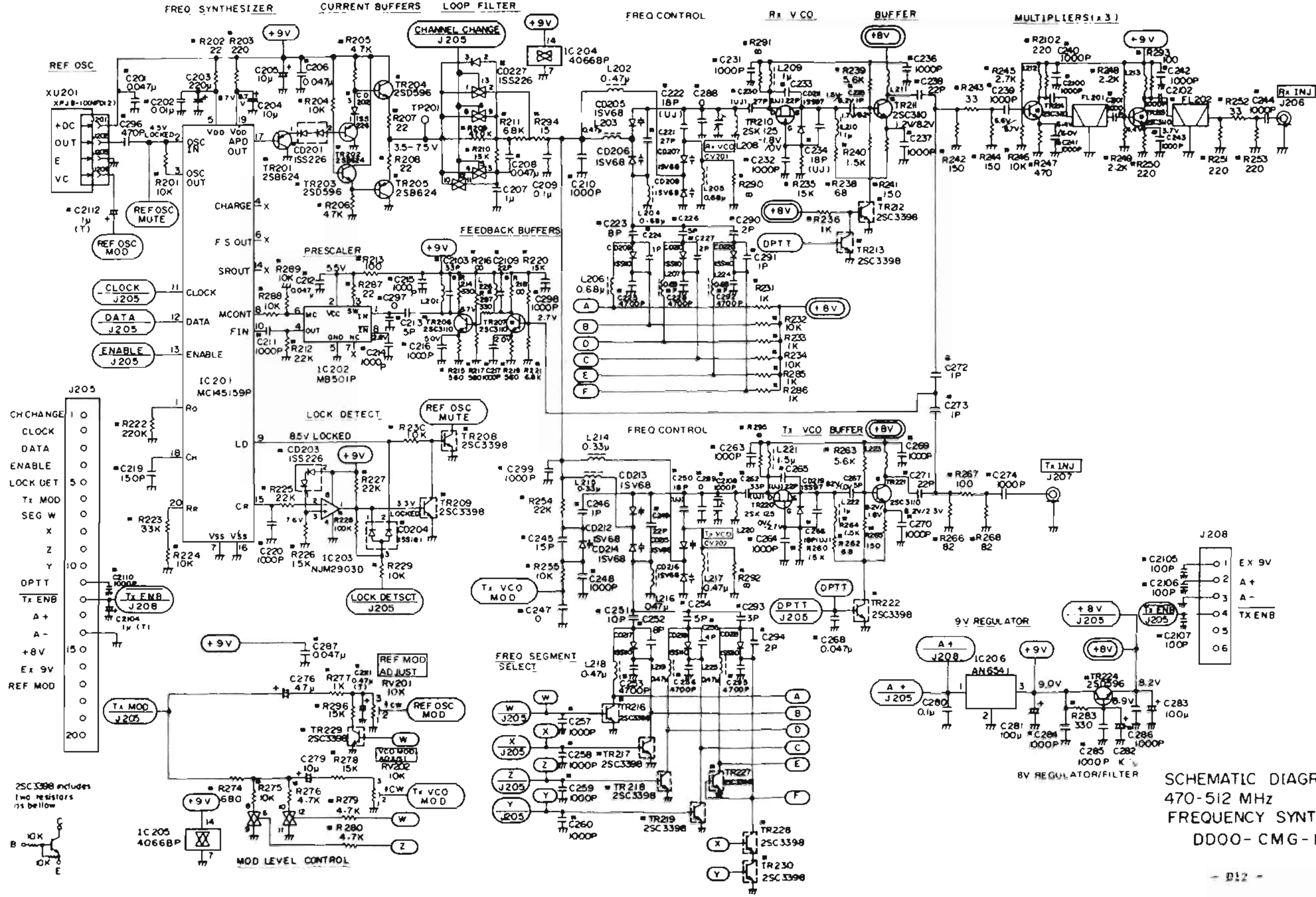
SCHEMATIC DIAGRAM
SYSTEM CONTROL 2/2
DDOO-CMC-383G



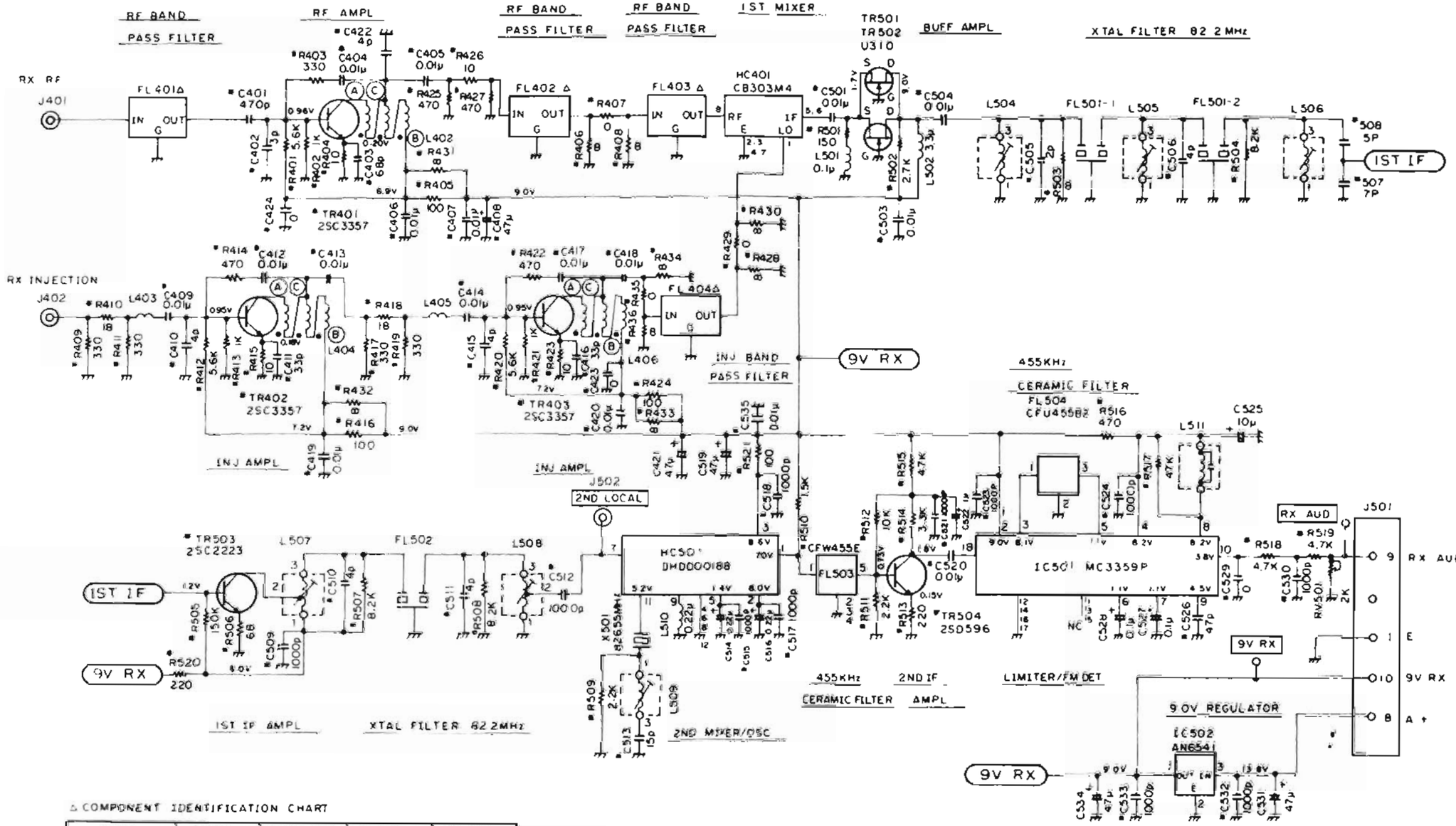
SCHEMATIC DIAGRAM
403-440MHz
FREQUENCY SYNTHESIZER
DDOO-CMG-132A



SCHEMATIC DIAGRAM
440 – 470 MHz
FREQUENCY SYNTHESIZER
DDOO – CMG – 132 B



SCHEMATIC DIAGRAM
470-512 MHz
FREQUENCY SYNTHESIZER
DD00-CMG-132C



Δ COMPONENT IDENTIFICATION CHART

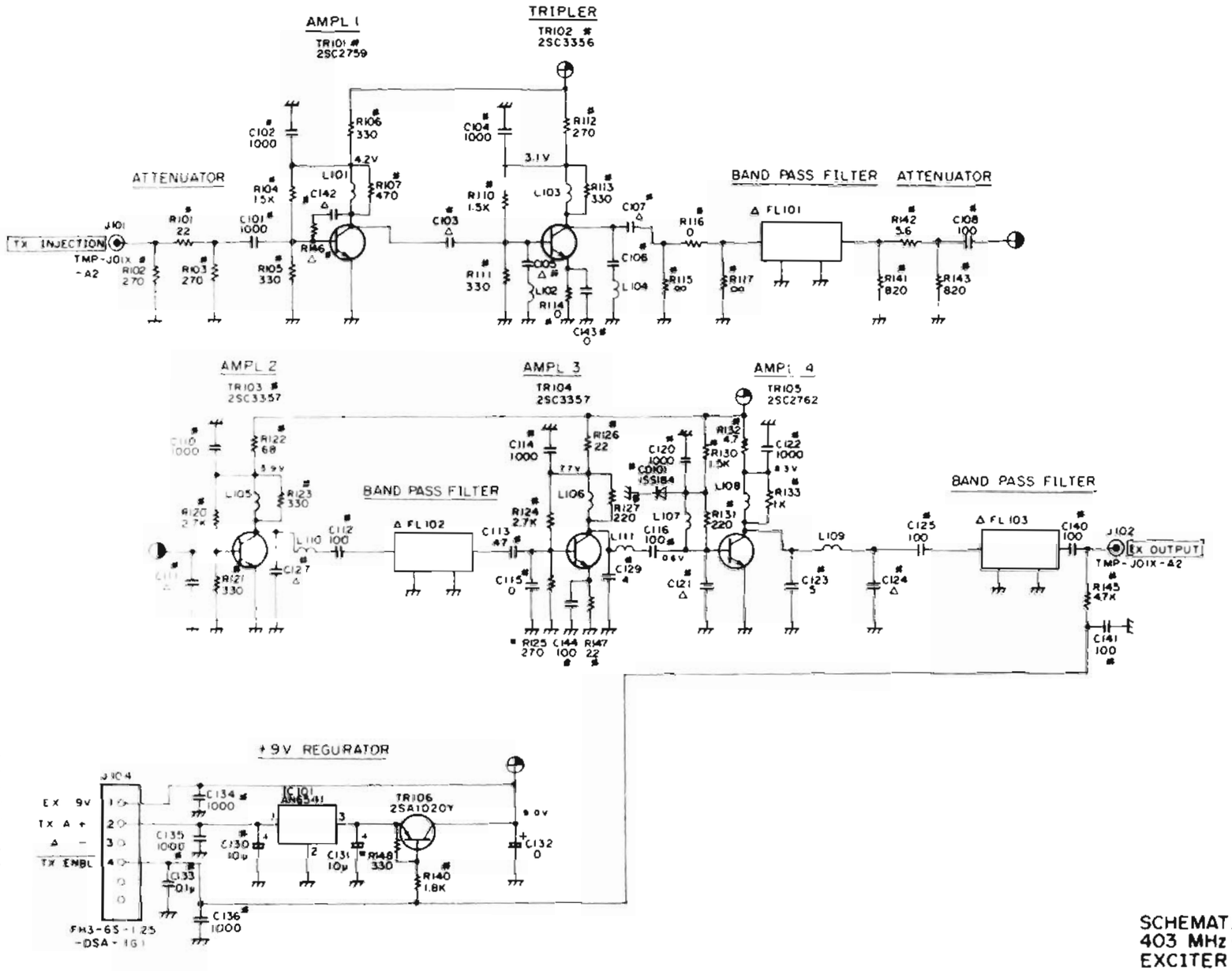
PWB	BAND	FL401-403	FL402	FL404
CMA-239A	A Band	BP403-423A2	BP403-423A1	BP320-358A2
CMA-239B	B Band	BP410-430A2	BP410-430A1	BP320-358A2
CMA-239C	C Band	BP420-440A2	BP420-440A1	BP320-358A2
CMA-239D	D Band	BP440-460A2	BP440-460A1	BP357-388A2
CMA-239E	E Band	BP450-470A2	BP450-470A1	BP357-388A2
CMA-239F	F Band	BP470-488A2	BP470-488A1	BP384-430A2
CMA-239G	G Band	BP482-500A2	BP482-500A1	BP384-430A2
CMA-239H	H Band	BP488-512A2	BP488-512A1	BP384-430A2

NOTES

■ IDENTIFIES "CHIP" COMPONENTS (EXAMPLE ■ R4501) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.

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

SCHEMATIC DIAGRAM
403-512MHz RECEIVER
DDOO-CMA-239



Δ COMPONENT
IDENTIFICATION CHART

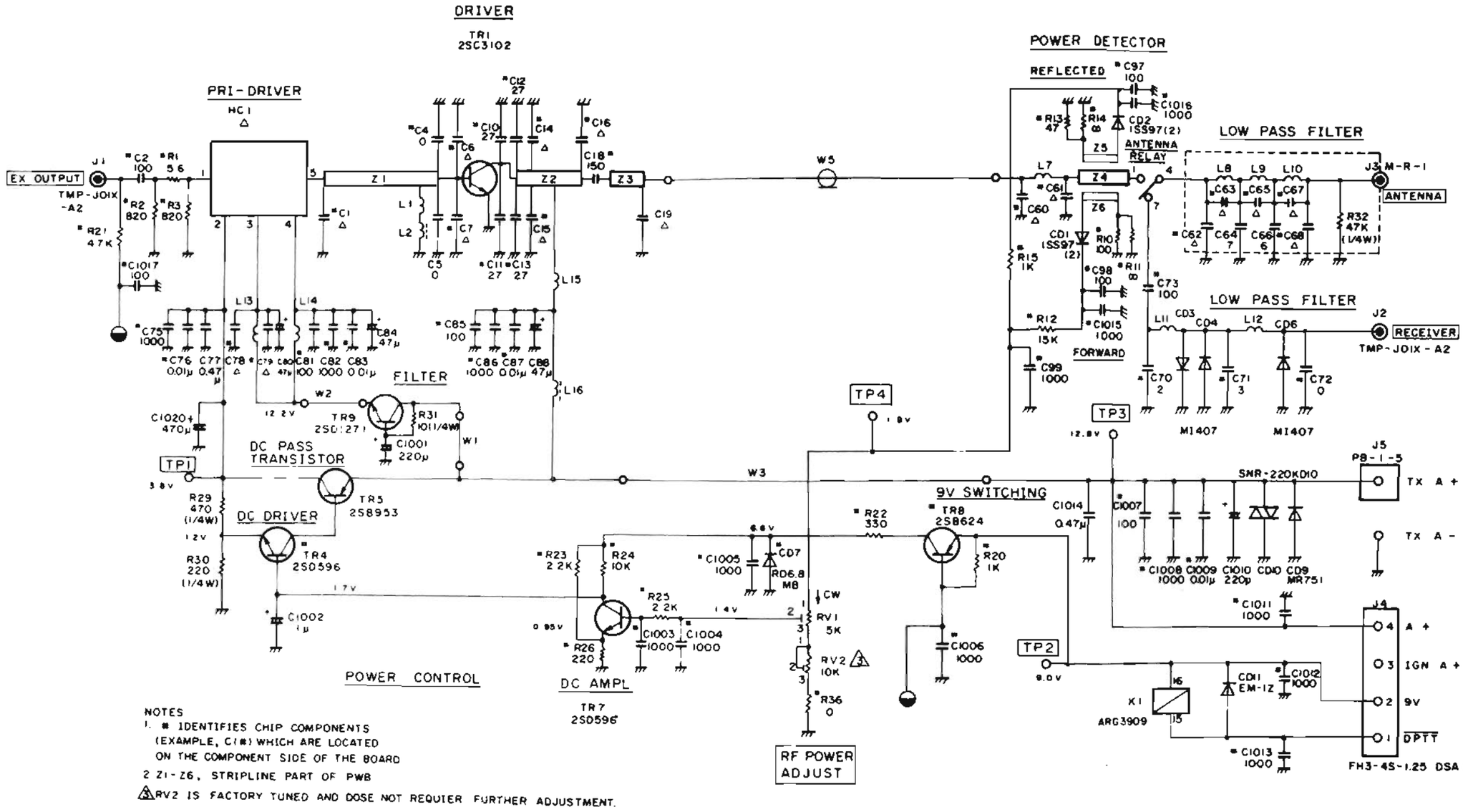
PART	CAF-256A	CAF-256B	CAF-256C
	403-440 MHz	440-470 MHz	470-512 MHz
C103	27 pF	22 pF	18 pF
C105	18 pF	15 pF	12 pF
C107	22 pF	18 pF	10 pF
C121	15 pF	12 pF	12 pF
C124	3 pF	2 pF	2 pF
C127	6 pF	6 pF	2 pF
C142	2200 pF	2200 pF	—
R146	330Ω	330Ω	—
FL101	BP403-440A2	BP440-470A1	BP470-512A1
FL102	BP403-440A1	BP440-470A1	BP470-512A1
FL103	BP403-440A1	BP440-470A1	BP470-512A1
C111	0 pF	2 pF	0 pF

NOTES
'#' IDENTIFIES CHIP COMPONENTS
(EXAMPLE, #C101) WHICH ARE LOCATED
ON THE COMPONENT SIDE OF THE BOARD.

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

SCHEMATIC DIAGRAM
403 MHz - 512 MHz
EXCITER

DDOO-CAF-256



NOTES

1. # IDENTIFIES CHIP COMPONENTS (EXAMPLE, C(#) WHICH ARE LOCATED ON THE COMPONENT SIDE OF THE BOARD
2. Z1-Z6, STRIPLINE PART OF PWB

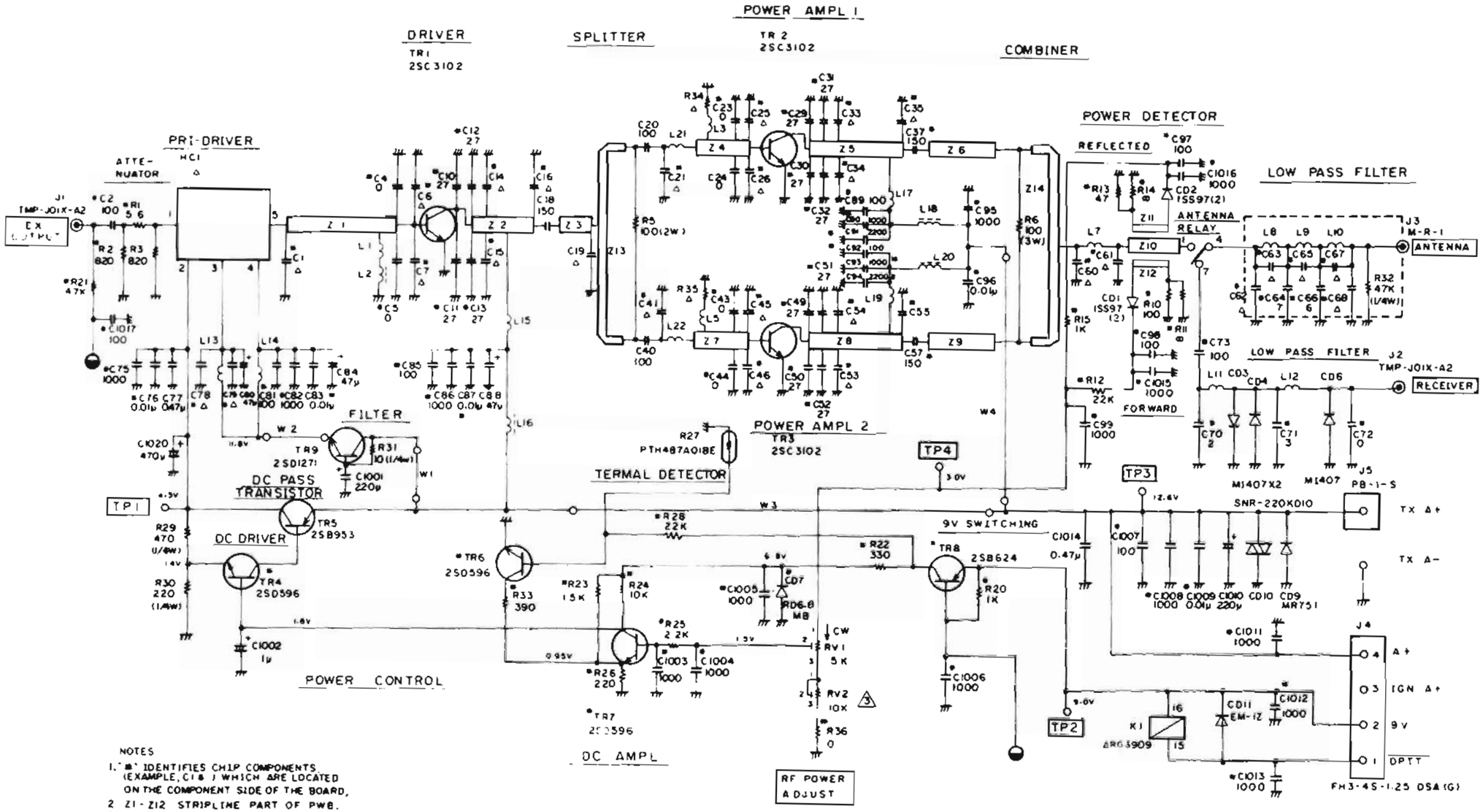
⚠3 RV2 IS FACTORY TUNED AND DOSE NOT REQUIER FURTHER ADJUSTMENT.

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

SCHEMATIC DIAGRAM
403 MHz - 512 MHz
POWER AMPLIFIRE
DDOO-CAH-256L

5. COMPONENT IDENTIFICATION CHART

PART	CAH-256AL 403 ∿ 440MHz (35W)	CAH-256BL 440 ∿ 470MHz (35W)	CAH-256CL 470 ∿ 512MHz (30W)
# C1	10P	10P	8P
# C6	47P	39P	30P
# C7	47P	39P	30P
# C14	15P	15P	10P
# C15	15P	-	-
# C16	12P	14P	10P
C19	3P	3P	-
# C60	3P	2P	2P
# C61	3P	1P	2P
# C62	6P	4P	2P
# C63	2P	-	0.5P
# C65	2P	1P	1P
# C67	3P	2.5P	2.5P
# C68	3P	1P	2P
# C78	1000P	1000P	-
# C79	0.01μ	0.01μ	-
HC1	M57704M-37	M57704H-37	M57704SH-37



NOTES

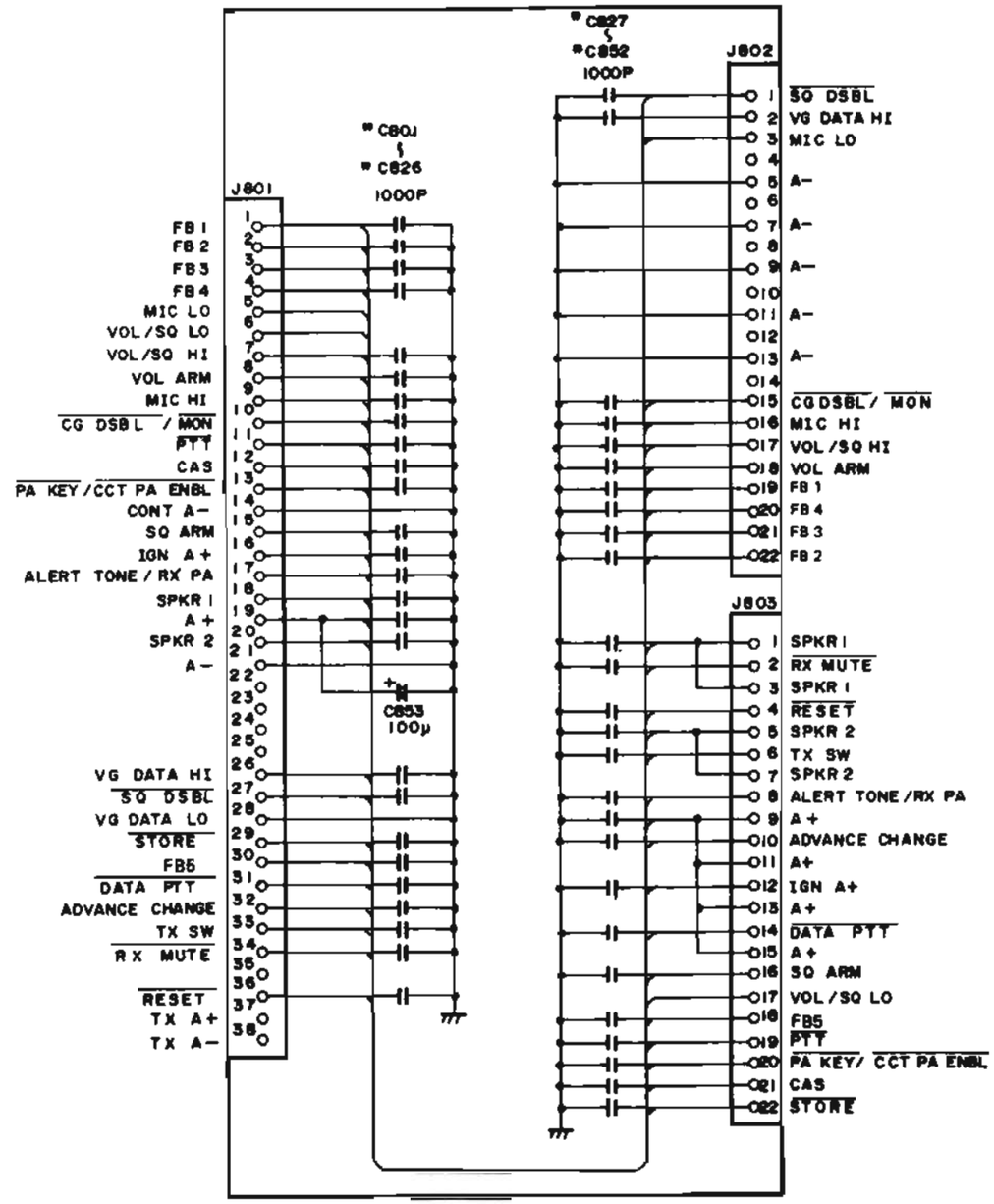
1. "■" IDENTIFIES CHIP COMPONENTS (EXAMPLE, C16) WHICH ARE LOCATED ON THE COMPONENT SIDE OF THE BOARD.
2. Z1 - Z12 STRIPLINE PART OF PWB.
3. RV2 IS FACTORY TUNED AND DOSE NOT REQUIER FURTHER ADJUSTMENT.

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

SCHEMATIC DIAGRAM
403 MHz - 512 MHz
POWER AMPLIFIRE
DDOO - CAH - 256H

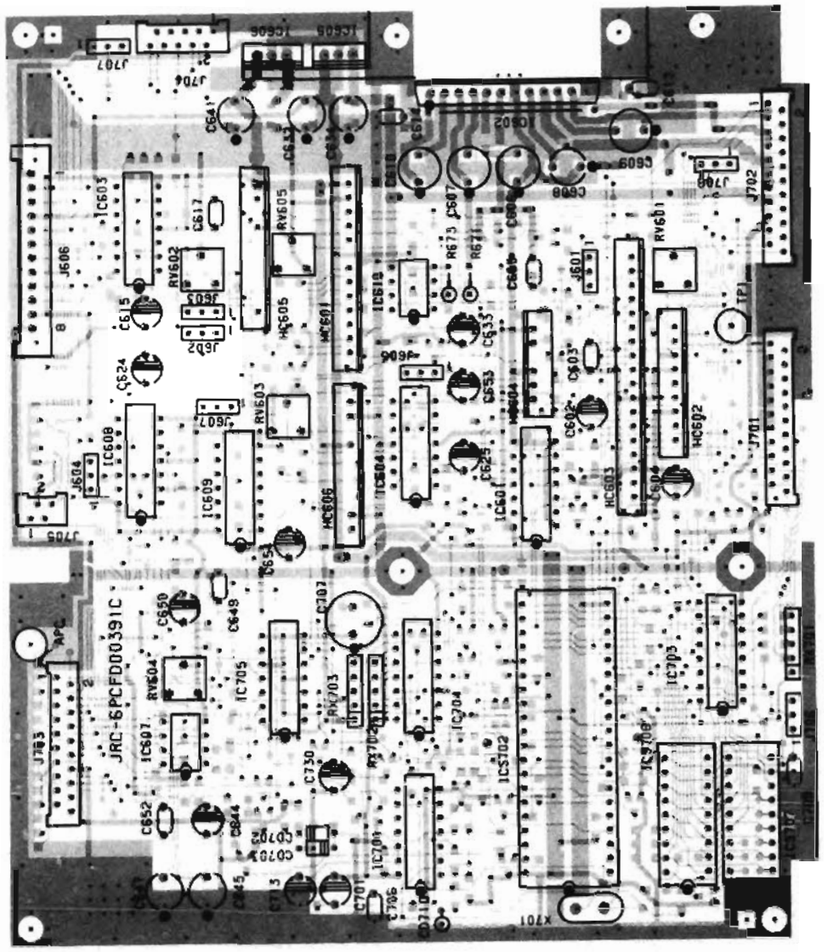
△ COMPONENT IDENTIFICATION CHART

PART	CAH-256AH 403 ~ 440MHz (100W)	CAH-256BH 440 ~ 470MHz (100W)	CAH-256CH 470 ~ 512MHz (80W)
# C1	10P	10P	8P
# C6	47P	39P	30P
# C7	47P	39P	30P
# C14	15P	15P	10P
# C15	15P	-	-
# C16	12P	13P	10P
C19	3P	3P	-
# C21	10P	10P	8P
# C25	47P	39P	36P
# C26	47P	39P	36P
# C33	15P	-	-
# C34	15P	-	-
# C35	12P	10P	10P
# C41	10P	10P	8P
# C45	47P	39P	36P
# C46	47P	39P	36P
# C53	15P	-	-
# C54	15P	-	-
# C55	12P	10P	10P
# C60	3P	2P	2P
# C61	3P	1P	2P
# C62	6P	4P	2P
# C63	2P	-	0.5P
# C65	2P	1P	1P
# C67	3P	2.5P	2.5P
# C68	3P	1P	2P
# C78	1000P	1000P	-
# C79	0.01μ	0.01μ	-
R34	4.7Ω,1W	1.5Ω,1W	1.5Ω,1W
R35	4.7Ω,1W	1.5Ω,1W	1.5Ω,1W
IC1	M57704M-37	M57704H-37	M57704SH-37



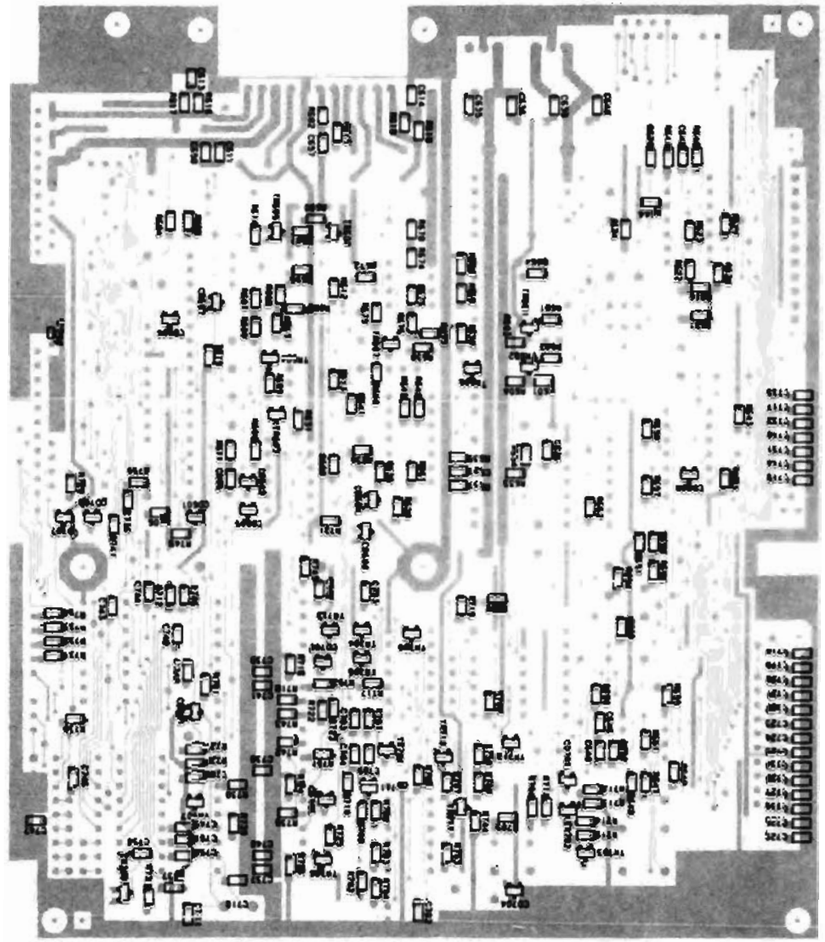
INTERFACE
SCHEMATIC DIAGRAM
DD00-CFQ-2223
1/1

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



(TOP VIEW)

SYSTEM CONTROL BOARD



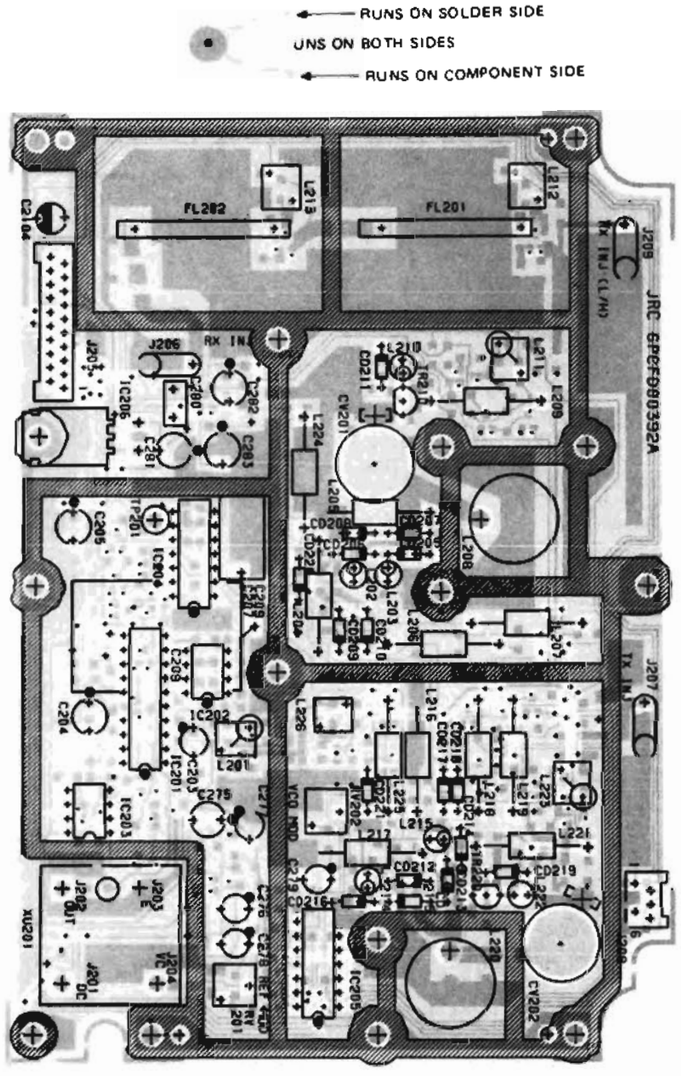
LEAD IDENTIFICATION FOR TRANSISTOR

(TOP VIEW)

LEAD IDENTIFICATION FOR DIODES

(TOP VIEW)

SYSTEM CONTROL BOARD

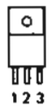


LEAD IDENTIFICATION
FOR TR210, TR220
(TOP VIEW)

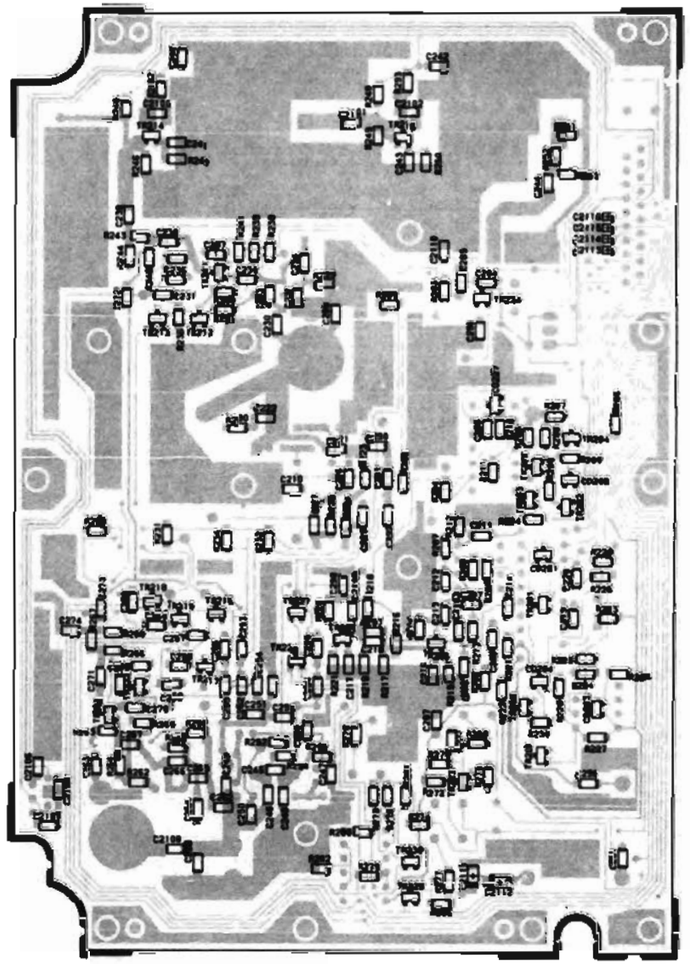
LEAD IDENTIFICATION
FOR DIODES
(TOP VIEW)

LEAD IDENTIFICATION
FOR RV201, RV202
(TOP VIEW)

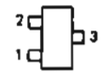
LEAD IDENTIFICATION
FOR IC206
(TOP VIEW)



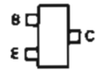
FREQUENCY SYNTHESIZER BOARD



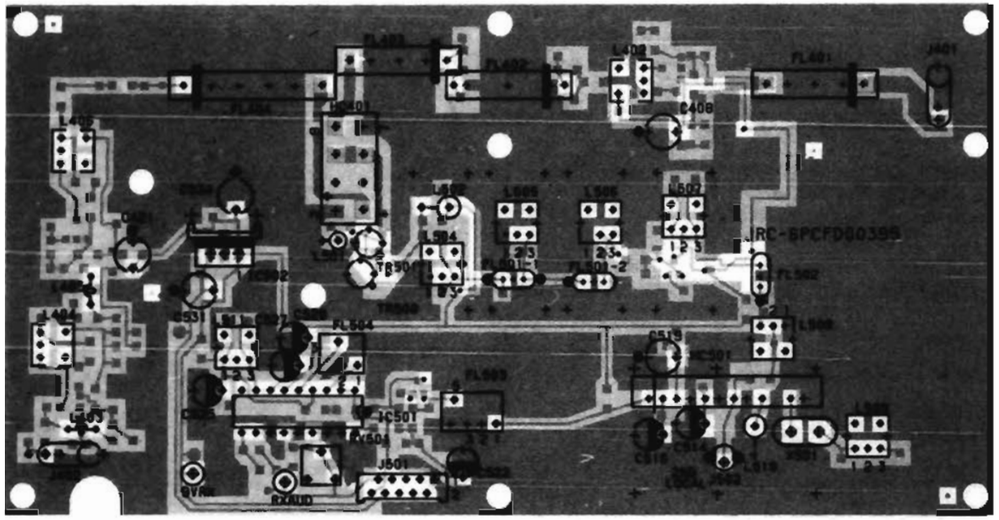
LEAD IDENTIFICATION
FOR DIODES
(TOP VIEW)



LEAD IDENTIFICATION
FOR TRANSISTORS
(TOP VIEW)

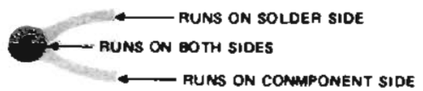


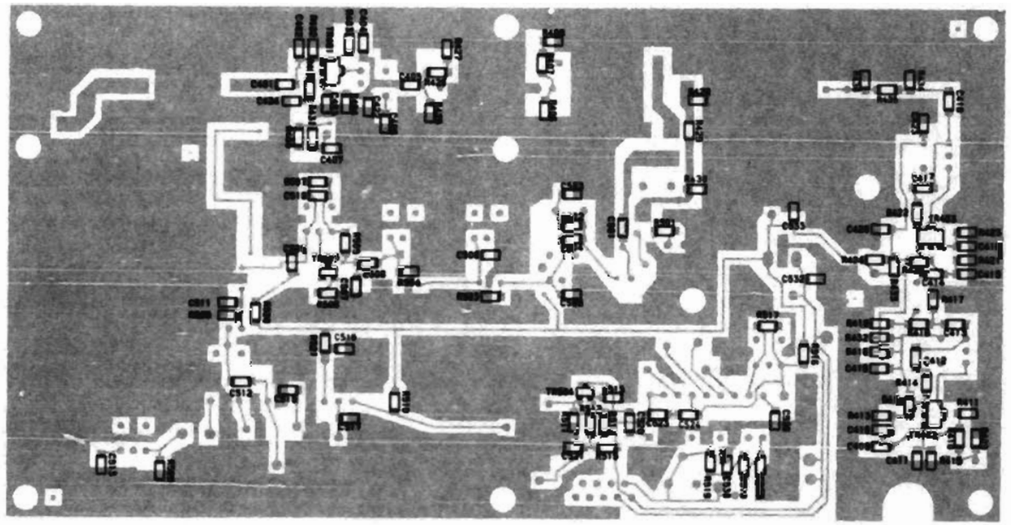
FREQUENCY SYNTHESIZER

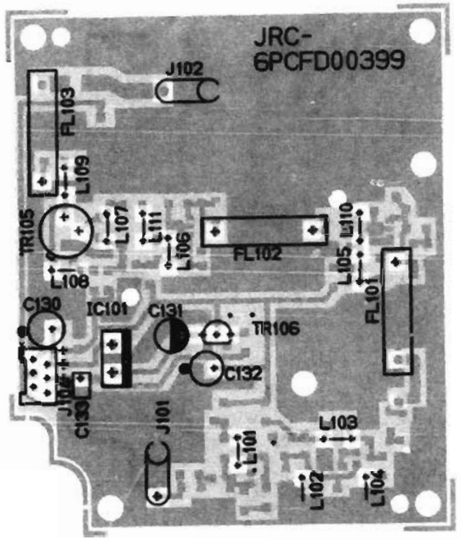


RECEIVER BOARD

LEAD IDENTIFICATION
FOR RV 501
(TOP VIEW)



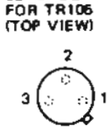




LEAD IDENTIFICATION
FOR TR108
(TOP VIEW)

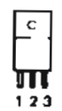
1: EMITTER
2: COLLECTOR
3: BASE

LEAD IDENTIFICATION
FOR TR106
(TOP VIEW)



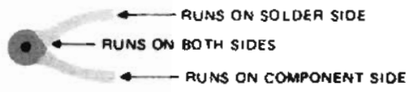
1: EMITTER
2: BASE
3: COLLECTOR

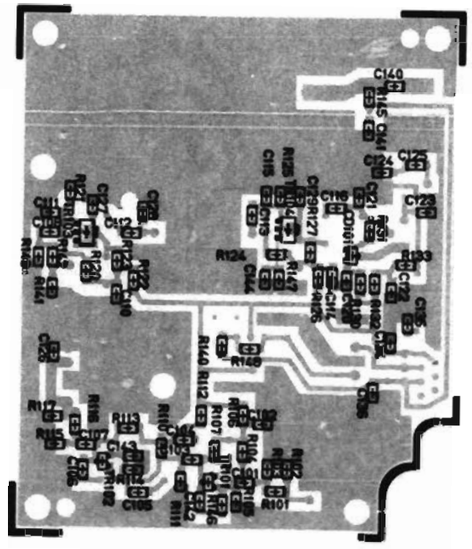
LEAD IDENTIFICATION
FOR IC101
(TOP VIEW)



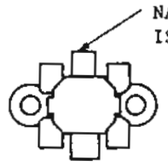
1: INPUT
2: COMMON
3: OUTPUT

TRANSMIT EXCITER BOARD

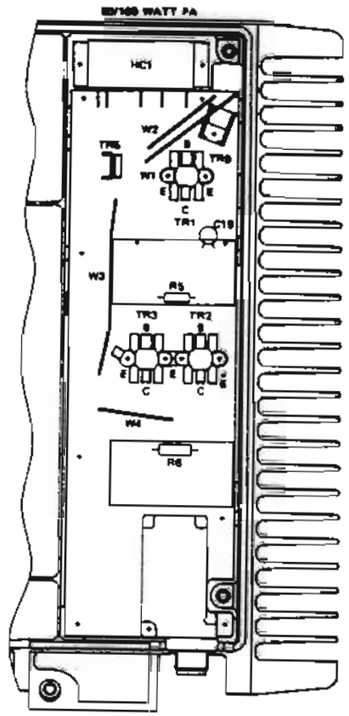


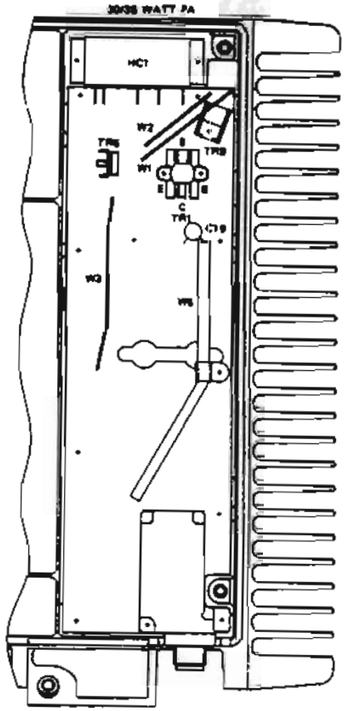


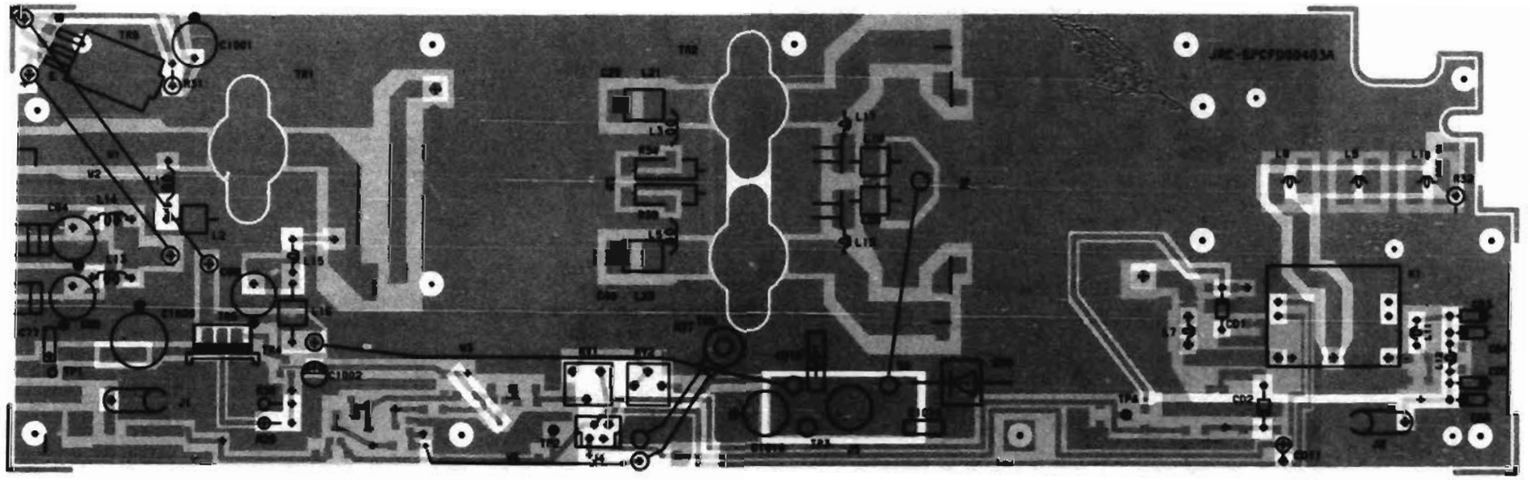
TRANSMIT EXCITER BOARD



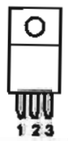
TYP LEAD TRIMMING
FOR TR 1 TO TR 3



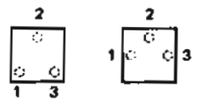




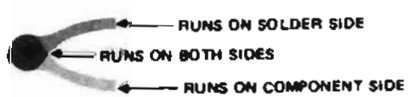
LEAD IDENTIFICATION
FOR TR5 AND TR9

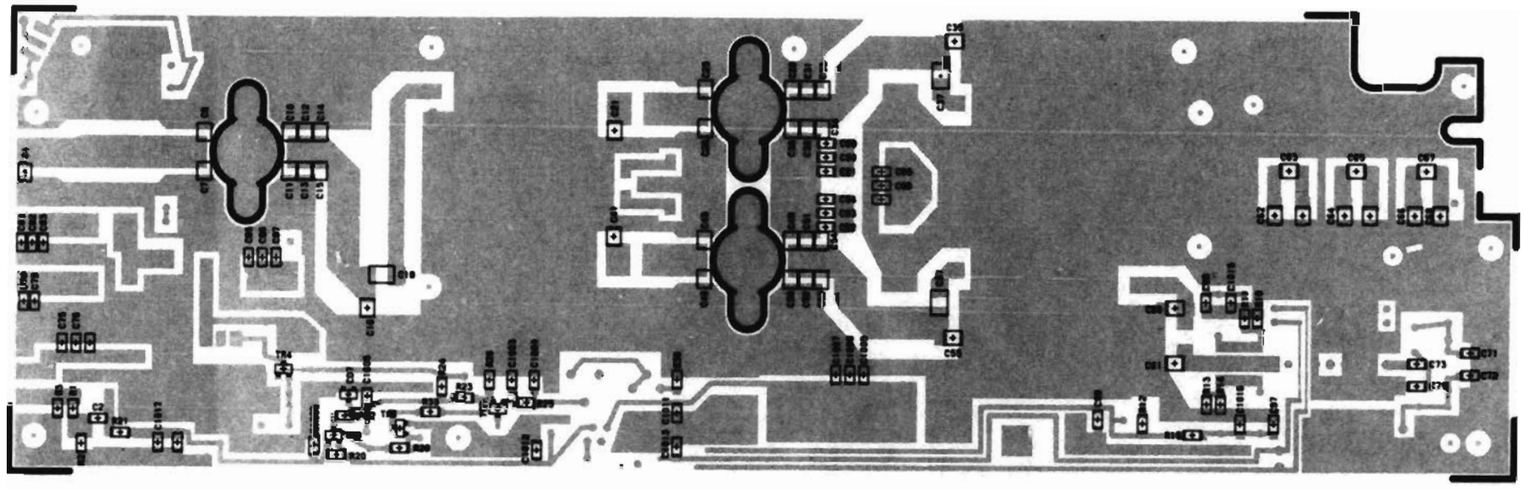


LEAD IDENTIFICATION
FOR RV1 AND RV2
(TOP VIEW)



LEAD IDENTIFICATION
FOR DIODES
(TOP VIEW)

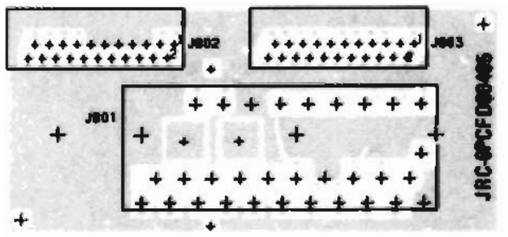




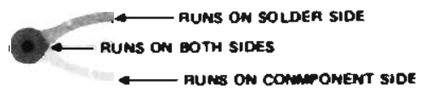
POWER AMPLIFIER BOARD

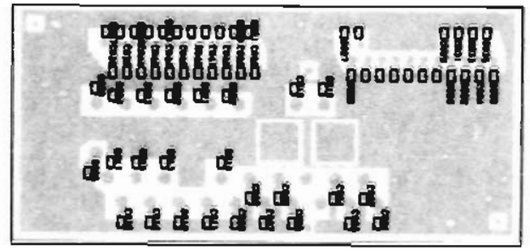
LEAD IDENTIFICATION
FOR CD1, CD8, CD13, CD14 and CD15
(TOP VIEW)

LEAD IDENTIFICATION
FOR TRANSISTORS
(TOP VIEW)

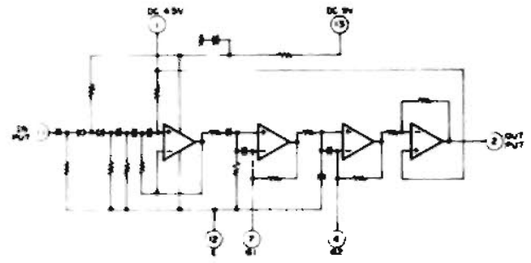
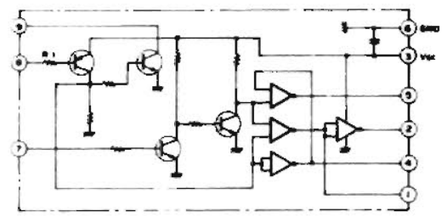
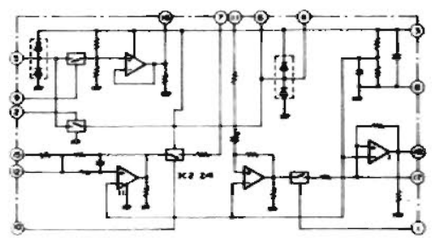
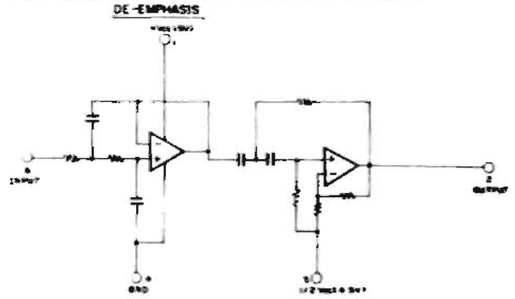


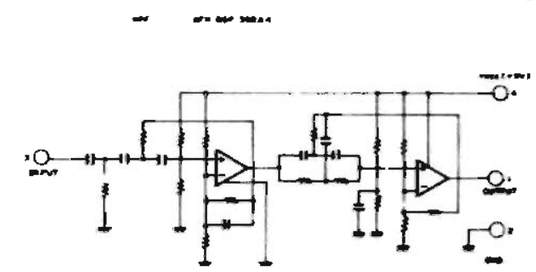
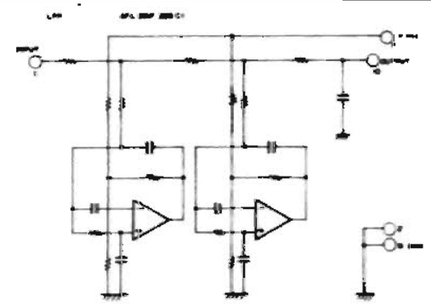
INTERFACE BOARD





INTERFACE BOARD

SYMBOL	JRC PART NO	EQUIVALENT CIRCUIT
HC601	JRC / 6DHFD00160	
HC602	JRC / 6DHFD00165	
HC603	JRC / 6DHFD00164	
HC604	JRC / 6DHFD00167	

SYMBOL	JRC PART NO.	EQUIVALENT CIRCUIT
HC605	JRC / 6DHFD00168	
HC606	JRC / 6DHFD00169	

PARTS LIST

SYMBOL	GE PART NO.	DESCRIPTION
		PA BOARD
B19/CAR-256AL:		LOW POWER (35W)
256AH:		HIGH POWER (100W)
256BL:		LOW POWER (35W)
256BH:		HIGH POWER (100W)
256CL:		LOW POWER (80W)
256CH:		HIGH POWER (80W)
		---------- CAPACITORS ----------
C1	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 AL, AH, BL and BH).
C1	B19/5CHAB01173	Mica: 8pF ±0.5pF, 500VDCW. (Used in CAR-256 CL and CH).
C6 and C7	B19/5CHAB01252	Mica: 47pF ±5%, 500VDCW. (Used in CAR-256 AL and AH).
C6 and C7	B19/5CHAB01430	Mica: 39pF ±5%, 500VDCW. (Used in CAR-256 BL and BH).
C6 and C7	B19/5CHAB01466	Mica: 30pF ±5%, 500VDCW. (Used in CAR-256 CL and CH).
C10 thru C13	B19/5CHAB01155	Mica: 27pF ±5%, 500VDCW.
C14	B19/5CHAB01351	Mica: 15pF ±5%, 500VDCW. (Used in CAR-256 AL, AH, BL and BH).
C14	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 CL and CH).
C15	B19/5CHAB01351	Mica: 15pF ±5%, 500VDCW. (Used in CAR-256 AL and AH).
C16	B19/5CHAB01443	Mica: 12pF ±5%, 500VDCW. (Used in CAR-256AL and AH).
C16	B19/5CHAB01495	Mica: 13pF ±0.5pF, 500VDCW. (Used in CAR-256 BL and BH).
C16	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 CL and CH).
C18	B19/5CHAB01471	Mica: 150pF ±5%, 500VDCW.
C19	B19/5CAAB00843	Ceramic: 3pF ±0.25pF, 500VDCW. (Used in CAR-256 AH, AL, BL and BH).
C20	B19/5CAAN00015	Mica: 100pF ±5%, 100VDCW. (Used in CAR-256 AH, BH and CH).
C21	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 AH and BH).
C21	B19/5CHAB01173	Mica: 8pF ±0.5pF, 500VDCW. (Used in CAR-256 CH).
C25 and C26	B19/5CHAB01252	Mica: 47pF ±5%, 500VDCW. (Used in CAR-256 AH).
C25 and C26	B19/5CHAB01430	Mica: 39pF ±5%, 500VDCW. (Used in CAR-256 BH).
C25 and C26	B19/5CHAB01466	Mica: 30pF ±5%, 500VDCW. (Used in CAR-256 CH).
C29 thru C32	B19/5CHAB01155	Mica: 27pF ±5%, 500VDCW. (Used in CAR-256 AH, BH and CH).

SYMBOL	GE PART NO.	DESCRIPTION
C33 and C34	B19/5CHAB01351	Mica: 15pF ±5%, 500VDCW (Used in CAR-256 AH).
C33	B19/5CHAB01351	Mica: 15pF ±5%, 500VDCW. (Used in CAR-256 BH).
C33	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 CH).
C35	B19/5CHAB01443	Mica: 12pF ±5%, 500VDCW. (Used in CAR-256 AH).
C35	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 BH and CH).
C37	B19/5CHAB01471	Mica: 150pF ±5%, 500VDCW. (Used in CAR-256 AH, BH and CH).
C40	B19/5CAAJ00015	Mica: 100pF ±5%, 100VDCW. (Used in CAR-256 AH, BH and CH).
C41	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 AH and BH).
C41	B19/5CHAB01173	Mica: 8pF ±0.5pF, 500VDCW. (Used in CAR-256 CH).
C45 and C46	B19/5CHAB01252	Mica: 47pF ±5%, 500VDCW. (Used in CAR-256 AH).
C45 and C46	B19/5CHAB01430	Mica: 39pF ±5%, 500VDCW. (Used in CAR-256 BH).
C45 and C46	B19/5CHAB01466	Mica: 30pF ±5%, 500VDCW. (Used in CAR-256 CH).
C49	B19/5CHAB01155	Mica: 27pF ±5%, 500VDCW. (Used in CAR-256 AH, BH and CH).
C52		
C53 and C54	B19/5CHAB01351	Mica: 15pF ±5%, 500VDCW. (Used in CAR-256 AH).
C53	B19/5CHAB01351	Mica: 15pF ±5%, 500VDCW. (Used in CAR-256 BH).
C53	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 CH).
C55	B19/5CHAB01443	Mica: 12pF ±0.5pF, 500VDCW. (Used in CAR-256 AH).
C55	B19/5CHAB01091	Mica: 10pF ±0.5pF, 500VDCW. (Used in CAR-256 BH and CH).
C57	B19/5CHAB01471	Mica: 150pF ±5%, 500VDCW. (Used in CAR-256 AH, BH and CH).
C60 and C61	B19/5CHAB01124	Mica: 3pF ±0.25pF, 500VDCW. (Used in CAR-256 AL and AH).
C60	B19/5CHAB01170	Mica: 2pF ±0.25pF, 500VDCW. (Used in CAR-256 BL).
C60	B19/5CHAB01397	Mica: 4pF ±0.25pF, 500VDCW. (Used in CAR-256 BH).
C61	B19/5CHAB01169	Mica: 1pF ±0.25pF, 500VDCW. (Used in CAR-256 BL and BH).

SYMBOL	GE PART NO.	DESCRIPTION
C60 and C61	B19/5CHAB01170	Mica: 2pF ±0.25pF, 500VDCW. (Used in CAR-256 CL and CH).
C62	B19/5CHAB01330	Mica: 6pF ±0.5pF, 500VDCW. (Used in CAR-256 AL and AH).
C62	B19/5CHAB01397	Mica: 4pF ±0.25pF, 500VDCW. (Used in CAR-256 BL and BH).
C62	B19/5CHAB01170	Mica: 2pF ±0.25pF, 500VDCW. (Used in CAR-256 CL and CH).
C63	B19/5CHAB01170	Mica: 2pF ±0.25pF, 500VDCW. (Used in CAR-256 AL and AH).
C63	B19/5CHAB01122	Mica: 0.5pF ±0.25pF, 500VDCW. (Used in CAR-256 BL, BH, CL and CH).
C64	B19/5CHAB01328	Mica: 7pF ±0.5pF, 500VDCW.
C65	B19/5CHAB01170	Mica: 2pF ±0.25pF, 500VDCW. (Used in CAR-256 AL and AH).
C65	B19/5CHAB01369	Mica: 1pF ±0.25pF, 500VDCW. (Used in CAR-256 BL, BH, CL and CH).
C66	B19/5CHAB01330	Mica: 6pF ±0.5pF, 500VDCW.
C67 and C68	B19/5CHAB01124	Mica: 3pF ±0.25pF, 500VDCW. (Used in CAR-256 AL and AH).
C67	B19/5CHAB01473	Mica: 2.5pF ±0.25pF, 500VDCW. (Used in CAR-256 BL, BH, CL and CH).
C68	B19/5CHAB01109	Mica: 1pF ±0.25pF, 500VDCW. (Used in CAR-256 BL and BH).
C68	B19/5CHAB01170	Mica: 2pF ±0.25pF, 500VDCW. (Used in CAR-256 CL and CH).
C70	B19/5CAAB00709	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0 ±60ppm.
C71	B19/5CAAB00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0 ±60ppm.
C73	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef 0 ±60ppm.
C75	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -100ppm.
C76	B19/5CAAB00709	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C77	B19/5CAAB00366	Ceramic: 0.47uF ±10%, 50VDCW.
C78	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm. (Used in CAR-256 AL, AH, BL and BH).
C79	B19/5CAAB00709	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%. (Used in CAR-256 AL, AH, BL and BH).
C80	B19/5CHAB01061	Electrolytic: 47uF ±20%, 35VDCW.
C81	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef 0 ±60ppm.
C82	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C83	B19/5CAAB00709	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C84	B19/5CHAB01061	Electrolytic: 47uF ±20%, 35VDCW.
C85	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef 0 ±60ppm.

SYMBOL	GE PART NO.	DESCRIPTION
C86	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C87	B19/5CAAB00709	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C88	B19/5CHAB01061	Electrolytic: 47uF ±20%, 50VDCW.
C89	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef 0 ±60ppm. (Used in CAR-256 AH, BH and CH).
C90	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm. (Used in CAR-256 AH, BH and CH).
C91	B19/5CAAB00792	Ceramic: 2200pF ±5%, 50VDCW, temp coef +350 -1000ppm. (Used in CAR-256 AH, BH and CH).
C92	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef ±60ppm. (Used in CAR-256 AH, BH and CH).
C93	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm. (Used in CAR-256 AH, BH and CH).
C94	B19/5CAAB00792	Ceramic: 2200pF ±5%, 50VDCW, temp coef +350 -1000ppm. (Used in CAR-256 AH, BH and CH).
C95	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm. (Used in CAR-256 AH, BH and CH).
C96	B19/5CAAB00709	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%. (Used in CAR-256 AH, BH and CH).
C98 and C98A	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
C99	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C1001	B19/5CHAB01044	Electrolytic: 220uF ±20%, 25VDCW.
C1002	B19/5CHAC00796	Tantalum: 1uF ±20%, 35VDCW.
C1003 thru C1006	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C1007	B19/5CAAB00709	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
C1008	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C1009	B19/5CAAB00709	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C1010	B19/5CHAB01044	Electrolytic: 220uF ±20%, 25VDCW.
C1011 thru C1013	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C1014	B19/5CHAB01044	Ceramic: 0.47uF ±10%, 50VDCW.
C1015 and C1016	B19/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C1017	B19/5CAAB00780	Ceramic: 100pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C1018	B19/5CHAB01136	Electrolytic: 470uF ±20%, 25VDCW.

SYMBOL	CE PART NO.	DESCRIPTION
		——— DIODES ———
CR1 and CR2	B19/5TAAA00313	Silicon, (Schottky Barrier): Sim to NEC 18897 (2).
CR3 and CR4	B19/5TAAB00051	Silicon, fast recovery, (RF Switch): sim to Mitsubishi MI407.
CR6	B19/5TAAB00051	Silicon, fast recovery, (RF Switch): sim to Mitsubishi MI407.
CR7	B19/5TAAA00402	Zener: 6.8V, 200mW, sim to NEC BZ6.8MD-T1.
CR9	B19/5TAAB00019	Silicon: Fwd current 3A, 200PIV: sim to MOTOROLA MR751.
CR10	B19/5TAAA00104	Ceramic Varistor: Limit voltage 30 to 135V, sim to Samkom SNR-220KB10.
CR11	B19/5TAAA00041	Silicon: 200V 1A, sim to Sanken EM1Z.
		——— HYBRID CIRCUIT ———
HC1	B19/5BBAB00249	RF Power Amplifier: sim to Mitsubishi M57704M-37 (Used in CAR-256AL and AR).
HC1	B19/5BBAB00247	RF Power Amplifier: sim to Mitsubishi M57704M-37 (Used in CAR-256 BL and BR).
HC1	B19/5BBAB00248	RF Power Amplifier: sim to Mitsubishi M57704AM-37 (Used in CAR-256 CL and CR).
		——— CONNECTORS ———
J1 and J2	B19/5JNCL00045	Connector, RF.
J3	B19/5JAAG00060	Co-axial connector N type
J4	B19/5JMB600176	Connector, EP: 4 pin.
J5	B19/5JTCM00060	Terminal.
		——— RELAY ———
K1	B19/5KLAB00657	Relay: DC5V.
		——— COILS ———
L1	B19/6LAFD01247	Coil, RF.
L2	B19/6LAFB01129	Coil, RF.
L3 and L5	B19/6LAFB01248	Coil, RF. (Used in CAR-256 AR, BR and CR)
L7	B19/6LAFB01250	Coil, RF.
L8	B19/6LAFB01251	Coil, RF.
L9	B19/6LAFB01251	Coil, RF.
L10	B19/6LAFB01251	Coil, RF.
L11	B19/6LAFB01256	Coil, RF.
L12	B19/6LAFB01256	Coil, RF.
L13	B19/6LAFB01247	Coil, RF.

SYMBOL	CE PART NO.	DESCRIPTION
L14	B19/6LAFB01247	Coil, RF.
L15	B19/6LAFB01256	Coil, RF.
L16	B19/6LAFB01129	Coil, RF.
L17	B19/6LAFB01260	Coil, RF: (Used in CAR-256 AR, BR and CR).
L18	B19/6LAFB01129	Coil, RF: (Used in CAR-256 AR, BR and CR).
L19	B19/6LAFB01260	Coil, RF: (Used in CAR-256 AR, BR and CR).
L20	B19/6LAFB01129	Coil, RF: (Used in CAR-256 AR, BR and CR).
L21	B19/6LAFB01261	Coil, RF: (Used in CAR-256 AR, BR and CR).
L22	B19/6LAFD01261	Coil, RF: (Used in CAR-256 AR, BR and CR).
		——— RESISTORS ———
R1	B19/5RZAC00595	Metal film: 5.6 ohms ±5%, 200VDCW, 1/8W.
R2 and R3	B19/5RZAC00636	Metal film: 820 ohms ±5%, 200VDCW, 1/8W.
R5	B19/5RZAC00014	Metal film: 100 ohms ±5%, 350VDCW, 2W. (Used in CAR-256 AR, BR and CR).
R6	B19/5RZAC00470	Metal film: 100ohms ±5%, 350VDCW, 3W. (Used in CAR-256 AR, BR and CR).
R10	B19/5RZAC00586	Metal film: 100ohms ±5%, 200VDCW, 1/8W.
R12	B19/5RZAC00596	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W. (Used in CAR-256 AL, BL and CL).
R12	B19/5RZAC00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W (Used in CAR-256 AR, BR and CR).
R13	B19/5RZAC00580	Metal film: 47 ohms ±5%, 200VDCW, 1/8W.
R15	B19/5RZAC00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R20	B19/5RZAC00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R21	B19/5RZAC00573	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R22	B19/5RZAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R23	B19/5RZAC00575	Metal film: 2.2K ohms ±5%, 200VDCW, 1/8W (Used in CAR-256 AL, BL and CL).
R23	B19/5RZAC00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W (Used in CAR-256 AR, BR and CR).
R24	B19/5RZAC00574	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R25	B19/5RZAC00594	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
R26	B19/5RZAC00575	Metal film: 2.2K ohms ±5%, 200VDCW, 1/8W.
R27	B19/5RZAB00020	Resistor (Used in CAR-256 AR, BR and CR).

SYMBOL	CE PART NO.	DESCRIPTION
R28	B19/5RZAC00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.(Used in CAR-256 AR, BR and CR).
R29	B19/5RZAA01541	Carbon film: 470 ohms ±5%, 300VDCW, 1/4W.
R30	B19/5RZAA01543	Carbon film: 220 ohms ±5%, 300VDCW, 1/4W.
R31	B19/5RZAA01576	Carbon film: 10 ohms ±5%, 300VDCW, 1/4W.
R32	B19/5RZAA01618	Carbon film: 47K ohms ±5%, 300VDCW, 1/4W.
R33	B19/5RZAC00585	Metal film: 390 ohms ±5%, 200VDCW, 1/8W (Used in CAR-256 AR, BR and CR).
R34 and R35	B19/5RZAC00412	Metal film: 4.7 ohms, 1W. (Used in CAR-256 AR).
R34 and R35	B19/5RZAC00588	Metal film: 1.5 ohms, 1W. (Used in CAR-256 BR and CR).
R36	B19/5RZAC00590	Metal film: 0 ohm 1/8W.
RV1	B19/5RVAA00077	Variable: 5K ohms ±30%, 0.1W.
RV2	B19/5RVAA00053	Variable: 10K ohms ±30%, 0.1W.
TR1	B19/5TCAA00006	Silicon, NPN: Power Amplifier, 60W (520MHz, 12.5V) sim to Mitsubishi 2SC3102.
TR2 and TR3	B19/5TCAA00006	Silicon, NPN: Power Amplifier, 60W (520MHz, 12.5V) sim to Mitsubishi 2SC3102 (Used in CAR-256 AR, BR and CR).
TR4	B19/5TBAA00054	Silicon, NPN: sim to NEC 2SD596-T1.
TR5	B19/5TAAB00401	Silicon, PNP: sim to Matsushita 2SB953A.
TR6	B19/5TBAA00054	Silicon, NPN: sim to NEC 2SD596-T1 (Used in CAR-256 AR, BR and CR).
TR7	B19/5TBAA00054	Silicon, NPN: sim to NEC 2SD596-T1.
TR8	B19/5TBAA00053	Silicon, NPN: sim to NEC 2SD636-T1.
TR9	B19/5TBAA00012	Silicon, NPN: sim to Matsushita 2SD1276A.
W1	B19/6LAFB01250	Wire.
W2	B19/6LAFB01250	Wire.
W3	B19/6LAFB01300	Wire.
W4	B19/6LAFB01301	Wire. (Used in CAR-256 AR, BR and CR).
W5	B19/5BCPB00005	Co-axial cable (Used in CAR-256 AR, BR and CR).
	B19/CAR-256A B19/CAR-256B B19/CAR-256C	ASSEMBLY BOARD
		——— CAPACITORS ———
C1R1 and C1R2	B19/5CAA00070	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.

SYMBOL	CE PART NO.	DESCRIPTION
C103	B19/5CAAB00093	Ceramic: 27pF ±0.5pF, 50VDCW, temp coef +350 -1000ppm. (Used in CAP-256A).
C102	B19/5CAAB00060	Ceramic: 22pF ±5%, 50VDCW, temp coef ±60ppm. (Used in CAP-256B).
C103	B19/5CAAB00060	Ceramic: 10pF ±5%, 50VDCW, temp coef ±60ppm. (Used in CAP-256C).
C104	B19/5CAAB00070	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C105	B19/5CAAB00088	Ceramic: 18pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CAP-256A).
C106	B19/5CAAB00707	Ceramic: 15pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CAP-256B).
C105	B19/5CAAB00706	Ceramic: 12pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CAP-256C).
C107	B19/5CAAB00060	Ceramic: 22pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CAP-256A).
C107	B19/5CAAB00060	Ceramic: 18pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CAP-256B).
C107	B19/5CAAB00705	Ceramic: 10pF ±0.5pF 50VDCW, temp coef 0±60ppm. (Used in CAP-256C).
C108	B19/5CAAB00707	Ceramic: 100pF ±5%, 50VDCW, temp coef 0 ±60ppm.
C110	B19/5CAAB00070	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C111	B19/5CAAB00709	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0 ±60ppm. (Used in CAP-256A).
C112	B19/5CAAB00700	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
C113	B19/5CAAB00064	Ceramic: 47pF ±5%, 50VDCW, temp coef 0±60ppm.
C114	B19/5CAAB00070	Ceramic: 1000pF ±10%, 50VDCW, temp coef 0±60ppm.
C115	B19/5CAAB00700	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
C116	B19/5CAAB00070	Ceramic: 1000pF ±10%, 50VDCW, temp coef 0±60ppm.
C117	B19/5CAAB00707	Ceramic: 15pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CAP-256 A).
C170	B19/5CAAB00705	Ceramic: 12pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CAP-256 B and C).
C112	B19/5CAAB00070	Ceramic: 1000pF ±10%, 50VDCW, temp coef 0±60ppm.
C113	B19/5CAAB00709	Ceramic: 2pF ±0.5pF, 50VDCW, temp coef 0±60ppm.
C114	B19/5CAAB00709	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CAP-256 A).
C115	B19/5CAAB00709	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CAP-256 B and C).

SYMBOL	GE PART NO.	DESCRIPTION
C125	819/5CAAD00780	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
C127	819/5CAAB00799	Ceramic: 6pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CAF-256 A and B).
C127	819/5CAAB00798	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CAF-256 C).
C129	819/5CAAB00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C130	819/5CEAA01045	Electrolytic: 10uF ±20%, 25VDCW.
C131	819/5CSAC00323	Tantalum: 10uF ±20%, 35VDCW.
C133	819/5CBAB01611	Ceramic: 0.1uF +80%, -20%, 50VDCW, temp coef +30 -80%.
C142	819/5CAAD00792	Ceramic: 2200pF ±5%, 50VDCW, temp coef +350 -1000ppm. (Used in CAF-256 A and B).
C144	819/5CAAB00780	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
		——— DIODE ———
CR101	819/5TKAD00291	Silicon, fast recovery (2 diodes in series): sim to Toshiba 1SS184.
		——— FILTERS ———
FL101	819/5MLAT00016	RF B.P.F.: Pass band 403-440 MHz. (Used in CAF-256A).
FL101	819/5MLAT00023	RF B.P.F.: Pass band 440-470 MHz. (Used in CAF-256B).
FL101	819/5MLAT00024	RF B.P.F.: Pass band 470-512MHz. (Used in CAF-256C).
FL102	819/5MLAT00022	RF B.P.F.: Pass band 403-440MHz. (Used in CAF-256A).
FL102	819/5MLAT00023	RF B.P.F.: Pass band 440-470MHz. (Used in CAF-256B).
FL102	819/5MLAT00024	RF B.P.F.: Pass band 470-512MHz. (Used in CAF-256C).
FL103	819/5MLAT00022	RF B.P.F.: Pass band 403-440MHz. (Used in CAF-256A).
FL103	819/5MLAT00023	RF B.P.F.: Pass band 440-470MHz. (Used in CAF-256B).
FL103	819/5MLAT00024	RF B.P.F.: Pass band 470-512MHz. (Used in CAF-256C).
		——— INTEGRATED CIRCUITS ———
IC101	819/5MAA80021	Linear, Positive Voltage Regulator: sim to Matsushita AN6541.
		——— CONNECTORS ———
J101 and J102	819/5JMCL00845	Connector, RF.
J104	819/5JM000176	Connector, 6 pin.

SYMBOL	GE PART NO.	DESCRIPTION
		——— COILS ———
L101	819/6LAFB01263	Coil, RF.
L102	819/6LAFB01264	Coil, RF.
L103	819/6LAFB01265	Coil, RF.
L105 thru L108	819/6LAFB01265	Coil, RF.
L109 and L110	819/6LAFB01264	Coil, RF.
L111	819/6LAFB01265	Coil, RF.
		——— RESISTORS ———
R101	819/5REAC00419	Metal film: 22 ohms ±5%, 200VDCW, 1/8W.
R102 and R103	819/5REAC00422	Metal film: 270ohms ±5%, 200VDCW, 1/8W.
R104	819/5REAC00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.
R105 and R106	819/5REAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R107	819/5REAC00579	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R110	819/5REAC00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.
R111	819/5REAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R112	819/5REAC00622	Metal film: 270ohms ±5%, 200VDCW, 1/8W.
R113	819/5REAC00597	Metal film: 330ohms ±5%, 200VDCW, 1/8W.
R114 and R116	819/5REAC00590	Metal film: 0 ohms, 1/8W.
R120	819/5REAC00623	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R121	819/5REAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R122	819/5REAC00621	Metal film: 68 ohms ±5%, 200VDCW, 1/8W.
R123	819/5REAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R124	819/5REAC00623	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R125	819/5REAC00622	Metal film: 270ohms ±5%, 200VDCW, 1/8W.
R126	819/5REAC00619	Metal film: 22ohms ±5%, 200VDCW, 1/8W.
R127	819/5REAC00596	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
R130	819/5REAC00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R131	819/5REAA00094	Metal film: 220ohms ±5%, 200VDCW, 1/8W.
R132	819/5REAC00615	Metal film: 4.7ohms ±5%, 200VDCW, 1/8W.
R133	819/5REAA00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R140	819/5REAA00582	Metal film: 1.8K ohms ±5%, 200VDCW, 1/8W.
R141	819/5REAC00636	Metal film: 820 ohms ±5%, 200VDCW, 1/8W.
R142	819/5REAC00595	Metal film: 5.6 ohms ±10%, 200VDCW, 1/8W.
R143	819/5REAC00636	Metal film: 820 ohms ±5%, 200VDCW, 1/8W.
R145	819/5REAA00573	Metal film: 4.7K ohms ±5% 200VDCW, 1/8W.
R146	819/5REAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W. (Used in CAF-256 A and B).
R147	819/5REAC00619	Metal film: 22 ohms ±5%, 200VDCW, 1/8W.
R148	819/5REAC00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
TR101	819/5TKCA00045	Silicon, NPN: sim to NEC 2SC2759.
TR102	819/5TKCA00208	Silicon, NPN: sim to NEC 2SC3356.
TR103	819/5TKCA00287	Silicon, NPN: sim to Toshiba 2SC3357.
TR104	819/5TKCA00287	Silicon, NPN: sim to Toshiba 2SC3357.
TR105	819/5TKCA00282	Silicon, NPN: sim to NEC 2SC2762.
TR106	819/5TKAA00093	Silicon, PNP: sim to Toshiba 2SA1020-Y.

SYNTHESIZER BOARD

819VCHD-132A: 403-440MHz
819VCHD-132B: 440-470MHz
819VCHD-132C: 470-512MHz

		——— CAPACITORS ———
C201	819/5CEAA01131	Ceramic: 0.047uF ±10%, 25VDCW, temp coef ±15%.
C202	819/5CAAB00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±15%.
C203	819/5CEAA02119	Electrolytic: 220uF ±20%, 10VDCW.
C204 and C205	819/5CEAA00820	Electrolytic: 10uF ±20%, 16VDCW.
C206	819/5CEAB01131	Ceramic: 0.047uF ±10%, 25VDCW, temp coef ±15%.
C207	819/5CEAC00471	Polypropylene: 1uF ±5%, 200VDCW.
C208	819/5CEAB01131	Ceramic: 0.047uF ±10%, 25VDCW, temp coef ±15%.
C209	819/5CEAA00680	Polypropylene: 0.1uF ±5%, 50VDCW.
C210 and C211	819/5CAAB00800	Ceramic: 100pF ±5%, 50VDCW, temp coef +350 -1000ppm.

SYMBOL	GE PART NO.	DESCRIPTION
C212	819/5CAAB01131	Ceramic: 0.047uF ±10%, 25VDCW, temp coef ±15%.
C213	819/5CAAB00880	Ceramic: 5pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132A, C).
C213	819/5CAAB00977	Ceramic: 7pF ±0.5pF, 50VDCW, temp coef 0±60 ppm (Used in CHC-132B).
C214 thru C217	819/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C219	819/5CAAB00870	Ceramic: 150pF ±5%, 50VDCW, temp coef 0±60ppm.
C220	819/5CAAB00870	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C221	819/5CAAB00869	Ceramic: 22pF ±5%, 50VDCW, temp coef 0±60ppm (Used in CHC-132A).
C221	819/5CAAB00796	Ceramic: 33pF ±5%, 50VDCW, temp coef ±60ppm. (Used in CHC-132B).
C221	819/5CAAB00793	Ceramic: 27pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CHC-132C).
C222	819/5CAAB00795	Ceramic: 27pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CHC-132A).
C222	819/5CAAB01298	Ceramic: 18pF ±5%, 50VDCW, temp coef -750 +120ppm. (Used in CHC-132B,C).
C223	819/5CAAB00864	Ceramic: 12pF ±5%, 50VDCW, temp coef 0±60ppm. (Used in CHC-132A).
C223	819/5CAAB00785	Ceramic: 18pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132B).
C223	819/5CAAB00822	Ceramic: 8pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132C).
C224	819/5CAAB00798	Ceramic: 8pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132A).
C224	819/5CAAB00799	Ceramic: 8pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132B).
C224	819/5CAAB01795	Ceramic: 8pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132C).
C225	819/5CAAB00882	Ceramic: 470pF ±20%, 50VDCW, temp coef ±20%.
C226	819/5CAAB00897	Ceramic: 8pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132A).
C226	819/5CAAB00798	Ceramic: 8pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132B, C).
C227	819/5CAAB00798	Ceramic: 8pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132A, C).
C227	819/5CAAB00799	Ceramic: 8pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used in CHC-132B).

SYMBOL	GE PART NO.	DESCRIPTION
C228	819/5CAAD00783	Ceramic: 4700pF ±10%, 50VDCW, temp coef ±10%.
C230	819/5CAAD01303	Ceramic: 27pF ±5%, 50VDCW, temp coef -750 ±120ppm.
C231 and C232	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C233	819/5CAAD01303	Ceramic: 27pF ±5%, 50VDCW, temp coef -750 ±120 ppm. (Used in CMG-132A, B).
C233	819/5CAAD01306	Ceramic: 22pF ±5%, 50VDCW, temp coef -750 ±120ppm. (Used in CMG-132C).
C234	819/5CAAD01306	Ceramic: 22pF ±5%, 50VDCW, temp coef -750 ±120 ppm (Used in CMG-132A, B)
C234	819/5CAAD01298	Ceramic: 18pF ±5%, 50VDCW, temp coef -750 ±120ppm (Used in CMG-132C).
C235	819/5CAAD00796	Ceramic: 3pF±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A)
C235	819/5CAAD00800	Ceramic: 5pF ±0.25pF, 50VDCW, temp coef 0±60ppm (Used In CMG-132B).
C235	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm (Used In CMG-132C).
C236 and C237	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C238	819/5CAAD00869	Ceramic: 22pF ±5%, 50VDCW, temp coef 0±60ppm.
C239 thru C244	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C245	819/5CAAD00787	Ceramic: 15pF ±5%, 50VDCW, temp coef 0±60ppm.
C246	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C248	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C249	819/5CAAD00868	Ceramic: 18pF ±5%, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C249	819/5CAAD00869	Ceramic: 22pF ±5%, 50VDCW, temp Coef 0±60ppm. (Used In CMG-132B, C).
C250	819/5CAAD01306	Ceramic: 22pF ±5%, 50VDCW, temp coef -750 ±120ppm. (Used in CMG-132A).
C250	819/5CAAD01299	Ceramic: 15pF ±5%, 50VDCW, temp coef -750 ±120ppm. (Used in CMG-132B).
C250	819/5CAAD01298	Ceramic: 18pF ±5%, 50VDCW, temp coef -750 ±120ppm. (Used in CMG-132C).
C251	819/5CAAD00800	Ceramic: 5pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).

SYMBOL	GE PART NO.	DESCRIPTION
C251	819/5CAAD00822	Ceramic: 8pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B).
C251	819/5CAAD00785	Ceramic: 10pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132C).
C252	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C252	819/5CAAD00977	Ceramic: 7pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B).
C252	819/5CAAD00822	Ceramic: 8pF ±0.5pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132C).
C253	819/5CAAD00783	Ceramic: 4700pF ±10%, 50VDCW, temp coef ±10%.
C254	819/5CAAD00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C254	819/5CAAD00810	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B).
C254	819/5CAAD00800	Ceramic: 5pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132C).
C255	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C255	819/5CAAD00798	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B).
C255	819/5CAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132C).
C256	819/5CAAD00783	Ceramic: 4700pF ±10%, 50VDCW, temp coef ±10%.
C257 thru C260	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C262	819/5CAAD01291	Ceramic: 33pF ±5%, 50VDCW, temp coef -750 ±120ppm.
C263 and C264	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 - 1000ppm.
C265	819/5CAAD01306	Ceramic: 22pF ±5%, 50VDCW, temp coef -750 ±120ppm.
C266	819/5CAAD01298	Ceramic: 18pF ±5%, 50VDCW, temp coef -750 ±120ppm.
C267	819/5CAAD00800	Ceramic: 5pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C268	819/5CAAD01131	Ceramic: 0.047µF ±10%, 25VDCW, temp coef ±10%.
C269 and C270	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C271	819/5CAAD00869	Ceramic: 22pF ±5%, 50VDCW, temp coef 0±60ppm.

SYMBOL	GE PART NO.	DESCRIPTION
C272	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C273	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C274	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C276	819/5CBAA01982	Electrolytic: 47µF ±20%, 16VDCW.
C279	819/5CBAA01826	Electrolytic: 10µF ±20%, 16VDCW.
C280	819/5CBAA00576	Metallized Plastic: 0.1µF ±5%, 50VDCW.
C281 thru C283	819/5CBAA01827	Electrolytic: 100µF ±20%, 16VDCW.
C284 thru C286	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, coef +350 -1000ppm.
C287	819/5CAAD01131	Ceramic: 0.047µF ±10%, 25VDCW, temp coef ±10%.
C289	819/5CAAD00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C290	819/5CAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C290	819/5CAAD00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B).
C290	819/5CAAD00798	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132C).
C291	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A, C).
C291	819/5CAAD00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B).
C292	819/5CAAD00783	Ceramic: 4700pF ±20%, 50VDCW, temp coef ±10%.
C293	819/5CAAD00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A, C).
C293	819/5CAAD00798	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm (Used In CMG-132B).
C294	819/5CAAD00795	Ceramic: 1pF ±0.25pF, 50VDCW, temp coef 0±60ppm (Used In CMG-132A).
C294	819/5CAAD00798	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm (Used in CMG-132 B, C).
C295	819/5CAAD00783	Ceramic: 4700pF ±10%, 50VDCW, temp coef ±10%.
C296	819/5CAAD00787	Ceramic: 470pF ±5%, 50VDCW, temp coef 0±60ppm.
C298 and C299	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.

SYMBOL	GE PART NO.	DESCRIPTION
C2100 thru C2102	819/5CAAD00878	Ceramic: 1000pF ±10pF, 50VDCW, temp coef +350 -1000ppm.
C2103	819/5CAAD00864	Ceramic: 47pF ±5%, 50VDCW, temp coef 0±60ppm. (Used In CMG-132A).
C2103	819/5CAAD00794	Ceramic: 33pF ±5%, 50VDCW, temp coef 0±60ppm (Used in CMG-132B, C)
C2104	819/5CBAC00982	Tantalum: 1µF ±20%, 35VDCW.
C2105 thru C2107	819/5CAAD00780	Ceramic: 100pF ±5%, 50VDCW, temp coef 0±60ppm.
C2108	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C2109	819/5CAAD00793	Ceramic: 27pF ±5%, 50VDCW, temp coef 0±60ppm (Used in CMG-132A).
C2109	819/5CAAD00869	Ceramic: 22pF ±5%, 50VDCW, temp coef 0±60ppm. (Used In CMG-132B,C).
C2110	819/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C2111	819/5CBAA02248	Tantalum: 0.47µF ±20%, 16VDCW.
C2112	819/5CBAA02249	Tantalum: 1µF ±20%, 16VDCW.
CV201 and CV202	819/5CVAA00145	Variable: max 10pF.
		——— DIODES ———
CR201 thru CR203	819/5TXAB00320	Silicon, fast recovery (2 diodes in series): sim to Toshiba 1SS226.
CR204	819/5TXAB00356	Silicon, fast recovery (2 diodes with anode common): sim to Toshiba 1SS181.
CR205 thru CR208	819/5TXAB00170	Silicon, Variable Capacitance Diode: sim to Hitachi 1SV60.
CR209 and CR210	819/5TXAB00230	Silicon, fast recovery (switching): sim to Hitachi 1SS110.
CR211	819/5TXAA00326	Silicon (Schottky Barrier): sim to NEC 1SS97.
CR212 thru CR216	819/5TXAB00170	Silicon, Variable Capacitance Diode: sim to Hitachi 1SV60.
CR217 and CR218	819/5TXAB00230	Silicon, fast recovery (switching): sim to Hitachi 1SS130.
CR219	819/5TXAA00326	Silicon (Schottky Barrier): sim to NEC 1SS97.
CR220 and CR221	819/5TXAB00230	Silicon, fast recovery (switching): sim to Hitachi 1SS130.
CR224 and CR225	819/5TXAB00170	Silicon, Variable Capacitance Diode: sim to Hitachi 1SV60. (Used in CMG-132A)

SYMBOL	GE PART NO.	DESCRIPTION
CD227	B19/SVXAD00920	Silicon, fast recovery (2 diodes in series): sim to Toshiba 1SS226.
		——— FILTERS ———
FL201	B19/SWLAT00051	RF filter BPF 320-358 MHz (Used in CMC-132A).
FL201	B19/SWLAT00050	RF filter BPF 357-388MHz (Used in CMC-132B).
FL201	B19/SWLAT00014	RF filter BPF 384-430MHz (Used in CMC-132C).
FL202	B19/SWLAT00051	RF filter BPF 320-358MHz (Used in CMC-132A).
FL202	B19/SWLAT00050	RF filter BPF 357-388MHz (Used in CMC-132B).
FL202	B19/SWLAT00014	RF filter BPF 384-430MHz (Used in CMC-132C).
		——— INTEGRATED CIRCUIT ———
IC201	B19/SDAAJ00328	Synthesizer: CMOS serial input.
IC202	B19/SDDAT00206	Prescaler: sim to Fujitsu MB501P.
IC203	B19/SDAAM00016	Dual Comparator: sim to NJRC NJM2903D.
IC204 and IC205	B19/SDAAJ00359	Digital, Bilateral switch: sim to Motorola MC14066.
IC206	B19/SDAAR00021	Positive Voltage Regulator: sim to Matsushita AN6541.
		——— JACKS ———
J201 thru J204	B19/SZJTL00001	Crystal Socket.
J205	B19/SJWBS00173	Connector, 20 pins.
J206 and J207	B19/SJWCL00045	Connector, RF.
J208	B19/SJWBP00174	Connector, 6 pins.
		——— COILS ———
L201	B19/SLAAC00052	Coil, RF.
L202	B19/SLCAC00174	Choke coil: 0.68 uH ±10% (Used in CMC-132A).
L202	B19/SLCAB00012	Choke coil: 1uH ±10%. (Used in CMC-132B).
L202	B19/SLCAC00174	Choke coil: 0.47 uH ±10% (Used in CMC-132C).
L203	B19/SLCAC00174	Choke coil: 0.68 uH ±10% (Used in CMC-132A).
L203	B19/SLCAB00012	Choke coil: 1 uH ±10% (Used in CMC-132B).
L203	B19/SLCAC00176	Choke coil: 0.47 uH ±10% (Used in CMC-132C).

SYMBOL	GE PART NO.	DESCRIPTION
L204 and L205	B19/SLCAC00174	Choke coil: 0.68uH ±10%
L206 and L207	B19/SLCAC00156	Choke coil: 1.5uH ±10% (Used in CMC-132A, B).
L206 and L207	B19/SLCAC00174	Choke coil: 0.68uH ±10% (Used in CMC-132C).
L208	B19/SLAAC00065	Coil, RF (Used in CMC-132A).
L208	B19/SLAAC00047	Coil, RF (Used in CMC-132B, C).
L209	B19/SLCAC00156	Choke coil: 1.5uH ±10%. (Used in CMC-132A, B).
L209	B19/SLCAC00173	Choke coil: 1uH ±10%. (Used in CMC-132C).
L210	B19/SLCAB00012	Choke coil: 1uH ±10%
L211	B19/SLAAC00051	Coil, RF.
L212	B19/SLAAC00052	Coil, RF (Used in CMC-132A, B).
L212	B19/SLAAC00050	Coil, RF (Used in CMC-132C).
L213	B19/SLAAC00052	Coil, RF.
L214	B19/SLCAB00176	Choke coil: 0.47uH ±10%. (Used in CMC-132A)
L214	B19/SLCAB00012	Choke coil: 1uH ±10% (Used in CMC-132B)
L214	B19/SLCAC00247	Choke coil: 0.33uH ±10% (Used in CMC-132C)
L215	B19/SLCAC00176	Choke coil: 0.47uH ±10% (Used in CMC-132A)
L215	B19/SLCAB00012	Choke coil: 1uH ±10% (Used in CMC-132B)
L215	B19/SLCAC00247	Choke coil: 0.33uH ±10% (Used in CMC-132C)
L216	B19/SLCAC00176	Choke coil: 0.47uH ±10% (Used in CMC-132A, C)
L216	B19/SLCAC00174	Choke coil: 0.68uH ±10% (Used in CMC-132C).
L217	B19/SLCAC00176	Choke coil: 0.47uH ±10% (Used in CMC-132A, C).
L217	B19/SLCAC00174	Choke coil: 0.68uH ±10% (Used in CMC-132B).
L218	B19/SLCAC00176	Choke coil: 0.68uH ±10% (Used in CMC-132A, B)
L218	B19/SLCAC00176	Choke coil 0.47uH ±10% (Used in CMC-132C).
L219	B19/SLCAC00176	Choke coil 0.68uH ±10% (Used in CMC-132A, B).
L219	B19/SLCAC00176	Choke coil 0.47uH ±10% (Used in CMC-132C).
L220	B19/SLAAC00067	Coil, RF (Used in CMC-132A).
L220	B19/SLAAC00049	Coil, RF (Used in CMC-132B).
L220	B19/SLAAC00063	Coil, RF (Used in CMC-132C).

SYMBOL	GE PART NO.	DESCRIPTION
L221	B19/SLCAC00173	Choke coil: 1.0 uH ±10% (Used in CMC-132A, B).
L221	B19/SLCAC00156	Choke coil: 1.5 uH ±10% (Used in CMC-132C).
L222	B19/SLCAB00012	Choke coil: 1uH ±10%.
L223	B19/SLAAC00051	Coil, RF.
L224	B19/SLCAC00156	Choke coil: 1.5uH ±10%. (Used in CMC-132A, B).
L224	B19/SLCAC00174	Choke coil: 0.68uH ±10% (Used in CMC-132C).
L225	B19/SLCAC00174	Choke coil: 0.68uH ±10%. (Used in CMC-132A, B)
L225	B19/SLCAC00176	Choke coil 0.47 uH ±10% (Used in CMC-132C)
L226	B19/SLAAC00052	Coil, RF.
		——— RESISTORS ———
R201	B19/SRMAC00576	Metal film: 10K ohms ±5%, 200PPMCM, 1/8W.
R202	B19/SRMAC00619	Metal film: 22 ohms ±5%, 200PPMCM, 1/8W.
R203	B19/SRMAC00594	Metal film: 220 ohms ±5%, 200PPMCM, 1/8W.
R204	B19/SRMAC00576	Metal film: 10K ohms ±5%, 200PPMCM, 1/8W.
R205 and R206	B19/SRMAC00573	Metal film: 4.7K ohms ±5%, 200PPMCM, 1/8W.
R207 and R208	B19/SRMAC00619	Metal film: 22 ohms ±5%, 200PPMCM, 1/8W.
R209	B19/SRMAC00593	Metal film: 470K ohms ±5%, 200PPMCM, 1/8W.
R210	B19/SRMAC00596	Metal film: 15K ohms ±5%, 200PPMCM, 1/8W.
R211	B19/SRMAC00577	Metal film: 5.6K ohms ±5%, 200PPMCM, 1/8W.
R212	B19/SRMAC00595	Metal film: 2.2K ohms ±5%, 200PPMCM, 1/8W.
R213	B19/SRMAC00586	Metal film: 100 ohms ±5%, 200PPMCM, 1/8W.
R214	B19/SRMAC00597	Metal film: 330 ohms ±5%, 200PPMCM, 1/8W.
R215	B19/SRMAC00571	Metal film: 560 ohms ±5%, 200PPMCM, 1/8W.
R216	B19/SRMAC00571	Metal film: 560 ohms ±5%, 200PPMCM, 1/8W.
R217	B19/SRMAC00617	Metal film: 330 ohms ±5%, 200PPMCM, 1/8W. (Used in CMC-132A.)
R218	B19/SRMAC00571	Metal film: 560 ohms ±5%, 200PPMCM, 1/8W.
R219	B19/SRMAC00596	Metal film: 15K ohms ±5%, 200PPMCM, 1/8W.
R220	B19/SRMAC00577	Metal film: 5.6K ohms ±5%, 200PPMCM, 1/8W.
R221	B19/SRMAC00577	Metal film: 5.6K ohms ±5%, 200PPMCM, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R222	B19/SRMAC00631	Metal film: 220K ohms ±5%, 200PPMCM, 1/8W.
R223	B19/SRMAC00592	Metal film: 33K ohms ±5%, 200PPMCM, 1/8W.
R224	B19/SRMAC00596	Metal film: 15K ohms ±5%, 200PPMCM, 1/8W. (Used in CMC-132A).
R224	B19/SRMAC00573	Metal film: 4.7K ohms ±5%, 200PPMCM, 1/8W. (Used in CMC-132B).
R224	B19/SRMAC00576	Metal film: 10K ohms ±5%, 200PPMCM, 1/8W. (Used in CMC-132C).
R225	B19/SRMAC00581	Metal film: 82K ohms ±5%, 200PPMCM, 1/8W.
R226	B19/SRMAC00574	Metal film: 5.6K ohms ±5%, 200PPMCM, 1/8W.
R227	B19/SRMAC00581	Metal film: 82K ohms ±5%, 200PPMCM, 1/8W.
R228	B19/SRMAC00587	Metal film: 100K ohms ±5%, 200PPMCM, 1/8W.
R229 and R230	B19/SRMAC00576	Metal film: 10K ohms ±5%, 200PPMCM, 1/8W.
R231	B19/SRMAC00572	Metal film: 3K ohms ±5%, 200PPMCM, 1/8W.
R232	B19/SRMAC00576	Metal film: 10K ohms ±5%, 200PPMCM, 1/8W.
R233	B19/SRMAC00572	Metal film: 3K ohms ±5%, 200PPMCM, 1/8W.
R234	B19/SRMAC00576	Metal film: 10K ohms ±5%, 200PPMCM, 1/8W.
R235	B19/SRMAC00596	Metal film: 15K ohms ±5%, 200PPMCM, 1/8W.
R236	B19/SRMAC00572	Metal film: 3K ohms ±5%, 200PPMCM, 1/8W.
R238	B19/SRMAC00621	Metal film: 68 ohms ±5%, 200PPMCM, 1/8W.
R239	B19/SRMAC00605	Metal film: 3.6K ohms ±5%, 200PPMCM, 1/8W.
R240	B19/SRMAC00574	Metal film: 5.6K ohms ±5%, 200PPMCM, 1/8W.
R241 and R242	B19/SRMAC00603	Metal film: 150 ohms ±5%, 200PPMCM, 1/8W.
R243	B19/SRMAC00620	Metal film: 39 ohms ±5%, 200PPMCM, 1/8W.
R244	B19/SRMAC00603	Metal film: 150 ohms ±5%, 200PPMCM, 1/8W.
R245	B19/SRMAC00623	Metal film: 2.7K ohms ±5%, 200PPMCM, 1/8W.
R246	B19/SRMAC00618	Metal film: 100K ohms ±5%, 200PPMCM, 1/8W.
R247	B19/SRMAC00579	Metal film: 6.8K ohms ±5%, 200PPMCM, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R248 and R249	B19/5REAG00575	Metal film: 2.2K ohms ±5%, 200VDCW, 1/8W.
R250 and R251	B19/5REAG00594	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
R252	B19/5REAG00620	Metal film: 33 ohms ±5%, 200 VDCW, 1/8W.
R253	B19/5REAG00594	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
R254	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.
R255	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R260	B19/5REAG00596	Metal film: 15K ohms ±5%, 200VDCW, 1/8W.
R262	B19/5REAG00621	Metal film: 68 ohms ±5%, 200VDCW, 1/8W.
R263	B19/5REAG00625	Metal film: 5.6K ohms ±5%, 200VDCW, 1/8W.
R264	B19/5REAG00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.
R265	B19/5REAG00583	Metal film: 150 ohms ±5%, 200VDCW, 1/8W.
R266	B19/5REAG00792	Metal film: 82 ohms ±5%, 200VDCW, 1/8W.
R267	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R268	B19/5REAG00792	Metal film: 82 ohms ±5%, 200VDCW, 1/8W.
R274	B19/5REAG00591	Metal film: 680 ohms ±5%, 200VDCW, 1/8W.
R275	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132A, B)
R275	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132C)
R276	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132A)
R276	B19/5REAG00577	Metal film: 6.8K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132B).
R276	B19/5REAG00573	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132C)
R277	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R278	B19/5REAG00596	Metal film: 15K ohms ±5%, 200VDCW, 1/8W.
R279	B19/5REAG00578	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R280	B19/5REAG00573	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R283	B19/5REAG00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R285 and R286	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R287	B19/5REAG00619	Metal film: 22 ohms ±5%, 200VDCW, 1/8W.
R288 and R289	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R293	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R294	B19/5REAG00618	Metal film: 15 ohms ±5%, 200VDCW, 1/8W.
R296	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132A)
R296	B19/5REAG00592	Metal film: 33 K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132B).
R296	B19/5REAG00596	Metal film: 15K ohms ±5%, 200VDCW, 1/8W. (Used in CMG-132C).
R297	B19/5REAG00597	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R298	B19/5RDAA01179	Carbon film: 47 ohms ±5%, 300VDCW, 1/4W. (Used in CMG-132A).
R2100	B19/5RDAA01179	Carbon film: 47 ohms ±5%, 300VDCW, 1/4W. (Used in CMG-132A).
R2102	B19/5REAG00594	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
RV201 and RV202	B19/5RVAB00279	Variable: 10K ohms ±30%, 0.1W.
		---------- TRANSISTORS ----------
TR201 and TR202	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624.
TR203 and TR204	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR205	B19/5TBAB00055	Silicon, PNP: sim to NEC 2SB624.
TR206 and TR207	B19/5TCAG00047	Silicon, NPN: sim to Matsushita 2SC3110.
TR208 and TR209	B19/5TCAZ00011	Silicon, NPN: sim to Sanyo 2SC3398.
TR210	B19/5TKAH00002	N-channel, field effect. (Junction Single Gate): sim to Sony 2SK125.
TR211	B19/5TCAG00047	Silicon, NPN: sim to Matsushita 2SC3110.
TR212 and TR213	B19/5TCAZ00011	Silicon, NPN: sim to Sanyo 2SC3398.
TR214 and TR215	B19/5TCAG00047	Silicon, NPN: sim to Matsushita 2SC3110.

SYMBOL	GE PART NO.	DESCRIPTION
TR216 thru TR219	B19/5TCAZ00011	Silicon, NPN: sim to Sanyo 2SC3398.
TR220	B19/5TKAN00002	N-channel, field effect (Junction Single Gate): sim to Sony 2SK125.
TR221	B19/5TCAG00047	Silicon, NPN: sim to Matsushita 2SC3110.
TR222	B19/5TCAZ00011	Silicon, NPN: sim to Sanyo 2SC3398.
TR224	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
TR227 thru TR230	B19/5TCAZ00011	Silicon, NPN: sim to Sanyo 2SC3398.
		---------- CRYSTALS ----------
XU201	B19/6XHFD00012	Reference Oscillator unit. (Standard 5ppm U)
XU701	B19/6XHFD00010	Reference Oscillator unit. (Option 2ppm U/800)
	B19/CNA-239A B19/CNA-239B B19/CNA-239C B19/CNA-239D B19/CNA-239E B19/CNA-239F B19/CNA-239G B19/CNA-239H	RECEIVER BOARD
		---------- CAPACITORS ----------
C401	B19/5CAAB00797	Ceramic: 470pF ±5%, 50VDCW, temp coef ±10%.
C402	B19/5CAAD00796	Ceramic: 3pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C403	B19/5CAAD00929	Ceramic: 68pF ±5%, 50VDCW, temp coef 0±60ppm.
C404 thru C407	B19/5CAAD00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C408	B19/5CEAA01816	Electrolytic: 47uF ±20%, 25VDCW.
C409	B19/5CAAD00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C410	B19/5CAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C411	B19/5CAAD00796	Ceramic: 33pF ±5%, 50VDCW, temp coef 0±60ppm.
C412 thru C414	B19/5CAAD00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C415	B19/5CAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C416	B19/5CAAD00796	Ceramic: 33pF ±5%, 50VDCW, temp coef 0±60ppm.
C417 thru C420	B19/5CAAD00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C421	B19/5CEAA01816	Electrolytic: 47uF ±20%, 25VDCW.
C422	B19/5CEAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C501	B19/5CAAD00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.

SYMBOL	GE PART NO.	DESCRIPTION
C503 and C504	B19/5CAAB00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C505	B19/5CAAD00798	Ceramic: 2pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C506	B19/5CAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW temp coef 0±60ppm.
C507	B19/5CAAD00977	Ceramic: 7pF ±0.5pF, 50VDCW, temp coef 0±60ppm.
C508	B19/5CAAD00800	Ceramic: 5pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C509	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C510 and C511	B19/5CAAD00801	Ceramic: 4pF ±0.25pF, 50VDCW, temp coef 0±60ppm.
C512	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C513	B19/5CAAD00787	Ceramic: 15pF ±5%, 50VDCW, temp coef 0±60ppm.
C514	B19/5CSAC00988	Tantalum: 0.72uF ±20%, 35VDCW.
C515	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C516	B19/5CSAC00988	Tantalum: 0.72uF ±20%, 35VDCW.
C517 and C518	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C519	B19/5CEAA01816	Electrolytic: 47uF ±20%, 25VDCW.
C520	B19/5CAAD00789	Ceramic: 0.01uF ±10%, 50VDCW, temp coef ±10%.
C521	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C522	B19/5CSAC00982	Tantalum: 1uF ±20%, 35VDCW.
C523 and C524	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C525	B19/5CSAC00950	Tantalum: 10uF ±20%, 25VDCW.
C526	B19/5CAAD00844	Ceramic: 47pF ±5%, 50VDCW, temp coef 0±60ppm.
C527 and C528	B19/5CSAC01068	Tantalum: 0.1uF ±20%, 35VDCW.
C530	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C531	B19/5CEAA01816	Electrolytic: 47uF ±20%, 25VDCW.
C532 and C533	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000 ppm.
C534	B19/5CEAA01816	Electrolytic: 47uF ±20%, 25VDCW.
C535	B19/5CEAA00789	Ceramic: 0.01 F ±10%, 50VDCW, temp coef ±10%.

SYMBOL	GE PART NO.	DESCRIPTION
		——— FILTERS ———
FLA01	B19/5WLAT00034	RF filter: BPF 403-423MHz (Used in CMA-239A).
FLA01	B19/5WLAT00035	RF filter: BPF 410-430MHz (Used in CMA-239B).
FLA01	B19/5WLAT00037	RF filter: BPF 420-440MHz (Used in CMA-239C).
FLA01	B19/5WLAT00049	RF filter: BPF 440-460MHz (Used in CMA-239D).
FLA01	B19/5WLAT00039	RF filter: BPF 450-470MHz (Used in CMA-239E).
FLA01	B19/5WLAT00040	RF filter: BPF 470-488MHz (Used in CMA-239F).
FLA01	B19/5WLAT00043	RF filter: BPF 482-500MHz (Used in CMA-239G).
FLA01	B19/5WLAT00053	RF filter: BPF 488-512MHz (Used in CMA-239H).
FLA02	B19/5DWBE00006	RF filter: BPF 403-423MHz (Used in CMA-239A).
FLA02	B19/5WLAT00036	RF filter: BPF 410-430MHz (Used in CMA-239B).
FLA02	B19/5WLAT00038	RF filter: BPF 420-440MHz (Used in CMA-239C).
FLA02	B19/5WLAT00046	RF filter: BPF 440-460MHz (Used in CMA-239D).
FLA02	B19/5WLAT00031	RF filter: BPF 450-470MHz (Used in CMA-239E).
FLA02	B19/5WLAT00041	RF filter: BPF 470-488MHz (Used in CMA-239F).
FLA02	B19/5WLAT00044	RF filter: BPF 482-500MHz (Used in CMA-239G).
FLA02	B19/5WLAT00054	RF filter: BPF 488-512MHz (Used in CMA-239H).
FLA03	B19/5WLAT00034	RF filter: BPF 403-423MHz (Used in CMA-239A).
FLA03	B19/5WLAT00035	RF filter: BPF 410-430MHz (Used in CMA-239B).
FLA03	B19/5WLAT00037	RF filter: BPF 420-440MHz (Used in CMA-239C).
FLA03	B19/5WLAT00049	RF filter: BPF 440-460MHz (Used in CMA-239D).
FLA03	B19/5WLAT00039	RF filter: BPF 450-470MHz (Used in CMA-239E).
FLA03	B19/5WLAT00040	RF filter: BPF 470-488MHz (Used in CMA-239F).
FLA03	B19/5WLAT00043	RF filter: BPF 482-500MHz (Used in CMA-239G).
FLA03	B19/5WLAT00053	RF filter: BPF 488-512MHz (Used in CMA-239H).
FLA04	B19/5DWBE00007	RF filter: BPF 320-358MHz (Used in CMA-239A, B and C).
FLA04	B19/5WLAT00032	RF filter: BPF 357-388MHz (Used in CMA-239D and E).

SYMBOL	GE PART NO.	DESCRIPTION
FLA04	B19/5WLAT00042	RF filter: BPF 384-430MHz (Used in CMA-239F, G and H).
FL501	B19/5XMAA00801	Crystal filter: 82.2MHz.
FL502	B19/5XMAA00803	Crystal filter: 82.2MHz
FL503	B19/5MRAA00094	Ceramic filter: 455kHz
FL504	B19/5MRAA00041	Ceramic filter: 455kHz.
		——— HYBRID CIRCUITS ———
MC401	B19/5DHAT00022	Double Balanced Mixer.
MC501	B19/6DHDD00188	Linear, 2'nd Mixer: sim to JRC DHDD188.
		——— INTEGRATED CIRCUITS ———
IC501	B19/5DDAS00074	Linear, IF Amplifier & Detector: sim to Motorola MC3359P.
IC502	B19/5DAAR00021	Linear, Positive Voltage Regulator: sim to Matsushita AN6541.
		——— CONNECTORS ———
J401 and J402	B19/5JWCL00045	Connector, RF.
J501	B19/5JWBS00178	Connector, 10pins.
J502	B19/5JWCL00047	Connector, RF.
		——— COILS ———
L402	B19/6LAFD01133	Coil, RF.
L403	B19/6LAFD01156	Coil, RF.
L404	B19/6LAFD01135	Coil, RF.
L405	B19/6LAFD01156	Coil, RF.
L406	B19/6LAFD01135	Coil, RF.
L501	B19/5LCAC00391	Choke coil: 0.1uH ±10%.
L502	B19/5LCAC00160	Choke coil: 3.3uH ±10%.
L504	B19/6LAFD01318	Coil, RF.
L505 thru L508	B19/6LADD00553	Coil, RF.
L509	B19/6LADD00554	Coil, RF.
L510	B19/5LCAC00165	Choke coil: 0.22uF ±20%.
L511	B19/6LAFD00877	Coil, RF.
		——— RESISTORS ———
R401	B19/5RDAC02154	Metal film: 5.6K ohms ±5%, 200VDCW, 1/8W.
R402	B19/5RDAC02132	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R403	B19/5RDAC02140	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R404	B19/5RDAC02141	Metal film: 10 ohms ±5%, 200VDCW, 1/8W.
R405	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R407	B19/5RDAC02380	Metal film: 0 ohms
R409	B19/5RDAC02140	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R410	B19/5RDAC02146	Metal film: 18 ohms ±5%, 200VDCW, 1/8W.
R411	B19/5RDAC02140	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R412	B19/5RADAC02154	Metal film: 5.6K ohms ±5%, 200VDCW, 1/8W.
R413	B19/5RADAC02132	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R414	B19/5RDAC02153	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R415	B19/5RADAC02141	Metal film: 10 ohms ±5%, 200VDCW, 1/8W.
R416	B19/5RADAC02137	Metal film: 100 ohms ±5%, 200VDCW 1/8W.
R417	B19/5RDAC02140	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R418	B19/5RDAC02146	Metal film: 18 ohms ±5%, 200VDCW, 1/8W.
R419	B19/5RDAC02140	Metal film: 330 ohms ±5%, 200VDCW, 1/8W.
R420	B19/5RDAC02154	Metal film: 5.6K ohms ±5%, 200VDCW, 1/8W.
R421	B19/5RDAC02132	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R422	B19/5RDAC02153	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R423	B19/5RDAC02141	Metal film: 10 ohms ±5%, 200VDCW, 1/8W.
R424	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R425	B19/5RDAC02257	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R426	B19/5RDAC02141	Metal film: 10 ohms ±5%, 200VDCW, 1/8W.
R427	B19/5RDAC02257	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R429 and R435	B19/5RDAC02380	Metal film: 0 ohms
R501	B19/5RDAC02135	Metal film: 150 ohms ±5%, 200VDCW, 1/8W.
R502	B19/5RDAC02128	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R504	B19/5RDAC02158	Metal film: 8.2K ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R505	B19/5RDAC02129	Metal film: 150K ohms ±5%, 200VDCW, 1/8W.
R506	B19/5RDAC02127	Metal film: 68 ohms ±5%, 200VDCW, 1/8W.
R507 and R508	B19/5RADAC02158	Metal film: 8.2K ohms ±5%, 200VDCW, 1/8W.
R509	B19/5RDAC02124	Metal film: 2.2K ohms ±5%, 200VDCW, 1/8W.
R510	B19/5RDAC02133	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.
R511	B19/5RDAC02124	Metal film: 2.2K ohms ±5%, 200VDCW, 1/8W.
R512	B19/5RDAC02125	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R513	B19/5RDAC02159	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
R514	B19/5RDAC02147	Metal film: 3.3K ohms ±5%, 200VDCW, 1/8W.
R515	B19/5RDAC02152	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R516	B19/5RDAC02153	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R517	B19/5RDAC02134	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R518 and R519	B19/5RDAC02152	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R520	B19/5RDAC02159	Metal film: 220 ohms ±5%, 200VDCW, 1/8W.
R521	B19/5RDAC02137	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
RV501	B19/5WVAB00275	Variable: max 2K ohms.
		——— TRANSISTORS ———
TR401 thru TR403	B19/5TCAB00287	Silicon, NPN: sim to NEC 2SC3357
TR501 and TR502	B19/5TKAG00007	N-channel, field effect: sim to Silicon U310.
TR503	B19/5TCAB00238	Silicon, NPN: sim to NEC 2SC2223.
TR504	B19/5TDAB00054	Silicon, NPN: sim to NEC 2SD596.
		——— CRYSTAL ———
X501	B19/5XMAA00802	Quartz crystal: 82.65MHz
		——— CRYSTAL SOCKETS ———
XS501-A and XS501-B	B19/5ZJDP00301	Crystal Socket.

SYMBOL	GE PART NO.	DESCRIPTION
	B19/CHC38JC	SYSTEM CONTROL BOARD
		---------- CAPACITORS ----------
C601	B19/5CAAB01737	Ceramic: 0.1 uF ±10%, 2VDCW, temp coef ±15%.
C602	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16VDCW.
C603	B19/5CRAA00585	Polyester: 1000pF ±5%, 50VDCW.
C604	B19/5CSAC01069	Tantalum: 2.7uF ±20%, 35VDCW.
C605	B19/5CAAD01237	Ceramic: 0.1uF ±10%, 25VDCW, temp coef ±15%.
C606 and C607	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16VDCW.
C608	B19/5CEAA01982	Electrolytic: 47 uF ±20%, 16VDCW.
C609 and C610	B19/5CEAA01827	Electrolytic: 100 uF ±20%, 16VDCW.
C611	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C613 and C614	B19/5CRAA00576	Polyester: 0.1 uF ±5%, 50VDCW.
C615	B19/5CSAC01065	Tantalum: 0.47 uF ±20%, 35VDCW.
C616	B19/5CAAD00797	Ceramic: 47pF ±5%, 50VDCW, temp coef 0±60ppm.
C617	B19/5CRAA00597	Polyester: 0.068 uF ±5%, 50VDCW.
C624	B19/5CSAC00982	Tantalum: 1 uF ±20%, 35VDCW.
C625	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16VDCW.
C626 and C627	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C633	B19/5CSAC00912	Tantalum: 10 uF ±20%, 35VDCW.
C634	B19/5CEAA01816	Electrolytic: 47 uF ±20%, 25VDCW.
C635 and C636	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C637	B19/5CEAA01816	Electrolytic: 47 uF ±20%, 25VDCW.
C640	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C641	B19/5CEAA01816	Electrolytic: 47 uF ±20%, 25VDCW.
C642	B19/5CAAD01737	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C644	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16VDCW.
C645	B19/5CEAA01982	Electrolytic: 47 uF ±20%, 16VDCW.
C646	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50VDCW, temp coef ±10%.
C647	B19/5CEAA01982	Electrolytic: 47 uF ±20%, 16VDCW.

SYMBOL	GE PART NO.	DESCRIPTION
C649	B19/5SCRAA00617	Polyester: 0.1 uF ±5%, 50VDCW.
C650	B19/5CSAC00912	Tantalum: 10 uF ±20%, 35VDCW.
C651	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50VDCW, temp coef ±10%.
C652	B19/5CRAA00585	Polyester: 1000pF ±5%, 50VDCW.
C653 and C654	B19/5CSAC00939	Tantalum: 22 uF ±20%, 16VDCW.
C655	B19/5CRAA00576	Polyester: 0.1 uF ±5%, 50VDCW.
C656	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50VDCW, temp coef ±10%.
C657	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C658	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C701	B19/5CSAC00982	Tantalum: 1 uF ±20%, 35VDCW.
C702 and C703	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C704	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50VDCW, temp coef ±10%.
C705	B19/5CAAD00878	Ceramic: 1000pF ±10%, 50VDCW, temp coef +350 -1000ppm.
C706	B19/5CRAA00597	Polyester: 0.068 uF ±5%, 50VDCW.
C707	B19/5CEAA01320	Electrolytic. 220 uF ±20%, 25VDCW.
C708	B19/5CAAD00783	Ceramic: 4700pF ±10%, 50VDCW, temp coef ±10%.
C709	B19/5CRAA00597	Polyester: 0.068 uF ±5%, 50VDCW.
C710	B19/5CAAD00785	Ceramic: 10pF ±5%, 50VDCW, temp coef 0±60ppm.
C711	B19/5CAAD00787	Ceramic: 15pF ±5%, 50VDCW, temp coef 0±60ppm.
C712	B19/5CAAD01204	Ceramic: 0.047 uF ±10%, 25VDCW, temp coef ±15%.
C713	B19/5CSAC01065	Tantalum: 0.47 uF ±20%, 35VDCW.
C714 thru C729	B19/5CAAD00782	Ceramic: 1000pF ±5%, 50VDCW, temp coef 0±60ppm.
C730	B19/5CSAC00982	Tantalum: 1 uF ±20%, 35VDCW.
C731 and C733	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50VDCW, temp coef ±10%.
C734	B19/5CAAD00782	Ceramic: 1000pF ±5%, 50VDCW, temp coef 0 ±60ppm.
C735	B19/5CAAD00782	Ceramic: 1000pF ±5%, 50VDCW, temp coef 0±60ppm.
C736	B19/5CAAD01201	Ceramic: 0.068 uF ±10%, 25VDCW, temp coef ±15%.
C737 and C739	B19/5CAAD01237	Ceramic: 0.1 uF ±10%, 25VDCW, temp coef ±15%.
C740 and C741	B19/5CAAD00789	Ceramic: 0.01 uF ±10%, 50VDCW, temp coef 0 ±30ppm.
C742 and C753	B19/5CAAD00834	Ceramic: 47pF ±5%, 50VDCW, temp coef ±0.5%.
C756	B19/5CAAD01237	Ceramic: 0.1uF ±10%, 25VDCW,

SYMBOL	GE PART NO.	DESCRIPTION
		---------- DIODES ----------
CD601 thru CD603	B19/5TXAD00320	Silicon, fast recovery (2 diodes in series); sim to Toshiba 1SS226.
CD604 and CD605	B19/5TXAD00290	Silicon, fast recovery (2 diodes in cathode common); sim to Toshiba 1SS184.
CD606	B19/5TXAD00320	Silicon, fast recovery (2 diodes in series); sim to Toshiba 1SS226.
CD607	B19/5TXAD00290	Silicon, fast recovery (2 diodes in cathode common); sim to Toshiba 1SS184.
CD608	B19/5TXAD00290	Silicon, fast recovery (2 diode in cathode common, sim to Toshiba 1SS184.
CD701	B19/5TXAD00320	Silicon, fast recovery (2 diodes in series); sim to Toshiba 1SS226.
CD702	B19/5TXAE00257	Zener: 500mW, 6.5V, sim to Hitachi HZ7A2.
CD703	B19/5TXAE00199	Zener: 500mW, 3.8V, sim to Hitachi HZ4B1.
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 and CD709	B19/5TXAD00290	Silicon, fast recovery (2 diodes in cathode common); sim to Toshiba 1SS184.
CD710	B19/5TZAD00020	Diode, optoelectronic: red; sim to Toshiba TLR 102A.
CD711	B19/5TXAD00290	Silicon, fast recovery (2 diodes in cathode common); sim to Toshiba 1SS184.
		--------- HYBRID CIRCUITS ---------
HC601	B19/6DWFD00160	Squelch; sim to JRC DWFD160.
HC602	B19/6DWFD00165	Switch, sim to JRC DWFD165.
HC603	B19/6DWFD00164	Filter; sim to JRC DWFD164.
HC604	B19/6DWFD00167	Filter; sim to MURATA DWFD167.
HC605	B19/6DWFD00168	Filter; sim to MURATA DWFD168.
HC606	B19/6DWFD00169	Filter; sim to MURATA DWFD169.
		------- INTEGRATED CIRCUITS -------
IC601	B19/5DAAJ00359	Digital, Bilateral switch; sim to Motorola MC14066.
IC602	B19/5DAAA00233	Linear, Audio Amplifier; sim to NEC PL1230H2.
IC603 and IC604	B19/5DAAN00004	Linear, Quad OP AMP, sim to NJRC NJM2902N.
IC605	B19/5DAAD00082	Linear, Positive Voltage Regulator; sim to Toshiba TA78005AP.
IC606	B19/5DAAR00021	Linear, Positive Voltage Regulator; sim to Matsushita AN6541.
IC607	B19/5DAAP00027	Linear, Dual OP AMP; sim to 455M type.

SYMBOL	GE PART NO.	DESCRIPTION
IC608 and IC609	B19/5DAAJ00359	Digital, Bilateral Switch, sim to Motorola MC14066.
IC610	B19/5DAAL00733	Linear, Voltage Detector, Sim to TI TL7700.
IC701	B19/5DAAB00140	Linear, Timer; sim to Mitsubishi M51847P
IC702	B19/6BLFD00002	Macrocomputer: M-6BLFD00002
IC703	B19/5DAAJ00358	Digital, Hex Non-inverting 3-state Buffer; sim to Motorola MC14503.
IC704	B19/5DAAF00216	Digital, Hex Inverter Buffer/Driver; sim to Hitachi HD7416
IC705	B19/5DDAB00209	Digital, Dual D-type Flip Flop; sim to Mitsubishi M4011.
IC706	B19/5DDWY00026	Digital, EEPROM; sim to Xicor X2212AP.
		---------- SOCKETS ----------
ICS702	B19/5ZJAB00029	IC Sockets, 40 pin.
ICS706	B19/5ZJAB00030	IC Sockets, 18 pin.
		---------- JACKS ----------
J601 thru J605	B19/5JTCA00137	Contact, electrical.
J606	B19/5JDAG00152	Connector, Metering, 12 pins.
J607	B19/5JTGA00137	Contact, electrical.
J701	B19/5JWBS00179	Connector, 22 pins.
J702	B19/5JWBS00179	Connector, 22 pins.
J703	B19/5JWBS00173	Connector, 20 pins.
J704	B19/5JWBS00138	Connector, 10 pins.
J705	B19/5JWBS00174	Connector, 4 pins.
J706 thru J708	B19/5JTCA00137	Connect, electrical.
		---------- PLUGS ----------
P601 thru P605	B19/5JDAN00012	Receptacle: 2 position, shorting, rated at 1 amp; sim to Honda DSC-5252.
P607	B19/5JDAN00012	Receptacle: 2 position, shorting;
P706 thru P708	B19/5JDAN00012	Receptacle: 2 position, shorting, rated at 1 amp; sim to Honda DSC-5252.
		---------- RESISTORS ----------
R601 thru R606	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R607	B19/5REAG00573	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R608	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R609	B19/5REAG00584	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R610	B19/5REAG00578	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R611	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R612	B19/5REAG00631	Metal film: 220K ohms ±5%, 200VDCW, 1/8W.
R613	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.
R614	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R615	B19/5REAG00583	Metal film: 150 ohms ±5%, 200VDCW, 1/8W.
R616 thru R619	B19/5RDAC02223	Metal film: 2.2 ohms ±5%, 200VDCW, 1/8W.
R620	B19/5REAG00590	Metal film: 0 ohms
R622	B19/5REAG00897	Metal film: 180K ohms ±5%, 200VDCW, 1/8W.
R623	B19/5REAG00584	Metal film: 8.2K ohms ±5%, 200VDCW, 1/8W.
R624	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R627	B19/5REAG00897	Metal film: 180K ohms ±5%, 200VDCW, 1/8W.
R628	B19/5REAG00575	Metal film: 2.2K ohms ±5%, 200VDCW, 1/8W.
R629	B19/5REAG00879	Metal film: 82K ohms ±5%, 200VDCW, 1/8W.
R630	B19/5REAG00631	Metal film: 220K ohms ±5%, 200VDCW, 1/8W.
R631	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R632	B19/5REAG00573	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R633	B19/5REAG00580	Metal film: 47 ohms ±5%, 200VDCW, 1/8W.
R634	B19/5REAG00623	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R635	B19/5REAG00582	Metal film: 1.0K ohms ±5%, 200VDCW, 1/8W.
R636	B19/5REAG00682	Metal film: 18K ohms ±5%, 200VDCW, 1/8W.
R637	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R638	B19/5REAG00626	Metal film: 27K ohms ±5%, 200VDCW, 1/8W.
R639	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R640	B19/5REAG00579	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R641	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R642	B19/5REAG00879	Metal film: 82K ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R643 thru R645	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R646	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R647	B19/5REAG00591	Metal film: 680 ohms ±5%, 200VDCW, 1/8W.
R648	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R649	B19/5REAG00591	Metal film: 680 ohms ±5%, 200VDCW, 1/8W.
R650	B19/5REAG00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.
R651	B19/5REAG00596	Metal film: 15K ohms ±5%, 200VDCW, 1/8W.
R652	B19/5REAG00632	Metal film: 330K ohms ±5%, 200VDCW, 1/8W.
R653	B19/5REAG00585	Metal film: 1.2K ohms ±5%, 200VDCW, 1/8W.
R654	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R655	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R656	B19/5REAG00682	Metal film: 18K ohms ±5%, 200VDCW, 1/8W.
R657	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R658	B19/5REAG00579	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R659	B19/5REAG00626	Metal film: 27K ohms ±5%, 200VDCW, 1/8W.
R660 and R661	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R662	B19/5REAG00578	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R664	B19/5REAG00577	Metal film: 6.8K ohms ±5%, 200VDCW, 1/8W.
R665	B19/5REAG00625	Metal film: 5.6K ohms ±5%, 200VDCW, 1/8W.
R666	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R667	B19/5REAG00589	Metal film: 3.3K ohms ±5%, 200VDCW, 1/8W.
R668	B19/5REAG00574	Metal film: 1.5K ohms ±5%, 200VDCW, 1/8W.
R669	B19/5REAG00584	Metal film: 8.2K ohms ±5%, 200VDCW, 1/8W.
R671	B19/5REAG02757	Metal film: 39.2K ohms ±1%, 250VDCW, 1/8W.
R672	B19/5REAG00623	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R673	B19/5REAA02533	Metal film: 2.21K ohms ±1%, 250VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R674	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R675	B19/5REAG00879	Metal film: 82K ohms ±5%, 200VDCW, 1/8W.
R676	B19/5REAG00573	Metal film: 4.7K ohms ±5%, 200VDCW, 1/8W.
R677 thru R680	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R681	B19/5REAG00772	Metal film: 1M ohms ±5%, 200VDCW,
R682	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R683	B19/5REAG00587	Metal film: 100K ohms ±5%, 200VDCW, 1/8W.
R684 and R685	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R701	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R702	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.
R703	B19/5REAG00587	Metal film: 100K ohms ±5%, 200VDCW, 1/8W.
R704 and R705	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R706	B19/5REAG00579	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R707	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R708	B19/5REAG00589	Metal film: 3.3K ohms ±5%, 200VDCW, 1/8W.
R709	B19/5REAG00572	Metal film: 1K ohms ±5%, 200VDCW, 1/8W.
R710	B19/5REAG00623	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R711	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R712 and R713	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.
R714	B19/5REAG00879	Metal film: 82K ohms ±5%, 200VDCW, 1/8W.
R715	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R716	B19/5REAG00623	Metal film: 2.7K ohms ±5%, 200VDCW, 1/8W.
R717	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.
R718	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R719	B19/5REAG00585	Metal film: 1.2K ohms ±5%, 200VDCW, 1/8W.
R720	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.

SYMBOL	GE PART NO.	DESCRIPTION
R721 and R722	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R723	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R724	B19/5REAG00578	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R725	B19/5REAG00596	Metal film: 15K ohms ±5%, 200VDCW, 1/8W.
R726	B19/5REAG00579	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R727	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R728	B19/5REAG00578	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R729	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R730 thru R735	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R736	B19/5REAG00579	Metal film: 470 ohms ±5%, 200VDCW, 1/8W.
R737	B19/5REAG00578	Metal film: 47K ohms ±5%, 200VDCW, 1/8W.
R738 thru R740	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R741	B19/5REAG00586	Metal film: 100 ohms ±5%, 200VDCW, 1/8W.
R742 and R743	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R744	B19/5REAG00584	Metal film: 8.2K ohms ±5%, 200VDCW, 1/8W.
R745	B19/5REAG00587	Metal film: 100K ohms ±5%, 200VDCW, 1/8W.
R746	B19/5REAG00631	Metal film: 220K ohms ±5%, 200VDCW, 1/8W.
R747	B19/5REAG00626	Metal film: 27K ohms ±5%, 200VDCW, 1/8W.
R748 and R749	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R750	B19/5REAG00626	Metal film: 27K ohms ±5%, 200VDCW, 1/8W.
R751 and R752	B19/5REAG00576	Metal film: 10K ohms ±5%, 200VDCW, 1/8W.
R753	B19/5REAG00584	Metal film: 8.2K ohms ±5%, 200VDCW, 1/8W.
R754	B19/5REAG00622	Metal film: 270 ohms ±5%, 200VDCW, 1/8W.
R755	B19/5REAG00581	Metal film: 22K ohms ±5%, 200VDCW, 1/8W.
RV601	B19/5RVAB00279	Variable: 10K ohms ±30%, 0.1W.

SYMBOL	GE PART NO.	DESCRIPTION
RV602	B19/5RVAB00276	Variable: 100K ohms ±30%, 0.1W.
RV603 and RV604	B19/5RVAB00279	Variable: 10K ohms ±30%, 0.1W.
RV605	B19/5RVAB00277	Variable: 5K ohms ±30%, 0.1W.
RK701 thru RK703	B19/5RZAB00133	Quad Resistor array; 10K ohms ±5%, 1/8W.
		——— TRANSISTORS ———
TR601 thru TR608	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 (DV3).
TR709 thru TR713	B19/5TDAB00054	Silicon, NPN; sim to NEC 2SD596 (DV3).
		——— CRYSTALS ———
X701	B19/5XHAA00778	Quartz crystal: 6MHz.
		——— SOCKETS ———
X701-A and X701-B	B19/5ZJDP00001	Crystal Socket.
	B19/CPQ-2223	INTERFACE BOARD
		——— CAPACITORS ———
C801 thru C852	B19/5CAAD00838	Ceramic: 1000pF ±10%, 50VDCW, temp coef ±15%.
C853	B19/5CEAA01813	Electrolytic: 100uF ±20%, 25VDCW.
		——— JACKS ———
J801	B19/5JCAP00006	Connector; sim to SMK CSC0333-0301R.
J802 and J803	B19/5JWBS00175	Connector, 22 pins.
	B19/JWH451S35A	------ INTERCONNECTION CABLE ———
X601	B19/5XHAA00776	Crystal kit
ZC601 and ZC602	B19/5ZCCL00025	Flexible cable:
ZC603	B19/5ZCCL00026	Flexible cable:
ZC604	B19/5ZCCL00027	Flexible cable:
ZC605	B19/5ZCCL00028	Flexible cable:
ZC606	B19/5ZCCL00029	Flexible cable:
ZC607	B19/6JJFB00054	Co-axial cable:
ZC608	B19/6JJFB00063	Co-axial cable:

SYMBOL	GE PART NO.	DESCRIPTION
ZC608	B19/6JJFB00063	Co-axial cable:
ZC609	B19/6JJFB00083	Co-axial cable:
ZC610	B19/6JJFB00051	Co-axial cable:
ZC612	B19/6ZCFB00145	Power cable:
ZC613	B19/6ZCFB00146	Power cable:
		——— MISCELLANEOUS ———
	B19/MPDMD01167	Radio key
	B19/MPBX14964	Radio Mounting Plate
	B19/MPXP01744	Hardware Kit (Radio Mounting)
	B19/MPBC07112	Bottom Cover (Complete Assembly)
	B19/MPBC07110	Top Cover (Complete Assembly)
	19A704978P1	Keylock Assembly
	B19/CMG-132-X	2 PPM Kit
	19B216021G3	Tx Fuse, 20A-low power
	19B216021G6	Tx Fuse, 30A-high power