VXR-5000

Commercial-Grade UHF Repeater

YAESU MUSEN CO., LTD.
C.P.O. Box 1500, Tokyo, Japan
YAESU U.S.A.
17210 Edwards Rd., Cerritos, California 90703
U.S.A.
YAESU EUROPE B.V.
Snipweg 3. 1118AA Schiphol, The Netherlands
YAESU UK LTD.
Unit 2, Maple Grove Business Centre
Lawrence Rd., Hounslow, Middlesex TW4 6DR, UK

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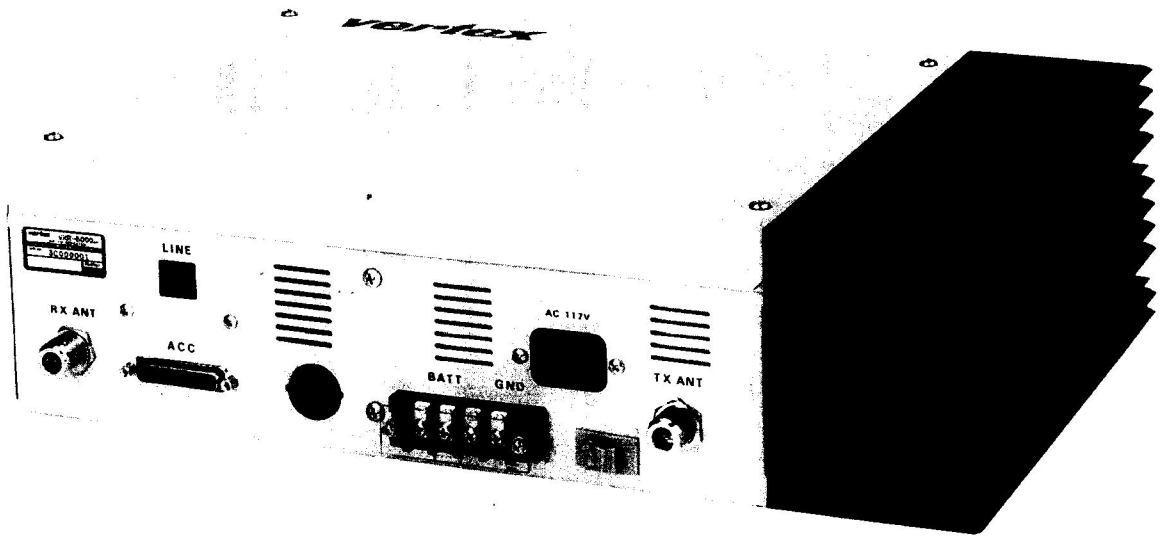
Introduction



This manual provides technical information necessary for servicing the VXR-5000 FM Land Mobile Repeater. A reprint of the CE-8 channel-programming software manual is also included for easy reference.

Servicing this equipment requires expertise in handling surface-mount chip components. Attempts by non-qualified persons to service this equipment may result in permanent damage not covered by the warranty, and may be illegal in some countries.

Two PCB layout diagrams are provided for each double-sided circuit board in the repeater. Each side of the board is referred to by the type of the majority of components installed on that side ("leaded" or "chip-only"). In most cases one side has only chip components, and the other has either a mixture of both chip and leaded components (trimmers, coils, electrolytic capacitors, ICs, etc.), or leaded components only.

While we believe the technical information in this manual to be correct, Yaesu Musen assumes no liability for damage that may occur as a result of typographical or other errors that may be present. Your cooperation in pointing out any inconsistencies in the technical information would be appreciated.

Repeater Version Identification

The VXR-5000 version can be determined from the identification label located on the rear panel. From the production code on the identification label, use the table below to determine the various hardware, options and operational features for which the repeater is configured, based on the example at the bottom of the table.

VXR-5000 Production Codes

Frequency Range	
13	134 - 147 MHz version A
14	146 - 160 MHz version B
15	156 - 168 MHz version BS-1
16	164 - 175 MHz version C
40	400 - 420 MHz version A
43	430 - 450 MHz version C
45	450 - 470 MHz version D
47	470 - 490 MHz version E
49	490 - 512 MHz version F

Channel Separation	
E	12.5 kHz
G	20 kHz
H	25 / 30 kHz

Power Output	
25	25 Watts RF Output

Not Used	
9	This digit not used (placeholder)

Control Units	
J	Standard Type

Options	
0	w / o Options
1	FTS-22 CTCSS Encoder/Decoder

AC Mains Voltage/AC Plug	
B	117 VAC 2P USA Plug w/o ground
C	117 VAC 3P USA Plug w/ground
E	220 VAC 2P USA Plug w/o ground
F	220 VAC 3P Europe Plug
G	234 VAC 3P Europe Plug
H	234 VAC 3P Australia Plug
L	220 VAC 3P Australia Plug
Z	12 VDC w/o AC Power Supply

Remarks	
A	without Special Instructions
X	with Special Instructions

VXR5000	45	E	25	9	J	-	1	C

↑ This is an example of a typical Production Code and its meaning.

Specifications

General

Frequency Range (MHz): Vers (A) 400 - 420; (C) 430 - 450; (D) 450 - 470; (E) 470 - 490; (F) 490 - 512

No. of Channels: up to 8

Channel Separation: 12.5, 20 or 25 kHz

Frequency Stability: ± 2 ppm

Emission Type: F3E

Transmit Activation System: carrier-operated, CTCSS-tone-operated or remote control

Power Requirements: 100/117/220/234-V AC (50/60 Hz), 13.8 VDC

Input Power: 200 W max. (25 watts RF output), 30 W standby
6.0-A DC (25 watts RF output), 500 mA standby

Operating Temperature Range: -30 ~ +60° C

Case Size: 375 x 275 x 110 mm (WHD)

Weight: 12 kg

Transmitter

RF Power Output: 25 Watts (continuous-duty)

Maximum Deviation: ± 2.5 kHz (12.5 kHz spacing)
± 4.0 kHz (20 kHz spacing)
± 5.0 kHz (25 kHz spacing)

Audio Response: + 6 dB/octave (+1.0/-3.0 dB)

Audio Distortion: < 5%

FM Noise Ratio: 40 dB

Spurious Emissions: –80 dBc

Receiver

Receiver Type: Double-Conversion, Superheterodyne

Sensitivity(12-dB SINAD): 0.5 µV, 0 dBµ

Intermediate Frequencies: 47.9 MHz (1st IF) 455 kHz (2nd IF)

Adjacent Channel Selectivity: 70 dB

Intermodulation: 70 dB

Spurious Response: 75 dB

AF Response: 750 µs de-emphasis

Interface

Line Port: 600-Ω 4-wire (E+M signalling)

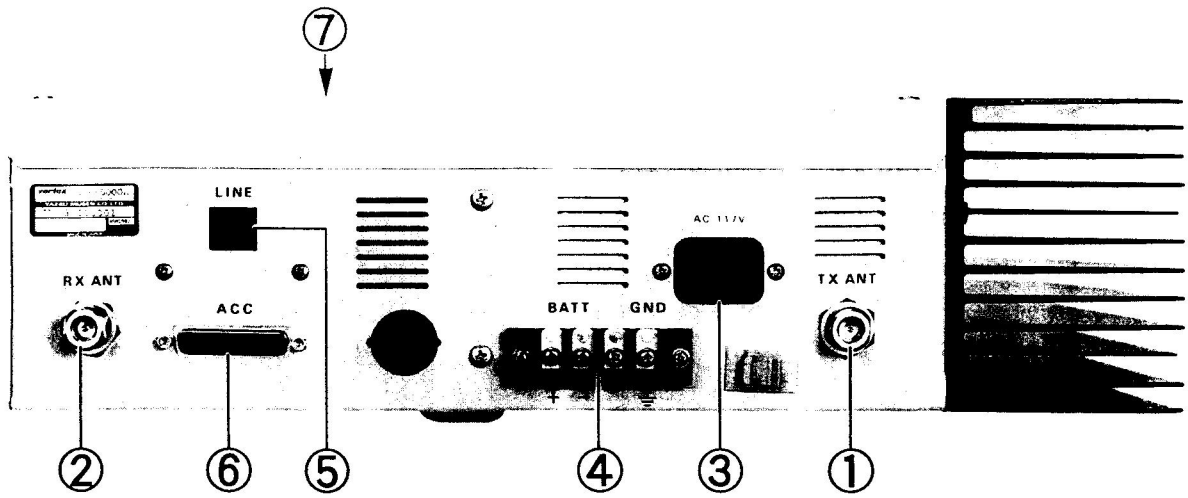
Accessory Port: 25-pin (DB-25F type)

Specifications may be subject to change without notice or obligation.

VXR-5000 Options & Accessories

Model	Item	P/N
FTS-22	CTCSS Tone Squelch Unit	A02970002
YH-2	Intercom Headset w/Boom Microphone	D3000319
VTS-100	VX-TRUNK Unit	A06150001
MR-KIT 1	19" Cabinet Rack-Mount Unit	A06500001
PD-696 (A)	UHF Cavity Duplexer Unit (406 - 470 MHz)	D3000261
(E)	UHF Cavity Duplexer Unit (470 - 512 MHz)	D3000268
VPL-1	Programming Connection Cable	A06420001
CE-8	Programming Software	N/A

Rear Panel Controls & Connectors



1. **TX ANT**

   This N-type coaxial jack provides the transmitter output signal for connection to the transmitting antenna, or TX jack on the duplexer, if used. Impedance requirement is 50Ω.

2. **RX ANT**

   This N-type coaxial jack accepts the receiver input signal from the receiving antenna or RX jack on the duplexer, if used. Impedance requirement is 50Ω.

3. **AC**

   This receptacle accepts the AC power cord, which should be connected to the AC Mains supply or wall outlet. The AC line voltage must match that for which the repeater is wired.

4. **BATT** terminal posts

   The terminal posts accept 12~15-V DC for operating the repeater from a battery or other DC source. When operating from AC mains, a small trickle current is present at these terminals to maintain battery charge. A battery rated for 12 volts, 55 Ah (minimum) is recommended for short-term emergency/backup operation.

5. **LINE**

   This 8-pin modular jack is used for remote control and provides TX & RX audio, TX keying and squelch status output. Impedance is 600Ω.

6. **ACC**

   This DB-25 connector provides a data interface between the microprocessor in the VXR-5000 and peripheral devices (such as the VTS-100 VX-TRUNK unit).

7. Programming Jack (inside cabinet)

   This 8-pin modular-type jack is located inside the repeater cabinet on top of the CNTL unit. The modular plug from the VPL-1 Cable or FRB-2 Service Kit cable is inserted here for channel programming using the CE-8 channel editor software, and an IBM PC®/PC-compatible personal computer with RS-232 serial port.

CNTL-1 Unit Status LEDs:

Three LED status indicators on the CNTL-1 Unit provide for visual monitoring of repeater operation while performing servicing and alignement. The repeater cabinet cover must be removed to view these (see photograph below).

LED indicators are as follows:

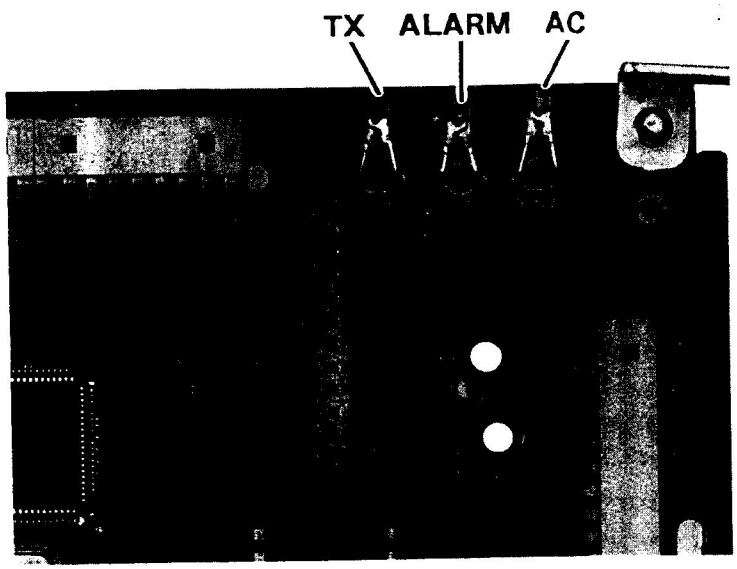
AC (D1002) - Indicates AC Mains operation, off during DC backup (battery) power operation.

TX (D1008) - Indicates transSmitter is keyed.

ALARM (D1001) - Illuminates when any of four conditions are present:

- Rx PLL Unlock*
- Tx PLL Unlock*
- PA Module Hi Temp (PWR Reduction)*
- EEPROM Data Error

*indicates parameter can also be monitored using the CE-8 Programming Software (see the *EEPROM Programming Sofware Instructions* chapter for details).



Installation

Repeater operation without a duplexer requires that two antennas be installed, one for receiving and one for transmitting, so that the receiving antenna does not absorb energy from the transmitting antenna. There are a number of ways to do this, depending on the TX/RX frequency separation, and on the location available for antenna mounting. If a duplexer is used, a single antenna suffices for both transmitting and receiving. If using a reduced-size duplexer, a six-cavity model (minimum) is recommended.

Regardless of the above choice, it is of paramount importance that the antenna(s) be mounted as high as possible, and in the clear as possible, preferably within line-of-sight to all repeater users. Furthermore, losses in the feedline(s) must be minimized, so the feedline(s) should be high quality, and as short as possible. If a long feedline is necessary, use coaxial hardline cable to reduce losses.

Repeater antennas should have an impedance of 50 ohms at the operating frequency. When separate receive and transmit antennas are used, high-Q narrow-band types may serve to minimize interaction. However, when a single antenna is used with a duplexer, it should be a low-Q wide-band type.

NEVER TRANSMIT WITHOUT HAVING A TRANSMIT ANTENNA CONNECTED TO THE REPEATER.

AC Power Supply Voltage Selection

Each repeater is wired for a particular AC mains voltage between 100 and 234 VAC. This should be indicated by a label near the AC jack on the rear panel. If no label is present, or if the AC voltage on the label is different from the local AC line, check the wiring to the power transformer inside the repeater, and change the connections (and label) if necessary, as shown on the following page.

Changing the transformer wiring also requires changing the fuse in the power supply if the voltage is changed from below 117 V AC to above 200 VAC, or vice-versa. Use a 5-amp fuse for for 117 VAC or less, or a 3-amp fuse for 200 VAC or more.

Operation

DC Power Supply Backup

For uninterrupted operation during power failures, a 12-volt rechargeable type battery (55-Ah or more recommended) may be connected to the DC terminal posts on the rear panel. While the repeater is operating from the AC source, a slight charging current will maintain battery charge. In the even of AC power outage, the automatic power control circuit will automatically switch the repeater to the backup battery, and operation will not be interrupted.

After prolonged operation from the battery, it should be disconnected from the repeater and recharged separately before re-connecting, as the trickle charge is not sufficient for recharging a completely discharged battery. ***Never reapply AC power to the repeater with a discharged battery connected, as the DC startup current can damage the repeater and battery.*** While operating from a battery or DC supply, the repeater requires approximately 7 amperes at 12 volts during transmit.

Equipment Location

While the operating temperature range of the repeater is quite broad, the best location is still one in which the air temperature does not approach the extremes or change rapidly. Make sure to allow for free air circulation around the heatsink on the rear apron at all times. In warm climates, the repeater should not be sealed in a small closed room.

Protect the repeater from wind and rain, and extremes in temperature or humidity that may shorten the useful life of the equipment. Try to locate the repeater in an environment that is also comfortable for service personnel, if possible.

Changing Power Transformer AC Mains Wiring

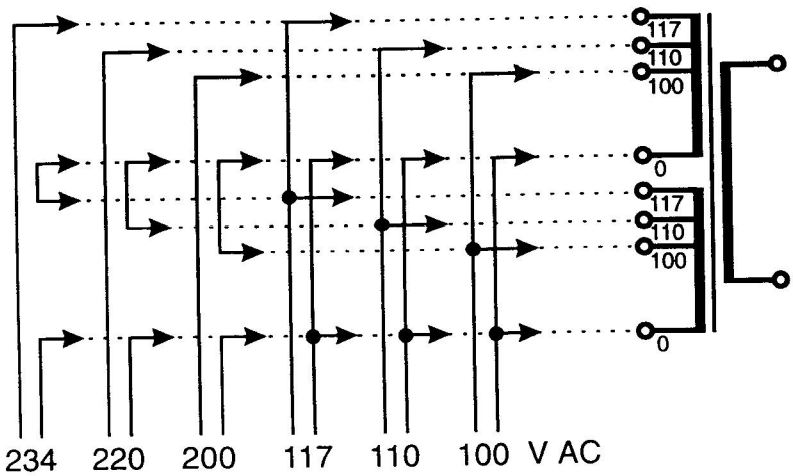
Before attempting this wiring change, remove the AC power cord from the rear panel jack.

- ❒ Remove the four screws affixing the top cover of the repeater, and remove the cover.
- ❒ Note the location of the AC fuse, and the three screws affixing the clear protective plastic sheet to the repeater (one screw near the fuse block, and two on the PA Unit).
- ❒ Remove the four screws and the plastic sheet.
- ❒ Referring to the diagram below, determine the correct transformer primary jumper wiring for the AC Mains voltage used in your area.
- ❒ Next, using a medium power (approx. 30-watt) soldering iron, rewire the jumpers according to the diagram.
- ❒ If necessary, replace the AC fuse according to the AC Mains voltage range:

  100~117-V AC: 5A

  200~234-V AC: 3A

- ❒ Replace the clear protective sheet and cover, this completes the wiring change.



AC Mains Voltage Selection

Important!

If you change the AC voltage range, you must also change the rear-panel AC fuse. Do not replace with a slow-blow type fuse. Also make sure the voltage marking on the rear-panel label matches the new voltage setting.

Caution!

To avoid blowing the rear-panel AC fuse, wait at least 30 seconds after un-plugging the repeater AC power cord before plugging it in again. This allows the DC power supply capacitor-bank residual voltage to bleed down, and prevent a high start-up current when power is reapplied.

Optional FTS-22 Installation

If you plan to install the optional FTS-22 CTCSS Unit, refer to the *Cover Removal and Unit Access* chapter and affix the FTS-22 first before setting up the repeater. This makes repeater installation easier and prevents having to access the units later to install the option at what may be an inconvenient location.

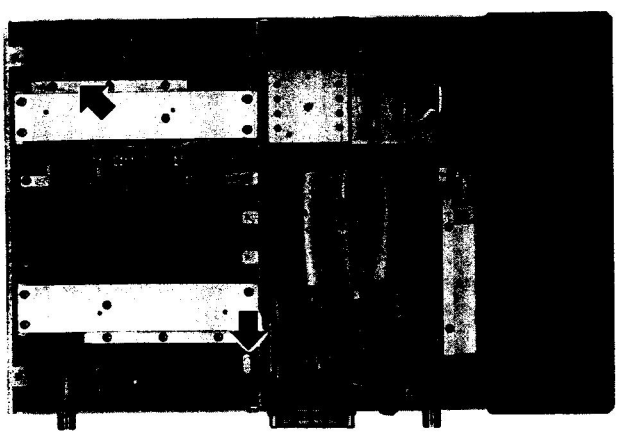
You also may want to program repeater channel frequencies at this time, as outlined in the *EEPROM Programming Software Instructions* chapter, if a PC is not available at the repeater site.

Repeater Mounting & Installation

Rack Mount

The optional MR-KIT 1 bracket kit is required for installation into an EIA-standard 19-inch rack. When stacking multiple VXR-5000 units in a rack, use forced air cooling. In addition, repeater output power should be reduced by approximately 50% when continuous duty operation is expected.

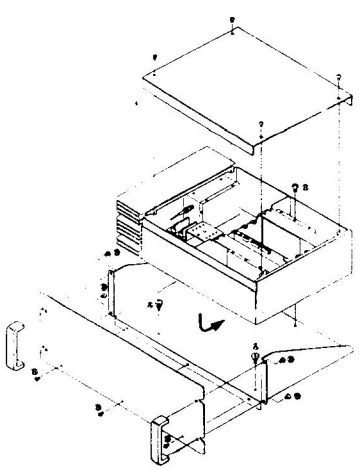
❒ To install the repeater, first remove the top cover and locate the three mounting holes.



❒ Attach the VXR-5000 to the mounting cradle using the three supplied screws, then replace the top cover.

❒ Next, install the cradle front panel using three machine screws along the panel bottom, and one rack mount handle (two screws each) on each side.

❒ Insert the unit into the rack cabinet and secure it with four screws.

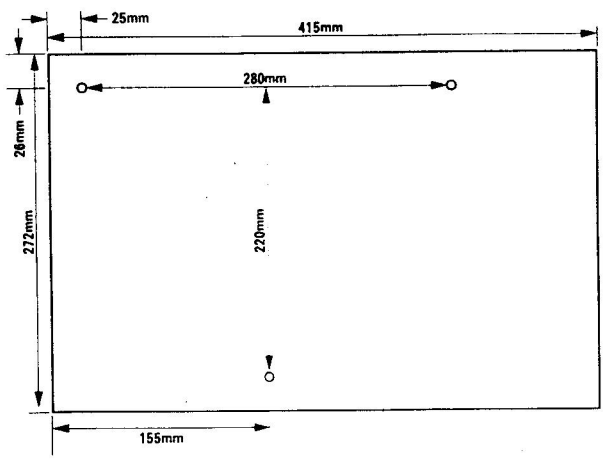


Wall Mount

The repeater can be affixed vertically to a wall using the three mounting holes in the bottom panel of the repeater chassis.

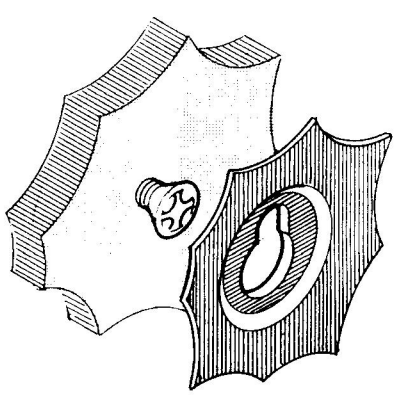
❒ Remove the top cover of the repeater and clear protective sheet, then locate the three mounting holes.

❒ Lay the repeater flat on a large sheet of paper or cardboard, and trace the outline of the mounting holes onto the paper to make a drilling template.



❒ Drive three large screws (not supplied) into the wall studs (anchor bolts can be used for concrete walls), leaving approximately 1 cm of the screw exposed.

❒ After aligning the repeater chassis mounting holes with the three exposed screws (or anchor bolts), hang the repeater in place, then drive the screws home to securely attach the repeater (see below).



Accessory Interface Modification

If you intend to connect any external peripherals to the repeater that require +13.8 VDC or TX AUDIO via the **ACC** connector (covered next), perform the following modification.

This modification must be done if using the VTS-100 Trunking Control Unit, or other accessories such as a community repeater tone panel or telephone patch.

Tx Audio (ACC pin 3) Modification

❒ First, refer to the *Cover Removal and Unit Access* chapter on page 1-16, and loosen the CNTL-1 and CNTL-2 Units from the chassis. It is not necessary to completely remove the units as the modification is performed on the solder-side of each unit's PCB.

❒ On the solder-side of CNTL-1 Unit, locate and connect a length of hook-up wire between J1003, pin 3 and J1009, pin 3 (see Figure 1).

❒ Next, on the CNTL-2 Unit, connect a piece of hook-up wire from J2005, pin 3 to the land at the junction of S2003 com, T2001, R2001 & R2005, as shown in Fig. 2.

+13.8 VDC (ACC pin 2) Modification

❒ On the solder-side of the CNTL-1 Unit PCB, locate 2-kΩ chip resistor R1088 (near J1009 pin 2). Remove this and install a leaded external miniature fuse rated for 500 mA (Fig. 1). *Caution: currents in excess of 750 mA may damage the PCB track on the D-SUB Unit, check your wiring and connections carefully!*

❒ This completes the modification, re-check all connections, reinstall the CNTL-1 and CNTL-2 Units in the chassis, and replace the repeater cabinet cover.

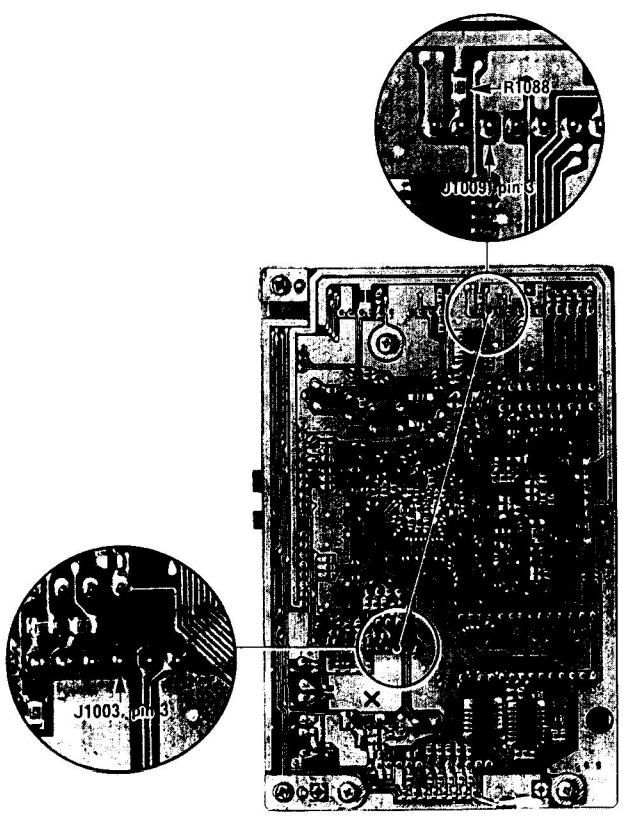


Fig. 1 CNTL-1 Unit Modification Points

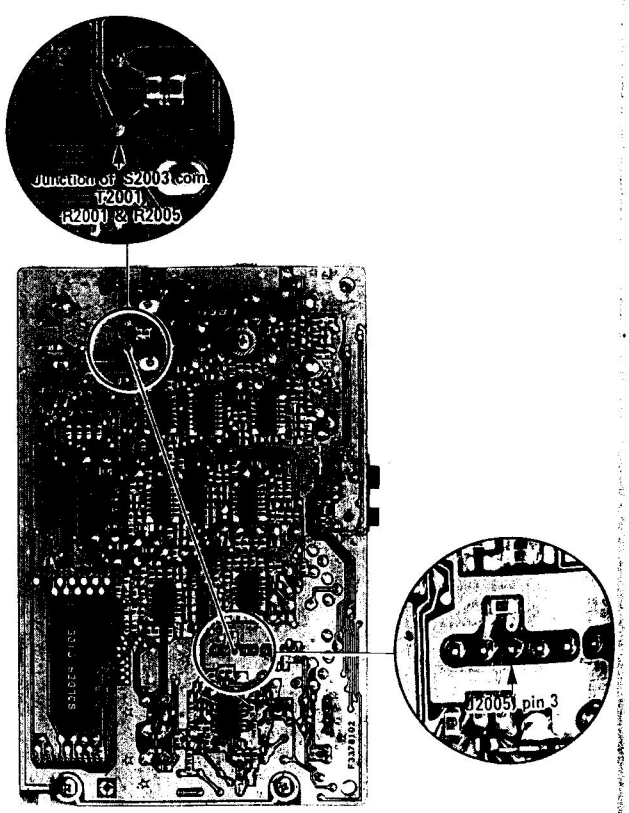
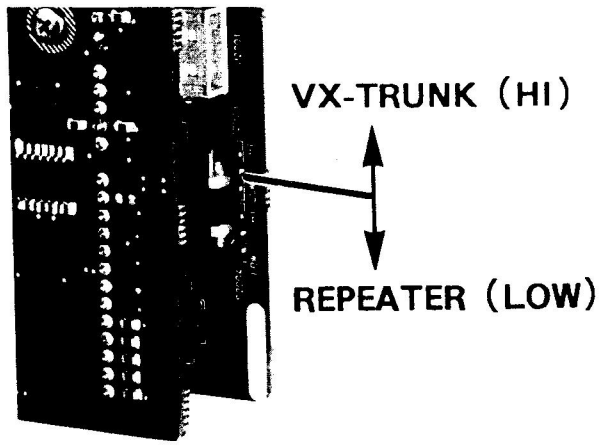


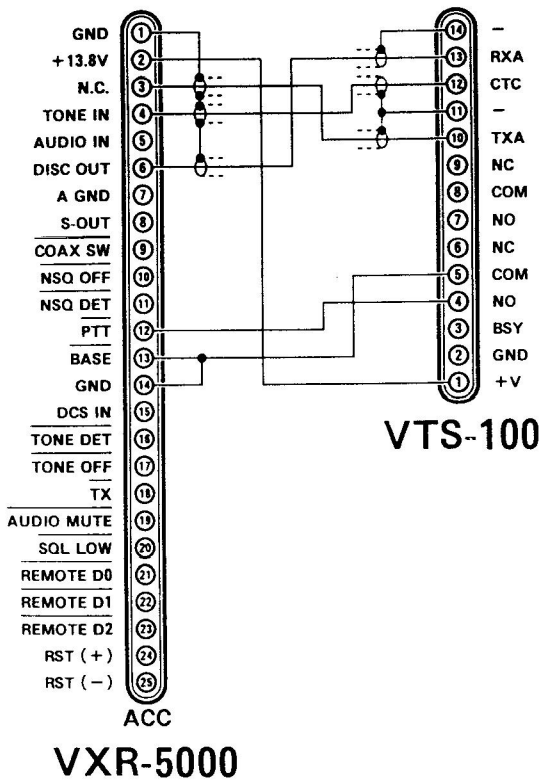
Fig. 2 CNTL-2 Unit Modification Points

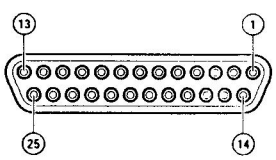
VTS-100 VX-TRUNK I Interconnection

The VTS-100 VX-TRUNK I rack-mount unit is used with the VXR-5000 as part of a land-mobile trunking system. The VTS-100 connects to the repeater using the DB-25 connector (**ACC**). Interconnection requires a cable constructed according to the diagram below. Note: this diagram assumes the modification described on page 1-10 has been performed (TX AUDIO available at pin 3).

For VTS-100 operation, free the CNTL Unit card from the chassis as described later under *Cover Removal and Unit Access*, then slide switch S2003 on CNTL-2 Unit to the VX-TRUNK position, as shown below.







ACC Jack
DB-25 Pin Numbering

ACC *Connector DB-25 Pin-Out Data*

Pin	Signal	Logic I/O	Active State
1	GND	Logic & PS ground	N/A
2	+13.8 V	N/A	N/A
3	N.C.	N/A	N/A
4	TONE IN	Analog TX input	N/A
5	AUDIO IN	Analog Input	N/A
6	DISC OUT	Analog Output	N/A
7	AUDIO GND	Analog Ground	N/A
8	S-METER OUT	Proportional output	N/A
9	COAXIAL SWITCH	Logic Output	Active Low
10	NSQ OFF	Logic Input	Active Low
11	NSQ DET	Logic Output	Active Low
12	PTT	Logic Input	Active Low
13	BASE	Logic Input	Active Low
14	GND	Logic & PS ground	N/A
15	DCS IN	DCS/LTR Data Input	< 2.5V = logic 0 >2.5V = logic 1
16	TONE DET	Logic Output	Active Low
17	TONE OFF	Logic Input	Active Low
18	TX	Logic Output	Active Low
19	AUDIO MUTE	Logic Input	Active Low
20	SQL LOW	Logic Input	Active Low
21	DATA 0	Logic Input	Active Low
22	DATA 1	Logic Input	Active Low
23	DATA 2	Logic Input	Active Low
24	RST (+)	Logic Input	level of 3 - 5 V DC causes CPU reset
25	RST (-)	Logic Input	

VXR-5000 Accessory Connector

The VXR-5000 repeater is provided with a 25-pin DB-25F female connector for accessories. Use a DB-25M 25-pin male connector to connect accessories to the repeater. The pins on the accessory connector are listed in the table on the previous page and are explained in detail as follows:

1. *GND Logic and Power Supply Ground Connection*

   Chassis ground for all logic levels and power supply return. Common with pin 13. Do not connect to pin 7 (A GND), which is for grounding of analog signals only.

2. *+13.8 V Power Supply*

   This pin provides 13.8 volts regulated DC from the repeater power supply and can source approximately 750 mA provided that the modification to link R1088 (2 kΩ) on the repeater CNTL-1 Unit has been performed. Use an external fuse to prevent damage to the repeater.

3. *TX AUDIO Analog Transmitter Input (Voice Band 300 -3000 Hz)*

   Normally, this pin is not used. However, after performing the modification on page 1-10, 1.5-V_{p-p} audio input on this pin will produce full system deviation at 1 kHz (i.e. with 25 kHz channel spacing, ± 5-kHz deviation). Input impedance is 600 Ω. This audio is injected before transmitter pre-emphasis and limiting stages, so excess signal input levels are clipped.

   This pin is intended to be used as a voice-band input to the repeater for telephone patch audio, line control panel audio or community repeater tone panel audio. The repeater must be in BASE mode (pin 13 grounded) for signals on this pin to be fed to the transmitter. The absolute level on this pin can be adjusted by VR2001 (LINE SENSITIVITY control) and also by S2003, which provides 10 dB attenuation, both on the CNTL-2 Unit.

   Note: This pin only accepts TX AUDIO input if the modifications to the CNTL-1 Unit and CNTL-2 Units have been made. Use shielded cable to connect to this pin, connecting the shield to pin 7 (A GND).

4. *TONE IN Analog Transmitter Input (Sub-Audible Band 67-250 Hz)*

   Applying a 400 mV_{p-p} sub-audible tone produces 10% of full system deviation. This input is high impedance (approx. 10 kΩ), and has a flat response characteristic (repeater deviation is constant for a given signal level over the frequency range of 67-250 Hz). This pin is intended to be used for CTCSS transmission from a community repeater tone panel. This input is applied after limiting and pre-emphasis, and therefore exhibits flat direct FM input characteristics.

   Injecting too high a voltage here causes over-deviation of the subaudible tone, degrading performance. Signals with DC content (such as DCS or LTR data) ***should not*** be connected to this pin, but to pin 15 (refer to 15). If the repeater is fitted with an internal FTS-22 CTCSS Unit, then its output will be present on this pin. The absolute sub-audible tone level is also internally preset by VR2006 on the CNTL-2 unit inside the repeater. Use shielded cable to connect to this pin, connecting the shield to pin 7 (A GND).

5. *AUDIO IN Analog Input*

   Set S2002 on the CNTL-2 Unit to EXT to enable audio input to the LINE OUT using this pin. This allows receiver audio to be intercepted (at the DISC OUT pin, see below), and externally processed for special applications, such as descrambling. The normal position of S2002 is INT, and in this case, AUDIO IN signals come from receiver audio.

6. *DISC OUT Analog Output (Wide-Band 0-3000 Hz)*

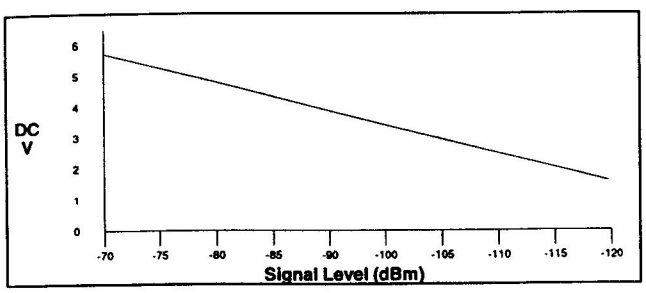
   Received signals with full system deviation produce 1 V_{p-p} audio at this pin. The output is low impedance, and is extracted before de-emphasis and squelch circuitry. This pin should be used as the Discriminator Audio Signal required by most community repeater tone panels and telephone patch units. Use shielded cable to connect to this pin, and connect the shield to pin 7 (A GND).

7. A GND Analog Ground

Connect the shields of any accessory analog signal lines to this pin. Do not connect this pin to pin 1 or pin 13, as an audio hum loop may result.

8. S-OUT S-Meter Output

A DC voltage proportional to the strength of the signal currently being received (Receiver Signal Strength) is output on this pin. This low impedance output is generated by the receiver IF sub-system and buffered by an internal op-amp. Typical voltages are graphed as follows:



S-Meter Output Proportional Voltage Graph

9. COAX SW Logic Output (Active Low)

This output is intended for controlling an external coaxial switching relay. It is an open collector output which can sink approx. 100 mA when active. This signal only switches if the repeater has been programmed for simplex mode. If programmed for duplex, the signal remains open (at high impedance) at all times.

10. NSQ OFF Logic Input (Active Low)

This input is internally pulled up to 5-V DC. When pulled low by an external device, receiver squelch is canceled. If the FTS-22 CTCSS option is installed, and CTCSS decode is programmed, pin 17 (TONE OFF) should also be pulled low during monitoring. If the repeater is in the REPEATER mode, the transmitter is *not* keyed when this pin is activated, but an incoming signal on the receiver channel *does* cause the transmitter to be keyed and the signal repeated as normal. Do not apply more than 5 V to this pin, as this can damage the CPU on the repeater CNTL-1 Unit.

11. NSQ DET Logic Output (Active Low)

This is an open-collector, active-low output capable of sinking about 100 mA. It indicates that the receiver squelch is open. Assuming that the squelch control has been properly set, this indicates the presence of a carrier on the receiver channel, and is sometimes referred to as a COR (Carrier Operated Relay) signal. Some telephone interconnect panels and community repeater tone panels require this signal.

12. PTT Logic Input (Active Low)

This input is internally pulled up to 5-V DC. When pulled low by an external device, it keys the repeater transmitter, provided that the BASE signal is present on pin 13 (indicating the repeater is in the base mode of operation). The pin has no effect if the BASE signal on pin 13 is not present (i.e. the REPEATER mode is selected). Avoid voltage in excess of 5 V on this pin, or internal damage to the CPU on the repeater CNTL-1 unit may result.

13. BASE Logic Input (Active Low)

This input is internally pulled up to 5-V DC. In simplex mode, this pin is not normally used. However, after programming via CE-8 Software and pulled low by an external device, BASE or REPEATER modes of operation can be selected. In BASE mode, the receiver and transmitter operate independently: receiver signals do not key the transmitter. In the alternate (REPEATER) mode, a proper signal on the receive channel causes the transmitter to be keyed and modulated by receiver audio. Avoid voltage in excess of 5 V on this pin or internal damage to the CPU on the repeater CNTL-1 unit may result.

14. GND

This is the chassis ground for all logic levels and power supply return, and is also common with pin 1. Do not connect to pin 7 (A GND), which should only be used for grounding of analog signals.

15. DCS IN Digital Input for DCS / LTR data

This pin accepts sub-audible tones in the range of 6 - 136 Hz for modulation of the transmitter with DCS or LTR data. Internal buffering allows the data to be DC referenced from 5~9 VDC. Signals below 2.5 V are transmitted as Logic "0" while levels above 2.5 V are Logic "1". Voltage in excess of 9 V may cause internal damage.

16. TONE DET Logic Output (Active Low)

This open-collector output can sink about 100 mA, and is activated when the internal FTS-22 CTCSS option detects a valid CTCSS tone at the demodulator.

17. TONE OFF Logic Input (Active Low)

This input is internally pulled up to 5-V DC. When pulled low by an external device, it disables the internal CTCSS decoder (if installed). The FTS-22 encoder section is not affected by this input. Use this input when channel monitoring with squelch action is required (e.g. tone monitor function). Voltage in excess of 5 V on this pin may damage the CPU on the repeater CNTL-1 Unit.

18. TX Logic Ouput (Active Low)

This open-collector logic output is pulled low when the transmitter is activated. It can sink approx. 100 mA. The signal on this pin is always true when the transmitter is on. It is intended to be used where an "ON-AIR" indication is required.

19. AUDIO MUTE Logic Input (Active Low)

This input is internally pulled up to 5-V DC. When pulled low by an external device, it disables receiver output to pins 5 & 6 of the modular **LINE** jack. In the REPEATER mode, the repeat audio is not affected by signals on this pin. Avoid voltage in excess of 5 V on this pin or internal damage to the CPU on the repeater CNTL-1 Unit may result.

20. SQ LOW Logic Input (Active Low)

This input is internally pulled up to 5-V DC. When pulled low by an external device it selects the low squelch mode. In low squelch mode, the hysteresis between squelch open and closed is only 3 dB (instead of the normal 6 dB). The squelch closing level is unchanged.

The absolute squelch closing level is set by VR4001 on the RX Unit. For example, if the squelch on the RX Unit has been set to open at -110 dBm in normal mode, then with the **SQ LOW** pin grounded, the squelch will now open at about -113 dBm. In either case, the squelch will close at -116 dBm. Avoid voltage in excess of 5 V on this pin, which could damage the CPU on the repeater CNTL-1 Unit.

21, 22 & 23. REMOTE D0, D1 & D2 Logic Inputs (Active Low)

These inputs are internally pulled up to 5-V DC. When pulled low by an external device, they select one of the eight pre-programmed repeater operating channels. The logic truth table below shows the combinations for selecting all 8 channels.

In the truth table, "1" represents no connection, and "0" represents a ground connection on the pin.

The channel selection logic is not inhibited while the transmitter is keyed: the repeater will change frequency when instructed, even while transmitting.

Avoid voltage in excess of 5 V on these pins or internal damage to the CPU on the repeater CNTL-1 Unit may result.

VXR-5000 Channel Access
(D0-D2, pins 21, 22 & 23)

CH	D2	D1	D0
1	1	1	1
2	1	1	0
3	1	0	1
4	1	0	0
5	0	1	1
6	0	1	0
7	0	0	1
8	0	0	0

24 & 25. RST+ & RST– Logic Inputs

An opto-isolated RESET input is provided between pins 24 and 25. A voltage of between 3 and 15 V resets the repeater microprocessor.

VXR-5000 Line Interface Port

The VXR-5000 is provided with an 8-pin modular jack for line interfacing applications. A Western Electric modular-type RJ45 plug should be used to connect to the jack. The **LINE** jack provides –10 dBm line-level audio for two uses:

- Provides an impedance-balanced, 4-wire audio port with E+M auxilliary signalling.
- Provides audio for SINAD meter connection during alignment procedures (see diagram on page 4-1).

LINE jack pin-out is shown below.

Note that there are both 4-line and 8-line types of modular plugs. If a 4-pin modular plug is used, only the LINE OUT and LINE IN connections will be made. An 8-pin plug is required to access all lines. In accordance with standard telecommunications interfacing, the line connections on the **LINE** interface jack are impedance balanced, and are described as follows:

Pins 1 & 2. RX SQ+, RX SQ–

An opto-isolator is provided to facilitate E signaling (EAR). The opto-isolator comes on when a signal exceeding the receiver squelch appears on the receiver channel (with correct CTCSS tone if the optional FTS-22 CTCSS unit is installed). The RX SQ– pin is the emitter, and RX SQ+ is the collector.

Pins 3 & 4. LINE IN Tx Line Audio

Analog signals between 300 and 3000 Hz supplied to this pair are fed to the transmitter when the repeater is set to the BASE mode (**ACC** connector, pin 13 grounded) and keyed either by the TX KEY input signal (see below), or by the PTT signal on pin 12 of the **ACC** jack. Full system deviation is obtained with a line level of -10 dBm.

Pins 5 & 6. LINE OUT Rx Line Audio

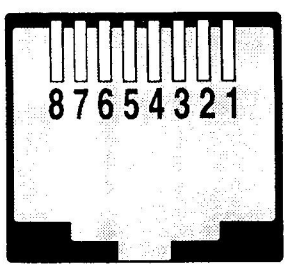
Receiver audio is available from this pair, subject to CTCSS decode (when the FTS-22 is installed), if the received signal strength is above the squelch threshold. Receiver audio can be monitored by activating the NSQ OFF signal on pin 10 of the **ACC** jack.

As shipped from the factory, a 1-kHz receiver signal with full system deviation gives –10 dBm on the line, but this can be varied over the range –55 dBm to +10 dBm by VR2003 and S2004 on the repeater CNTL-2 Unit.

Pins 7 & 8. TX KEY+, TX KEY–

An opto-isolator is provided to facilitate M signalling (MIC). That is, a voltage presented to these pins turns *on* the opto-isolator and keys the transmitter. The TX KEY+ pin is the anode of the opto-isolator and TX KEY– is the cathode.

Socket J8201



1 Rx SQL +
2 Rx SQL –
3 Line IN
4 " "
5 Line OUT
6 " "
7 Tx Key +
8 Tx Key –

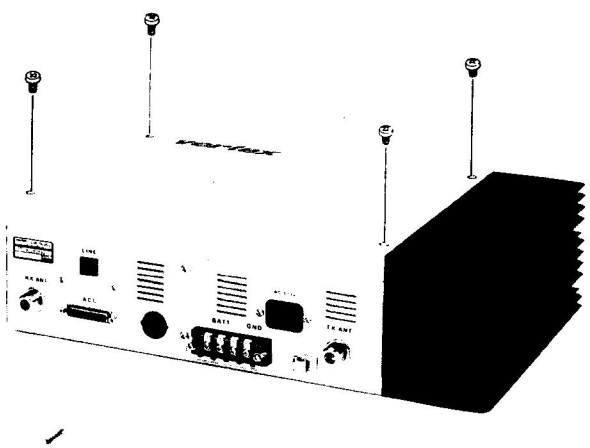
LINE jack pin-out

Cover Removal and Unit Access

The VXR-5000 repeater uses professional modular card-style unit construction and mounting. Major units are secured in a miniature rack-mount cage for easy access and servicing. Each unit can be removed by unscrewing the mounting-tab screws, unplugging the cables to the unit, then sliding the unit out from the chassis. Plastic guide rails on the chassis body ensure positive insertion and support the units firmly in place.

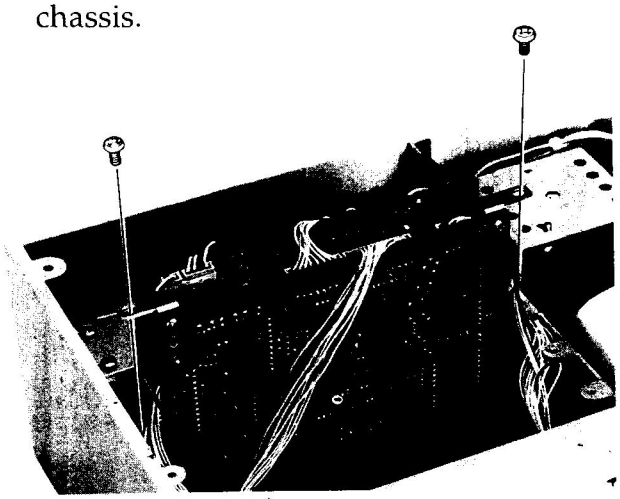
Opening the Repeater Cabinet

❒ To remove the cover, remove the 4 screws as shown below and lift the cover off. Unit identification and locations are shown below.



Control Unit Access

❒ Remove the two screws from the Control Unit mounting tabs to loosen it from the chassis.



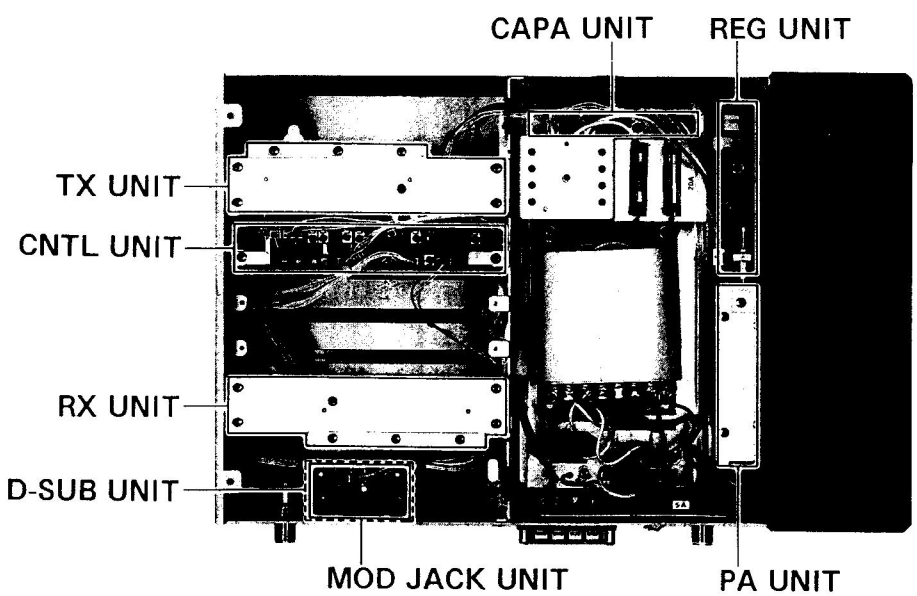
CNTL-1 & 2 Units

TX Unit Access

❒ Remove the four screws from the TX unit mounting tabs to loosen it from the chassis.

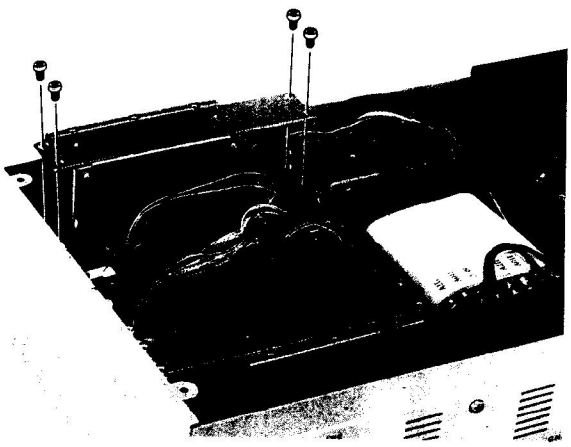
❒ Next remove the 10 screws affixing the top cover, and lift it off (note the type of screws used and location) to expose the VCO Unit.

❒ This is all the disassembly that is normally required for servicing, to completely remove the unit, disconnect the TX coaxial



Unit Location & Identification

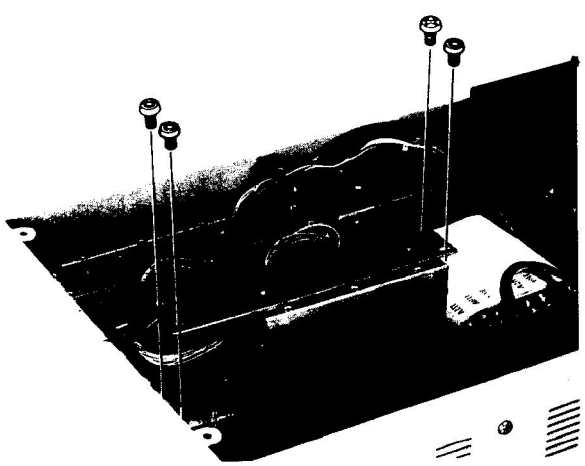
cable from the BNC jack, and unplug the two cables leading to the CNTL Unit from J3001 & J3002.



TX Unit

RX Unit Access

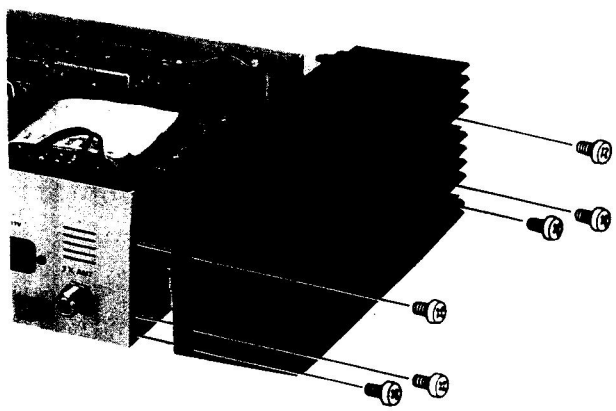
❒ This unit is removed in the same manner as described for the TX Unit. Control Unit cables connect to J4001 & J4002. To completely remove the unit, disconnect the coaxial cable leading to the **RX ANT** jack from the BNC jack.



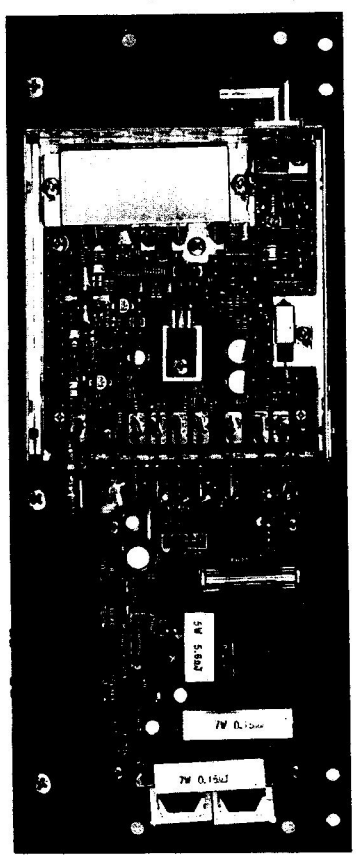
RX Unit

PA Unit Access

❒ First remove the 6 large screws affixing the heat sink/PA Unit to the chassis. Loosen the heat sink unit from the chassis.



❒ Next remove the **TX ANT** cable from the BNC connector on the TX Unit, and remove the 8 screws affixing the top cover to expose the PA Unit (see below).



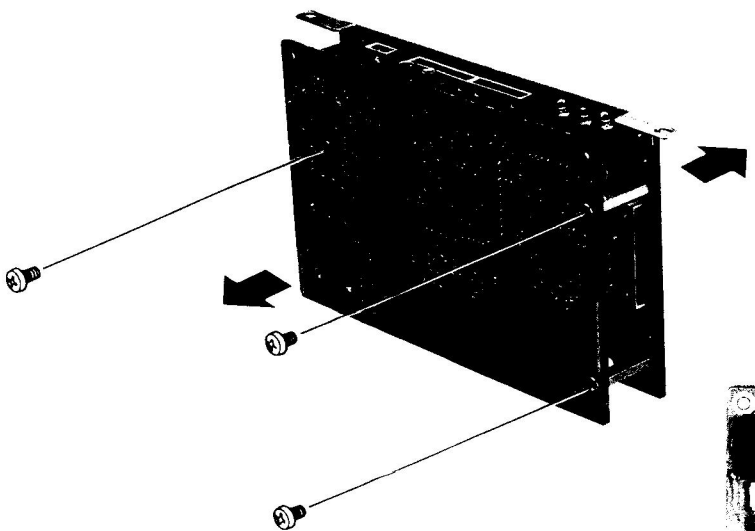
TX PA Unit

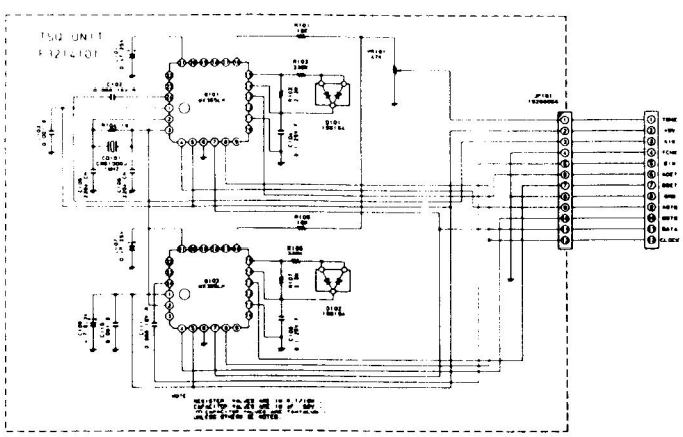
Installing the FTS-22 CTCSS Unit

For CTCSS operation, the optional FTS-22 provides a duplex CTCSS tone encoder/decoder programmable for any one of 39 subaudible tones.

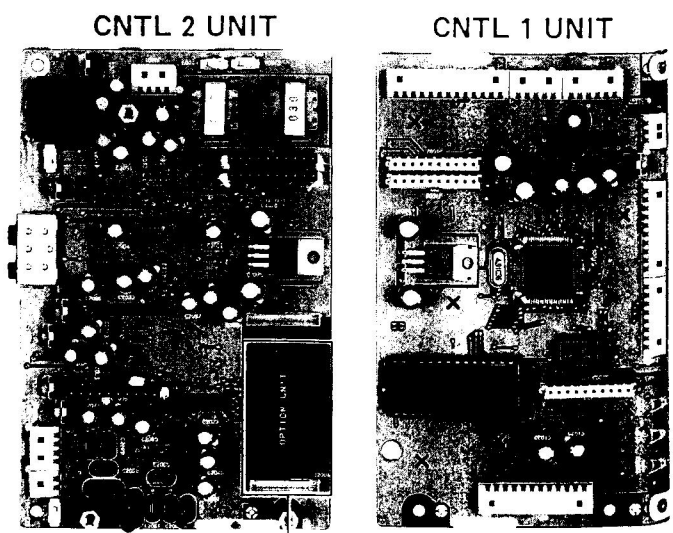
- ❒ To install the FTS-22, first remove the cover and loosen the CNTL Unit card from the chassis as described on the previous pages.
- ❒ Next, after carefully noting the wiring cable plug locations leading to the CNTL Unit board, disconnect all wiring connectors from the CNTL Unit, remove the CNTL Unit card and place it on soft, flat surface.
- ❒ Remove the three small screws affixing CNTL-1 & -2 Units together *from the* CNTL-1 Unit *side*, and carefully separate the two boards. Lay CNTL-2 Unit flat as shown below.
- ❒ Apply the strip of supplied double-sided adhesive tape to the connector side of the FTS-22, then install the unit by aligning the 12-pin connector on the unit with J2004 on CNTL-2 Unit, and gently pressing the unit into place.
- ❒ Carefully realign both CNTL Unit boards, then press them together. Insert and tighten the three small screws.
- ❒ After reconnecting all wiring cables to both CNTL-1 & -2 Units, reinstall the assembled unit card into the repeater chassis.

This completes installation of the FTS-22 CTCSS Unit, refer to the *EEPROM Programming Software Instructions Chapter for further details on CTCSS tone selection.*





Schematic Diagram



FTS-22 CTCSS Unit Installation

Circuit Description

Receive Signal Path

Incoming RF from the RX antenna jack is delivered to the RX Unit and passes through the bandpass filter consisting of coils L4025, L4024 and L4002, capacitors C4105, C4106, C4107, C4007 & CV4001. Signals within the frequency range of the receiver are then amplified by Q4010 (SGM2016). The amplified RF is then bandpass filtered again by CV4002 to ensure pure in-band input to first double-balanced mixer D4003 (DBM0127).

Buffered output from the VCO Unit is amplified by Q4012 (2SC3357) and low-pass filtered by L4012, L4013, C4043, C4045 and C4047, to provide a pure first local signal between 352.1 and 464.1 MHz to the first double-balanced mixer. The 47.9 MHz first mixer product is amplified by Q4017 (2SC3356), then passed through dual monolithic crystal filter (± 7.5 kHz BW) XF-4001 (48L15B1-1), to strip away all but the desired signal, which is then amplified by Q4025 (2SC3356).

The amplified 1st IF signal is then applied to FM IF subsystem IC Q4018 (MC3372D), which contains the 2nd mixer, 2nd local oscillator, limiter amplifier, noise amplifier, and squelch gates. A 2nd L.O. signal generated from 47.445-MHz crystal X4003 produces the 455 kHz 2nd IF when mixed with the 1st IF within Q4018. The 2nd IF then passes through ceramic filter CF4001 (CFW455E) to strip away any unwanted mixer products, and is applied to the limiter amp in Q4018. This removes any amplitude variations in the 455 kHz IF before detection of modulation by ceramic discriminator CD4001 (CDB455C16). The detected audio is amplified by Q4016 (NJM2902M) and delivered to J4002 pin 1 (DISC OUT).

Squelch Control

When no carrier is received, noise at the output of the detector stage from Q4018, pin 9, is sampled and fed to squelch gate Q4022 (2SA1179), VR-4001 adjusts the squelch threshold before delivery to the 3-pole active bandpass filter formed by Q4026 and Q4027 (both 2SC2812), where the audio is high-pass filtered and audio frequencies above 5 kHz are rejected. The noise signal is next amplified by Q4023 and Q4021 (both 2SC2812), then rectified by diode D4004 (1SS226) to produce a DC control voltage for the squelch switch section in Q4024. This resulting DC voltage is amplified by Q4016-4 (NJM2902M). The output of Q4016 is then compared with a 9-V reference voltage at Q4016-3. The open-collector output voltage from analog switch Q4024 (DTC144EK) is delivered to J4001 pin 7 (NSQ DET) and on to microprocessor Q1009 pin 26 (NSQ DET).

Then Q1009 pin 14 (LINE OUT) goes high, turning on analog mute gate Q2001 (NJU4066DM) on Control Unit 2, allowing audio to pass from J2007 (DISC IN) through audio stages discussed earlier (Q2008 and Q2006) to analog switch Q2004 (μPD4052BG).

S-Meter

S-meter signal output from pin 13 of Q4018 (MC3372D) is applied to C4081, where the 455 kHz signal is rejected (filtered), and to buffer amplifier Q4016-2 (NJM2902M) through J4001 pin 1 to CNTL-1 Unit.

CTCSS Operation

CTCSS (Continuous Tone-Coded Squelch System) operation is provided by the optional FTS-22 Tone Squelch Unit when installed at J2004 on CNTL-2 Unit, and programmed via CE-8 Software. The FTS-22 contains a CTCSS tone encoder/decoder for any one of 39 subaudible tones. The CTCSS audio level output from J2004, pin 1 (TONE OUT) is adjusted by VR2006 and amplified by Q2005-1, then low-pass filtered by Q2005-2 (both μPC474162) before injection into the audio chain at Q2003-4.

RX PLL Circuit

PLL circuitry on the RX unit consists of PLL subsystem IC Q4014 (MC1415190F), which contains a reference oscillator/divider, serial-to-parallel data latch, programmable divider, and a phase comparator. Stability is obtained by a regulated 5-V DC supply via Q4001 (TA78L05) to Q4011 (DTA143EK) and

temperature-compensating capacitors associated with the 12.8-MHz frequency reference crystal X4002 (GFS-720).

RX Unit VCO Q5501(2SK508) oscillates between 352.1 and 464.1 MHz according to the programmed receiving frequency and repeater version type (see chart on page 1-2). A sample of the VCO output is amplified by Q4015 (2SC3356) and returned to the prescaler/swallow counter in Q4014. There the VCO signal is divided by 64 or 65, according to a control signal from the data latch section of Q1009 on CNTL-1 Unit, before being applied to the programmable divider section of the PLL chip.

The data latch section of Q4014 also receives serial dividing data from microprocessor Q1009 on CNTL-1 Unit, which causes the pre-divided VCO signal to be further divided by 28,168 ~ 46,410 in the programmable divider section, depending upon the desired receive frequency, so as to produce a 10-kHz or 12.5-kHz derivative of the current VCO frequency. Meanwhile, the reference divider section of Q4014 divides the 12.8-MHz crystal reference by 1280 (or 1024) to produce the 10-kHz (or 12.5-kHz) loop reference (respectively).

The 10-kHz or 12.5-kHz signal from the programmable divider (derived from the VCO), and that derived from the crystal are applied to the phase detector section of Q4014, which produces a dual 5-V pulsed output with pulse duration depending on the phase difference between the input signals. This pulse train is then converted to DC, low-pass filtered, then fed back to varactor diodes D5501, D5502, on the RX Unit.

Changes in the level of the DC voltage applied to the varactor diodes affect the reactance in tank circuit VCO Q5502, changing the oscillating frequency according to the phase difference between the signals derived from the VCO and the crystal reference oscillator. The output of receiver VCO Q5501, after buffering by Q5502, is delivered for amplification by Q4013 (2SC3356) before application to the first mixer, as described previously.

Transmitter

Transmitter VCO Q5001 (2SC508) oscillates between 400 and 512 MHz according to the programmed TX frequency. The theory of operation of the remainder of the PLL circuitry is similar to that of the RX VCO unit. However, dividing data from the microprocessor is such that the VCO frequency is the actual transmit frequency (rather than offset for IFs as in the receiving case).

IDC-processed speech audio from CNTL-2 Unit is pre-emphasized by C2010, R2006 and Q2002-4 (μPC4747), before application to the TX VCO. Speech audio is delivered to diode D5003 (1SV229) from Control Unit 2, frequency modulating the PLL carrier up to ± 5 kHz from the unmodulated carrier at the transmitting frequency. DCS modulation from CNTL-2 Unit is low-pass filtered by Q3001 (NJM2904M), then applied to both the VCO and to the PLL frequency reference, via crystal oscillator unit X3001 (GFS-720). The modulated signal from the TX VCO unit is buffered by Q5002 (2SC3356) and Q3005 (2SC3356), then passes through buffer-amp Q3007 (2SC3356). The signal then enters RF diode switch D3004 (HSU277) and amplifier Q3011(2SC3357). The signal level is then attenuated before delivery to the PA Unit. The low-level transmit signal passes through buffer amp Q6001 (2SC23357) before being applied to pre-driver amplifier Q6002 (MRF559). The transmit signal is finally amplified by PA module Q6003 (M57729) up to 25 watts. Harmonic and spurious radiation in the final output is suppressed by a 5-pole low-pass filter formed by inductors L6008, L6009 and L6010 and capacitors C6016, C6017, C6018, C6019 and C6020 on the PA unit, before delivery to the TX antenna jack.

APC (Automatic Power Control)

RF power output from final amplifier Q6003 (M57729) is sampled by C6023 and delivered to detector diode D6003 (1SS319) where it is rectified. The resulting DC voltage (DET) is delivered to the REG Unit. There the APC voltage is fed through buffer amplifier Q7003-1 to comparator Q7003-4 (both NJM2902M) where the voltage is compared with a reference voltage from the CPU (POWER REF) to produce a control voltage to

the Automatic Power Controller Q6005 (2SB1134R), which regulates supply voltage to RF power module Q6003, to maintain stable high or low output power under varying antenna loading conditions.

If a CTCSS tone is enabled for transmission, the sub-audible tone from the CTCSS unit on the CNTL Unit is low-pass filtered, then mixed with the IDC-processed speech audio.

CNTL-1 Unit

CNTL-1 Unit consists of 8-bit microprocessor Q1009 (M38063EGP), 256-kByte EPROM Q1016 (AM27C256), EEPROM Q1002 (BR93C56), and various analog switches. Microprocessor operational code is stored in Q1016, while channel and optional data, and repeater configuration information, is programmed from an external computer at 4800 bits/sec. connected to J2009 on CNTL-2 Unit, and stored in Q1002.

The output from microprocessor Q1009 contains three-line serial control data (DATA, CLOCK & ENABLE) used for repeater/base mode control, TX and RX PLL data, and to control analog switch Q2001 (NJU4066-BM) on CNTL-2 Unit.

Crystal X1001 oscillates at 4.9152 MHz, and provides stable clock timing for the microprocessor. When the repeater is powered on, the voltage at pin 71 becomes stable, and the output of voltage detector IC Q1017(Q1009 pin 25- RST) becomes high, resetting the CPU and initializing it for operation.

First, the CPU performs an initialization routine which loads the operating program from RAM, and frequency and other system data from Q1002. The CPU then sends PLL and analog switch control data (J1001 pins 2, 3, & 4; and J1002 pins 2, 3 & 4), to prepare the repeater for operation. If an abnormal signal (such as PLL unlock or HI TEMP) is detected at pin 2 or pin 6 of the CPU, CPU pin 12 becomes low, inhibiting transmission by disabling the TX voltage rail.

Watch-Dog Timer

Watch-Dog Timer Q1018 (MC74HC4060F) monitors the CPU for thrashing. When abnormal CPU operation occurs, Q1009, pin 70 goes low, pulling diode OR gate Q1007, which in turn enables the pulse train generated by Q1018 to be input to pin 12.

Q1018, pin 1 then outputs a control pulse to transistor driver Q1019, which in turn switches the output of 5-V DC regulator Q1017 low, resetting microprocessor Q1009 at pin 25.

Three LEDs are used on CNTL-1 Unit for TX, ALARM and AC indications. The TX LED indicates the repeater is transmitting, the ALARM LED warns of four possible conditions: PLL unlock (TX & RX), high final amplifier temperature, EEPROM programming data loss and microprocessor thrashing.

CNTL-2 Unit

CNTL-2 Unit contains most of the analog switching gates used to control the various repeater interconnections. RX & TX speech audio is processed here.

Base Operation (TX, line-input audio)

Line input from J2001 pins 3 & 4 is impedance matched by transformer T2001, then delivered to analog switch Q2004 (μPD4052BG). Line level can be attenuated by switch S2003 and line sensitivity can be adjusted –10 dB ±10 dB by potentiometer VR2001 to compensate for audio line level variations. Part of this audio is amplified by Q2002-1 (μPC4741G2) for local speaker output.

Line audio then passes through analog switch Q2001-1 (NJU4066BM) where the audio is pre-emphasized (+6dB/octave) by C2010 & R2006. The audio then passes through IDC (instantaneous deviation control) amplifier Q2002-4 & Q2002-3 (both μPC4741G2). Potentiometer VR2002 sets maximum deviation. The signal is then amplified by Q2003-4 before passing through the 5-section active low-pass filter formed by Q2003-1 and Q2003-2, where frequencies

above 3 kHz are attenuated and bandwidth is limited to prevent over-deviation.

The CTCSS Tone audio level output is adjusted by VR2006 then delivered to Q2002-3 and the transmitter line input.

Modulated audio from the Rx unit is delivered to J2008-1 where it is fed through int/ext audio select switch S2002 to Chebyshev Filter Q2008-3 (NJM2902M) and then high-pass filtered by R2118 and R2146. The output is then delivered to five-section, active high-pass filter Q2008-1 which rejects audio frequencies below 300 Hz. 3-pole active low-pass filter Q2006-3 rejects audio tone frequencies above 3000 Hz. Audio is then de-emphasized by Q2006-2 (μPC4741G2) and R2043 & C2036, providing a flat audio response from 300 Hz ~ 3 kHz. The filtered audio signal then passes through attenuator S2004 and line output level potentiometer VR2003 to buffer amplifier Q2006-4 (μPC4741G2) and impedance matching transformer T2002 to line output jack J2001 pins 1 & 2.

Repeater Operation

Duplex Operation

The demodulated audio is delivered from the RX unit to Q2008 and is high-pass filtered and de-emphasized as described above. Repeater "sensitivity" is adjusted using VR2005 before delivery to Q2005 (μPC4741G2) via repeater switch S2001-3. When the repeater mute switch Q2001-4 is closed, the gain of Q2005 is reduced to 0, effectively muting repeater audio. Repeater audio deviation is controlled by potentiometer VR2004 before the signal is delivered to audio amplifier Q2003-4, where the signal is processed in the same manner as previously described.

Intercom Function

Inserting a standard speaker/mic headset into the INTERCOM jack (J2010) provides closed-loop audio for test/communications with an installed remote base, for use by service technicians.

Inserting the headset into the jack disables speaker audio via J2002, pins 1 & 2. Headset microphone audio is delivered to buffer amplifiers Q2007-3 and Q2007-4 (both NJM2902) before application to line audio selector Q2004.

Power Supply

The power supply includes the power transformer and bridge rectifier D0002 (S25VB20) on the chassis, a filter capacitor bank on the CAPA Unit, and various regulation and switching circuitry on the REG Unit.

AC power is applied to the primary of T0001 through fuse FH0001 and relay RL0001. The 16.5-V AC at the secondary is the dual-fused by FH0002 and FH0003 before delivery to full-wave bridge rectifier D0002 and the CAPA Unit.

The output of D0002 is filtered by capacitor bank C8501 and C8502 and the resulting DC is applied to the collectors of Q7002 and Q7004 (both 2SD1842Q) on the REG Unit, and regulator IC Q7013 (FMW1). The control output of Q7103 is applied to the base of Q7007 (2SB1134R), the emitter of which then controls the bases of Q7002 and Q7004, thus highly regulating the voltages at the emitters. This output voltage is delivered through relay RL7001 (FBR631D012) and fuse FH7001 to supply the 13.8-V DC bus for the rest of the repeater. A sample of the 13.8-V DC from the pass transistors is also delivered to 9-volt regulator IC Q7001 (AN6541) to provide a regulated 9-volt output for repeater circuitry that requires it.

While operating from the AC power, regulated 13.8-V DC is fed through R7004 and D7002 (1SS226), providing a trickle charge for a battery that might be connected. If the AC power source is interrupted, the DC current from the battery then flows back through Q7016 (2SC2812), RL7001 and the DC fuse, which is now switched (when AC fails) to bypass R7004 and D7002, and apply full battery voltage directly to the DC bus.

EEPROM Programming Software Instructions

To program the Vertex VXR-5000 repeater, you will need the VPL-1 connection cable, programming diskette and an IBM PC/AT or PS/2 -compatible type computer with:

- ❒ at least 512 K RAM
- ❒ PC DOS or MS DOS 2.0 or later
- ❒ one 5-1/4" (360 K or 1.2 MB) floppy drive
- ❒ a monochrome or color monitor
- ❒ one serial port (COM 1) with 25-pin connector (or suitable 9-pin adapter).

Of course you also need a printer if you want to get hard copy of the data.

The Vertex programming diskette contains the following files:

- ❒ CE8.EXE - The EEPROM programming program
- ❒ CE8.HLP - The help file used by the main program
- ❒ INSTRUCT.DOC - A text file containing a copy of these instructions (in case you mislay these instructions)

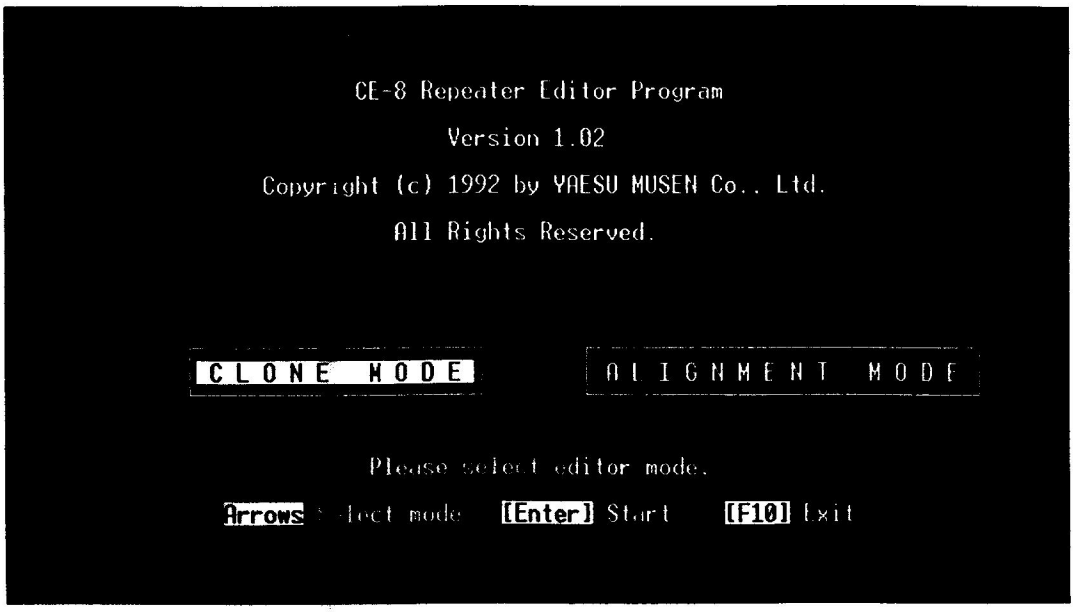
Before connecting the repeater for programming, turn off your computer and the repeater, and connect the VPL-1 programming interface cable to the computer and repeater as shown below. Then restart the computer. Turning off the equipment during interconnection avoids damage to the electronics.

When ready to run the program (after booting DOS), place your copy of the Vertex diskette (not the original!) into drive A, and log on to this drive (type A:Enter). Then type CE8 -A Enter to start the program. You should be greeted briefly by an introductory screen, as shown at the top of the next page. Depending on which data you will be editing in the VXR-5000, you may have to add a different software "switch" to the command line, see the the next page for details.

Important!

Do not work directly with the CE-8 programming diskette! Make a copy of it and use the copy when programming the repeater, since you will be storing data on it. Keep it in a safe place in case you need to make another copy of it later. The manuals that come with your computer should explain how to make a copy of the diskette, using the DOS COPY command. If you want to be able to boot your computer from the programming diskette copy, use the FORMAT command with /S parameter (on a blank diskette) to make a system disk, and then copy the files from the original diskette.

VXR-5000 Programming Setup



CE-8 Introductory Screen (using "-A" switch)

The Programming Screen

The introductory screen (above) prompts you with a choice of "CLONE" or "ALIGNMENT" selections. Clone mode is used to program operating and repeater hardware information (such as channel data, TX/RX frequencies, IF parameters, etc).

The alignment mode is used to change I/O parameters that affect repeater/base station configuration (i.e. remote control, tone squelch settings), and when servicing the repeater (to adjust power output).

For now you will want to start with the CLONE mode. Use your ← → arrow keys to select the appropriate mode and press the Enter key to begin.

CE-8 Software "Switches"

When booting up the CE-8 software, remember that the switch appended to the command line determines which repeater parameters can be viewed and edited via software. There are three "switch" combinations, as follows:

CE8 **-A**: Selectable Clone or Alignment Mode. Environment Settings (I.F., injection, channel steps, etc.) *cannot* be changed.

CE8 **-P**: Clone Mode only, Environment Settings can be edited.

CE8 : Clone Mode only, Environment Settings *cannot* be edited.

Main Screen Display (Clone Mode)

The main screen for the CLONE mode includes five major edit items: Environment, Frequency, Timer, Setup, & Option, and, along the bottom of the screen, Function Key Selections. These are described in a bit more detail next.

Main Screen Edit Items

Each edit item at the top of the screen can be selected by using the keyboard (← → arrow) keys, edit programming selections will appear below in the center frame on the screen.

Edit Items

To choose a specific selection for data entry, press the ↑↓ arrow keys to highlight the selection to be edited. If you get lost at any time, the box beneath this screen lists the appropriate keys needed for data entry and toggling item selections. To leave the programming selections at any time to return to the edit items, simply press Esc.

VXR-5000 — **Simplex Base**
Duplex — **Repeater**
Duplex Base

A brief explanation of the five main screen edit items follows:

Environment

Contains operating parameters used by hardware (circuitry) in the VXR-5000, including 1st IF selection, L.O. Injection Side, and Channel Step information. This information is hardware-specific for the repeater version you have, and should not need to be changed, except in the event of hardware or version modification. Changing environment parameters requires the CE8 -P extension when starting the program.

Frequency

Contains channel data information. Up to eight individual Tx and Rx channel frequencies are edited here, and channels can also be locked out, if desired.

Timer

Repeater Time-Out Timer, TX Hang-Timer and Penalty Timers are edited from these selections, time values in seconds or minutes can be entered, while others preset values can be toggled on-off.

Setup

System operating configuration and parameters such as simplex/duplex operation, power output on auxiliary DC power, Hi-Temp power reduction, alarm beeper and TX Hang-Time audio selection are selected and edited here.

Option

CTCSS Tone Encode/Decode frequency selection can be made. One of thirty-nine EIA standard CTCSS tones can be programmed for each channel (TX & RX). CTCSS operation can also be disabled completely for individual or all channels.

Sub Help Messages

In the box below the editing selection are Sub-Help Messages. These briefly instruct you how to select items, enter channel data, toggle default settings on/off and accept changes. New messages automatically appear pertaining to the edit menu and edit item currently selected. Instructions such as frequency entry format, time values and ranges, and keys used to toggle or increment/decrement a setting are given here.

Sub-Help Messages

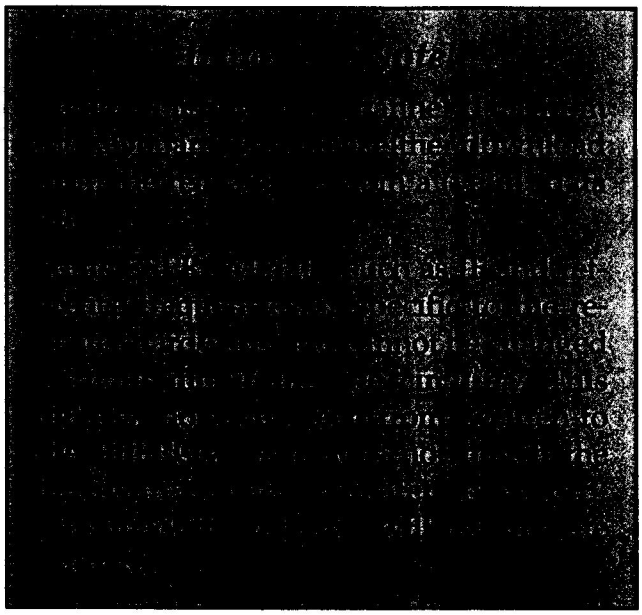
Function-Key Help Messages

At the bottom of the screen appears Function-Key selections and their corresponding functions. While the Main Edit Item Screen is selected, F1-Help, F2-Print, F3-Upload, F4-Download, F5-Disk Load, F6-Disk Save, F7-Dump and F10-Exit appear showing options available for this screen. When individual programming selection is done, only three options (F1-Help, F2-Print and F10-Exit) are available.

What to do First

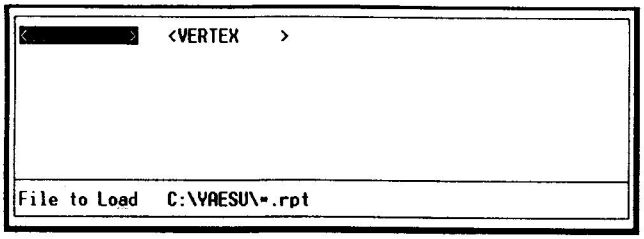
Reading data from the Repeater

If you have the repeater connected to the computer, first download the data from the repeater and save it to disk before doing anything else. Press the F4-Down Load key to do this, and follow the prompts. If an error message is displayed when attempting to download data, check the VPL-1 connection cable and connectors at both the computer and repeater. After downloading the data from the repeater, save it to disk right away as described next in *"Saving Data to Disk"*.



Loading Data from Disk

If no repeater is connected to the computer and you just want to view or edit data file already on disk, press F5-Disk Load. A window similar to that below appears, asking for the name of the file to load, which must be the name of a channel data file already on the disk.



There are no such files provided on the original diskette (you must first download data from the repeater, and save it).

If an error message appears during the loading, either no file could be found on the disk with that name, or the file data was corrupted since the last time it was stored. If the data was corrupted, you will have to build a new file from scratch, or enter another file name. We suggest you erase any corrupted files from the disk to avoid confusion. Just enter DEL filename.rpt Enter from the DOS prompt (substituting the name of your file for *filename*).

Editing Repeater Data

After loading data from a repeater or a data file, you are ready to edit it. Just move the cursor from one field to another, and enter the new data as desired. Refer to the Sub-Help messages and Function-Key functions as you go along. You can always press the F1-Help key for additional help on each field, as needed. The CTCSS decoder/encoder field (under the Option menu) will allow you to choose tone frequencies from a selection table, shown later.

When you have entered all of the channel and operating data as desired, we recommend that you first save it to disk before uploading it to the repeater.

Saving Data to Disk

You can save data to a disk file at any time by pressing the F6-Disk Save function key. A file list window like that illustrated for Disk Load will appear. Remember that you must save a file if you have just edited data and want to see it again later, but we also suggest you do this whenever you have downloaded from a repeater (so you can restore it if a problem develops later). You will be asked for a file name to save to. This can be any valid DOS file name, but we recommend you choose a name that you will be able to recognize easily later, and be careful not to select a name that already exists.

Sending Data to the Transceiver

After editing data and saving it to a file on disk, you can upload to a repeater, if connected. If the cables are not connected, however, you should press F10 - Exit after making sure you have saved any edited data to a file, and then turn off the computer to connect the cable and repeater. Then turn the computer back on, restart the program, reload the saved file from disk (F5-Disk Load), and press function key F4-Download. Follow the prompts on the screen (pressing the spacebar starts the download). If an error message is displayed when attempting to download, check your cables and connections carefully. Any key returns you to the Main Menu where you can try again, if necessary. To program another repeater with the same data, you can change the cable connection without having to reboot and start the program again.

Listing Data to Screen or Printer

To get a printed copy of a set of data, or to view data without making any changes, press F2-Print from the main screen. To print a displayed page on the printer if you have a PC keyboard with the Print Screen key also serving as an asterisk key, press Shift and Print Screen together. Other types of keyboards have an enhanced AT key that must use the Print Screen key.

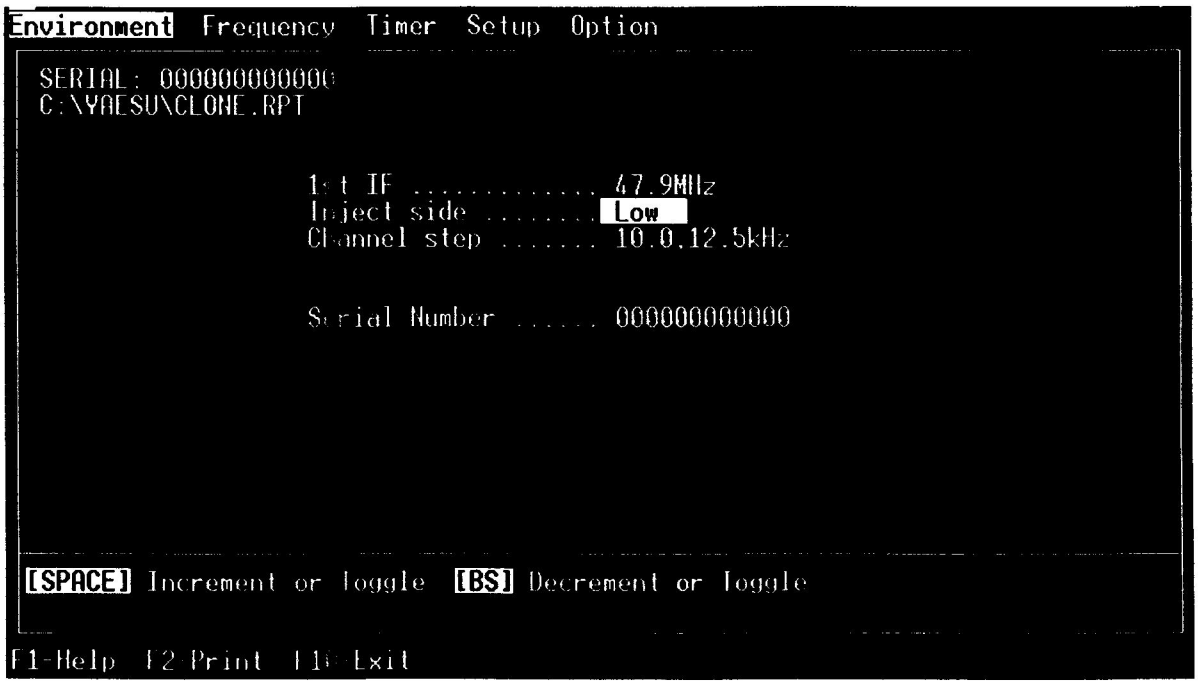
Editing Common Data

Environment Data

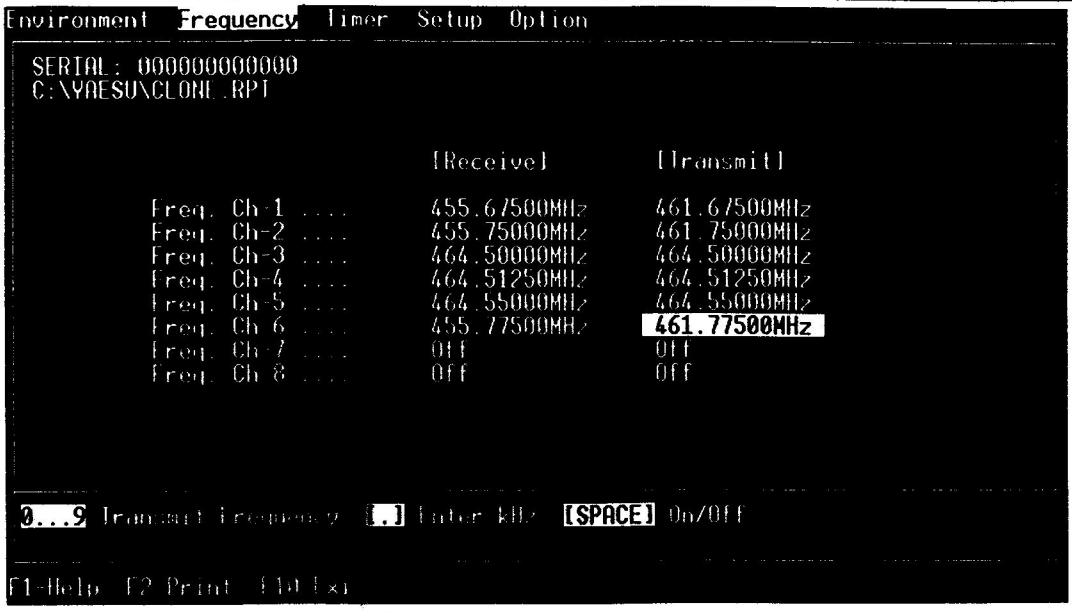
Environment Data (most of which cannot be changed without changing the hardware), can be viewed by entering the first Main Menu item. These parameters are stored in EEPROM along with the changeable parameters, but they must match the circuitry of the repeater being programmed.

Remember to be careful whenever editing this data as *entering an incorrect IF frequency or Injection Offset will render the repeater non-operational.* To change any of the environment parameters, you must restart the program with the -P switch ("CE8 -P").

- **1st IF** - should be set to 21.6 MHz for VHF versions, 47.9 MHz for UHF. Do not alter this setting unless making hardware changes.
- **L.O. Injection**- selectable upper/lower offset determines the local oscillator injection. Can be changed to improve intermodulation performance in urban areas or high RF environments. Do not alter this setting, as receiver re-alignment is necessary.
- **Channel Steps**- determine the minimum channel step size. Select 5 kHz, 6.25 kHz, 10 kHz, or 12.5 kHz, according to your spacing requirements.
- **Serial Number** - up to 12 digits can be entered here to identify the repeater being programmed. We recommend entering the VXR-5000 identification code found on the side panel of the repeater cabinet for easy future reference.



Repeater Environment Window (using " -P" switch)



Channel Editor Window

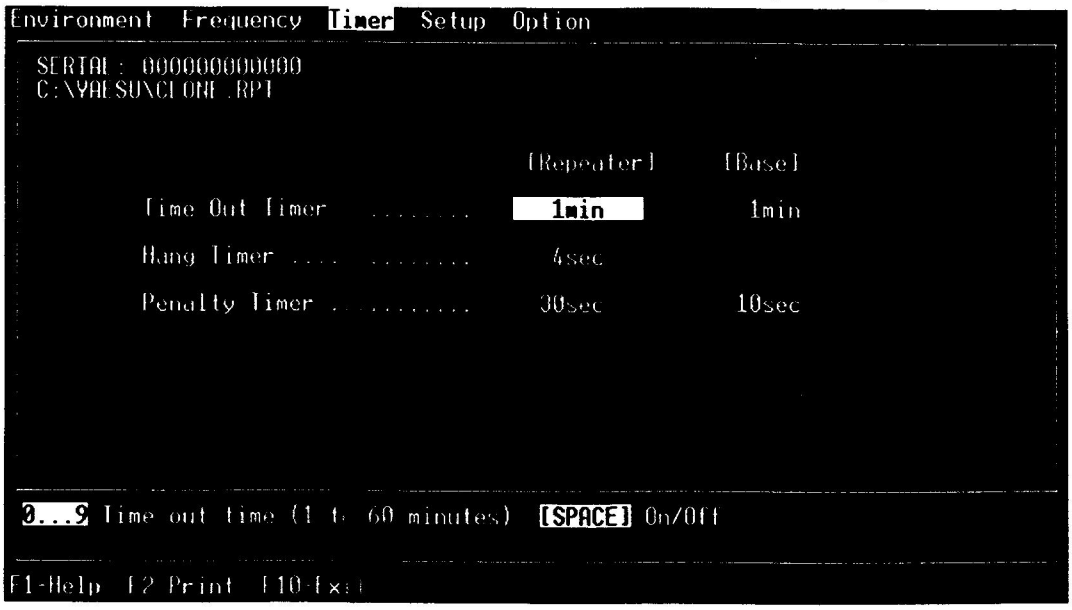
Frequency

Channel data (TX and RX) must be entered individually for channels 1 ~ 8, as shown above. Channels are enabled/disabled by toggling the SPACE bar. Frequencies are entered using the numeric keypad or top-row keys. Up to eight digits can be entered and displayed. However, frequencies will be rounded to the nearest channel-step (as set in the environment window). Confirm that the frequencies entered are within the operating range of the repeater version you are programming.

Timer

Time-Out Timer, Hang-Timer and Penalty-Timer settings for both repeater and remote-base operation can be edited in this menu (shown below). These affect overall system operation, and therefore should be configured according to user requirements.

- **Time-Out Timer** - this selects a maximum time period for continuous transmission (1 ~ 60 mins.), or is disabled by pressing the SPACE bar.
- **Hang-Timer** - this controls how long the repeater will remain keyed after a transmitting station's carrier drops (stops transmitting). Hang-Time can be adjusted



Timer Settings Window

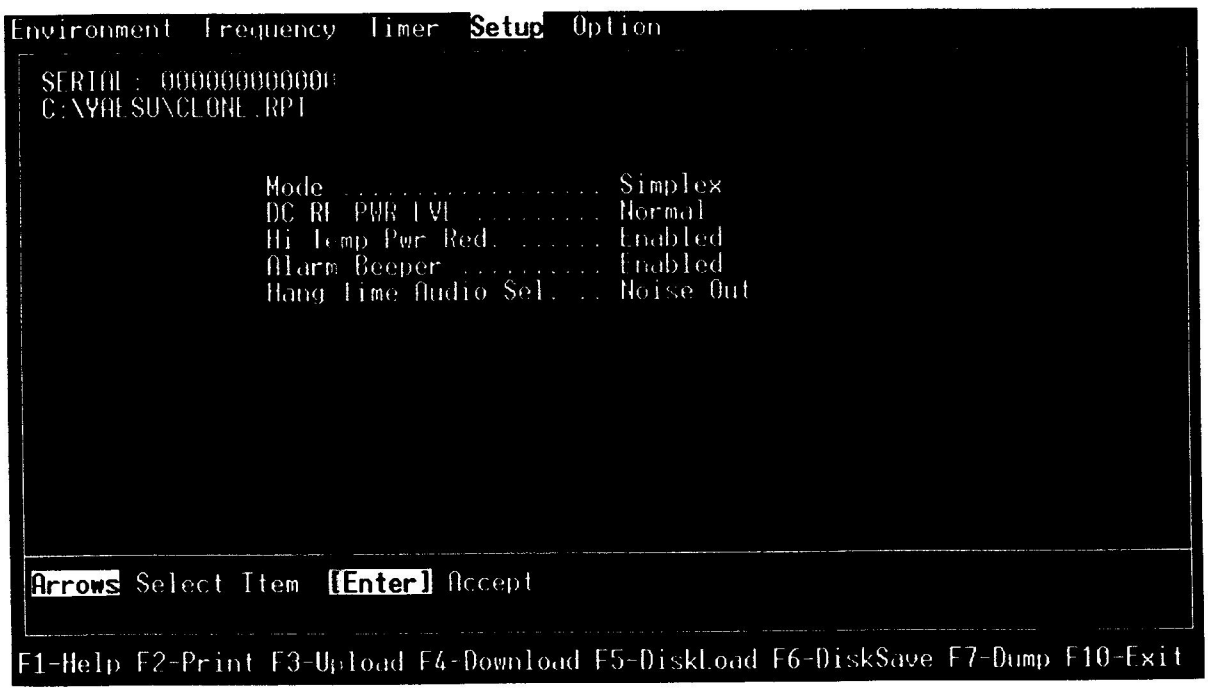
from 1 ~ 60 secs. or disabled by pressing the SPACE bar.

- **Penalty-Time** - this determines the repeater "dead"- or penalty-time after the Time-Out Timer has expired before any station can access the repeater again. Timer is adjustable from 10 ~ 360 seconds.

Set Up

The following repeater system operation can be programmed according to user requirements from this menu:

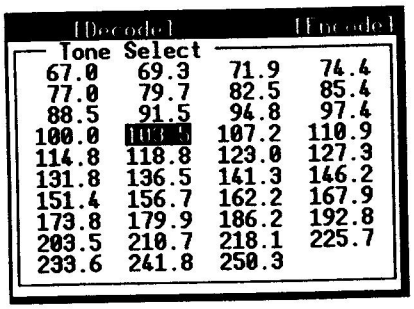
- **Mode** - Use the SPACE bar to toggle between Simplex or Duplex operation.
- **DC RF PWR LVL** - When operation shifts to an auxiliary DC power source, selecting low power results in TX power automatically switching to low power to extend operation time under battery power. Normal selection retains TX power at the default power setting (as set in the alignment mode).
- **Hi Temp Pwr Red** - This feature automatically monitors repeater TX power amplifier temperature, and, if safe operating temperatures are exceeded, reduces TX output power (or disables the transmitter) to prevent damage from over-heating.
- **Alarm Beeper** - Enables/disables the Alarm beep tone about 30 secs. before the Time-Out Timer is about to expire.
- **Hang-Time Audio Sel** - Determines if channel audio (noise) will be heard during TX hang-time (repeater keyed with carrier not present). With *Quiet* selected, receiver audio will remain squelched, *Noise-Out* enables open-channel noise (muted –10 dB) to be heard. Use the SPACE bar to make a selection.



Repeater System Configuration Setup

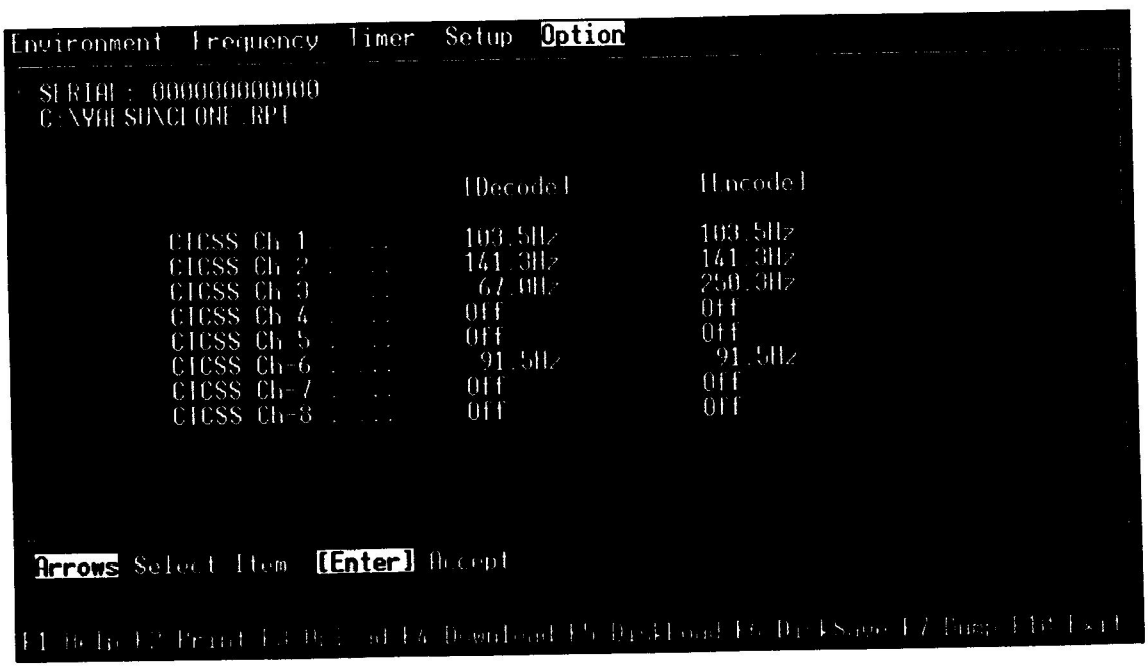
Option

CTCSS tone encode/decode options are selected in this menu. Toggling the SPACE bar enables/disables the encoder/decoder for each channel. CTCSS tone frequencies can then be entered numerically (if the exact frequency is already known), or else selected from a standard tone table by pressing Enter and using the ← → arrow keys to select the desired EIA-standard tone.



CTCSS Tone Selection Window

This completes operational and programming information for the CLONE mode, for repeater internal system alignment and monitoring I/O (input/output) status, proceed with the ALIGNMENT mode covered next.



Option - CTCSS Entry Window

Alignment Mode

This mode is selectable from the introductory screen as selected with the "-A" switch from DOS (type A: CE8 -A Enter), forgetting the "-A" switch permits opening the CLONE mode only. The Alignment Mode enables you to view current repeater I/O status and adjust repeater output power level during battery operation. Two items are selectable here: Status and Alignment (see the full-screen display at the bottom of the next page).

Repeater System Status Display

This window displays three areas: Alarm, Logic In and Logic Out. Note that these parameters cannot be modified, only viewed. Along the bottom of the screen, Function Key selections appear as before. After pressing Enter, a different function key submenu will appear, as shown below.

Alignment Mode Sub-Menu

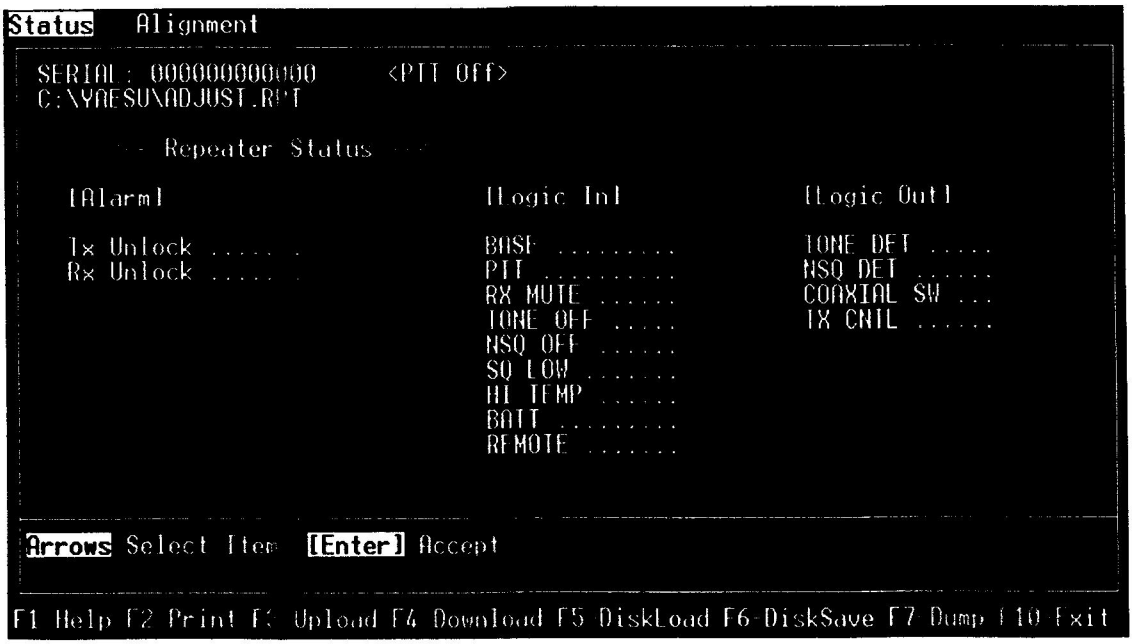
To monitor the present I/O status of the repeater, press F4. An "Accessing Repeater" message appears briefly as the I/O data is loaded, then all parameters are displayed. This feature is useful for network monitoring, confirming system programming changes, or to assist in troubleshooting in the event that an repeater system alarm is received.

Repeater System Status Parameters

The following table provides brief explanations of system I/O parameters:

VXR-5000 System Parameters

Parameter	Indication	Comment
[Alarm]		
Tx Unlock	Normal / Unlock	TX PLL state
Rx Unlock	Normal / Unlock	RX PLL state
[Logic In]		
BASE	L - base H - rptr	Mode of Operation from pin 13, BASE
PTT	L - tx H - rx	TX keyed from pin 12, PTT
RX MUTE	L -muted H - unmuted	Line audio from pin 19, RX MUTE
TONE OFF	L - off H - on	CTCSS Audio Off from pin 17, TONE OFF
NSQ OFF	L - off H - on	Noise Squelch Off from pin 10, NSQ OFF
SQ LOW	L - low H - high	Squelch Status from pin 20, SQL LOW
HI TEMP	L - norm. op. temp. H - hi-temp. condition	PA Unit High Temp from Thermal Sensor
BATT	L - Battery Operation H - AC Operation	Aux. Battery Oper.
REMOTE	1 - 8	Channel of Operation from pins 21-23, REMOTE D0, D1, D2
[Logic Out]		
TONE DET	L - none H - tone detect	CTCSS Tone Receive
NSQ DET	L - close H - open	Noise Squelch
COAXIAL SW	L -relay de-energized H - relay energized	Antenna Relay from pin 9, COAX SW
TX CNTL	L - rx H - tx	Logic Output from pin 18, TX



Repeater System Status Window

Power Alignment

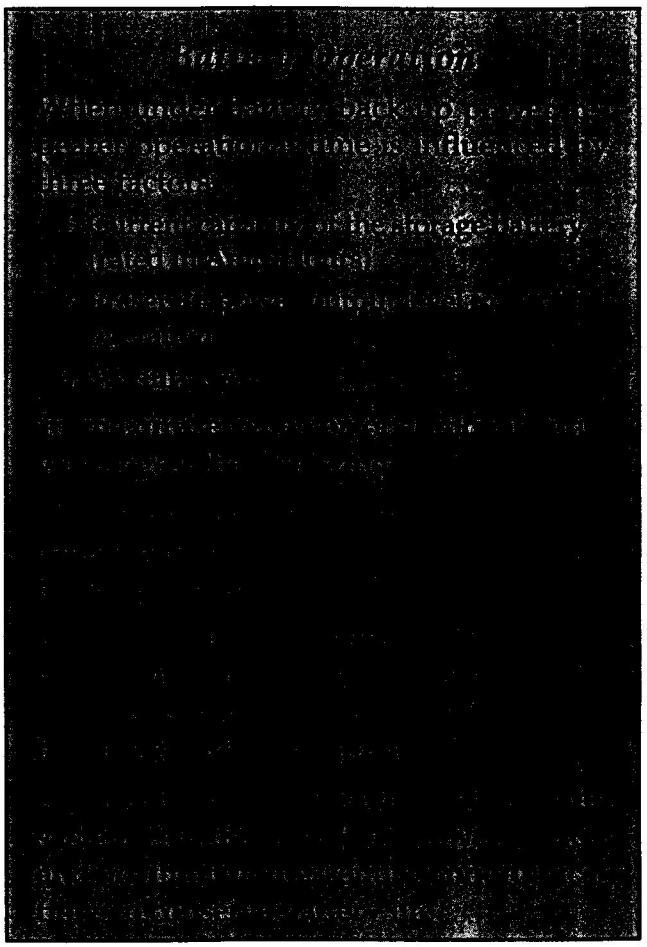
When enabled from the CLONE mode, transmitter RF output automatically switches to a reduced level as soon as operation switches to DC (battery) power. In addition, continued transmit capability during a high-temperature condition (HI TEMP) *at reduced power* is possible if this setting is enabled. In either case, the reduced RF power level is set in the alignment mode.

From this window you can view or adjust reduced RF power output level as described above, and the normal RF output power level. Two bargraphs show each RF power output for comparison, along with a discrete power level calibration value (0-255) displayed above the graph (see display at page bottom).

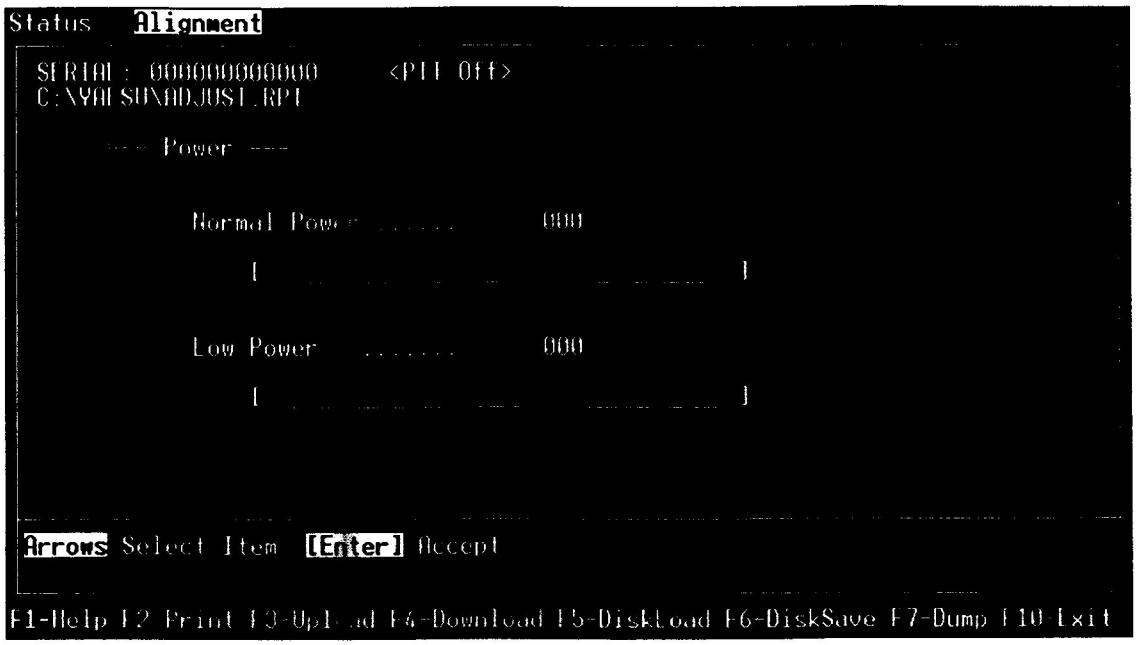
To change either level, press Enter to bring up the function-key sub-menu.

Power Alignment Sub-Menu

Use the F6 & F7 keys to adjust the desired power level, or else you can enter a discrete level from 0-255 using the keyboard and pressing Enter.



To manually key the transmitter, press F3. You can do this now, with a wattmeter connected to the **TX ANT** jack to check actual power against the software reference level. You will also need to do this as part of the transmitter alignment step in the *Alignment* Chapter, covered later.



Alignment Power Settings Window

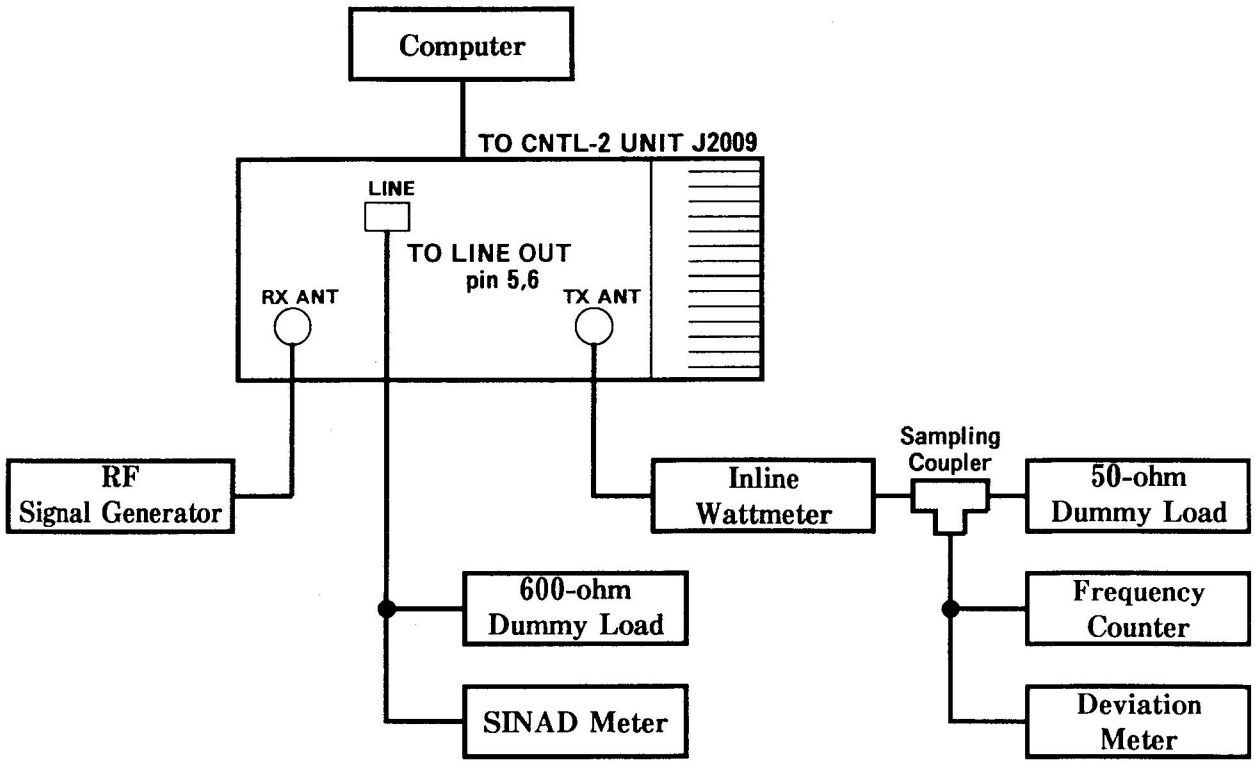
Alignment

The VXR-5000 has been factory aligned for the specified performance across the entire operating frequency range. Realignment should not be necessary except in the event of a component failure. All components replacement and service should only be performed by an authorized Yaesu service representative, or the warranty policy may be voided.

Required Test Equipment

- ❒ IBM PC/compatible computer
- ❒ Yaesu CE-8 Channel Programming Diskette and VPL-1 connection cable.
- ❒ RF Signal Generator with calibrated output level at 1000 MHz.
- ❒ Deviation Meter (linear detector)
- ❒ Oscilloscope
- ❒ AF millivoltmeter
- ❒ SINAD Meter
- ❒ In-line Wattmeter with 5% accuracy at 1000 MHz.
- ❒ Regulated DC Power Supply adjustable from 10 to 17-V DC, 15 A.
- ❒ 50-Ohm, non-reactive Dummy Load: 100 W @ 1000 MHz.
- ❒ Frequency Counter ± 0.2 ppm accuracy at 1000 MHz
- ❒ AF Signal Generator
- ❒ DC Voltmeter: high input impedance
- ❒ Spectrum Analyzer
- ❒ UHF Sampling Coupler

Before alignment, connect the VPL-1 connection cable to the repeater and PC as described in the *EEPROM Programming Software Instructions* chapter, and download the



Alignment Setup

EEPROM data from the transceiver to the computer. Then store this data in a file so that it can be uploaded when alignment is finished.

Next, using the CE-8 Channel Editor and referring to the table below, program band-edge channels 1, 2 and 3 according to version. Ensure REPEATER operation is enabled via software, then set these three channels to duplex, and turn off any tone settings for these channels. Download this data to the repeater.

VERSION	LOW BAND-EDGE CHANNEL (1)	BAND CENTER CHANNEL (2)	HIGH BAND-EDGE CHANNEL (3)
C	430	440	450
D	450	460	470
E	470	480	490
F	490	510	512

Note: When finished with alignment, be sure to reload the original channel data from disk, and upload it back to the repeater.

Before beginning the alignment, preset the controls and switches as follows:

- ❒ VR2001 - VR2005: centered, 12 o'clock position
- ❒ L4002, L4003, L4005, L4011, L4013, L4015 T4001, T4002: flush with the top of the coil form
- ❒ VR7071: centered
- ❒ VR4001: fully clockwise
- ❒ S2001: OFF
- ❒ S2002: INT
- ❒ S2003 & S2004: LOW
- ❒ pin 10 of ACC connector to GND

Power Supply Voltage

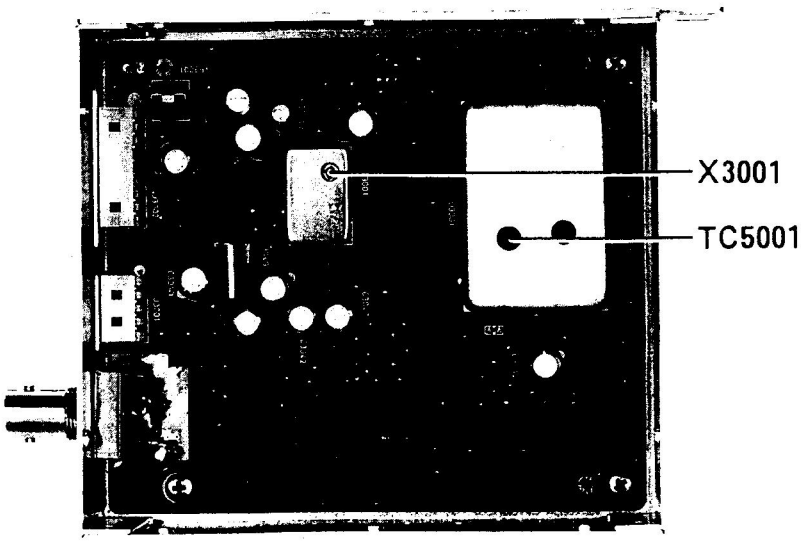
- ❒ Connect the positive (+) lead of the DC voltmeter to P7001 on the REG Unit, and negative (–) to P7002, then adjust VR7001 for 13.8 ± 0.1-V DC.

Transmitter

- ❒ Set up the test equipment as shown below for TX alignment. Adjust the supply voltage to 13.8-V DC (as above) for all steps.

VCV Adjustment

- ❒ Select the high band-edge channel, connect the DC voltmeter between VCV land and GND on the TX Unit. Then key the repeater and adjust TC5001 on the TX VCO Unit for 7.5-V DC.
- ❒ Connect a frequency counter to the **TX ANT** jack via a sampling coupler (attenuator pad), key the transmitter and adjust X3001, so that the TX frequency is within ±150 Hz of the programmed TX frequency.



TX Unit Alignment Points

RX Unit

Refer to the bottom of the page for receiver alignment points.

VCV Adjustment

❒ Set the channel to the high band-edge, then connect a DC voltmeter between VCV land and GND on the RX Unit. Adjust TC5501 on the RX VCO Unit for 7.5-V DC.

Sensitivity Adjust

❒ Inject a 0 dBμ signal modulated with a 1 kHz tone at 20 mVrms and 5 kHz deviation to the **RX ANT** jack.

❒ Adjust L4003 & L4009 for maximum SINAD indication.

❒ Repeat the above step several times.

❒ Increase the SG output level +40 dBμ, then adjust T4001 and T4002 for minimum distortion level on the SINAD meter.

TX Output Power

❒ Connect a dummy load wattmeter to the **TX ANT** jack.

Full Power Set

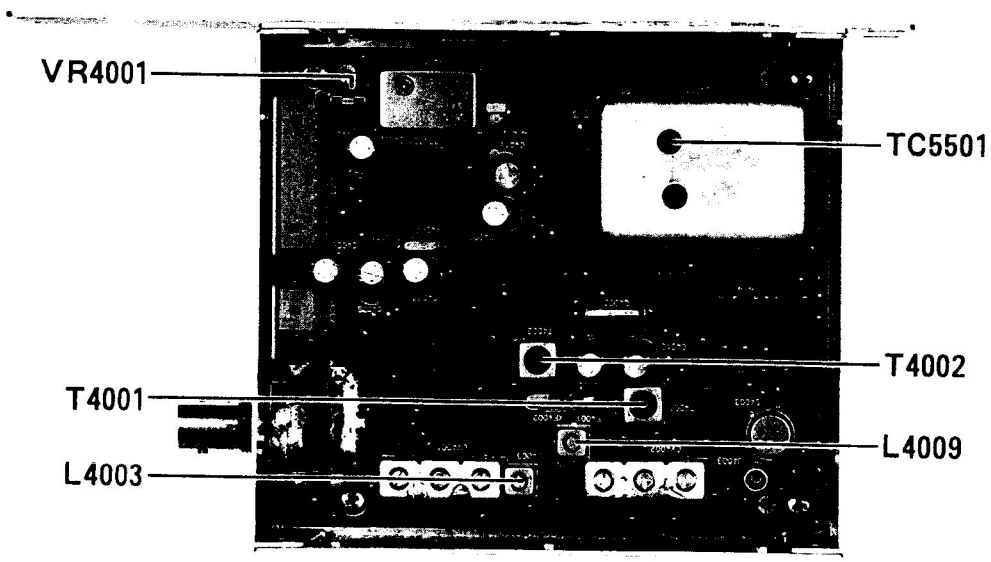
❒ Connect the VPL-1 connection cable to J2009 on CNTL Unit 2, then load the CE-8 programming software. Recall the alignment adjustment file, and press the return key. Key the repeater and press the function key indicated in the program for an indication of 25 watts (± 0.5 watt) on the wattmeter.

Low Power Set

❒ Repeat the above procedure for an indication of 12.5 Watts (± 0.5 watts) on the wattmeter.

❒ Press the F10 key to exit the adjustment mode, then press F4 to save the settings to memory. Disconnect the VPL-1 cable.

Note: do not adjust the low power setting below 10 watts.



RX Unit Alignment Points

Repeater Mode

Squelch Adjust

❒ First ensure DUPLEX mode of operation is enabled via CE-8 programming.

❒ Next inject a standard deviation 0 dBμ signal into the **RX ANT** jack. Adjust VR4001 on the RX Unit to the point where the TX is activated.

Deviation Adjustment

❒ Inject 40-dBμ with ± 5-kHz deviation of a 1-kHz tone to the **RX ANT** jack, and adjust VR2004 for 4.6 kHz (± 0.1 kHz) TX deviation.

❒ Change SG deviation to 3 kHz, then adjust VR2005 for 3 kHz (± 0.1 kHz) TX deviation.

Base Mode

Note: When making Base Mode adjustments, connect pin 13 of the **ACC** jack to **GND**.

Audio Level Adjust

❒ Connect the SG to the **RX ANT** jack and adjust the SG output level to 40 dBμ and standard deviation. Adjust VR2003 for –10 dBm ± 0.1 dBm line out audio level.

Deviation Adjustment

❒ Connect an audio signal generator to line-in jack, then adjust generator output level to +10 dBm @ 1 kHz. Adjust VR2002 for 4.6 kHz ± 0.1 kHz deviation.

❒ Reduce audio generator output level to –10 dBm, then adjust VR2001 for 3 kHz ± 0.1 kHz deviation.

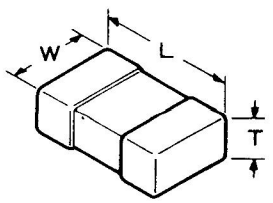
CTCSS (FTS-22) Deviation Adjustment

❒ Ensure the FTS-22 option has been installed and adjust VR2006 on CNTL-2 Unit for 0.7 kHz ± 0.1 kHz deviation.

Chip Component Information

The diagrams below indicate some of the distinguishing features of common chip components.

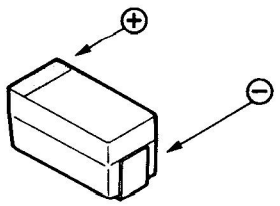
Ceramic Capacitors



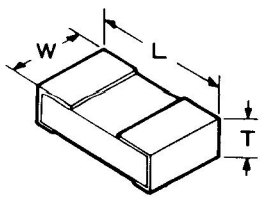
(Unit : mm)

Type	L	W	T
3216	3.2	1.6	0.45~0.60
2125	2.0	1.25	0.35~0.50
1608	1.6	0.8	0.65~0.95

Tantalum Capacitors



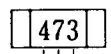
Resistors



Type	L	W	T
1/10	2.0	1.25	0.45
1/16	1.6	0.8	0.45

Type RMC 1/10W, 1/16W

Marking* 100,222,473·····



Ten unit	One unit	Multiplier code
0	0	10^0
1	1	10^1
2	2	10^2
3	3	10^3
4	4	10^4
5	5	10^5
6	6	10^6
7	7	10^7
8	8	10^8
9	9	10^9

Examples :

100 = 10Ω

222 = 2.2kΩ

473 = 47kΩ

Indicated Letters

1 2 3 4

5 6 7 8

9 0 .

Replacing Chip Components

Chip components are installed at the factory by a series of robots. The first one places a spot of adhesive resin at the location where each part is to be installed, and later robots handle and place parts using vacuum suction.

For single-sided boards, solder paste is applied to the board is then baked to harden the resin and flow the solder. For double-sided boards, no solder paste is applied, but the board is baked (or exposed to UV light) to cure the resin before dip-soldering.

In our laboratories and service shops, small quantities of chip components are mounted manually by applying a spot of resin, placing with tweezers, and then soldering by very small dual streams of hot air (without physical contact during soldering). We remove the parts by first removing solder using a vacuum suction iron, which applies a light, steady vacuum at the iron tip, and then breaking the adhesive with tweezers.

The special vacuum soldering/de-soldering equipment is recommended if you expect to do a lot of chip replacements. Otherwise, it is usually possible to remove and replace chip components with only a tapered, temperature controlled soldering iron, a set of tweezers and braided copper solder wick. Soldering iron temperature should be below 280°C (536°F).

Precautions for Chip Replacement

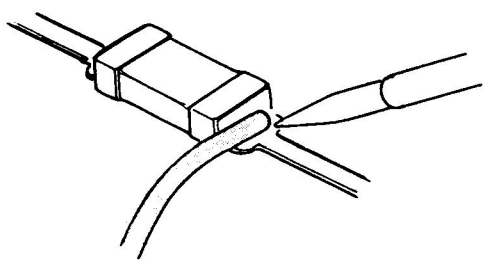
✘ Do not disconnect a chip forcefully, or the foil pattern may peel off the board.

✘ Never re-use a chip component. Dispose of all removed chip components immediately to avoid mixing with new parts.

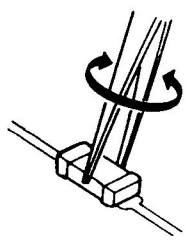
✘ Limit soldering time to 3 seconds or less to avoid damaging the component and board.

Removing Chip Components

❒ Remove the solder at each joint, one joint at a time, using solder wick wetted with non-acidic flux as shown below. Avoid applying pressure, and do not attempt to remove the tinning from the chip's electrode.



❒ Grasp the chip on both sides with tweezers, and gently twist the tweezers back and forth (to break the adhesive bond) while alternately heating each electrode. Be careful to avoid peeling the foil traces from the board. Dispose of the chip when removed.

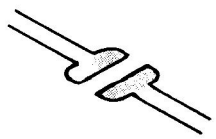


❒ After removing the chip, use the copper braid and soldering iron to wick away any excess solder and smooth the land for installation of the replacement part.

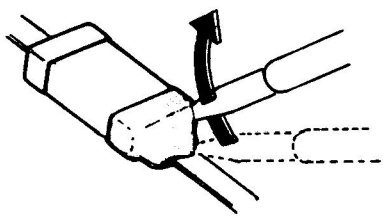
Installing a Replacement Chip

As the value of some chip components is not indicated on the body of the chip, be careful to get the right part for replacement.

❒ Apply a small amount of solder to the land on one side where the chip is to be installed. Avoid using too much solder, which may cause bridging (shorting to other parts).

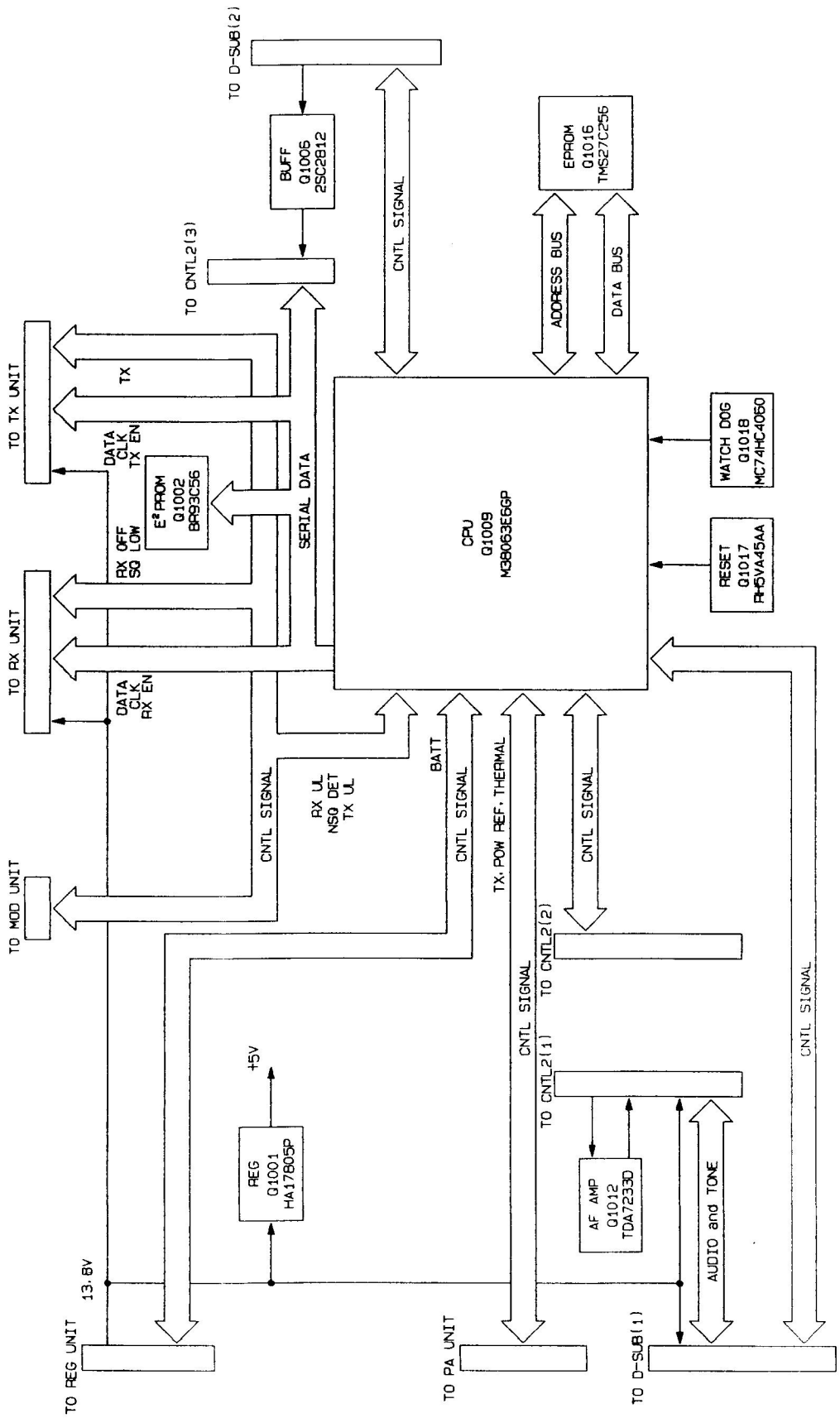


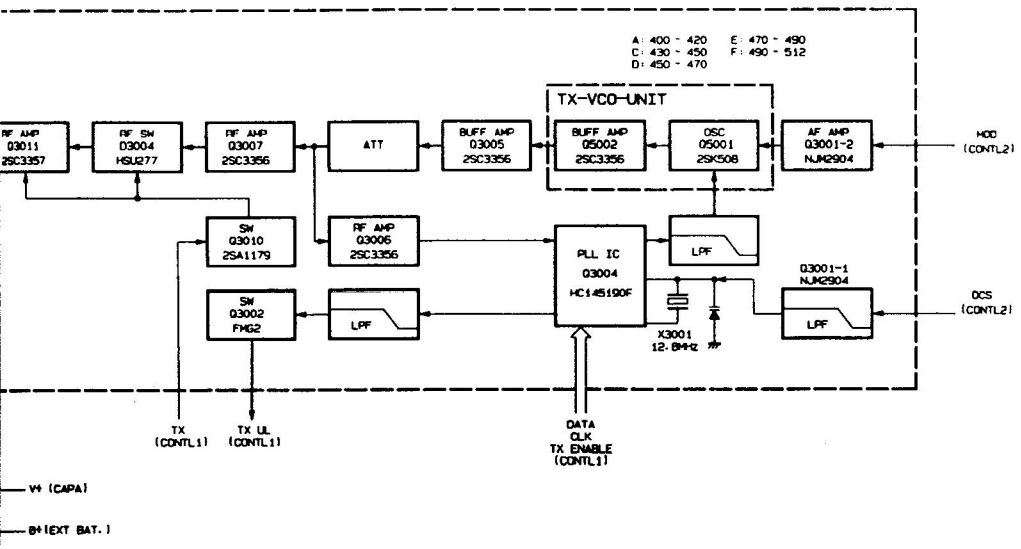
❒ Hold the chip with tweezers in the desired position, and apply the soldering iron with a motion line that is indicated by the arrow in the diagram below. Do not apply heat for more than 3 seconds.

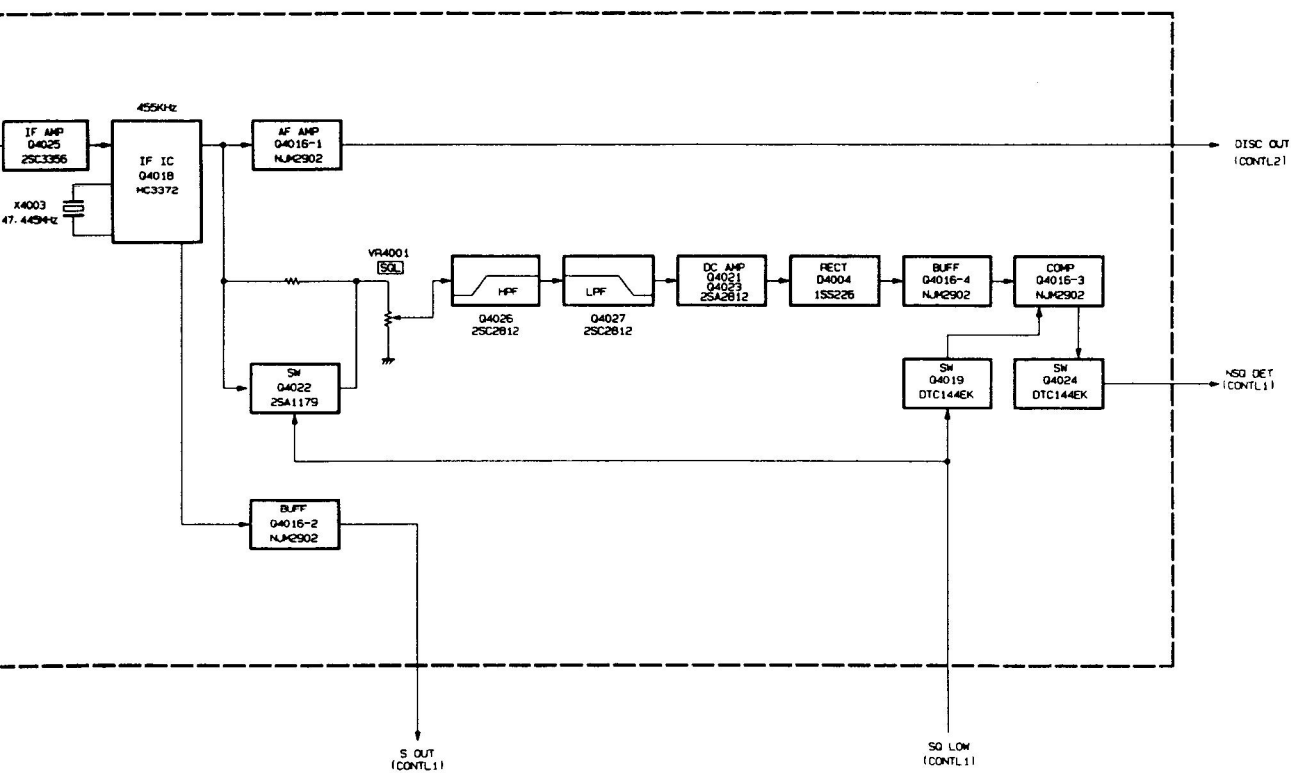


❒ Remove the tweezers and solder the electrode on the other side in the manner just described.

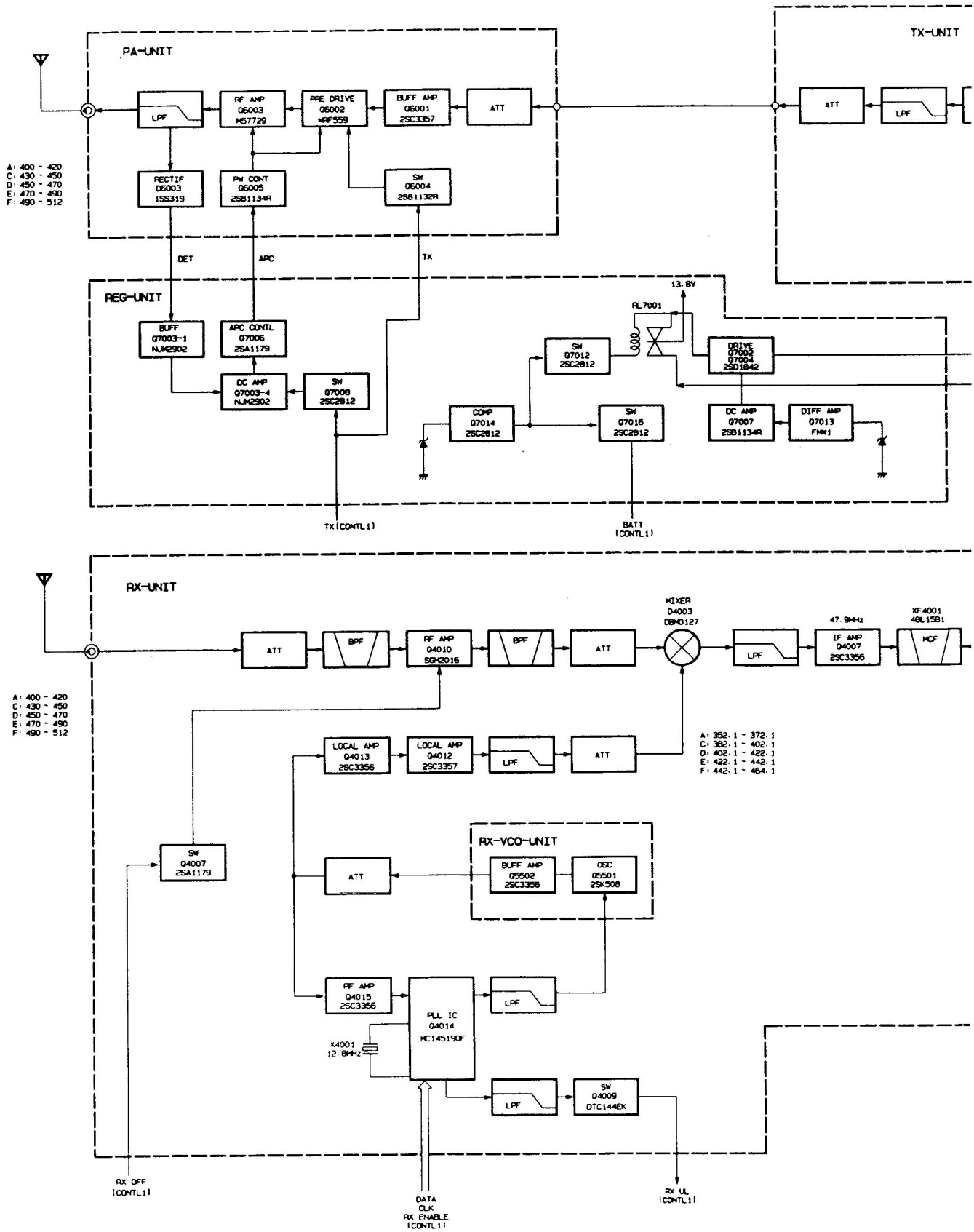
CNTL1 Block Diagram



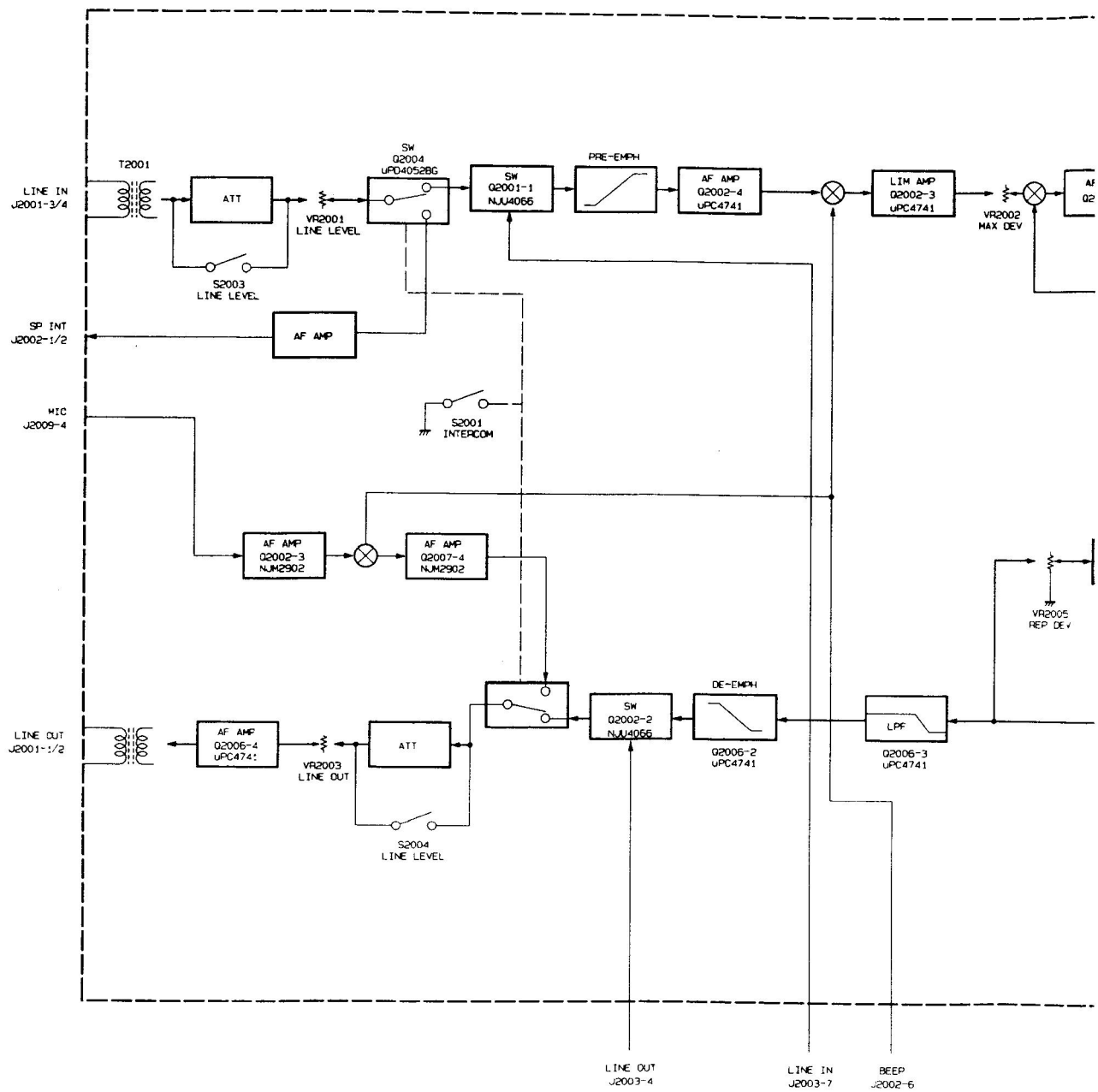

A: 400 ~ 420
C: 430 ~ 450
D: 450 ~ 470
E: 470 ~ 490
F: 490 ~ 512
TX-VCO-UNIT
RF AMP Q3011 2SC3357
RF SW Q3004 HSU277
RF AMP Q3007 2SC3356
ATT
BUFF AMP Q3005 2SC3356
BUFF AMP Q5002 2SC3356
OSC Q5001 2SK508
AF AMP Q3001-2 NJM2904
MOD (CONTL2)
SW Q3010 2SA1179
RF AMP Q3006 2SC3356
PLL IC Q3004 MC145190F
LPF
Q3001-1 NJM2904
SW Q3002 FMG2
LPF
LPF
X3001 12.8MHz
DCS (CONTL2)
TX (CONTL1)
TX UL (CONTL1)
DATA CLK TX ENABLE (CONTL1)
V4 (CAPA)
B+ (EXT BAT.)

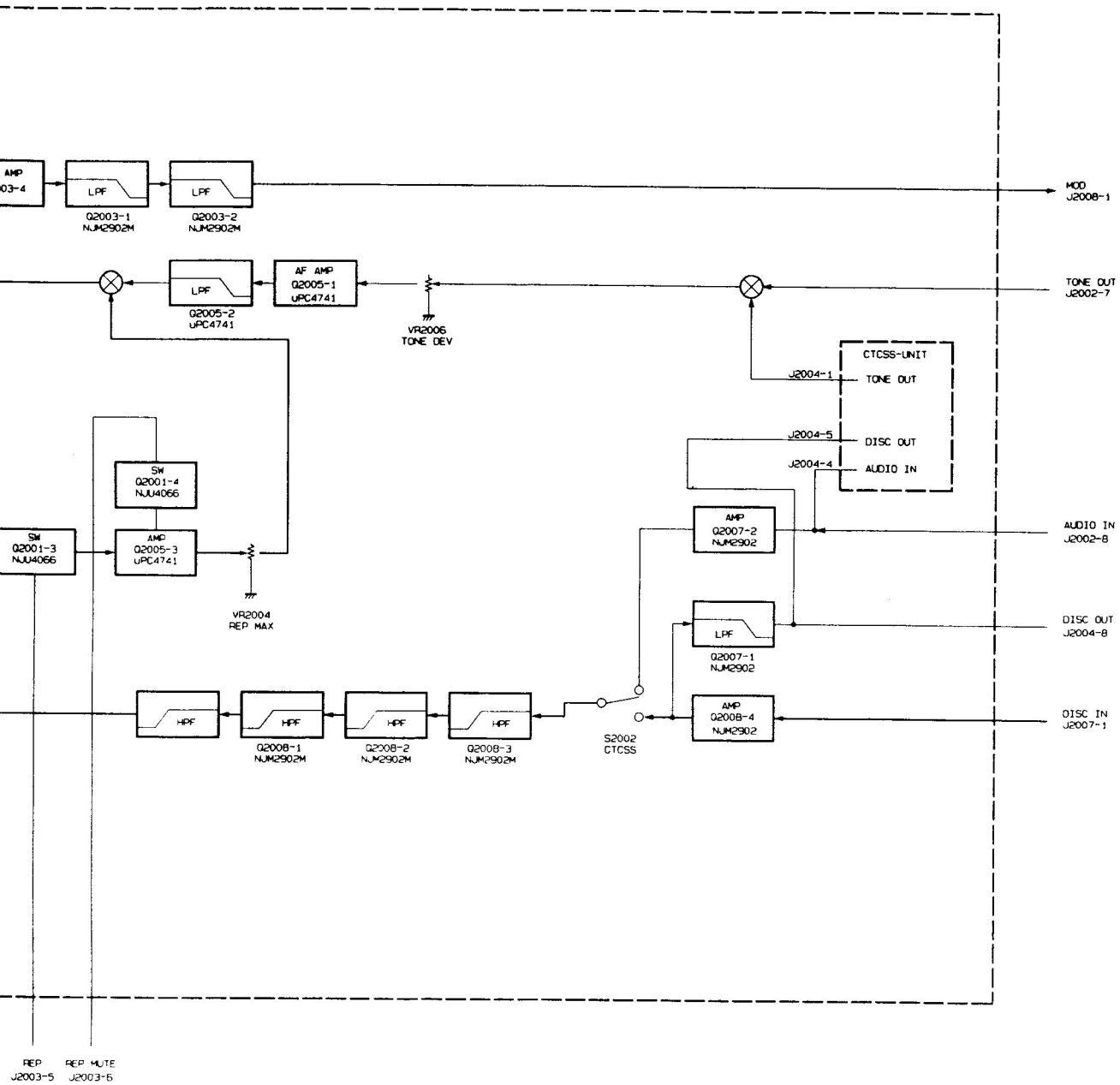

455KHz
IF AMP Q4025 2SC3356
IF IC Q4018 MC3372
X4003 47.4454Hz
AF AMP Q4016-1 NJM2902
DISC OUT (CONTL2)
VR4001
SQL
HPF
LPF
Q4026 2SC2812
Q4027 2SC2812
DC AMP Q4021 Q4053 2SA2812
RECT D4004 1SS226
BUFF Q4016-4 NJM2902
COMP Q4016-3 NJM2902
SW Q4022 2SA1179
SW Q4019 DTC144EK
SW Q4024 DTC144EK
NSQ DET (CONTL1)
BUFF Q4016-2 NJM2902
S OUT (CONTL1)
SQ LOW (CONTL1)

Block Diagram

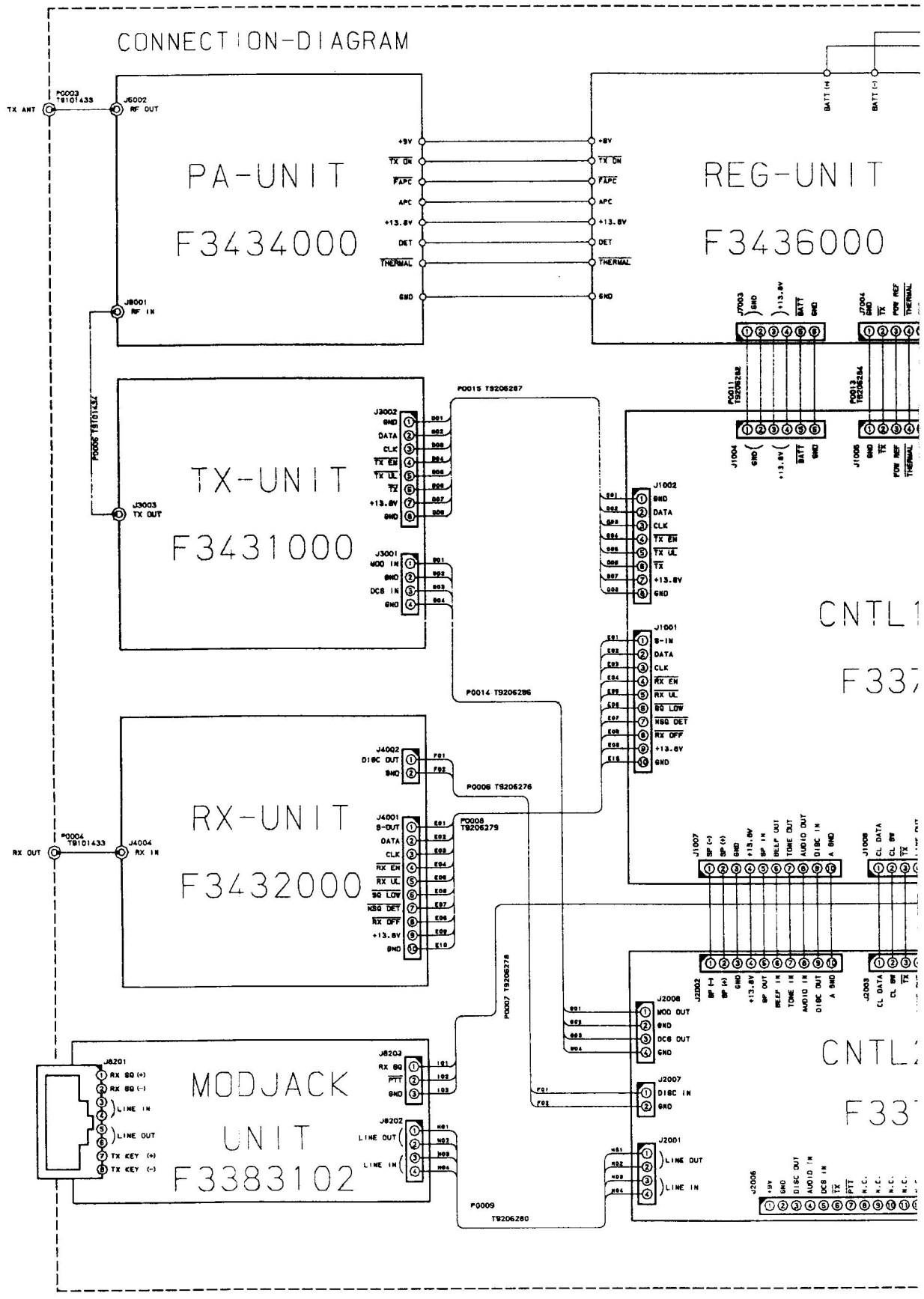


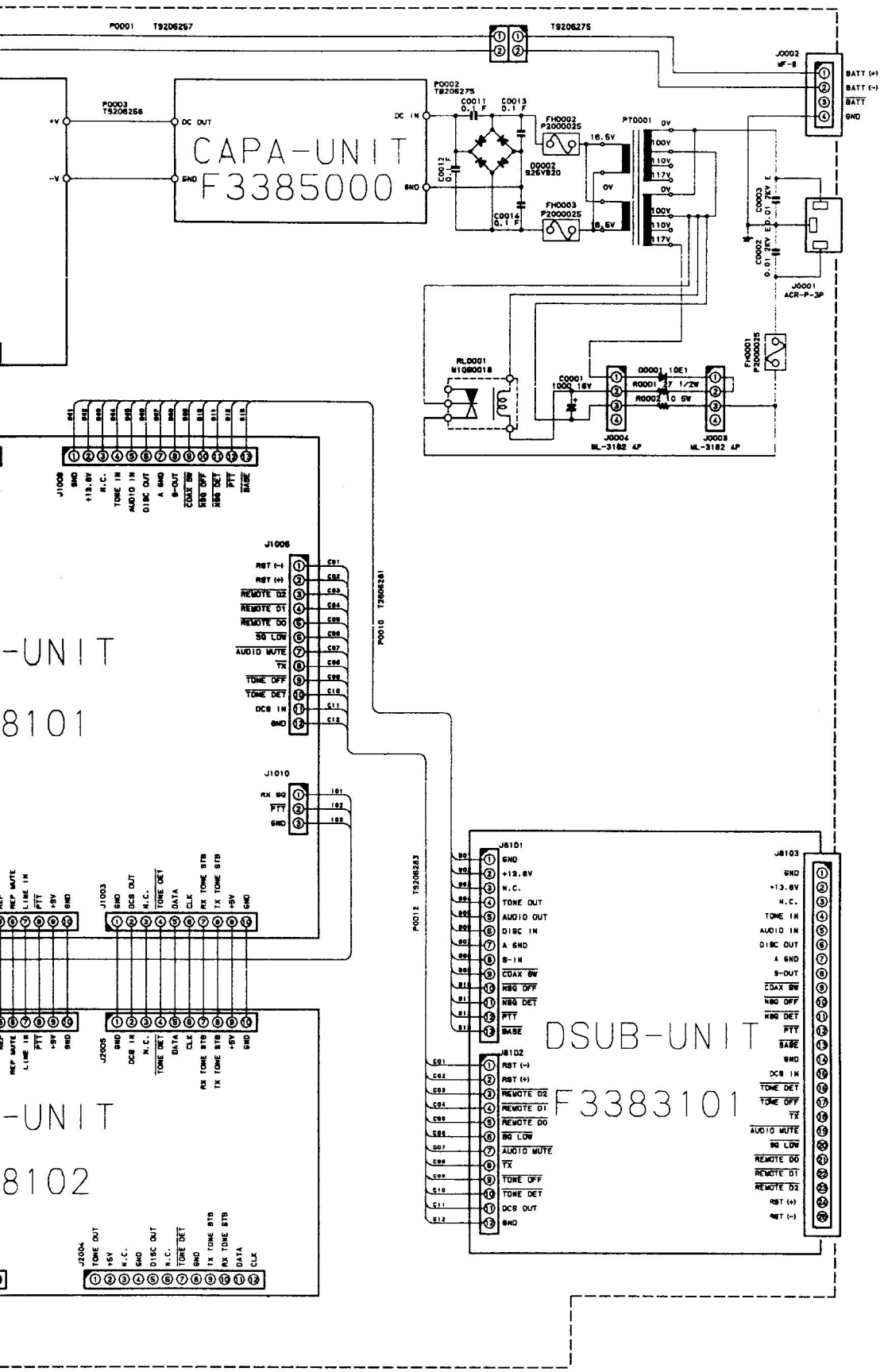
AF Block Diagram



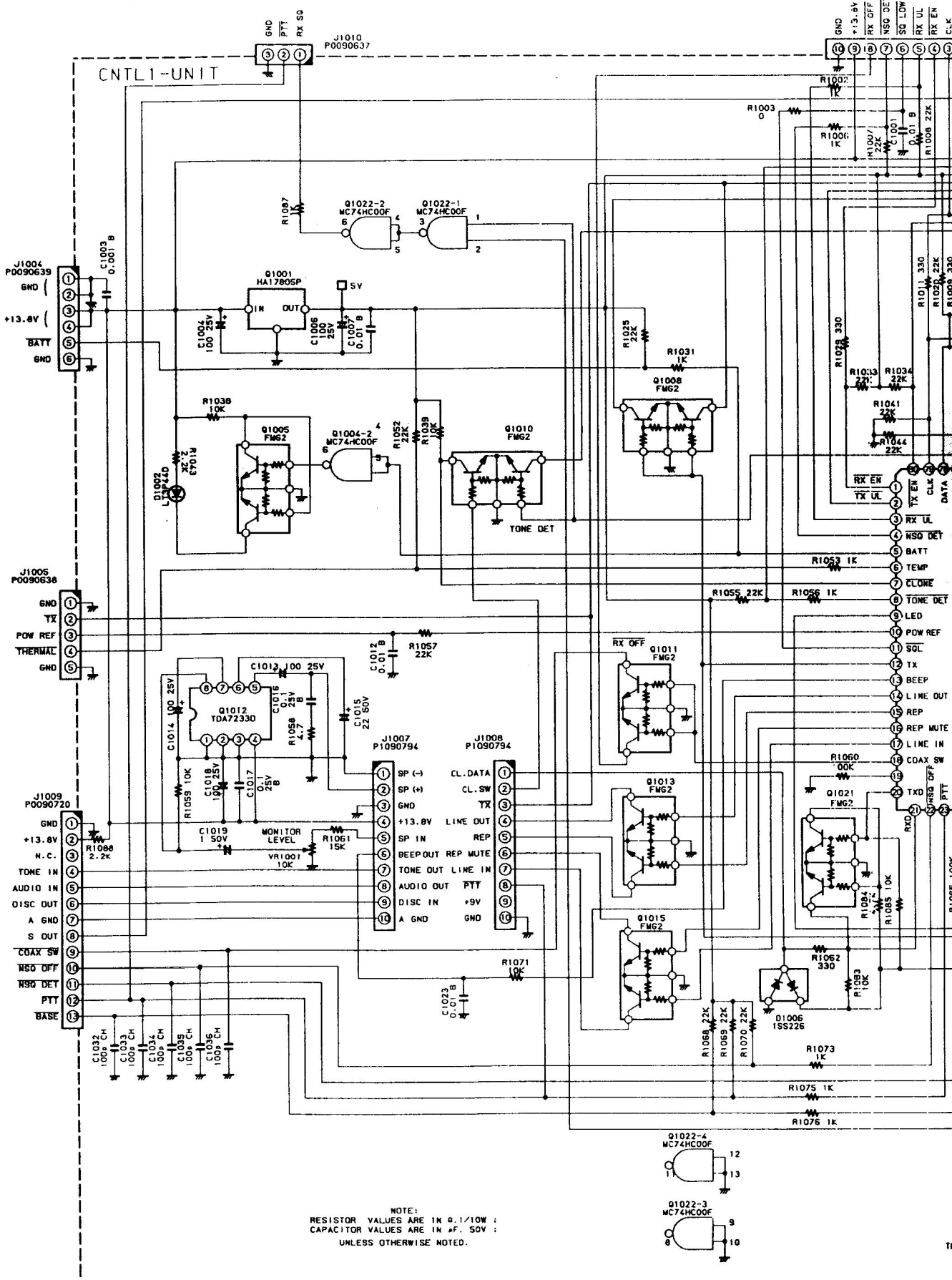

AMP
03-4
LPF
Q2003-1
NJM2902M
LPF
Q2003-2
NJM2902M
MOD
J2008-1
LPF
Q2005-2
uPC4741
AF AMP
Q2005-1
uPC4741
VR2006
TONE DEV
TONE OUT
J2002-7
CTCSS-UNIT
J2004-1
TONE OUT
J2004-5
DISC OUT
J2004-4
AUDIO IN
SW
Q2001-4
NJU4066
SW
Q2001-3
NJU4066
AMP
Q2005-3
uPC4741
VR2004
REP MAX
AMP
Q2007-2
NJM2902
AUDIO IN
J2002-8
LPF
Q2007-1
NJM2902
DISC OUT
J2004-8
HPF
HPF
Q2008-1
NJM2902M
HPF
Q2008-2
NJM2902M
HPF
Q2008-3
NJM2902M
S2002
CTCSS
AMP
Q2008-4
NJM2902
DISC IN
J2007-1
REP
J2003-5
REP MUTE
J2003-6

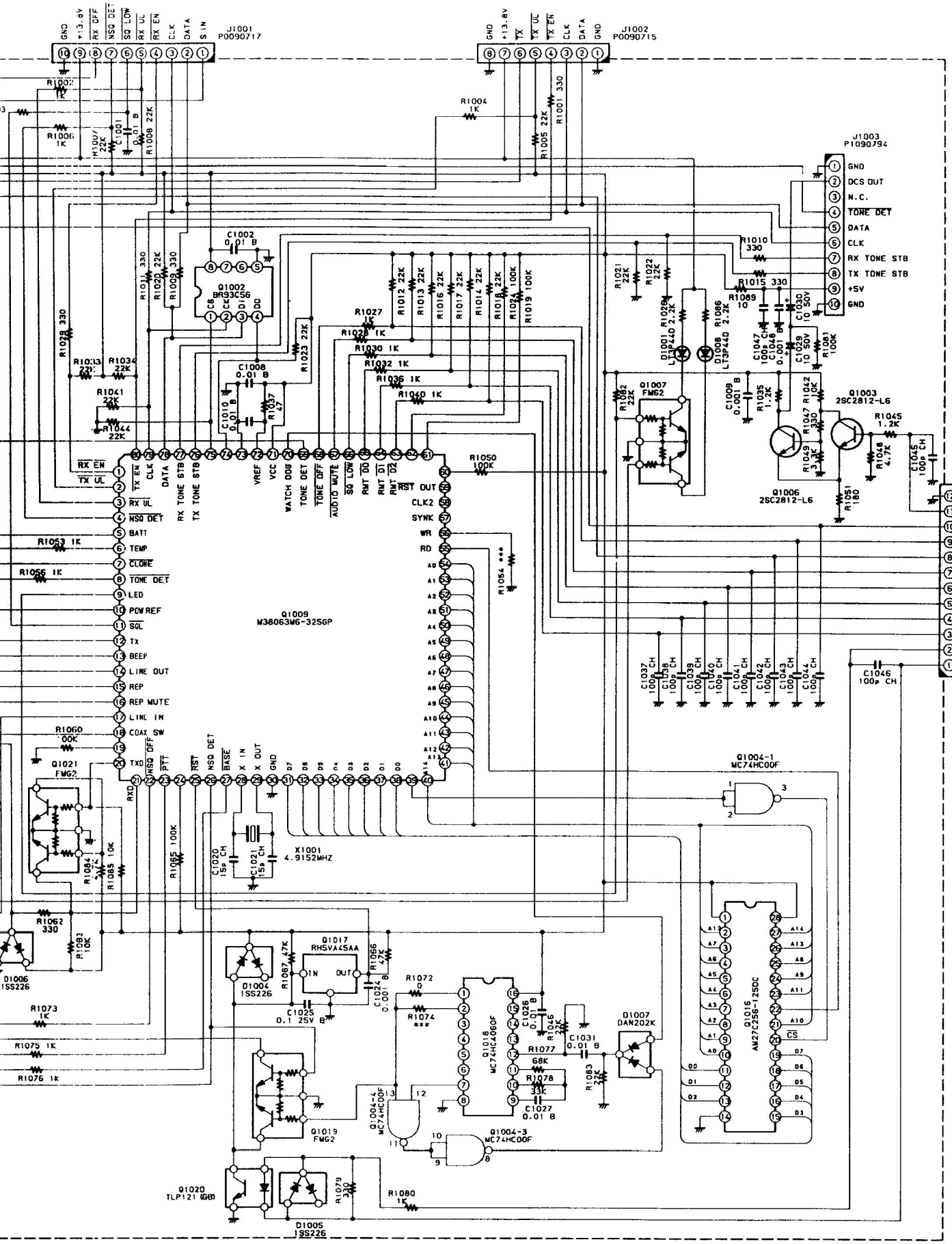
Interconnection Diagram

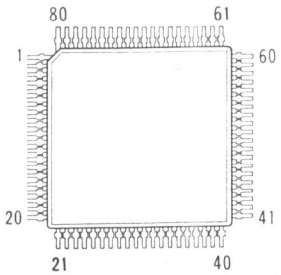



CAPA-UNIT
F3385000
DSUB-UNIT
F3383101
-UNIT
8101
-UNIT
8102
P0001 T9206257
T9206275
P0003 T9206256
P0002 T9206275
J0002 MF-8
BATT (+)
BATT (-)
BATT
GND
DC OUT
DC IN
GND
+V
-V
C0011 0.1 F
C0013 0.1 F
C0012 0.1 F
C0014 0.1 F
FH0002 P2000025
FH0003 P2000025
D0002 S26VB20
PT0001
16.5V
8.5V
0V
100V
110V
117V
C0003 0.01 25V F
C0002 0.01 25V F
J0001 ACR-P-3P
RL0001 M1080018
C0001 1000 16V
D0001 10E1
R0001 27 1/2W
R0002 10 5W
J0004 ML-3182 4P
J0008 ML-3182 4P
FH0001 P2000025
J1008
J1006
J1010
J1003
J2005
J2004
J8101
J8102
J8103
P0010 T2606281
P0012 T9206283
GND
+13.8V
N.C.
TONE IN
AUDIO IN
DISC OUT
A GND
S-IN
COAX SW
NBQ OFF
NBQ DET
PTT
BABE
RST (-)
RST (+)
REMOTE D2
REMOTE D1
REMOTE D0
SQ LOW
AUDIO MUTE
TX
TONE OFF
TONE DET
DCS IN
DCS OUT
RX BQ
MIC MUTE
LINE IN
+5V
DATA
CLK
RX TONE STB
TX TONE STB
TONE OUT

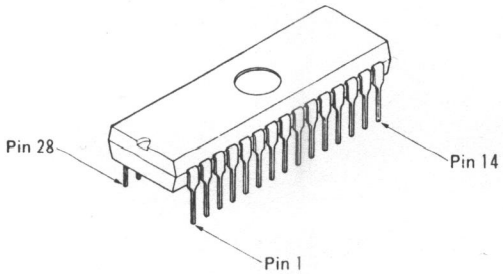
Circuit Diagram



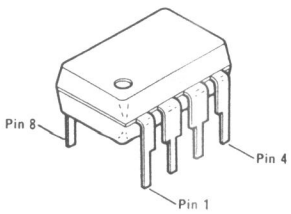

J1001
P0090717
J1002
P0090715
J1003
P1090794
J1006
P0090719
Q1009
M38063M6-325GP
X1001
4.9152MHZ
Q1003
2SC2812-L6
Q1006
2SC2812-L6
Q1007
FMG2
Q1021
FMG2
Q1019
FMG2
Q1002
BR93C56
Q1004-1
MC74HC00F
Q1004-3
MC74HC00F
Q1004-4
MC74HC00F
Q1018
MC74HC4060F
Q1017
RHSVA45AA
Q1020
TLP121 (GB)
Q1015
AM27C256-250DC
D1001
LTP44D
D1008
LT3P44D
D1007
DAN202K
D1004
1SS226
D1005
1SS226
D1006
1SS226
J1003 P1090794
1 GND
2 DCS OUT
3 N.C.
4 TONE DET
5 DATA
6 CLK
7 RX TONE STB
8 TX TONE STB
9 +5V
10 GND
J1006 P0090719
12 GND
11 DCS IN
10 TONE DET
9 TONE OFF
8 TX
7 AUDIO MUTE
6 SQ LOW
5 REMOTE D0
4 REMOTE D1
3 REMOTE D2
2 RST (+)
1 RST (-)



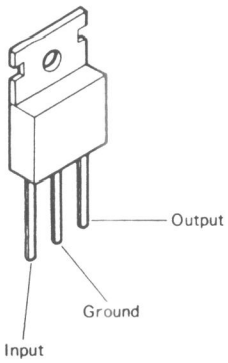
M38063M6
(Q1009)



AM27C256-125DC
(Q1016)

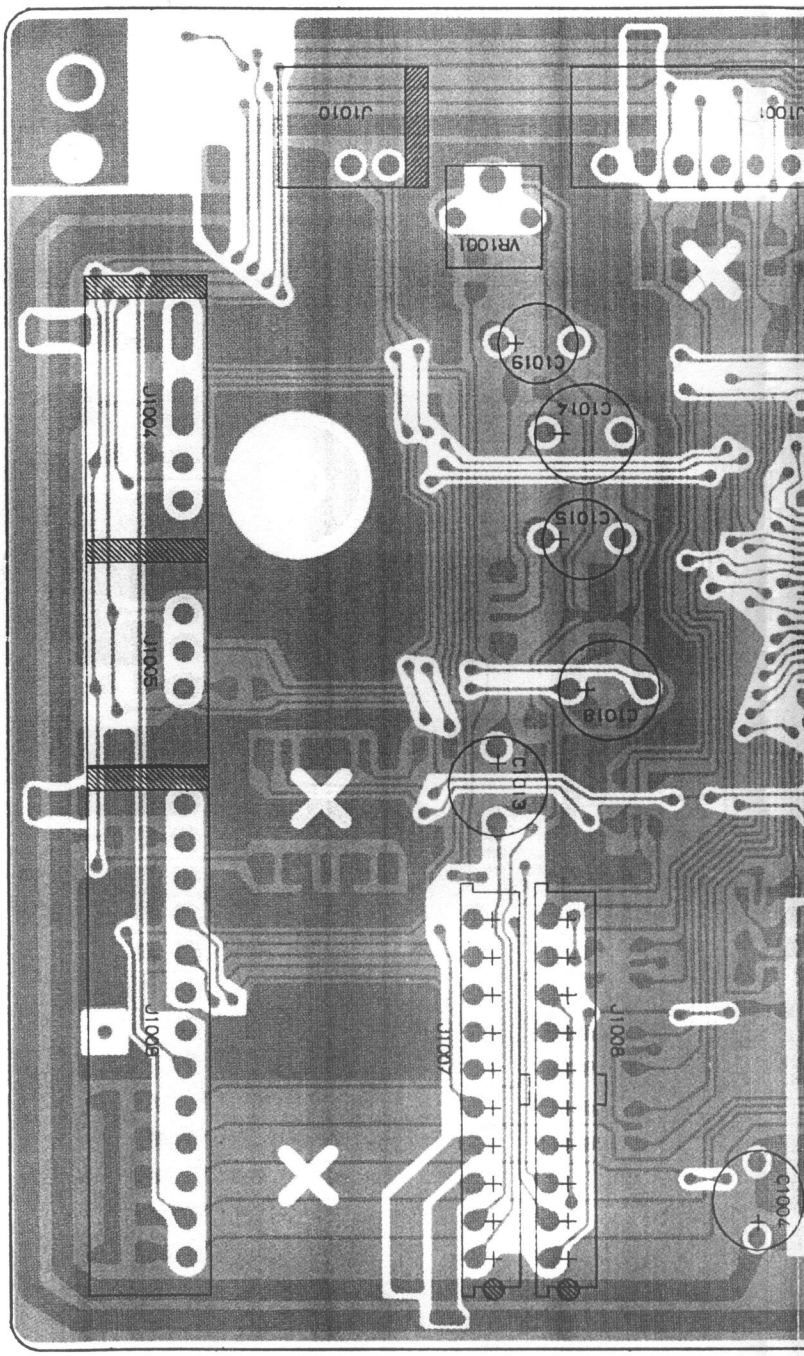


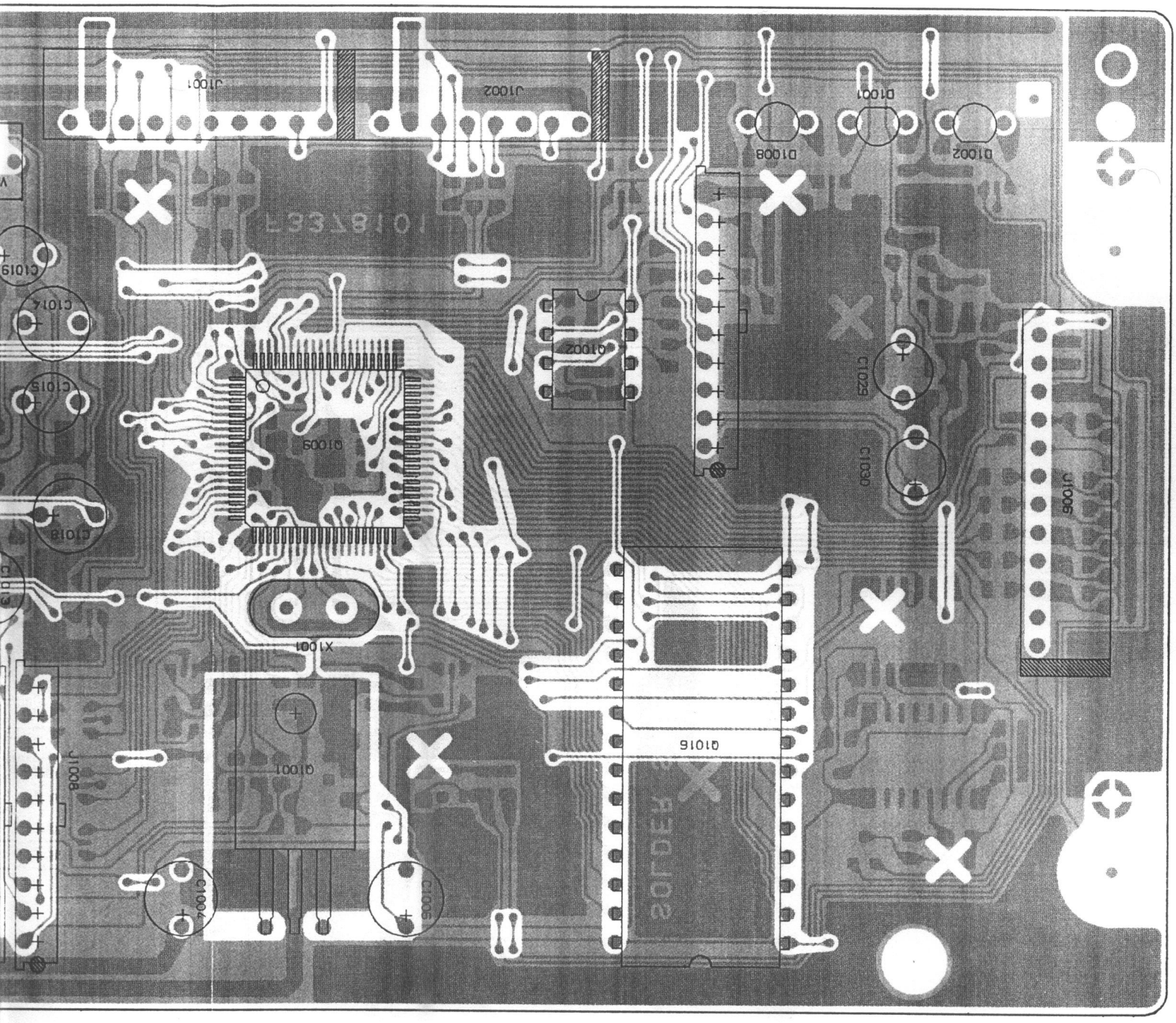
BR93C56
(Q1002)



HA17805P
(Q1001)

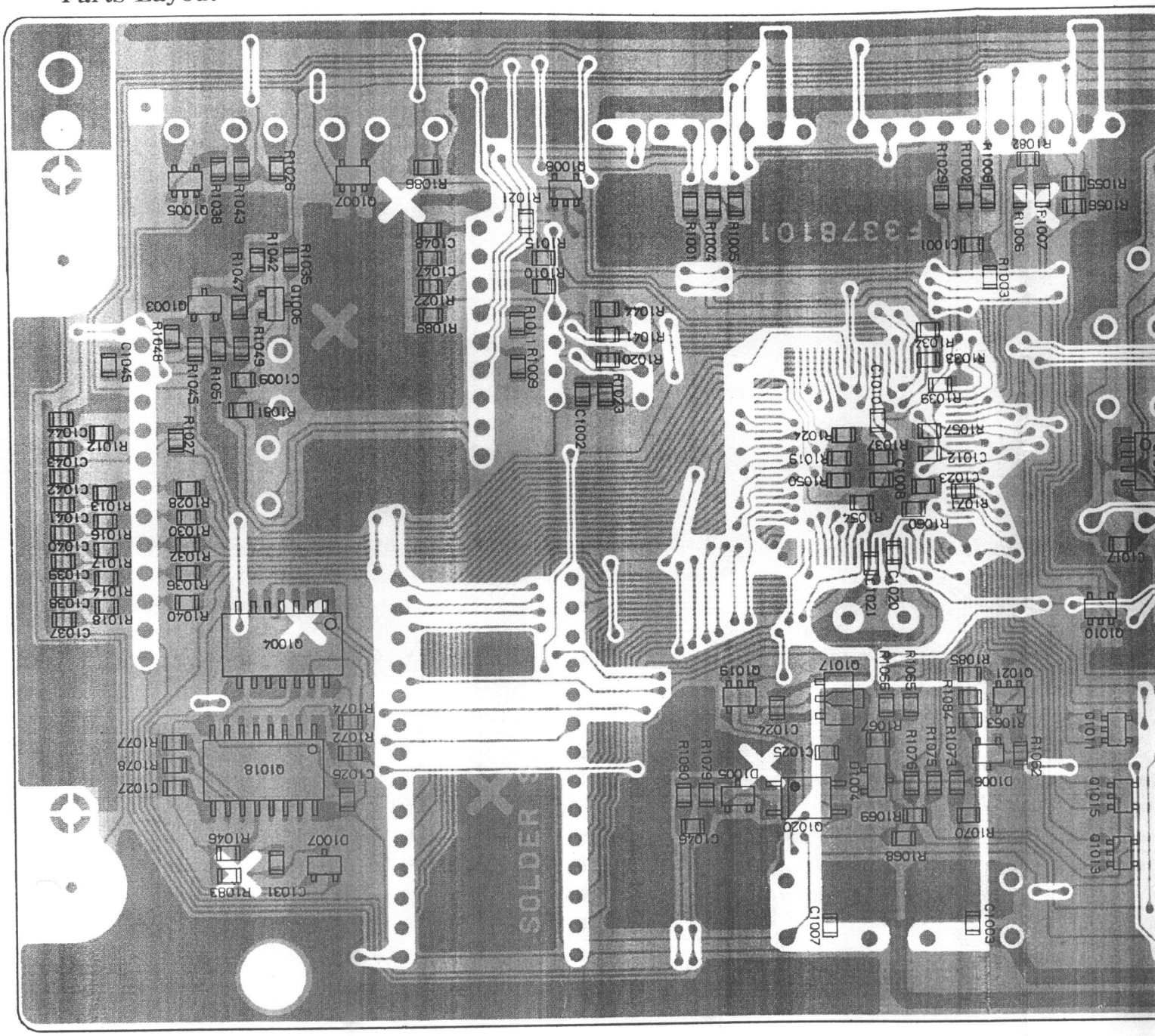
Parts Layout

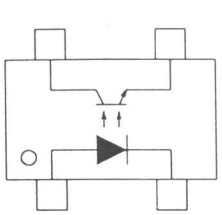




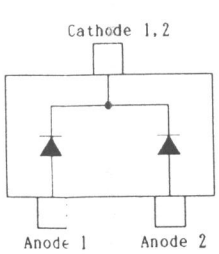
obverse view of component side

Parts Layout

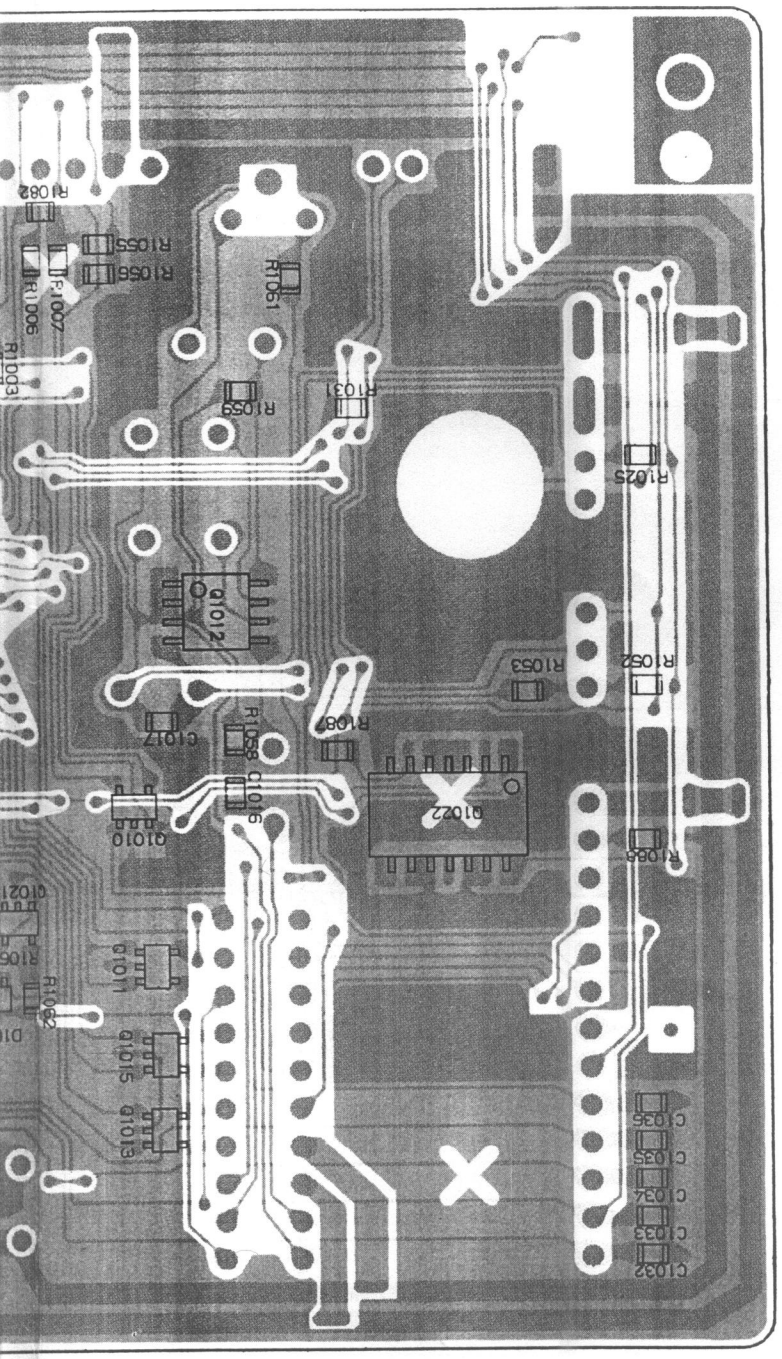




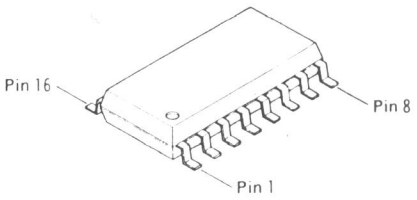
TLP121
(Q1020)



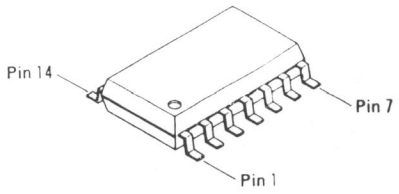
DAN202K (N)
(D1007)



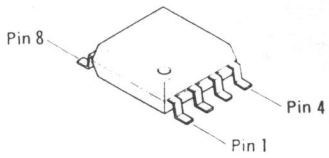
obverse view of chip side



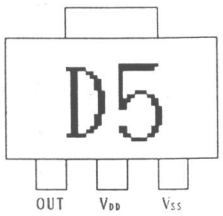
MC74HC4060FL
(Q1018)



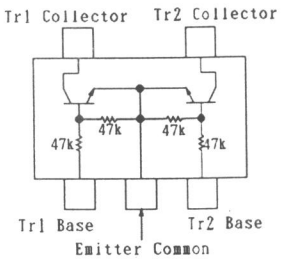
MC74HC00FL
(Q1004,1022)



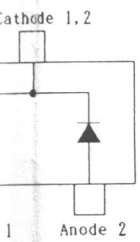
TDA7233D
(Q1012)



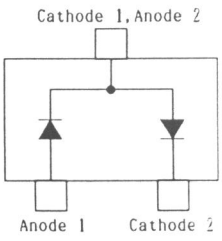
RH5VA45AA (D5)
(Q1017)



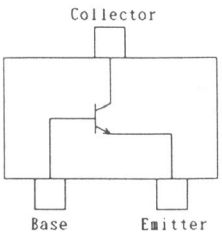
FMG2 (G2)
(Q1005,1007,1008
1010,1011,1013
1015,1019,1021)



N202K (N)
1007)



1SS226 (C3)
(D1004,1005,1006)



2SC2812 (L6)
(Q1003,1006)

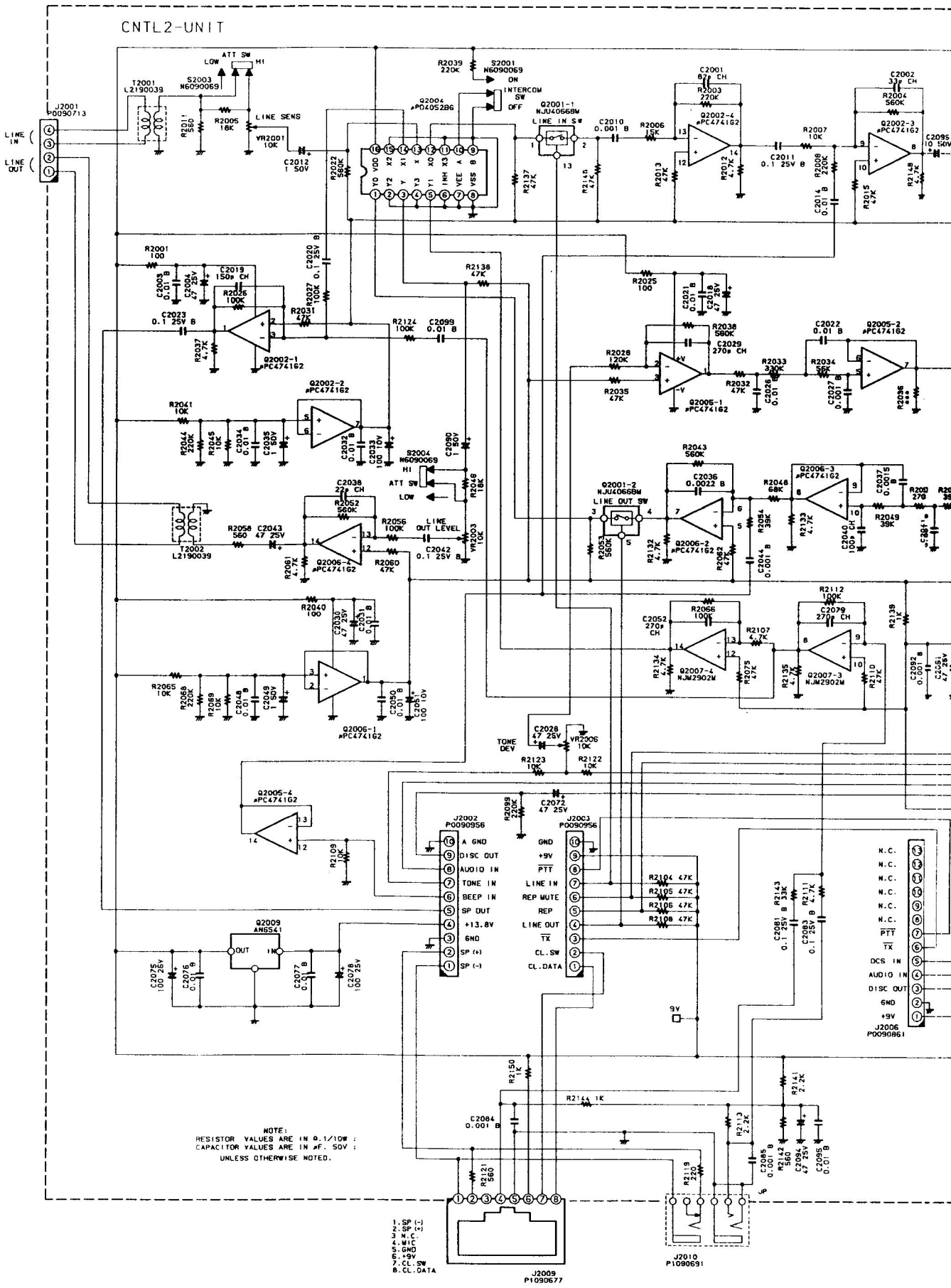
REF.	DESCRIPTION	VALUE	WV	TOL.	MFGR'S DESIG	YAESU P/N	VERS.
		*** CNTL1 UNIT ***					
	PCB With Components					CA1316001	
	Printed Circuit Board					F3378101	
C 1001	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1002	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1003	CHIP CAP.	0.001uF	50V	B	GRM40B102M50PT	K22170805	
C 1004	AL. ELECTRO. CAP.	100uF	25V		25V101M6X11TR5	K46140005	
C 1006	AL. ELECTRO. CAP.	100uF	25V		25V101M6X11TR5	K46140005	
C 1007	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1008	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1009	CHIP CAP.	0.001uF	50V	B	GRM40B102M50PT	K22170805	
C 1010	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1012	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1013	AL. ELECTRO. CAP.	100uF	25V		25V101M6X11TR5	K46140005	
C 1014	AL. ELECTRO. CAP.	100uF	25V		25V101M6X11TR5	K46140005	
C 1015	AL. ELECTRO. CAP.	22uF	50V		50V220M5X11TR5	K46170022	
C 1016	CHIP CAP.	0.1uF	25V	B	GRM40B104M25PT	K22140811	
C 1017	CHIP CAP.	0.1uF	25V	B	GRM40B104M25PT	K22140811	
C 1018	AL. ELECTRO. CAP.	100uF	25V		25V101M6X11TR5	K46140005	
C 1019	AL. ELECTRO. CAP.	1uF	50V		50V010M5X11TR5	K46170017	
C 1020	CHIP CAP.	15pF	50V	CH	GRM40CH150J50PT	K22170215	
C 1021	CHIP CAP.	15pF	50V	CH	GRM40CH150J50PT	K22170215	
C 1023	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1024	CHIP CAP.	0.001uF	50V	B	GRM40B102M50PT	K22170805	
C 1025	CHIP CAP.	0.1uF	25V	B	GRM40B104M25PT	K22140811	
C 1026	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1027	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1029	AL. ELECTRO. CAP.	10uF	50V		50V100M5X11TR5	K46170021	
C 1030	AL. ELECTRO. CAP.	10uF	50V		50V100M5X11TR5	K46170021	
C 1031	CHIP CAP.	0.01uF	50V	B	GRM40B103M50PT	K22170817	
C 1032	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1033	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1034	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1035	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1036	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1037	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1038	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1039	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1040	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1041	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1042	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1043	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1044	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1045	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1046	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1047	CHIP CAP.	100pF	50V	CH	GRM40CH101J50PT	K22170235	
C 1048	CHIP CAP.	0.001uF	50V	B	GRM40B102M50PT	K22170805	
D 1001	LED				LT3P44D	G2050010	
D 1002	LED				LT3P44D	G2050010	

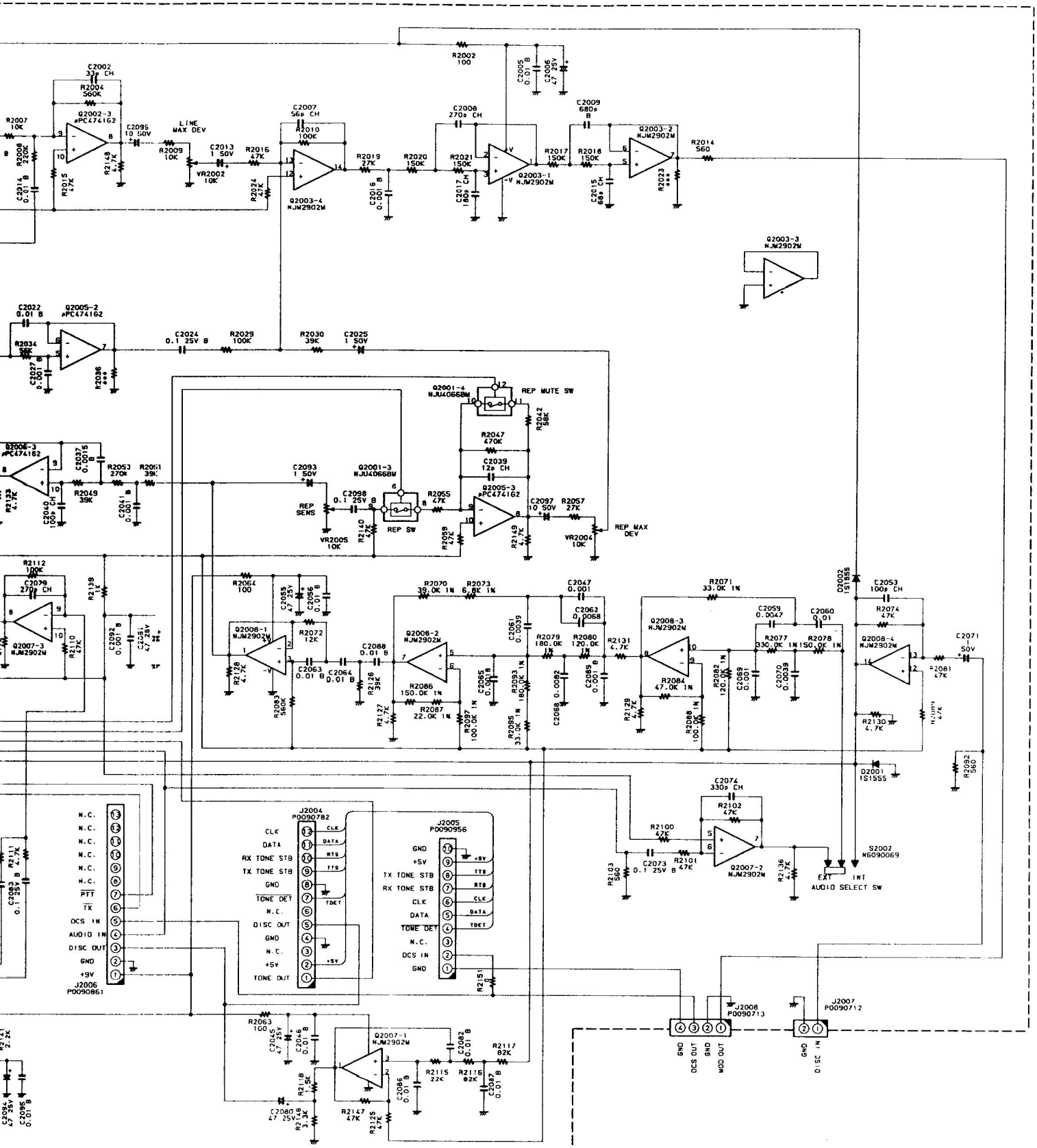
REF.	DESCRIPTION	VALUE	WV	TOL.	MFGR'S DESIG	YAESU P/N	VERS.
D 1004	DIODE				1SS226 TE85R	G2070003	
D 1005	DIODE				1SS226 TE85R	G2070003	
D 1006	DIODE				1SS226 TE85R	G2070003	
D 1007	DIODE				DAN202K T146	G2070182	
D 1008	LED				LT3P44D	G2050010	
J 1001	CONNECTOR				SC25-10WL	P0090717	
J 1002	CONNECTOR				SC25-08WL	P0090715	
J 1003	CONNECTOR				9130S-10	P1090794	
J 1004	CONNECTOR				SC25-06WL	P0090639	
J 1005	CONNECTOR				SC25-05WL	P0090638	
J 1006	CONNECTOR				SC25-12WL	P0090719	
J 1007	CONNECTOR				9130S-10	P1090794	
J 1008	CONNECTOR				9130S-10	P1090794	
J 1009	CONNECTOR				SC25-13WL	P0090720	
J 1010	CONNECTOR				SC25-03WL	P0090637	
Q 1001	IC				HA17805P	G1090936	
Q 1002	IC				BR93C56	G1091191	
Q 1003	TRANSISTOR				2SC2812L6-TA	G3328127F	
Q 1004	IC				MC74HC00FL	G1090997	
Q 1005	TRANSISTOR				FMG2 T99	G3070015	
Q 1006	TRANSISTOR				2SC2812L6-TA	G3328127F	
Q 1007	TRANSISTOR				FMG2 T99	G3070015	
Q 1008	TRANSISTOR				FMG2 T99	G3070015	
Q 1009	IC				M38063M6-325GP	G1091815	
Q 1010	TRANSISTOR				FMG2 T99	G3070015	
Q 1011	TRANSISTOR				FMG2 T99	G3070015	
Q 1012	IC				TDA7233D-TR	G1091112	
Q 1013	TRANSISTOR				FMG2 T99	G3070015	
Q 1015	TRANSISTOR				FMG2 T99	G3070015	
Q 1016	IC				AM27C256-125DC	G1091827	
Q 1017	IC				RH5VA45AA-T2	G1090922	
Q 1018	IC				MC74HC4060FL	G1090984	
Q 1019	TRANSISTOR				FMG2 T99	G3070015	
Q 1020	PHOTO COUPLER				TLP121(GB-TPR)	G0090019	
Q 1021	TRANSISTOR				FMG2 T99	G3070015	
Q 1022	IC				MC74HC00FL	G1090997	
QS1001	IC SOCKET				C842802	P3090066	
R 1001	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1002	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1003	CHIP RES.	0	1/10W	5%	RMC1/10T 000J	J24205000	
R 1004	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1005	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1006	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1007	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1008	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1009	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1010	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1011	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1012	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	

REF.	DESCRIPTION	VALUE	WV	TOL.	MFGR'S DESIG	YAESU P/N	VERS.
R 1013	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1014	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1015	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1016	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1017	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1018	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1019	CHIP RES.	100K	1/10W	5%	RMC1/10T 104J	J24205104	
R 1020	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1021	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1022	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1023	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1024	CHIP RES.	100K	1/10W	5%	RMC1/10T 104J	J24205104	
R 1025	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1026	CHIP RES.	2.2K	1/10W	5%	RMC1/10T 222J	J24205222	
R 1027	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1028	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1029	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1030	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1031	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1032	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1033	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1034	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1035	CHIP RES.	1.2K	1/10W	5%	RMC1/10T 122J	J24205122	
R 1036	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1037	CHIP RES.	47	1/10W	5%	RMC1/10T 470J	J24205470	
R 1038	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1039	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1040	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1041	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1042	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1043	CHIP RES.	2.2K	1/10W	5%	RMC1/10T 222J	J24205222	
R 1044	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1045	CHIP RES.	1.2K	1/10W	5%	RMC1/10T 122J	J24205122	
R 1046	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1047	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1048	CHIP RES.	4.7K	1/10W	5%	RMC1/10T 472J	J24205472	
R 1049	CHIP RES.	3.3K	1/10W	5%	RMC1/10T 332J	J24205332	
R 1050	CHIP RES.	100K	1/10W	5%	RMC1/10T 104J	J24205104	
R 1051	CHIP RES.	180	1/10W	5%	RMC1/10T 181J	J24205181	
R 1052	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1053	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1055	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1056	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1057	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1058	CHIP RES.	4.7	1/10W	5%	RMC1/10T 4R7J	J24205479	
R 1059	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1060	CHIP RES.	100K	1/10W	5%	RMC1/10T 104J	J24205104	
R 1061	CHIP RES.	15K	1/10W	5%	RMC1/10T 153J	J24205153	
R 1062	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1063	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1065	CHIP RES.	100K	1/10W	5%	RMC1/10T 104J	J24205104	
R 1066	CHIP RES.	47K	1/10W	5%	RMC1/10T 473J	J24205473	
R 1067	CHIP RES.	47K	1/10W	5%	RMC1/10T 473J	J24205473	

REF.	DESCRIPTION	VALUE	WV	TOL.	MFGR'S DESIG	YAESU P/N	VERS.
R 1068	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1069	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1070	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1071	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1072	CHIP RES.	0	1/10W	5%	RMC1/10T 000J	J24205000	
R 1073	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1075	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1076	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1077	CHIP RES.	68K	1/10W	5%	RMC1/10T 683J	J24205683	
R 1078	CHIP RES.	33K	1/10W	5%	RMC1/10T 333J	J24205333	
R 1079	CHIP RES.	330	1/10W	5%	RMC1/10T 331J	J24205331	
R 1080	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1081	CHIP RES.	100K	1/10W	5%	RMC1/10T 104J	J24205104	
R 1082	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1083	CHIP RES.	22K	1/10W	5%	RMC1/10T 223J	J24205223	
R 1084	CHIP RES.	4.7K	1/10W	5%	RMC1/10T 472J	J24205472	
R 1085	CHIP RES.	10K	1/10W	5%	RMC1/10T 103J	J24205103	
R 1086	CHIP RES.	2.2K	1/10W	5%	RMC1/10T 222J	J24205222	
R 1087	CHIP RES.	1K	1/10W	5%	RMC1/10T 102J	J24205102	
R 1088	CHIP RES.	2.2K	1/10W	5%	RMC1/10T 222J	J24205222	
R 1089	CHIP RES.	10	1/10W	5%	RMC1/10T 100J	J24205100	
VR1001	POT.	10K			EVN-DCAA03B14	J50784103	
X 1001	XTAL	4.9152MHz				H0103064	
	FITTING R					R0136960	
	FITTING L					R0136970	
	FIBER					R7107410	

Circuit Diagram




R2002 100
C2005 0.01 B
C2008 47 25V
C2002 33p CH
R2004 560K
Q2002-3 μPC4741G2
C2095 10 50V
LINE MAX DEV
R2007 10K
R2008 220K
C2014 0.01 B
R2015 47K
R2148 4.7K
R2009 10K
C2013 1 50V
R2016 47K
VR2002 10K
C2007 56p CH
R2010 100K
R2024 47K
Q2003-4 NJM2902M
R2019 27K
C2016 0.001 B
R2020 150K
C2008 270p CH
R2021 150K
C2017 CH 180p
Q2003-1 NJM2902M
C2009 680p B
R2017 150K
R2018 150K
C2015 CH 68p
Q2003-2 NJM2902M
R2023
R2014 560
Q2003-3 NJM2902M
C2022 0.01 B
Q2005-2 μPC4741G2
R2034
C2027 0.001 B
R2036
C2024 0.1 25V B
R2029 100K
R2030 39K
C2025 1 50V
Q2001-4 NJU40668M
REP MUTE SW
R2042 56K
R2047 470K
C2039 12p CH
Q2005-3 μPC4741G2
C2037 0.015 B
R2050 270K
R2051 39K
R2049 39K
C2040 CH 100p
C2041 0.001 B
C2093 1 50V
Q2001-3 NJU40668M
REP SENS
VR2005 10K
C2098 0.1 25V B
R2140 4.7K
REP SW
R2055 47K
R2059 47K
C2097 10 50V
R2057 27K
R2149 4.7K
VR2004 10K
REP MAX DEV
R2112 100K
C2079 270p CH
R2139 1K
Q2007-3 NJM2902M
R2110 47K
C2092 0.001 B
C2091 47 25V
R2064 100
C2055 47 25V
C2056 0.01 B
Q2008-1 NJM2902M
R2072 12K
R2128 4.7K
R2083 560K
C2063 0.01 B
C2064 0.01 B
C2088 0.01 B
R2126 39K
R2127 4.7K
R2070 39.0K 1%
R2073 6.8K 1%
Q2008-2 NJM2902M
R2086 150.0K 1%
R2087 22.0K 1%
C2065 0.0018
R2097 100.0K 1%
C2061 0.0039
C2047 0.001
C2062 0.0068
R2079 180.0K
R2080 120.0K
R2093 180.0K 1%
R2085 33.2K 1%
C2068 0.0082
C2089 0.001 B
R2131 4.7K
R2071 33.0K 1%
Q2008-3 NJM2902M
R2084 47.0K 1%
R2082 120.0K 1%
C2069 0.001
C2059 0.0047
C2060 0.01
R2077 330.0K 1%
R2078 150.0K 1%
C2070 0.039
D2002 1S1555
C2053 100p CH
R2074 47K
Q2008-4 NJM2902M
C2071 1 50V
R2081 47K
R2130 4.7K
R2092 560
D2001 1S1555
C2074 330p CH
R2102 47K
R2100 47K
C2073 0.1 25V B
R2101 47K
Q2007-2 NJM2902M
R2103 560
R2136 47K
S2002 N60900069
EXT INT
AUDIO SELECT SW
J2004 P0090782
CLK
DATA
RX TONE STB
TX TONE STB
GND
TONE DET
N.C.
DISC OUT
GND
N.C.
+5V
TONE OUT
J2005 P0090956
GND
+5V
TX TONE STB
RX TONE STB
CLK
DATA
TONE DET
N.C.
DCS IN
GND
R2151
J2006 P0090861
N.C.
N.C.
N.C.
N.C.
N.C.
N.C.
PTT
TX
DCS IN
AUDIO IN
DISC OUT
GND
+9V
R2063 100
C2045 47 25V
C2046 0.01 B
Q2007-1 NJM2902M
C2082 0.01 B
R2117 82K
R2118 5K
R2115 22K
R2116 82K
C2087 0.01 B
C2086 0.01 B
C2080 47 25V
R2147 47K
R2125 47K
J2008 P0090713
GND
DCS OUT
GND
MOD OUT
J2007 P0090712
GND
DISC IN