

FT-1000

OPERATING MANUAL

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FT-1000 Operating Manual

Errata & Addendum

External ALC Voltage

On page 19, in the description of the **EXT ALC** Phono Jack (Item 12), the range of the voltage to be provided by a linear amplifier to reduce excitation is shown with the wrong polarity: the correct range is 0 to -4V.

CAT System Addendum for Revision 6.0+ EPROM

To improve the versatility of external computer control of the FT-1000, a facility to read back only the current memory number, or a 16-byte block of VFO or specified memory parameters has been added to EPROM Q5003 on the Control Unit, from revision 6.0.

The installed EPROM revision number can be non-destructively checked by holding the 1 and 3 keys at the upper corners of the keypad while switching on. The revision number appears after the display test and manufacturer ID display. If your revision is below 6.0, contact your Yaesu dealer for availability and price of the upgrade.

Revision 6.0 EPROM firmware adds two optional parameter bytes (#'s 1 and 4) to the Update command: Parameter Byte 1 selects the type (and quantity) of data to be returned by the transceiver, and Parameter Byte 4 specifies, when necessary, which memory to read. This table indicates the possible parameter values, and what they do:

Parameter	Data Returned	Comment
P1=0	All 1,636 bytes	same as earlier revs.
P1=1	1-Byte: Memory Number -1	Current or Last-Selected Memory
P1=2	16-Byte structure for Current Operation (either a VFO or Mem)	See the Table on page 38 of the Operating Manual
P1=3	Two 16-Byte structures (32 bytes) for Main & Sub VFOs	
P1=4 and P4=1 ~ 63h	16-Byte structure for memory number P4	

Table Notes:

- Software written for previous firmware revisions may not be compatible with revision 6 and later (if the Update command is sent with non-zero parameters). Such software can be made compatible simply by zeroing the Update command parameters.
- Parameter Byte 4 is significant only when requesting memory data (with Parameter Byte 1 = 4). Otherwise, Parameter Byte 4 is ignored by the transceiver.

Note to Programmers:

Yaesu models FT-1000, FT-990 and FT-890 all use similar, although not identical, programming interface commands. All of these models share the Read Flags command (0FAh), which returns 5 bytes, the last two of which may be used to uniquely identify the transceiver model:

Model	"Read Flags" Update Bytes 4 and 5
FT-1000	10h 00h
FT-990	09h 90h
FT-890	08h 41h



General Description



The FT-1000 is a high performance hf transceiver providing dual-channel reception on all frequencies between 100 kHz and 30 MHz, adjustable transmitter power output of up to 200 watts on all hf amateur radio bands in CW, SSB, FM, RTTY and Packet (F1 and F2) modes, and up to 50 watts carrier in AM mode. A heavy-duty AC power supply, automatic antenna tuner and iambic electronic speed keyer/bug simulator are supplied, built in, as standard accessories, along with eight IF filters for the 2nd and 3rd IFs of the main and sub receivers.

Inside the FT-1000, modular construction with extensive use of surface mount components on composite epoxy boards allows greater RF circuit isolation and higher reliability than previous manufacturing techniques. A squirrel cage blower in the heart of the transceiver replaces the usual rotary fan to cool the interdigital final heatsinks quietly and efficiently.

For exceptionally clean receiver and transmitter performance, the FT-1000 incorporates two 10-bit and three 8-bit Direct Digital Synthesizers for its local oscillators (all driven by a single TCXO master oscillator), and the operator's choice of front end RF amplification (using four FETs in a double push-pull, constant-gain stage), direct feed to the double-balanced quad FET ring mixer, or three levels of RF attenuation in 6-dB steps. Two receiver front ends, IF strips and vfos allow simultaneous reception and display of two different frequencies, even in different modes and with different IF bandwidths. Receiver audio can be completely or partially mixed, or monitored separately in each ear. With independent bandwidth and mode selection for each receiver, plus an option for separate antennas and bandpass filters, a variety of diversity reception modes are available when both vfos are tuned to the same frequency.

Six microprocessors in the FT-1000 are programmed to provide the simplest possible control interface for the operator, even for previously complex applications like diversity reception and hf packet. Two dual-

speed tuning knobs allow simple independent adjustment of the two vfos at all times. Fine tailoring of the IF passband is made possible with pushbutton crystal filter selection, concentric IF width and shift controls, and an IF notch filter. Separate keys are also provided for band selection, and each band key accesses two subband vfo frequency/mode/filter settings per band, so you can keep separate vfo settings for two different parts of the band, on all bands. In addition, 99 scanable memories are provided, each of which stores its own mode and IF filter selection, in addition to frequency, clarifier offset and scan status. The built-in automatic antenna tuner includes 39 memories of its own, automatically storing antenna matching settings for quick automatic recall later. Of course the front panel keypad can also be used to key in operating frequencies directly.

Special installable options for the FT-1000 include the BPF-1 Bandpass Filter Module to allow dual reception on separate antennas (and any hf frequencies), the TCXO-1 Temperature Controlled Crystal Oscillator module for precision stability over an expanded temperature range, and of course a wide selection of IF filters to complement the eight already installed as standard. External options include the DVS-2 Digital Voice Synthesizer for continuous recording and instant playback of received signals, and pushbutton pre-recorded transmissions; the SP-5 External Loudspeaker with audio filters and optional LL-5 Phone Patch module; the YH-77ST Stereo Headset; and the MD-1C8 Desktop Microphone and MH-1B8 Hand Microphone.

Before connecting the power cord, you should read the Installation section carefully, heeding the warnings in that section to avoid damage to the set. After installation, please take time to work through the Operation chapter, referring to the Controls & Connectors chapter as necessary for details. These chapters are intended to be read while sitting in front of the FT-1000, so you can try out each control and function as they are described.

Specifications

General

Receiving frequency range: 100 kHz — 30 MHz

Transmitting frequency ranges:

160-m band, 1.5 to 2.0 MHz

80-m band, 3.5 to 4.0 MHz

40-m band, 7.0 to 7.5 MHz

30-m band, 10.0 to 10.5 MHz

20-m band, 14.0 to 14.5 MHz

17-m band, 18.0 to 18.5 MHz

15-m band, 21.0 to 21.5 MHz

12-m band, 24.5 to 25.0 MHz

10-m band, 28.0 to 29.7 MHz

Frequency accuracy: $< \pm 0.5$ ppm at room temperature

Frequency stability: $< \pm 2$ ppm from 0 to $+50^{\circ}\text{C}$

(except FM, $< \pm 200$ Hz),

$< \pm 0.5$ ppm from -10 to $+60^{\circ}\text{C}$ w/TCXO-1 option

(FM $< \pm 150$ Hz from 0 to $+50^{\circ}\text{C}$)

Emission modes: LSB/USB (J3E), CW (A1A),

FSK (J1D, J2D), AM (A3E), FM (F3E)

Basic frequency steps:

10 Hz for J3E, A1A and J1D;

100 Hz for A3E, F3E and J2D

Antenna impedance: 16.5 to 150 Ω , 50 Ω nominal

Supply voltage:

100, 110, 117, 200, 220 or 234 VAC, 50/60 Hz

Power consumption (approx.):

95 VA receive, 1050 VA for 200 watts transmit

Dimensions (WHD): 420 \times 150 \times 375 mm

Weight (approx.): 25.5 kg. (51 lbs)

Transmitter

Power output:

adjustable up to 200 watts (50 watts AM carrier)

Duty cycle: 100% @ 100 watts,

50% @ 200 watts (FM & RTTY, 3-minute tx)

Modulation types

SSB: Balanced, filtered carrier

AM: Low-level (early stage)

FM: Variable reactance

FSK: Audio frequency shift keying

Maximum FM deviation: ± 2.5 kHz

FSK shift frequencies: 170, 425 and 850 Hz

Packet shift frequencies: 200, 1000 Hz

Harmonic radiation: at least 50 dB below peak output

SSB carrier suppression:

at least 40 dB below peak output

Undesired sideband suppression:

at least 50 dB below peak output

Audio response (SSB):

not more than -6 dB from 400 to 2600 Hz

3rd-order IMD: -36 dB @ 150 watts PEP,

-31 dB @ 200 watts PEP, or better

Microphone impedance: 500 to 600 Ω

Receiver

Circuit type:

quad-conversion superheterodyne

(triple conversion for FM)

Intermediate frequencies:

73.62 and 8.215 MHz, and 455 and 100 kHz

Sensitivity:

(With preamp on, for 10 dB S/N, 0 dB μ = 1 μ V)

Frequency \Rightarrow Mode (BW) \downarrow	100 – 250 kHz	250 – 500 kHz	0.5 – 1.8 MHz	1.8 – 30 MHz
SSB, CW (2.4 kHz)	$< 1.25 \mu\text{V}$	$< 1 \mu\text{V}$	$< 2 \mu\text{V}$	$< 0.25 \mu\text{V}$
AM (6 kHz)	$< 10 \mu\text{V}$	$< 8 \mu\text{V}$	$< 16 \mu\text{V}$	$< 1 \mu\text{V}$
29-MHz FM (for 12 dB SINAD)	—	—	—	$< 0.5 \mu\text{V}$

Selectivity ($-6/-60$ dB):

Button	Modes	Minimum -6 dB BW	Maximum -60 dB BW
2.4 kHz	all except FM	2.2 kHz	3.8 kHz
2.0 kHz	all exc. AM, FM	1.8 kHz	3.6 kHz
500 Hz	CW, RTTY, Packet	500 Hz	1.2 kHz
250 Hz	CW, RTTY	240 Hz	700 Hz
—	AM (wide)	6 kHz	14 kHz

Dynamic range (typical):

108 dB (@50 kHz, 500-Hz BW, RF amp off)

Squelch sensitivity:

1.8 — 30 MHz (CW, SSB, AM): $< 2.0 \mu\text{V}$

28 — 30 MHz (FM): $< 0.32 \mu\text{V}$

IF rejection (1.8 — 30 MHz):

80 dB or better

Image rejection (1.8 — 30 MHz):

80 dB or better

IF shift range: ± 1.12 kHz

Maximum audio power output:

2 watts into 4 Ω with $< 10\%$ THD

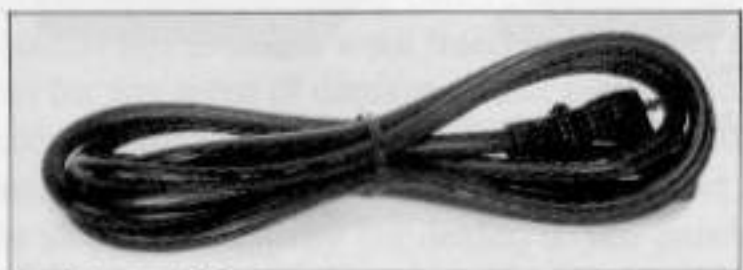
Audio output impedance: 4 to 8 Ω

Specifications are subject to change, in the interest of technical improvement, without notice or obligation.

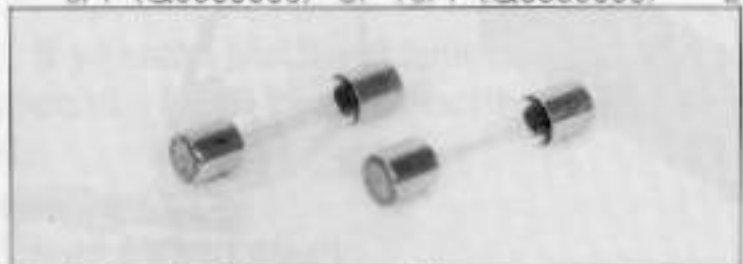
Accessories & Options

Supplied Accessories

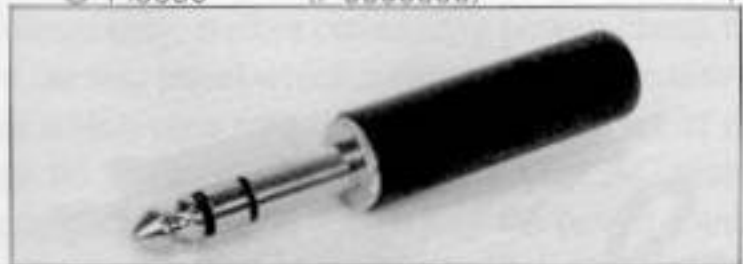
- AC Cord (T9017780) 1



- Spare Fuses 8A (Q0000039) or 15A (Q0000008) 2



- 1/2-inch, 3-contact Plug S-H3606 (P0090008) 1



- 1/4-inch, 3-contact Plug C110 (P0090726) 1



- 1/4-inch, 2-contact Plug C107 (P0090034) 1



- RCA Plug T-1447 (P0090544) 2



- 4-pin DIN Plug E4-701B-00 (P0090724) 1



- 5-pin DIN Plug E5-701B-00 (P0090725) 1



Options

BPF-1 Bandpass Filter Module

Consisting of 11 receiver bandpass filters and its own switchable attenuator network, the BPF-1 allows the sub receiver in the FT-1000 to be tuned to any frequency independently from the main receiver, using a separate antenna. The attenuator control on the BPF-1 can be used either to control sub receiver attenuation separately from the main receiver, or be overridden so that the FT-1000 front panel attenuator knob controls both receivers' attenuators in parallel.

TCXO-1 High Stability Master Reference Oscillator

For special applications and environments where extra frequency stability is essential, such as for long-term hf packet monitoring under wide temperature variations, the TCXO-1 provides ± 0.5 -ppm stability from -10 to $+60^\circ\text{C}$ for the master reference oscillator.



BPF-1



TCXO-1

MD-1C8 Desk-Top Microphone

Designed especially to match the electrical and cosmetic features of the FT-1000, the MD-1C8 has 600- Ω impedance, and includes up/down scanning buttons and a large PTT switch with latch.



MD-1C8

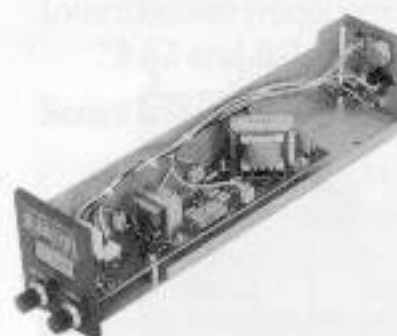


SP-5

SP-5 Loudspeaker with Audio Filters and LL-5 Phone Patch Option

Selectable audio high- and lowpass filters together with a large loudspeaker complement the superb audio characteristics of the FT-1000 with your choice of 12 different audio filtering combinations. Two input terminals are provided for multiple transceivers, with a front panel switch to select between them. A (monaural) phone jack is provided on the front panel to take advantage of the audio filters with headphones.

With the optional LL-5 Phone Patch Unit installed in the SP-5, the FT-1000 can be patched to the public telephone network. The LL-5 includes a hybrid transformer circuit to assure proper impedance matches, and front panel gain controls and level meter to set proper audio levels on the telephone line.



LL-5



YH-77ST

YH-77ST Lightweight Stereo Headphones

Dual samarium-cobalt transducers with sensitivity of 103dB/mW (± 2 dB, @1 kHz, 35 Ω) provide the perfect match for the FT-1000. During dual receive with the YH-77ST, one receiver can be monitored in each ear, allowing easy separation of the signals from the two receivers (or the audio can be mixed, if desired).



DVS-2



FIF-232C

DVS-2 Digital Voice System

Serving as either a continuous receiver recorder for instant pushbutton playback, or microphone audio recorder for multiple on air playback, the DVS-2 applies the advantages of random-access solid-state digital memory to serious communications. All data is stored electronically, with no moving parts except your finger and the pushbutton. More information is on page 33.

FIF-232C CAT System Interface

To control the FT-1000 from an RS-232C serial port of an external personal computer, use the FIF-232C to convert the TTL levels required by the transceiver to the RS-232C levels required by the serial port. A cable is included for connection between the transceiver and the FIF-232C (the cable to the computer must be provided separately). The FIF-232C includes its own AC power supply.



IF Crystal Filter

IF Crystal Filter Options

Five crystal filters may be installed in the 455-kHz 3rd IFs of the FT-1000, to function in cascade with the eight installed at the factory.

XF-C (XF-455K-262-01)

Main receiver 2.4-kHz BW (for all modes except FM)

XF-D (XF-455K-202-01)

Main receiver 2.0-kHz BW (for all except AM & FM)

XF-E (XF-455K-501-01)

Main receiver 500-Hz BW (for CW, RTTY & Packet)

XF-F (XF-455K-251-01)

Main receiver 250-Hz BW (for CW & RTTY)

XF-455MC

Sub receiver 600-Hz BW (for CW only)

General Setup & AC Power

Preliminary Inspection

Inspect the transceiver thoroughly immediately upon opening the packing carton. Check to see that all controls and switches work freely, and inspect the cabinet for any signs of damage. Make sure the accessory fuses and plugs pictured on page 3 are included. If any damage is found document it completely, and contact the shipping company (or dealer, if you purchased it over the counter) right away. Save the packing materials in case you need to return the set for service.

If you have purchased optional internal accessories separately, install them as described in Chapter 6 (page 40).

Power Connection

The FT-1000 is designed for operation from AC voltage only. Before connecting power, check the label on the rear panel which indicates the AC mains voltage for which your transceiver is currently set. If the voltage on this label does not match your AC mains voltage, the taps on the primary of the power transformer in the transceiver must be rewired, and the fuse may have to be changed. This requires only a screwdriver and is not difficult (see below), but you should make sure the transformer is wired correctly before connecting power. If you have any doubts about the procedure, contact your dealer for assistance.

CAUTION

Permanent damage will result if improper AC supply voltage is applied to the transceiver, your warranty does not cover damage caused by application of improper supply voltage, or use of an improper fuse.

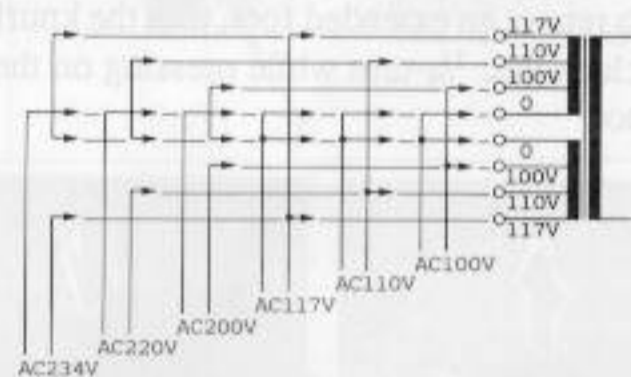
We also recommend that you open the fuse holder on the rear panel, and make sure that the fuse is correct for your mains voltage:

AC Mains Voltage	Fuse Capacity
100, 110 or 117	15 A
200, 220 or 234	8 A

After making certain the AC voltage for which the transceiver is set matches your mains voltage, and that the correct fuse is installed in the fuse holder, connect the AC power cord to the 3-pin AC jack on the rear panel. Wait until all other transceiver interconnections have been made before connecting the other end of the power cord to the wall outlet.

Changing the Power Transformer Primary Winding for Different AC Voltages

- Make certain that all cables are disconnected from the transceiver.
- Remove the three screws from each side of the transceiver, and two from the top edge of the rear panel. Remove the top cover.
- On the left side of the power transformer, locate the clear plastic insulating cover with voltage markings. Remove the four screws affixing this plate, and remove it and the plastic sheet underneath.
- AC from the power cable is provided by the grey and white wires connected to the lower row of terminals, and for voltages of 117 V and below, two jumpers are also used. Reconnect these wires for the desired voltage according to the diagram at the right. *Do not, under any circumstances, change the wiring of the upper row of terminals.*
- Replace the insulating sheets and their four screws, and the top cover and its eight screws.



IMPORTANT!

If you change the primary transformer taps, make sure to also change the voltage marking on the label on the rear panel to match the new voltage setting. Also, if you change the transformer taps for operation from 117V or below to 220V or above, or vice-versa, you must change the fuse in the fuse holder, as indicated in text above. Do not use slow-blow type fuses.

Transceiver Location

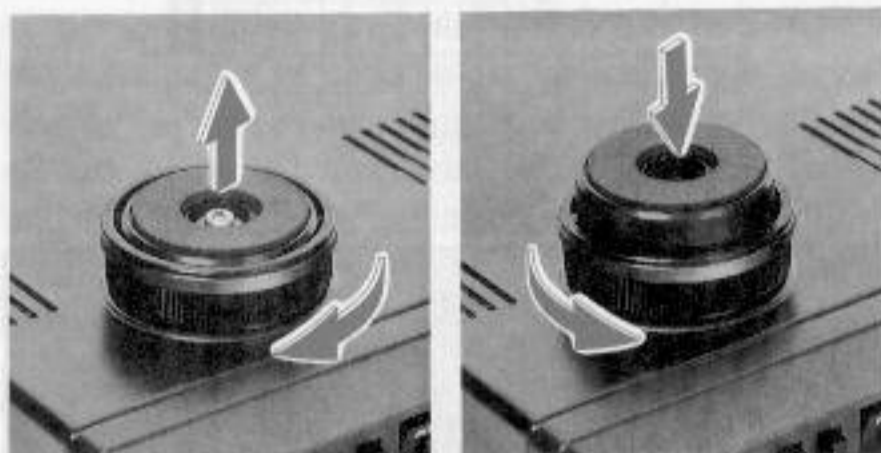
To assure long life of the components, a primary consideration in setting up the FT-1000 is providing for adequate ventilation around the cabinet. The cooling system of the FT-1000 must be free to draw cool air in at the lower rear of the transceiver, and to expel warm air out of the upper rear panel. Do not place the transceiver on top of another heat-generating device such as a linear amplifier, and do not place equipment, books or papers on top of the transceiver. Also, provide a few centimeters of space on either side of the transceiver, if possible. Avoid heating vents and window locations that could expose the transceiver to excessive direct sunlight, especially in hot climates.

Grounding

For protection from shock and proper performance, connect the **GND** terminal on the rear panel to a good earth ground, using a heavy braided cable of the shortest length possible. All other station equipment should be connected to the same grounding cable, as close together as practical. If you use a computer with or near the FT-1000, you may need to experiment with ground wiring to suppress computer noise in the receiver.

Adjusting the Front Feet

The two front feet of the FT-1000 can be set in either of two positions. By turning the knurled ring around a (retracted) foot clockwise, the middle of the foot will extend about one centimeter. Turn the ring as far as it will go (about 1/4-turn) to lock the extended foot in place. To retract an extended foot, turn the knurled ring counterclockwise 1/4-turn while pressing on the center of the foot.



Adjusting the Front Feet

Antenna Considerations

Any antennas connected to the FT-1000 should have coaxial feedlines with 50- Ω impedance, and in-

clude a well-grounded lightning arrestor. For the antenna connected to the main **ANT** jack, the automatic antenna tuner in the FT-1000 is capable of matching antennas with an SWR of up to 3:1 or more on the amateur bands to the transmitter. Nevertheless, optimum performance for both reception and transmission will generally result with an antenna designed to provide a 50- Ω unbalanced resistive load at the operating frequency. An antenna that is not designed for resonance at the operating frequency may present too high an SWR to allow proper matching with the built-in antenna tuner, in which case the antenna itself should be readjusted, or an outboard antenna tuner used. If the tuner is unable to bring the SWR down to an acceptable level, attempting to transmit will result in an automatic reduction in power output and increased losses in the feedline. Operation under such conditions is not recommended: it is better to install another antenna designed for that band. Also, if your antenna has a balanced feedpoint and you use a balanced feedline, install a balun between the feedline and the **ANT** jack of the transceiver.

The same precautions apply to any additional (receive-only) antennas connected to the **RX ANT** jack, or to the BPF-1 (if installed), except that neither of these antennas will have the benefit of the built-in antenna tuner. Therefore, unless such receive-only antennas have an impedance near 50 Ω at the operating frequency, you may need to install an external antenna tuner to obtain optimum performance.

Interconnection of Accessories

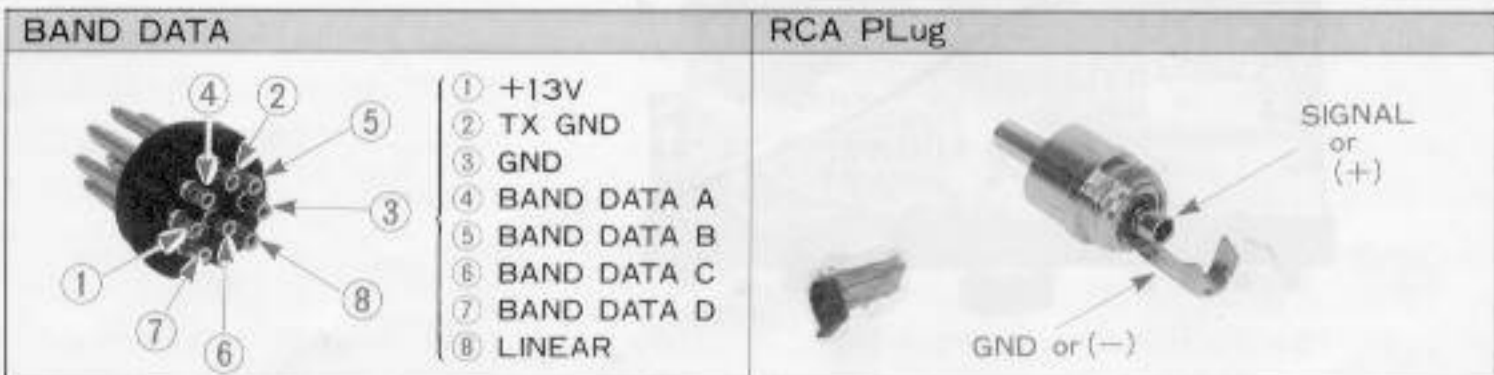
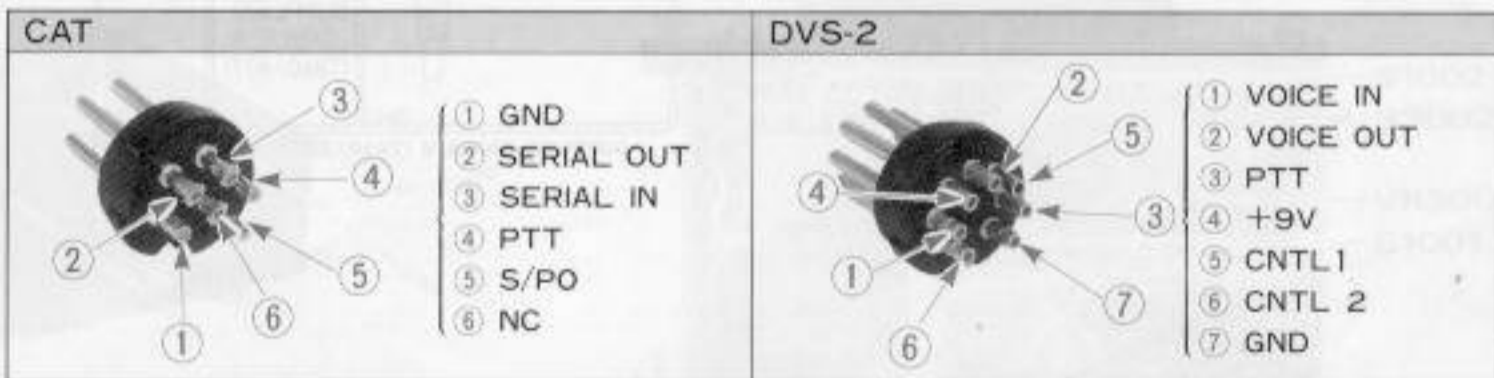
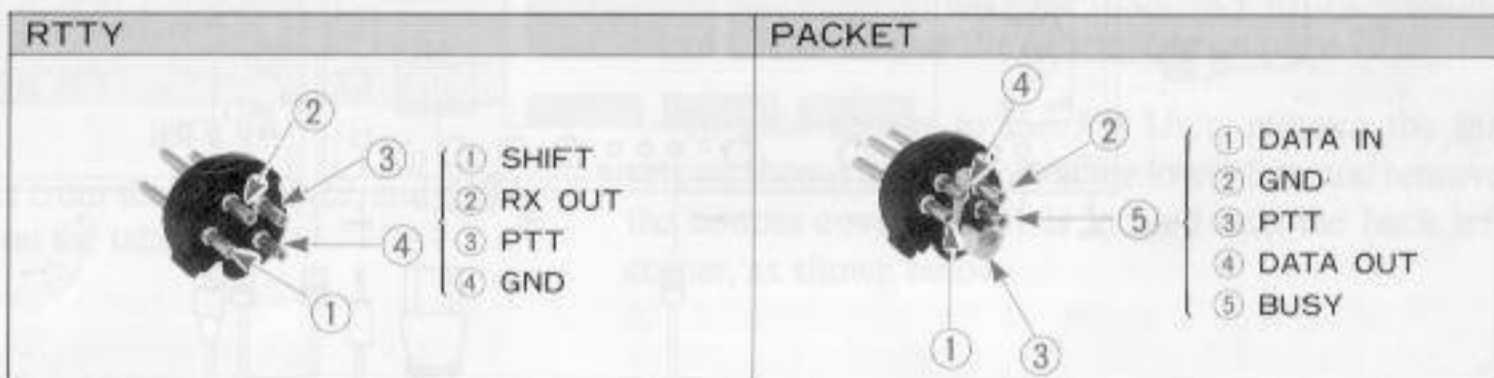
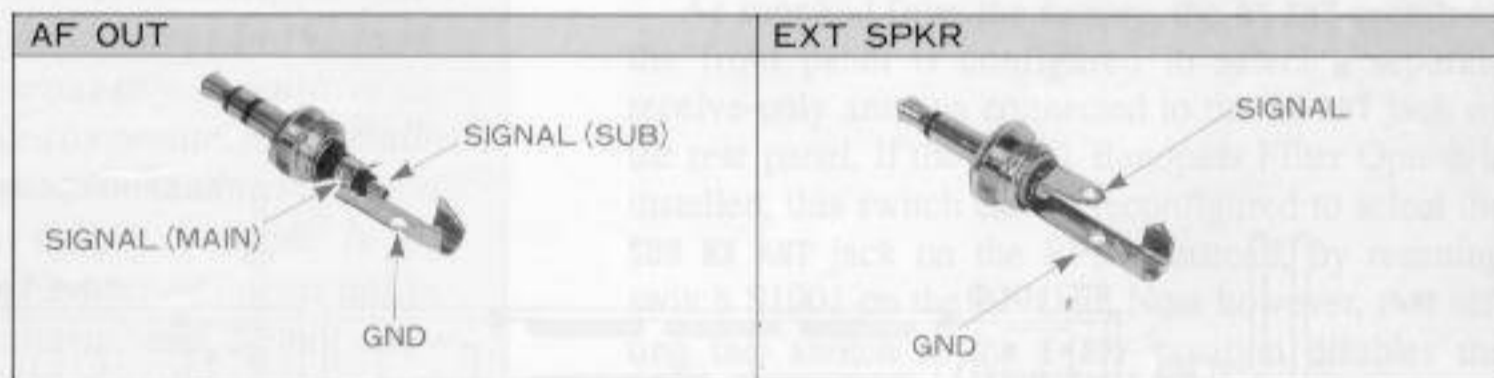
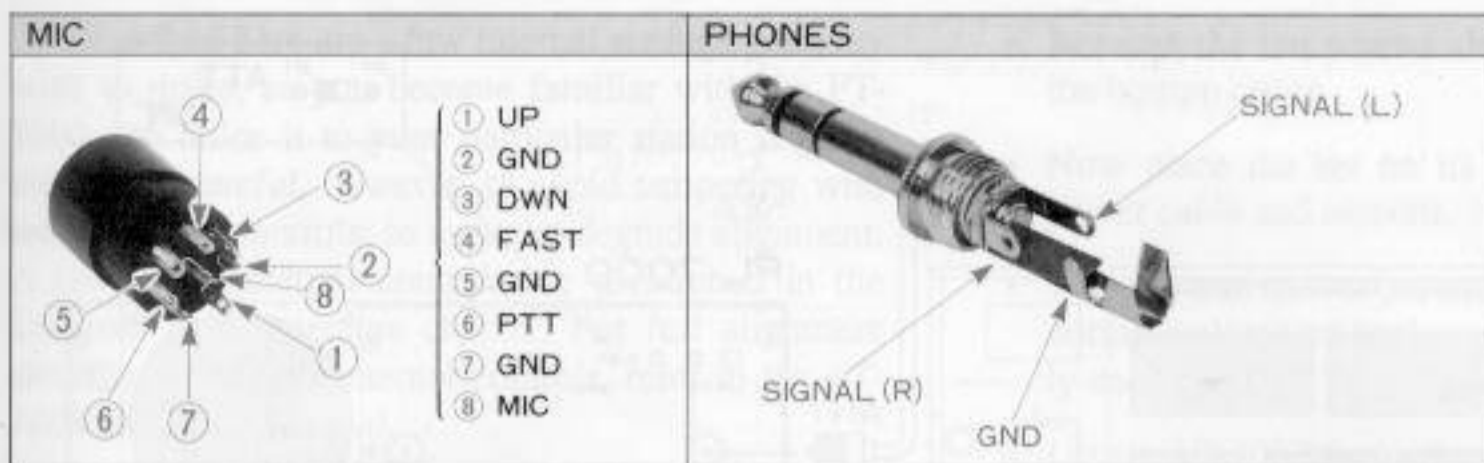
The diagrams on the following pages show interconnections of various external accessories. If you have any questions on these accessories or connecting devices not shown, contact your dealer for advice.

Memory Backup

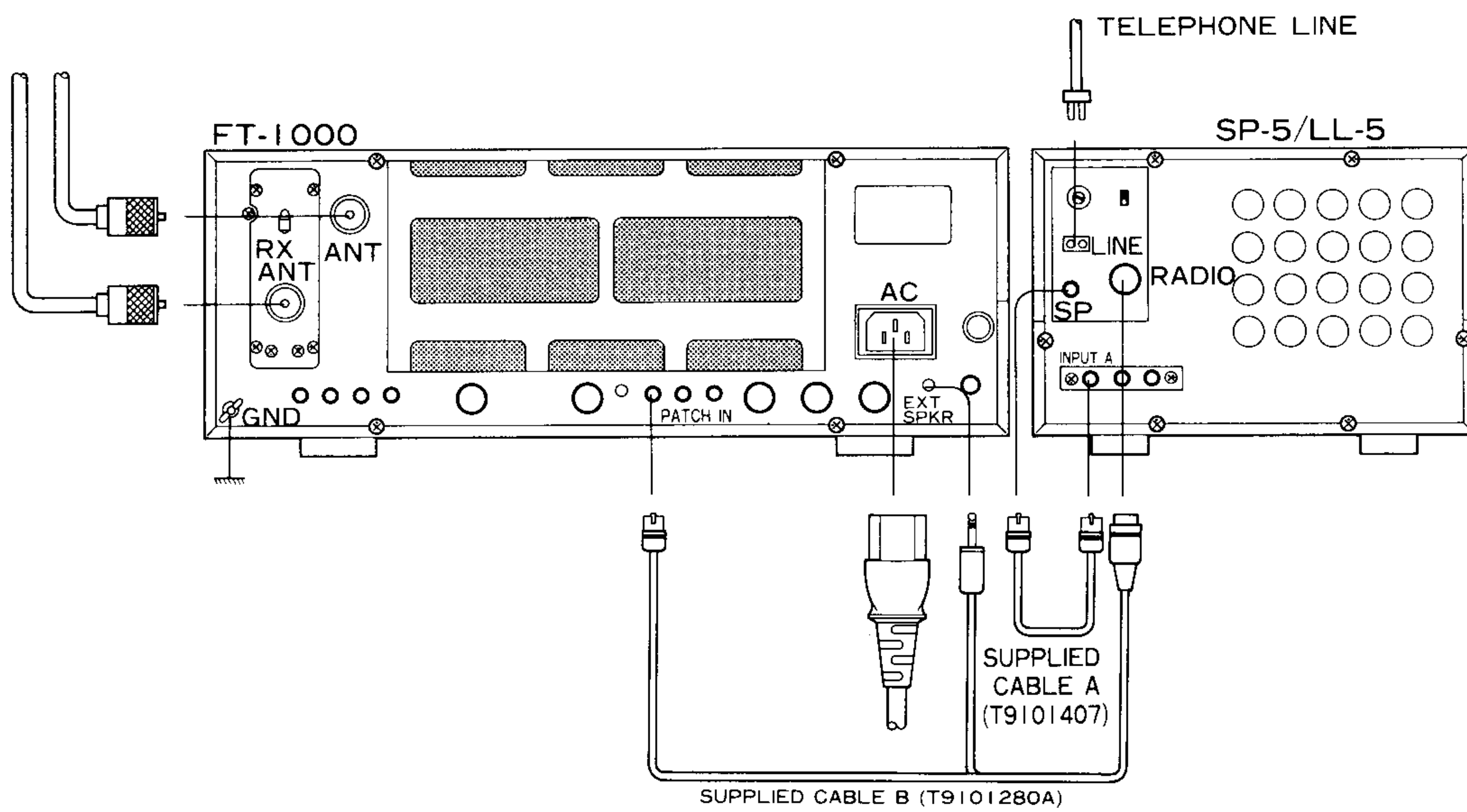
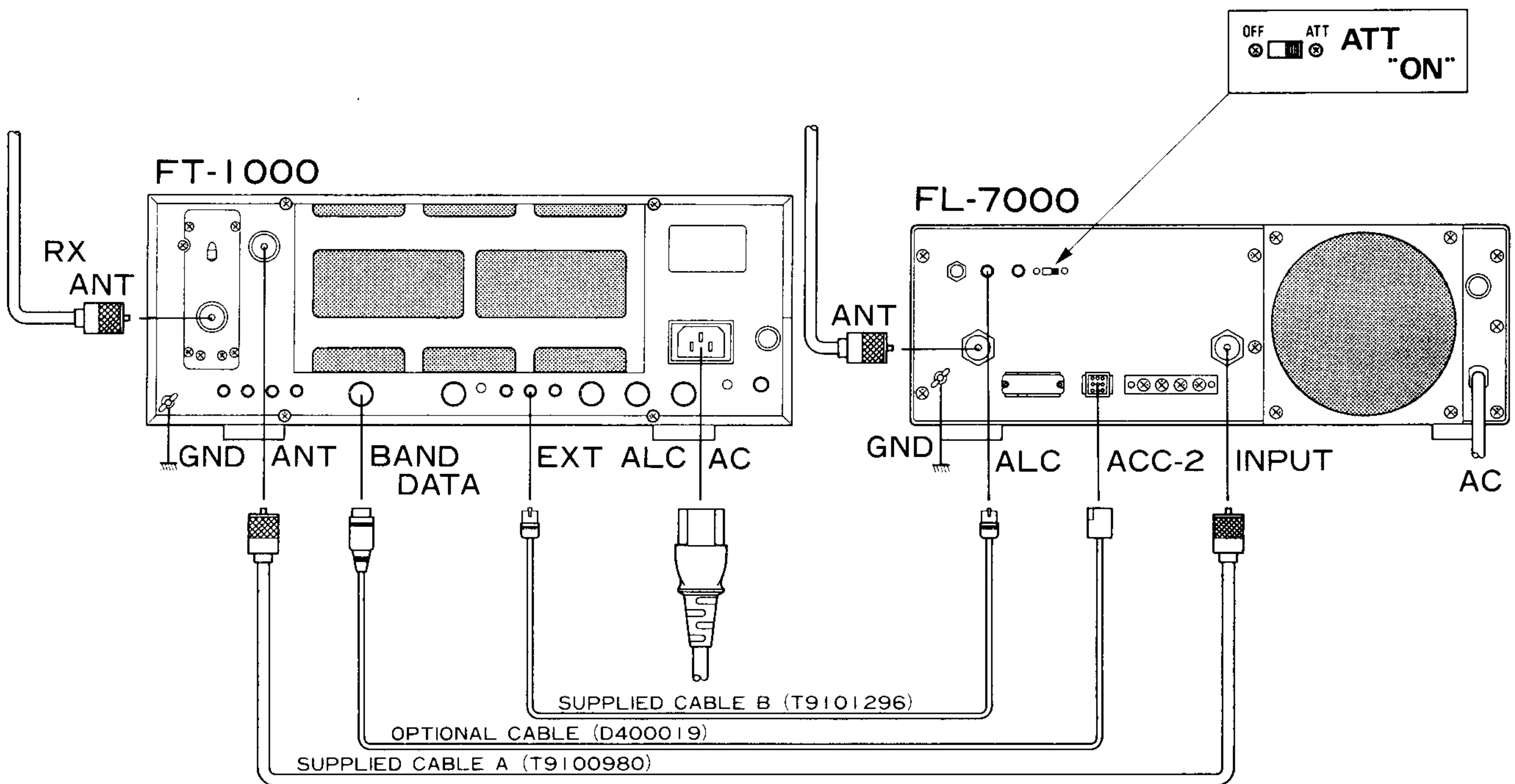
The lithium memory **BACKUP** switch inside the top access panel is turned on at the factory, allowing vfo and memory data to be retained while power is off. Backup current is miniscule, so it is not necessary to turn the **BACKUP** switch off unless the transceiver is to be stored for an extended period.

After five or more years of operation the transceiver may fail to retain memories, at which time the lithium battery should be replaced. Contact your dealer for replacement of the battery, or for instructions on how to do so yourself.

Connector Pinouts



Connecting External Accessories



Internal Settings

Described here are a few internal settings you may wish to make, as you become familiar with the FT-1000, to tailor it to your particular station requirements. Be careful, however, to avoid tampering with other internal controls, so as not to degrade alignment. A few other internal controls are mentioned in the Controls & Connectors chapter. For full alignment details covering all internal controls, refer to the *FT-1000 Technical Manual*.

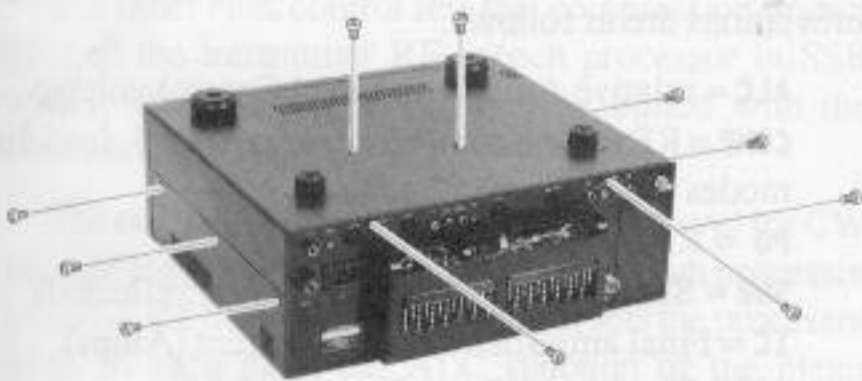
Key Beeper Volume

This trimmer potentiometer sets the volume (relative to receiver signal volume as set by the **AF** control) of the beep that sounds when one of the front panel buttons is pressed.

CAUTION

This adjustment must be made with power applied, and with the cover removed. Although the voltages at exposed places in the transceiver are not dangerous to you, sensitive circuitry can be damaged by contact with metallic tools. Therefore we recommend using a non-metallic adjustment tool, if available. In any case, avoid touching any components not involved in the adjustment, and do not allow anything to fall in the set while the cover is removed.

- Disconnect the cables from the transceiver, and turn the set upside-down on the table.

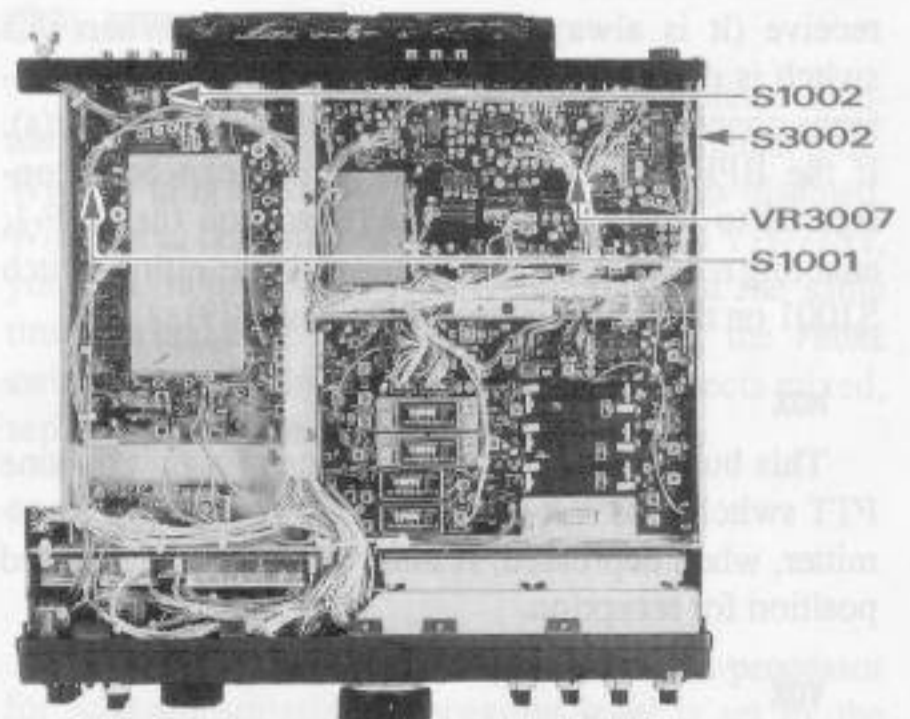


- Remove the ten screws shown below, and remove the bottom cover.
- Now place the set on its side, reconnect the AC power cable and antenna.
- Turn the transceiver on, and adjust the **AF** control for normal volume on background noise on a commonly-used band.
- Locate VR3007 from the photo below, and use a small screwdriver to adjust it for the desired beep volume while repeatedly pressing a front panel key.
- Switch the transceiver off, disconnect the power cable, turn the transceiver on its top again, and replace the bottom cover and ten screws removed above (unless also setting S1001, as described next).

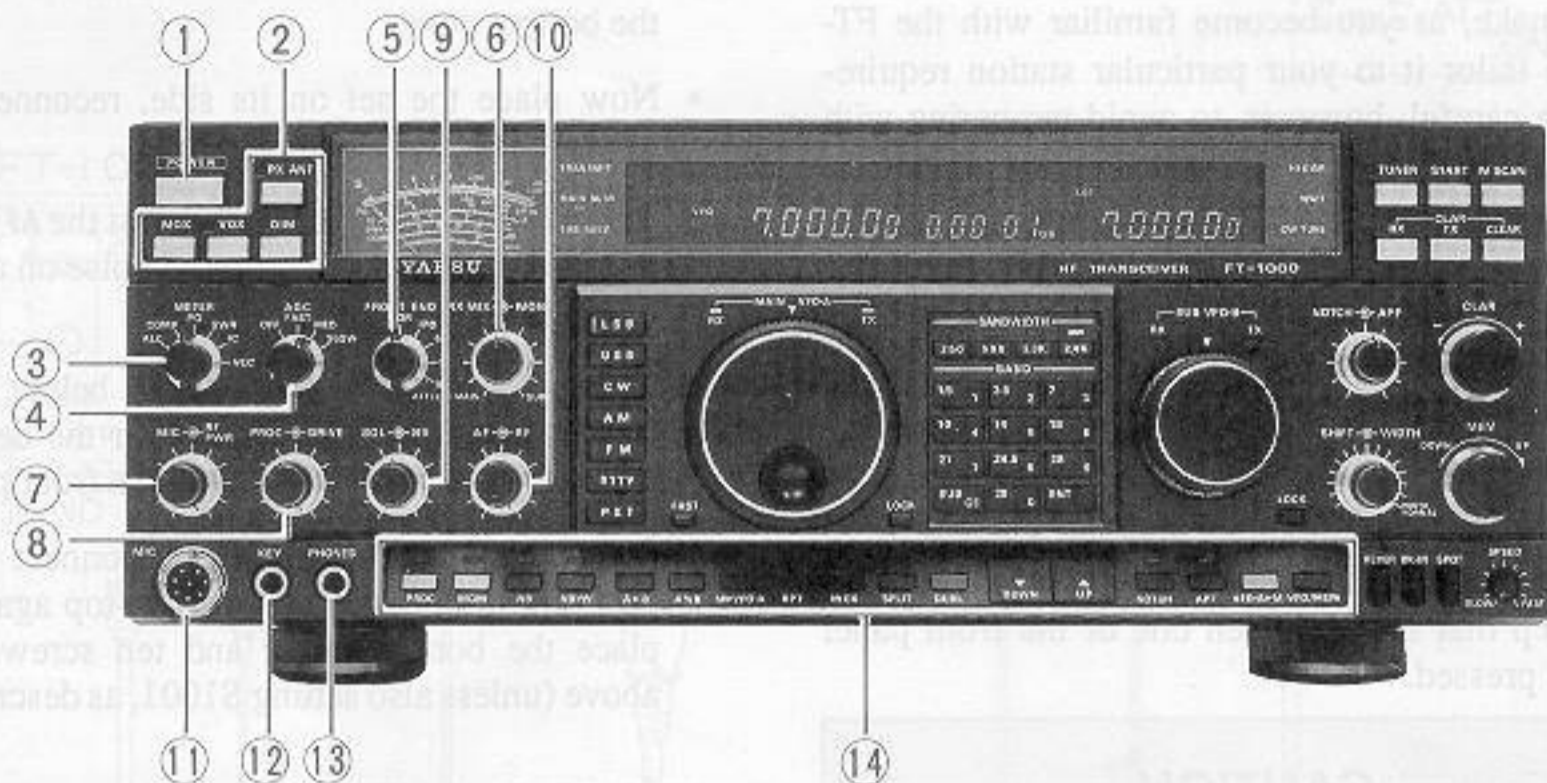
RX ANT Switch Selection Setting with BPF-1 Option (RF Unit Switch S1001)

As supplied from the factory, the **RX ANT** switch on the front panel is configured to select a separate receive-only antenna connected to the **RX ANT** jack on the rear panel. If the BPF-1 Bandpass Filter Option is installed, this switch can be reconfigured to select the **SUB RX ANT** jack on the BPF-1 instead, by resetting switch S1001 on the RF Unit. Note however, that setting this switch to the **E BPF** position disables the capability of operating split-frequency with a separate receive antenna (see the schematics on page 29).

To gain access to the RF Unit, remove the ten screws shown in the photo at the lower left, and remove the bottom cover. S1001 is located near the back left corner, as shown below.



Front Panel Controls



This chapter describes each control and connector on the FT-1000. You can just read through quickly now, but some of the descriptions will be more meaningful if you first work through the Getting Started Tutorial at the beginning of the Operating chapter, and then return to this chapter with the set powered up, as questions arise during operation. Some controls and switches are disabled under certain conditions.

(1) POWER

This button turns the transceiver on and off.

(2) 2-Position Pushbutton Switches

RX ANT

When this switch is in the undepressed position, the antenna connected to the main ANT socket is used for receive (it is always used for transmit). When this switch is depressed (LED indicator on), a second antenna connected to the RX ANT is used by the receiver(s). If the BPF-1 is installed, this switch can be reconfigured to select the SUB RX ANT jack on the BPF-1, enabling reception on two antennas, by resetting switch S1001 on the RF Unit (see pages 9 and 29).

MOX

This button may be used in place of a microphone PTT switch or CW key to manually activate the transmitter, when depressed. It must be in the undepressed position for reception.

VOX

Enables automatic voice-actuated transmitter switching in SSB, AM and FM modes; and semi break-in

keying in CW mode. The controls affecting VOX operation are located in the top access panel.

DIM

Dims the brightness of the display and meter lamp for comfortable viewing in the dark.

Display Dim Level Adjustment

The brightness of the dim selection is adjustable by holding the **FAST** button while turning the **CLAR** control.

(3) METER Selector

This selector determines the function of the multi-meter during transmission. The meanings of the abbreviations are as follows:

- ALC** = relative Automatic Level Control voltage
- COMP** = RF speech compressor level (in dB, for SSB modes only)
- PO** = RF Power Output (watts)
- SWR** = Standing Wave Ratio (forward:reflected)
- IC** = Final amplifier collector current (Amps)
- VCC** = Final amplifier collector voltage.

The meter indicates the selected parameter during transmission, and signal strength in S-units during reception (on the main receiver). Each S-unit is approximately 6 dB.

(4) AGC Selector

Selects main receiver Automatic Gain Control decay time for most comfortable reception, or disables

receiver AGC (off). Normally this switch is set to the **MED** position. Strong signals will cause distortion if this selector is set to **OFF**.

(5) FRONT END

Use this selector to set the optimum receiver front end characteristics. The **NOR** position activates the internal rf amplifier, for maximum receiver sensitivity on a quiet band. The **IPO** position bypasses the rf amplifier and feeds the received signals directly to the first mixer. The other positions insert 6-, 12- or 18-dB (1, 2 or 3 S-units) of attenuation before the mixer, to suppress band noise and possible overload from very strong signals. If the optional BPF-1 Bandpass Filter Unit is installed, the functions of this selector, for the sub receiver, may be controlled either in parallel with the main receiver via this selector, or independently via the selector on the BPF-1.

(6) RX MIX MONI

The inner **RX MIX** control adjusts the relative balance of receiver audio between the two receiver channels during dual reception.

The outer **MONI** control adjusts the audio volume of the CW sidetone, and transmit RF monitor during transmission, when activated by the gray button with the same name.

(7) MIC RF PWR

The inner **MIC** control adjusts the microphone input level for (non-processed) SSB and AM transmission.

The outer **RF PWR** control adjusts the transmitter output power in all modes. The adjustment range is from less than 20 to 200 watts, except in AM mode, where it is from about 5 to 50 watts.

(8) PROC DRIVE

The inner **PROC** control sets the compression (input) level of the transmitter RF speech processor in SSB modes, when activated by the gray button with the same name.

The outer **DRIVE** control sets the carrier level for CW and AM transmission. Also, when the speech processor is used in the SSB modes, this control sets the processor level. In each case, the ALC function of the meter should always be selected when setting this control, to avoid overdriving the transmitter final amplifier.

(9) SQL NB

The inner **SQL** control sets the signal level threshold at which receiver audio is muted (and the green **BUSY** LEDs turn off), in all modes. This control is normally kept fully CCW, except when scanning, and during FM operation. Both main and sub receivers are affected.

The outer **NB** control adjusts the blanking level when the noise blanker is activated during reception, for the main receiver. If set very far clockwise, receiver audio may be distorted.

(10) AF RF

The inner **AF** gain control adjusts the audio volume of the receiver(s) in the speaker or headphones.

The outer **RF** gain control adjusts the receiver signal level in front of the main receiver 1st mixer (via PIN diodes), and also the gain of the main receiver IF amplifiers. This control is normally set fully clockwise for maximum sensitivity. When rotated counterclockwise from maximum, the S-meter minimum deflection point will move up the scale. The peak deflection for a particular signal will remain the same if it is greater than the level set by this control, but the main receiver will be insensitive to weaker signals. This control also affects the **SQL** setting for the main receiver, and should be preset fully clockwise when setting the squelch threshold for vfo A or a recalled memory. This control does not affect the sub receiver.

(11) MIC

This 8-pin jack accepts the MD-1B8 or MD-1C8 Desktop Microphone or the MH-1B8 Handie Scanning Microphone. MIC pinout is shown on page 7. Proper microphone input impedance is 500 to 600 ohms.

(12) KEY

This 1/4-inch, 3-contact jack accepts a CW key or keyer paddles (for the built-in electronic keyer), or output from an external electronic keyer. *You cannot use a 2-contact plug in this jack.* Pinout is shown on page 7. Key up voltage is 5 V, and key down current is 0.5 mA. There is another jack with the same name, connected in parallel with this jack, on the rear panel.

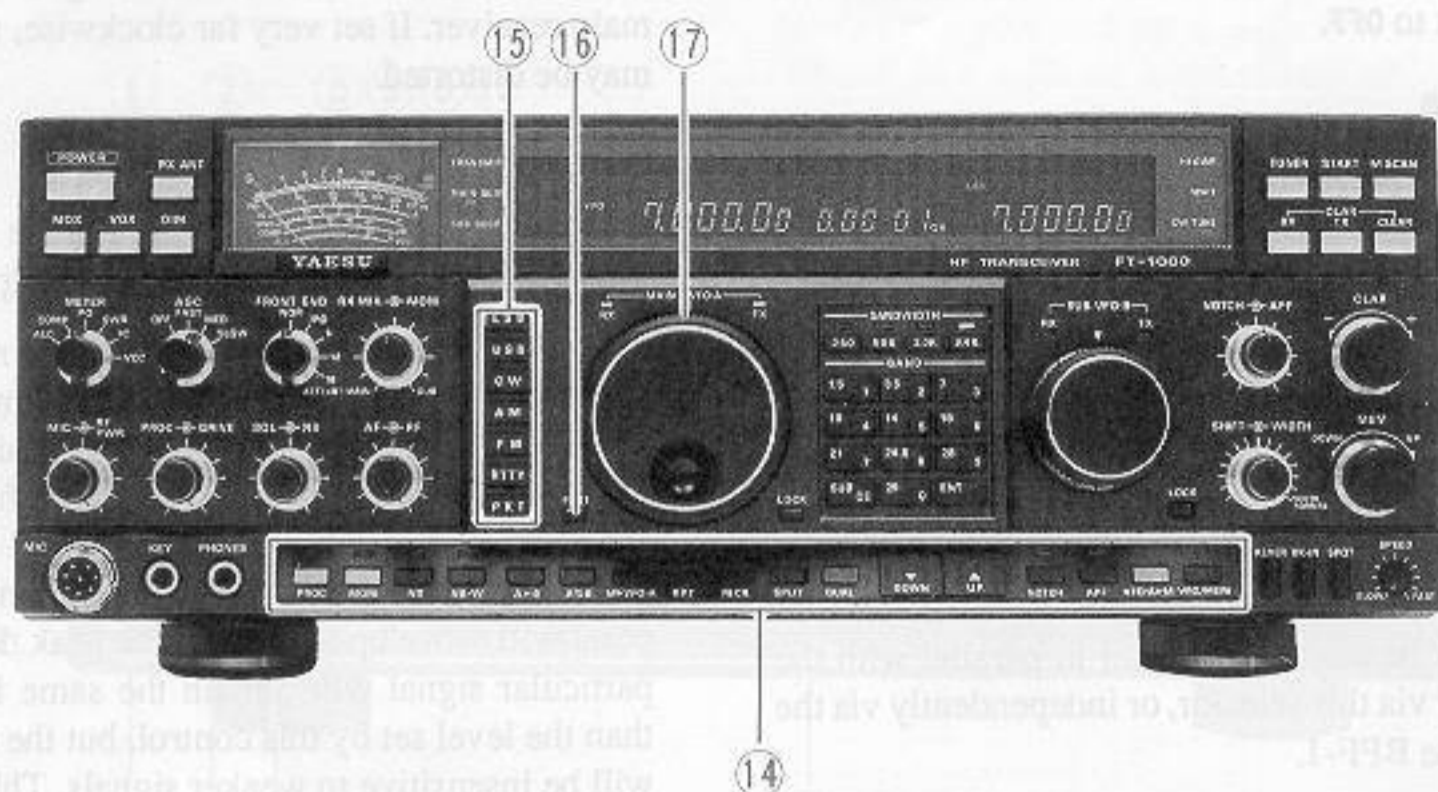
(13) PHONES

This 1/4-inch, 3-contact jack accepts either monaural or stereo headphones with a 2- or 3-contact plug. When a plug is inserted, the loudspeaker is disabled. With stereo headphones such as the optional YH-77ST, you can monitor both receiver channels at the same time during dual reception. In this case, the **PHONE** switch (page 17) in the top access panel selects mixed, separate or monaural headphone operation.

(14) Push Switches

PROC

This gray button enables the RF speech processor for SSB transmission. Processing level is set by the control with the same name. While activated, the LED above this button glows orange.



MONI

This gray button enables the transmit (RF) monitor in all modes (except CW, in which the monitor function is always on, to produce the sidetone). Audio level (relative to the main **AF** control) is set by the control with the same name. The LED above this button glows orange while activated.

NB & NB-W

These buttons activate the main receiver noise blankers. Press the **NB** button to blank short pulse noise such as from automobile ignitions, power lines and switching transient spikes. Press the **NB-W** button to blank long pulse noise, such as the "Woodpecker" over-the-horizon radar. The LEDs above each button glow green while activated. Blanking level for both blankers is set by the control with the same name.

A ← B

This button transfers data from the main display (either the main vfo (A) or a recalled memory channel) to the sub vfo (B), overwriting any previous contents in the sub vfo. Use this key to instantly set both main and sub receivers to the same frequency and mode.

A ⇌ B

This button exchanges the contents of the main display (either the main vfo (A) or a recalled memory channel), and sub vfo (B). No data is lost.

M → VFO-A

Pressing this button momentarily displays the contents of the currently selected memory channel for three seconds. Holding this button for for 1/2-second copies the data from the currently selected memory to

the main vfo (A), as two beeps sound. Previous data in the main vfo is overwritten.

RPT

When operating in the FM mode on the 29-MHz band, this button activates standard hf FM repeater operation. Pressing this button once or twice while receiving causes the transmit frequency to be shifted 100 kHz below or above the receiving frequency, respectively. An 88.5-Hz subaudible tone is also transmitted automatically at a low level when using this feature, to allow access to repeaters that require it. Pressing this button a third time cancels repeater shift operation.

MCK (Memory Check)

This button allows display of the contents of the memory channels without disturbing operation. When pressed, **MCK** is displayed just above the channel number. The contents of each memory channel can then be checked on the sub receiver display by rotating the **MEM** selector. Empty memory channels display as two decimals, with no frequency digits. Press this button again to cancel memory checking.

SPLIT

This button activates split frequency operation between the main display (either the main vfo (A) or a recalled memory channel), used for transmission, and the sub vfo (B), for reception. The **SPLIT** indicator on the display is lit while this function is active.

DUAL

This button activates dual-channel reception with the main and sub receivers. When this function is ac-

tive, **DUAL** is displayed in an orange box at the left edge of the display.

DOWN & UP

Pressing either of these buttons momentarily steps the operating frequency down or up 100 kHz, respectively. Pressing and holding the **FAST** button while pressing one of these buttons steps down or up 1 MHz. Continue holding either button for repeated stepping.

NOTCH

This button activates the IF notch filter for the main receiver. The frequency of the notch is set by the control with the same name. The LED above this button glows green while the notch filter is active. The notch filter does not affect the sub receiver.

APF

This button activates the Audio Peak Filter during CW operation with the main receiver. The peak frequency is set by the control with the same name. The LED above this button glows green while the audio peak filter is active. Sub receiver operation is unaffected.

VFO-A \rightarrow M

Pressing and holding this yellow button for 1/2-second transfers (writes) the current main operating data from the main vfo (A), or a recalled memory, to the currently selected memory channel, overwriting any previous data stored there. Also, pressing and holding this button after recalling a memory, without first retuning, causes the memory channel to be "blanked", and repeating the process restores the blanked memory.

VFO/MEM

This button toggles main receiver operation between the memory channel and the main vfo (A). Either **VFO**, **MEM** or **M TUNE** is displayed to the left of the main frequency display to indicate the current selection. If a displayed memory has been retuned, pressing this button returns the display to the original memory contents, and pressing it again returns operation to the main vfo.

(15) MODE

These seven momentary buttons select the operating mode, indicated by the LED in each button. Note that pressing the **RTTY** and **PACKET** buttons multiple times will switch between the possible modes of emission that can be used by these digital modes (LSB and USB for RTTY, and LSB and FM for packet).

(16) FAST

For fast tuning, press and hold this button while rotating the main or sub tuning knobs or pressing the **UP** or **DOWN** button to increase the tuning rate ten times. See the table on page 20 for all available steps.

(17) Main (VFO-A) Tuning Knob

This knob adjusts the operating frequency of the main vfo (A) or a recalled memory. Tuning increments are normally 10 Hz (100 Hz in AM and FM modes). When the **FAST** button is held, the increments are ten times these sizes. The markings on the knob represent 50 increments each, and one full turn of the knob provides 1,000 increments (10 kHz, or 100 kHz in AM/FM).

3. Controls & Connectors - Front Panel Controls

(18) MAIN VFO-A RX & TX LEDs

These lamps indicate the transmit/receive status of the main tuning knob and display. When the green **RX** lamp is lit, the receiving frequency is under control of the main knob and display (either vfo (A) or a recalled memory channel). When the red **TX** lamp is lit, the transmitting frequency is under control of the main knob and display.

(19) LOCK

This button toggles locking of the main tuning knob to prevent accidental frequency changes. **LOCK** is displayed in a red box above the main frequency when active (the knob can still be turned, but it does nothing). Press again to re-enable the tuning knob.

(20) BANDWIDTH

These four momentary buttons select the 2nd and 3rd IF filters for the receiver (except in the FM mode). In AM mode, either 2.4-kHz or 6-kHz bandwidths are selected by pressing the **2.4K** button (off = 6-kHz). The selectivity provided by these selections can be further enhanced by installing optional filters (page 40). See the diagram on page 23 for the available filter combinations. The sub receiver uses only 500-kHz (optional) and 2.4-kHz selections.

(21) BAND (Keypad)

The keypad provides one-touch band selection, or digital frequency entry. Normally, pressing one of the ten *white* numbered keys selects the corresponding (MHz) amateur band for operation (and pressing the **SUB** button first and then another key selects the band for the sub vfo. However, if the **ENT** key is pressed first, the *yellow* labels on the keys become effective, for entering any frequency one digit at a time. If you press the white numbered key for the band you are already on, you will select the alternate subband vfo on that band. See the Operation chapter for details.

(22) Sub (VFO-B) Tuning Knob

This knob adjusts the sub vfo (B) operating frequency. Tuning increments are the same as described for the main tuning knob.

(23) SUB VFO-B RX & TX LEDs

These lamps indicate the current status of the sub vfo. When the green **RX** lamp is lit, the receiving frequency is under control of the sub vfo (B). When the red **TX** lamp is lit, the transmitting frequency is under control of the sub vfo. During dual receive operation, the **RX** lamps above both tuning knobs are lit.

(24) LOCK

This button toggles locking of the sub vfo tuning to prevent accidental frequency changes. The red LED just above this button glows when active (the knob can still be turned, but it does nothing). Press the button again to re-enable the tuning knob.

(25) NOTCH APF

These controls are active only when their functions have been enabled by the corresponding buttons below the sub vfo tuning knob. The LEDs above the buttons indicate when the functions are active. The inner **NOTCH** control adjusts the IF notch filter frequency. The outer **APF** control adjusts the frequency of the Audio Peak Filter in CW mode. Both affect only the main receiver.

(26) CLAR Tuning Knob

This knob tunes the clarifier offset frequency up to ± 9.99 kHz, when activated by the **CLAR RX** and/or **TX** buttons just above it (the 3-digit offset frequency appears in the center of the display when the clarifier is active). Operating details are on page 28.

(27) SHIFT WIDTH

These controls tailor the IF passband of the main receiver (the main vfo (A), or a recalled memory channel) in all modes except FM. The inner **SHIFT** control offsets the center frequency of the IF passband from the displayed frequency when turned away from the 12-o'clock position. The outer **WIDTH** control, when turned counterclockwise from the fully clockwise position, reduces the overall IF bandwidth from the maximum selected by the **BANDWIDTH** buttons.

(28) MEM

This detented knob selects the operating memory channel when the memories are active (but not retuned). When the vfo or memory tune functions of the main display are active, turning this knob causes the sub vfo display to temporarily show the frequencies of the memories (memory check), without otherwise affecting operation. The channel number of the selected memory is displayed at all times at the center right of the display (in front of "CH").

(29) *Electronic CW Keyer Controls*

The **KEYER** button toggles the internal CW keyer on and off, as indicated by the LED above this button. **BK-IN** turns full break-in (QSK) CW operation on and off. **SPOT** turns the CW receiver spotting heterodyne oscillator on and off. The **SPEED** control sets the repetition rate of the keyer/bug simulator.

(30) **CLAR** Pushbuttons

Pressing the **RX** button activates the **CLAR** knob (below this button), to allow offsetting the receiving frequency temporarily (see (26), above). The **TX** button provides the same function for the transmit frequency. If both buttons are pressed, the receiver and transmitter are both offset from the original frequency. Pressing the **CLEAR** button zeros any offset tuned by the **CLAR** knob. Each memory and vfo retains all clarifier settings independently.

(31) **TUNER 2-Position** Pushbutton

Pressing this button so that its LED is lit places the antenna tuner in line between the transmitter final amplifier and the main antenna jack. Reception is not affected. The tuner is also activated when the **START** button (below) is pressed.

(32) **START** Momentary Pushbutton

Pressing this button while receiving in an amateur band activates the transmitter for a few seconds while the automatic antenna tuner rematches the antenna for minimum SWR. The resulting settings are automatically stored in one of the antenna tuner's 39 memories, for instant automatic recall later when the receiver is tuned near the same frequency.

(33) **M SCAN** Pushbutton

Activates scanning of the memory channels. Also used together with the **FAST** button to set/reset Scan Skip status of a recalled memory channel.

(34) **Right Side LED Indicators**

The **HI SWR** LED lights when an impedance mismatch is detected at the main **ANT** jack. *Avoid transmitting until the problem has been corrected.*

The **WAIT** LED lights while the antenna tuner is tuning, and flashes briefly when changing frequency, as the main cpu sends new frequency data to the antenna tuner coprocessor: this does not affect operation.

The **CW TUNE** LED is a visual tuning indicator for CW reception on the main receiver, which lights in synchronization with a signal tuned to the center of the IF passband during CW reception.

(35) **Digital Display**

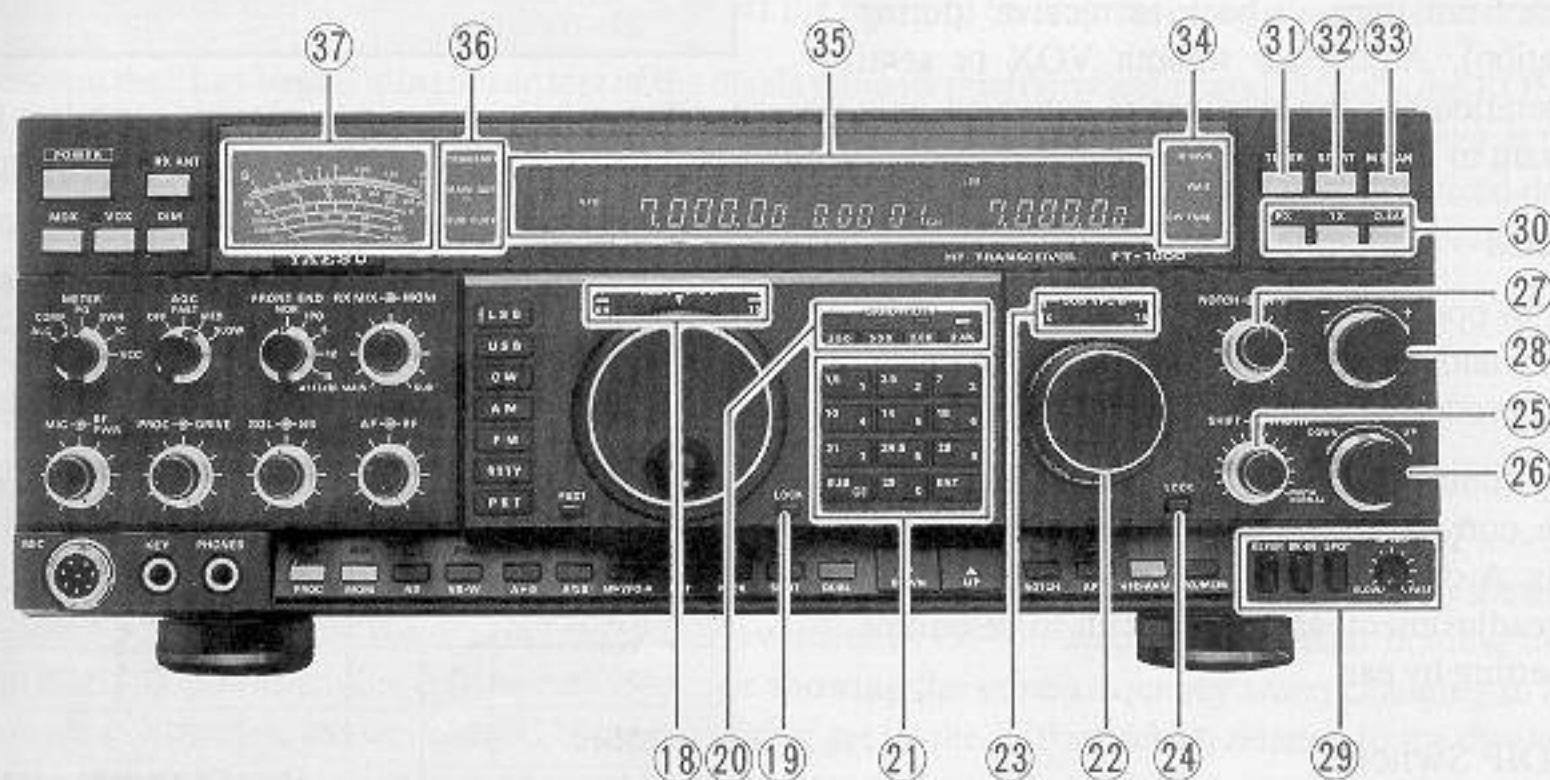
The display shows, from left to right, special operating status (**CAT SYSTEM**, **DUAL**, **SPLIT** or **GEN** (eral coverage)), **VFO**, **MEM** or **M TUNE** mode of the main receiver; main receiver operating frequency, clarifier offset, memory channel number; and sub vfo mode and frequency.

(36) **Left Side LED Indicators**

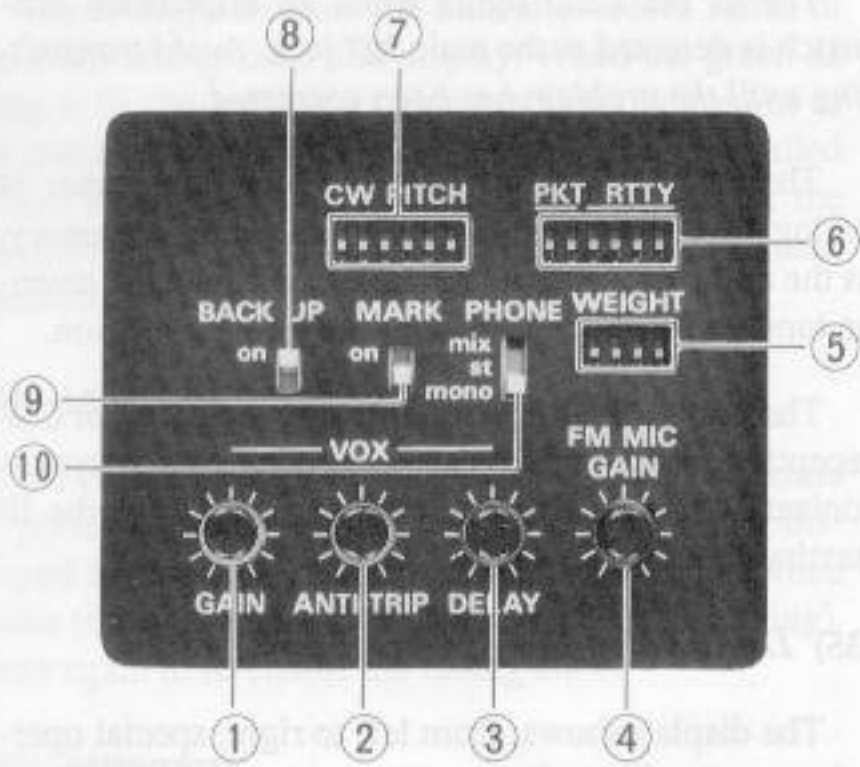
The **TRANSMIT** LED glows red when the transmitter is activated. The **MAIN BUSY** and **SUB BUSY** LEDs glow green when the main or sub vfo squelch is open, respectively.

(37) **Meter**

The 7-function multimeter normally indicates main receiver signal strength on the top scale, and one of six parameters (selected by the **METER** selector) during transmit on the lower scales.



Top Access Panel Controls



(1) VOX GAIN

This control sets the gain of the VOX (voice-actuated transmit/receive switching) circuit, to set the level of microphone audio needed to activate the transmitter during voice operation while the **VOX** button on the front panel is depressed.

(2) VOX ANTI-TRIP

This control sets the level of negative feedback of receiver audio to the microphone, to prevent receiver audio from activating the transmitter (via the microphone) during VOX operation. Adjustment is described in the Operation chapter.

(3) VOX DELAY

This control sets the hang time of the VOX circuit, between the moment you stop speaking (or open the CW key during semi break-in operation) and the automatic switch from transmit back to receive (during VOX operation). Adjust for smooth VOX or semi break-in operation (so the receiver is activated only when you want to listen).

(4) FM MIC GAIN

During FM operation, this control adjusts the microphone gain (and transmitter deviation). More clockwise settings produce a wider bandwidth signal.

NOTE: This control has been preset at the factory to produce the correct deviation with standard microphone levels. A deviation meter should be connected for proper readjustment, as it is difficult to determine the proper setting by ear.

(5) WEIGHT DIP Switches

These DIP switches select the weight (dot:dash ratio) of the internal electronic CW keyer, between 1:3

and 1:4.5. Selection is made by setting the switches for a binary number between 0 and 16, as shown below.

Keyer Weight Settings

Dot:Dash Ratio	DIP Switch				Dot:Dash Ratio	DIP Switch			
	1	2	3	4		1	2	3	4
1:3.0	0	0	0	0	1:4.0	0	-	0	-
1:3.1	-	0	0	0	1:4.1	-	-	0	-
1:3.2	0	-	0	0	1:4.2	0	0	-	-
1:3.3	-	-	0	0	1:4.3	-	0	-	-
1:3.4	0	0	-	0	1:4.4	0	-	-	-
1:3.5	-	0	-	0	1:4.5	-	-	-	-
1:3.6	0	-	-	0					
1:3.7	-	-	-	0					
1:3.8	0	0	0	-					
1:3.9	-	0	0	-					

(6) PKT RTTY DIP Switches

The two leftmost switches (1 and 2) of this set select the offset of the display and IF passband center from the BFO, to match most common packet tncs used for 300-baud hf packet operation. To set these switches, determine which AFSK tones are used by your tnc, and then set the switches to match as shown below.

Packet FSK Tone Pairs

TNC Tone Pair	DIP Switch	
	1	2
1070/1270-Hz	0	0
1600/1800-Hz	0	-
2025/2225-Hz	-	0
2110/2310-Hz	-	-

The remaining switches in this set select the function of the internal AFSK generator for RTTY transmission. Switches 3 and 4 select the RTTY shift, switch 5 selects either normal (low Mark) or reversed tones, and switch 6 selects either a 2125-Hz or 1275-Hz Mark tone. See the table below.

RTTY DIP Settings


Shift Frequency	DIP Sw.		Nor/Rev	Sw.	Mark Freq.	Sw.
	3	4				
170-Hz	-	-	Nor	-	2125-Hz	-
425-Hz	0	-	Rev	0	1275-Hz	0
850-Hz	-	0	Nor: LSB Keydown = Mark Tone Rev: LSB Keydown = Space Tone			

(7) **CW PITCH** DIP Switches

Set these switches to select your desired CW tone pitch, as shown below. The transmitter sidetone frequency, and receiver IF passband and display offset from the BFO (carrier) frequency are all affected.

CW Pitch DIP Settings

CW Pitch	DIP Switch					
	1	2	3	4	5	6
400-Hz	-	-	-	0	0	0
500-Hz	-	-	0	-	0	-
600-Hz	-	0	-	-	-	0
700-Hz	0	-	-	-	-	-



(8) **BACKUP** Slide Switch

Keep this switch in the **on** position to retain all memory and vfo settings during power-off periods. There is no need to turn this switch off unless you plan to store the transceiver for a long period without use.

(9) **MARK** Slide Switch

Set this switch **on** to activate the internal 10-kHz marker generator, for testing or calibration purposes. For normal receiver operation, this switch must be off.

(10) **PHONE** Slide Switch

This switch selects between three possible modes of dual-receive audio when stereo headphones are connected to the front panel **PHONES** jack.

The **mix** (mixed) mode is a combination of the other two modes described below: audio from both receivers can be heard in each ear, but the sub receiver audio is attenuated in the left ear, and the main receiver audio is attenuated in the right.

In the **st** (stereo) mode, audio from the main receiver is heard only in the left ear, and audio from the sub receiver is heard only in the right ear.

In the **mono** (monaural) mode, audio from both main and sub receivers is combined and heard the same in both ears (as from the loudspeaker when headphones are not used).

Note that both receivers must be activated by the **DUAL** button on the front panel, and the **RX MIX** control on the front panel must be set near the center position, to hear both receiver channels.

This switch does not affect dual-channel audio from the **AF OUT** jack on the rear panel, which should be processed by an external stereo amplifier.

Power Up Selections

By pressing and holding certain combinations of keypad keys while switching on the FT-1000, you can perform several functions and make some simple settings.

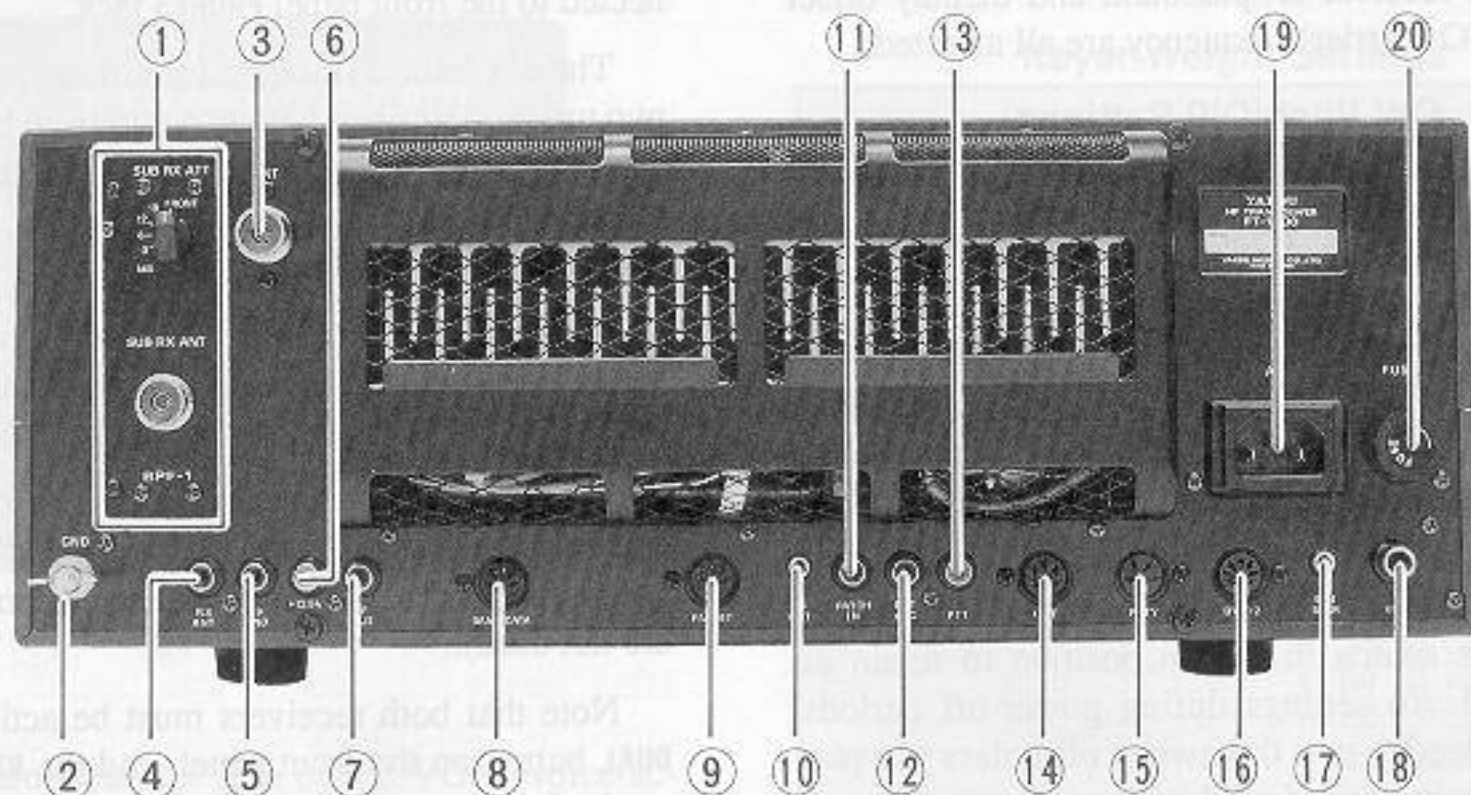
To reset the microprocessors and clear all memories, turn the transceiver off, and then press and hold the **SUB** and **ENT** keys at the lower corners of the keypad while also pressing the **POWER** switch. Normally there should be no need to do this, but it is provided for servicing purposes, to return all memories and other settings to their default states. Note that it is not necessary to turn off the memory backup to reset the microprocessors.

To perform the "Las Vegas" diagnostic test of the display and its microprocessor, and to check the ROM version of your transceiver, press and hold the 1.5 and 7 MHz band keys (yellow-labelled 1 and 3 keys) at the upper corners of the keypad while switching the power on. This procedure will not erase any memorized data. After testing the display segments, "YAESU" will be displayed, followed by a ROM version number. After a few seconds, the display will return to normal operation.

Pressing the 29 MHz band key (yellow-labelled 0 key) while switching on the power causes the 10-Hz digit on the main and sub vfo displays to be blanked. Repeat the same step to unblank it.

Pressing the 10, 14 and 18 MHz band keys (yellow-labelled 4, 5 and 6 keys) simultaneously while switching the power on toggles the manner in which the displayed frequency is affected when changing modes. In its default state, switching to and from CW, packet or RTTY modes causes the display to change by the amount of offset selected by the **CW PITCH** and **PKT/RTTY** DIP switches in the top access panel. After holding these keys while switching power on, the display will continue showing the same frequency when changing to and from these modes. However, the actual BFO (carrier) offsets, set by the DIP switches, relative to the display and IF bandpass are unaffected, regardless of either display state.

Rear Panel



(1) BPF-1 Optional Bandpass Filter Module

If you have the BPF-1 optional sub vfo bandpass filter unit installed, connect your receiving antenna (for the sub vfo) to the **SUB RX ANT** coaxial jack, and set the **SUB RX ATT** selector to the desired position (**FRONT** if you want the front panel attenuator selector to control both main and sub receivers). Switch S1001 on the RF Unit must also be set to the **E BPF** position to use the BPF-1 (page 9).

(2) GND Terminal Post

Use this terminal to connect the transceiver to a good earth ground, for safety and optimum performance. Use a large diameter, short braided cable.

(3) ANT Coaxial Jack

Connect your main antenna here, using a type-M (UHF, PL-259) plug and coaxial feedline. This antenna is always used for transmission, and is also used for reception unless a separate receive antenna is also used for the main receiver. The internal antenna tuner affects *only* the antenna connected here, during transmission.

(4) RX ANT Phono Jack

This antenna jack is for a separate receive-only antenna, activated when the switch with the same name on the front panel is pressed. If the BPF-1 option is not installed, an antenna connected here can be used by both the main and sub receivers. If the BPF-1 is installed, internal switch S1001 on the RF Unit deter-

mines whether this jack is used, or the **SUB RX ANT** on the BPF-1 instead. See the diagram on page 29.

(5) TX GND Phono Jack (normally disabled)

When enabled, this output jack connects inside the FT-1000 to a set of relay contacts which short together (to chassis ground) whenever the transmitter is active. This allows transmit/receive switching of an external device such as a linear amplifier. This jack is disabled at the factory to avoid the clicking of the relay when it is not used. To enable the jack when you are connecting a linear, move switch S1002 (shown on page 9) to its ON position.

Maximum ratings for these relay contacts are 500 mA @ 125 VAC, 300 mA @ 220 VDC or 2 A @ 30 VDC. *Before connecting an external device, make sure its switching requirements will not exceed these limits.*

If your amplifier requires higher current, or has higher voltage switching requirements, an external switching device such as the Yaesu FRB-757 Relay Box must be used, and may be connected here.

(6) +13.5V Phono Jack

This output jack provides regulated, *separately fused* 13.5 VDC at up to 200 mA, to power an external device such as a packet tnc. Make sure your device does not require more current (if it does, use a separate power source). Attempting to draw more power from here will blow the internal fuse behind this jack.

(7) IF OUT Phono Jack

This output jack provides a low level sample of the 73.62-MHz first IF signal of the main receiver, for use by a monitorscope. Peak output level is approximately 8 mV_{rms} @ 50-Ω impedance.

(8) BAND DATA DIN Jack

This 8-pin output jack provides control signals for the FL-7000 Solid-State Linear Amplifier or FC-1000 Remote Controlled Tower Mounting Antenna Tuner, including band selection data to automatically set the Linear or Tuner to the same band as the main display of the transceiver. Pinout is shown on page 7.

(9) PACKET DIN Jack

This 5-pin input/output jack provides receiver audio and squelch signals, and accepts transmit (AFSK) audio and PTT control, from an external packet tnc. Pinout is shown on page 7. The receiver audio level at this jack is at a constant 100-mV level (@600Ω), preset by VR3005 on the AF Unit (see *Beeper Volume Setting* on page 9 for how to gain access to this trimmer, if necessary).

(10) AF OUT Mini Phone Jack

This 3-contact jack provides dual-channel low level receiver output, for recording or external amplification. Peak signal level is 200 mV_{rms} at 600 Ω. Main receiver audio is on the left channel, and sub receiver audio is on the right channel. A stereo amplifier or recorder is recommended, to record each receiver separately when dual reception is enabled. The front panel **AF** and **RX MIX** controls and the **PHONE** switch setting in the top access panel do *not* affect the signals at this jack. Pinout is shown on page 7.

(11) PATCH IN Phono Jack

This input jack accepts transmitter audio – either AFSK or voice, for transmission. This line is mixed with the microphone audio input line, so the microphone should be disconnected if using this jack and mixing is not desired. Impedance is 500 – 600 Ω.

(12) EXT ALC Phono Jack

This output jack provides ALC (Automatic Level Control) voltage to control a linear amplifier. The voltage range is 0 to +4 VDC.

(13) PTT Phono Jack

This input jack may be used to control manual transmitter activation using a footswitch or other switching device. Its function is identical to the **MOX**

button on the front panel. The same line is available at the **PACKET** and **RTTY** jacks for tnc/tu control. Open-circuit voltage is +13.5 VDC, and closed-circuit current is 1.5 mA.

(14) CAT DIN Jack

This 6-pin input/output jack allows external computer control of the FT-1000. Signal levels are TTL (0 and 5V DC). Pinout is shown on page 7, and the signalling protocol and data formats are described in the CAT chapter, starting on page 36.

(15) RTTY DIN Jack

This 4-pin input/output jack provides connections for an RTTY terminal unit. Pinout is shown on page 7. The receiver audio level at this jack is at a constant 100-mV (@600 Ω) level, preset by VR3006 on the AF Unit (see *Beeper Volume Setting* on page 9 for how to gain access to this trimmer).

(16) DVS-2 DIN Jack

This 7-pin input/output jack is for connection of the DVS-2 Digital Voice Recording option, described on page 33.

(17) EXT SPKR Mini Phone Jack

This 2-contact output jack provides mixed receiver audio for an external loudspeaker, such as the SP-5. Inserting a plug into this jack disables the internal loudspeaker. Impedance is 4 to 16 Ω.

(18) KEY 3-Contact Phone Jack

This 1/4-inch phone jack accepts a CW key or paddle manipulator. It is connected in parallel with the jack with the same name on the front panel (either or both may be used). A 2-contact plug cannot be used in this jack. Keyup voltage is +5 V, and keydown current is 0.5 mA. Pinout is shown on page 7.

(19) AC Line Cord Socket

Connect the supplied AC line cord to this socket after ensuring that your AC mains voltage matches that on the label. See the Installation section for instructions on how to change the power transformer voltage, if necessary.

(20) FUSE Holder

This holder requires a 15-A fuse for operation from AC voltages below 125 V, and an 8-A fuse for AC voltages of 200 V and above. Only normal fast-blow type fuses should be used here.

Getting Started Tutorial

Before plugging in the transceiver the first time, double check your installation to make sure your AC voltage is correct, and that your ground and antenna are connected as described in the Installation chapter. Then preset the following controls as indicated:

POWER, RX ANT, MOX, VOX and **DIM** switches all off (■)

AGC Selector to **FAST**

FRONT END Selector to **NOR**

RX MIX 12 o'clock

MIC, RF PWR, PROC, DRIVE, SQL and **NB** all counter-clockwise

AF 10 o'clock

RF fully clockwise

SHIFT 12 o'clock

WIDTH fully clockwise

KEYER, BK-IN and **SPOT** switches all off (■)

Connect your microphone and/or CW key or paddles, and then plug the AC cord into the wall outlet.

Note: the following procedure assumes that the transceiver has not been used before, and so is not already set for dual reception. If **DUAL** appears in an orange box on the display when you switch on the set in the next step, you should press the blue **DUAL** button to return to the single-receiver mode (for now).

Press the **POWER** switch on. The meter and display should light up. If the display is too bright for your taste, press the **DIM** switch. For fine adjustment of the dim level, press and hold the **FAST** button below the main tuning knob while turning the **CLAR** control.

Take a moment to study the display. You should see **VFO** at the left, with the operating frequency of the main vfo just above the main tuning knob. To the right of that is the clarifier offset (**0.00**), followed by a memory channel number (**01ch** by default). At the right side of the display are the current mode and frequency of the sub vfo, which we'll talk about later.

Press a keypad key (between the two tuning knobs) to select a band for which your antenna is designed.

Refer to the white (MHz) labels, and press the appropriate one. Next press the mode button (just to the left of the main tuning knob) corresponding to the mode you wish to operate — for now, we suggest an SSB mode: **USB** if you have selected a

BAND		
1.5 1	3.5 2	7 3
10 4	14 5	18 6
21 7	24.5 8	28 9
SUB CE	29 0	ENT

band above 10 MHz, or **LSB** otherwise. The LED in the

band button indicates the selected band, and an LED above one of the four **BANDWIDTH** buttons (to the right of the tuning knob) indicates which IF bandwidth is currently selected for that mode (except in AM-wide and FM modes). Right now, if you have selected an SSB mode, the **2.4K** LED should be lit. If not, press that button. This bandwidth provides the best fidelity for SSB reception, so should be used unless interference from stations on adjacent frequencies becomes a problem (as described later).

Adjust the **AF** control for comfortable volume on signals or noise in the loudspeaker or headphones. Press the large **UP** and **DOWN** buttons below the keypad to step around the band in 100-Hz steps, and then tune around the band a bit with the main tuning knob. For faster (x10) tuning steps with either the tuning knob or **UP** and **DOWN** buttons, press and hold the **FAST** button at the lower left side of the knob (all available tuning steps in each mode are shown in the table below). If your microphone has **UP** and **DWN** buttons, you can press them to tune in 10-Hz steps, and if it has a **FAST** button, you can use it to duplicate the function of the key with the same name on the front panel.

Tuning Steps

Control ↓	Mode ⇒	LSB, USB, CW, RTTY, PKT-LSB	AM, FM, PKT-FM
Tuning knobs, Mic Up/Dwn Keys	Normal	10 Hz	100 Hz
	w/FAST button	100 Hz	1 kHz
DOWN/UP Pushbuttons	Normal	100 kHz	100 kHz
	w/FAST button	1 MHz	1 MHz
One rev of Tuning knobs	Normal	10 kHz	100 kHz
	w/FAST button	100 kHz	1 MHz

Alternate Subband Selection

An important feature of the FT-1000 that you'll want to start making use of right away is the subband selection feature. If you press the keypad key for the same band that you are already operating on, the display will shift to a different frequency in the same band (the bottom of the band, or 100 kHz above, by default). Pressing the same band key again switches you back to the frequency you were on before. What you have here are two completely independent vfo selections for each band, selectable by each band's keypad key. You can tune, select a mode and a bandwidth for each of these two vfo selections in each band, and they will be

remembered until you return to this “subband” selection.

Try this now: assuming you have already set one of the vfo selections to the SSB portion of the band (and in an SSB mode), press the keypad key for that same band, tune to the low end of the band, and press the **CW** button to the left of the tuning knob. You can consider this your CW subband vfo. Now press the keypad key for the same band again several times, and notice that operation shifts back and forth between the SSB and CW subband vfo frequencies and modes. You’ll be pleased to know that you can also select different IF bandwidths for the two subbands, just as you did above with the modes (and even different clarifier settings). Note that this dual subband feature is not related to the vfo A/B scheme — both main vfo A and sub vfo B support their own dual subbands, independently of one another. More on that later.

Keypad Frequency Entry

One other important tuning feature to try before going on is numeric keypad frequency entry. To do this, pick a new operating frequency, say, 14.25000 MHz, and enter it on the keypad as follows:

Press the **ENT** key at the lower right corner of the keypad (the leftmost operating frequency digit will blink). Then referring to the yellow numbers on the keypad, enter the digits of the new frequency, from left to right

(1-4-2-5-0-0-0), followed by the **ENT** key again. As you enter the numbers, the next digit to be entered will blink on the display. You can use the **DOWN** and **UP** buttons below the keypad to reposition the blinking digit location as desired (but ignore the direction labels on these buttons).

Only when you press the **ENT** key the second time will the operating frequency actually change, so if you decide to remain on the original frequency after starting to key in a new one, you can cancel any entered digits by pressing the **CE** key (“Clear Entry”, the yellow label at the lower left corner of the keypad) instead of the **ENT**

BAND					
1.5	1	3.5	2	7	3
10	4	14	5	18	6
21	7	24.5	8	28	9
SUB	CE	29	0	ENT	

Blanking the 10’s-of-Hz Digit

If you prefer to have the 10’s-of-Hz digit hidden on the frequency displays, you can toggle display of this digit off and on by switching off the transceiver, and holding the 0 key (at the bottom center of the keypad) while switching the transceiver back on. Repeat this process to redisplay the digit. Tuning steps are not affected.

key. Note that, to enter frequencies below 10 MHz, you must key in the leading zeros.

That’s all there is to tuning the main vfo (A). The sub vfo (B) has a lot more features of its own, which we’ll look at in detail later. First, however, let’s look at some other important receiver features.

General Coverage Reception

You may have already noticed that if you tune outside one of the amateur bands (actually, outside of the 500-kHz segment that includes each band), **GEN** appears in a box at the left side of the display. On such frequencies, the transmitter (and antenna tuner) are disabled. If you try to transmit, the **TRANSMIT** LED will blink.

Also, such frequencies are ignored by the band selection keys (including the alternate subband feature): so if you tune a vfo to a frequency outside of a ham band, you will have to store it in a memory (as described on page 32) if you want to be able to recall it quickly later. Otherwise, as soon as you press a band key, the general coverage frequency will be lost as the vfo reverts to the (ham-band) frequency it was on when the band was last changed.

Once you become familiar with the memories, you will find this really doesn’t present a problem, as each memory can be tuned just like a vfo, and stored into another channel without having to go through a vfo.

Aside from the above, general coverage reception provides all of the features available on ham frequencies, including dual channel reception, digital modes and diversity reception, described on the following pages.

Dealing with Interference

The FT-1000 includes a wide range of special features to suppress the many types of interference that may be encountered on the hf bands. However, real world interference conditions are constantly changing, so optimum setting of the controls is somewhat of an art, requiring familiarity with the types of interference and the subtle effects of some of the controls. Therefore the following information should be considered only as general guidelines for typical situations, and a starting point for your own experimentation.

The descriptions of the use of each control are arranged in the order that you would usually make them after changing bands. The possible exception to this is if strong pulse noise is present, such as from the "Woodpecker", in which case you may need to activate the noise blanker (described on this page) before you can make other adjustments.

Front End Selection

Perhaps the most important consideration for optimum receiver performance, after you have selected a particular band, is the receiver front end selection. The best selection will depend on background noise at the time, the presence or absence of strong signals, and whether or not you want to hear very weak signals. If the front end is set for too much gain, background noise will make listening difficult, and very strong signals on other frequencies may cause intermodulation interference, masking weaker signals. On the other hand, if the front end is set for too little gain (or too much attenuation), very weak signals will not be heard.

The **NOR** setting of the **FRONT END** selector activates a constant-gain, quad push-pull FET amplifier for maximum sensitivity. However, if background noise causes the S-meter to deflect on clear channels, turn the **FRONT END** selector clockwise until the S-meter drops below S-1 (the white area at the left end of the top meter scale). This setting optimizes the trade-off between sensitivity and interference immunity. Also, once you have tuned in a station you want to work, you may want to reduce sensitivity further (or add attenuation) by turning the **FRONT END** control to a more clockwise setting. This can make reception of the desired station more comfortable, important especially in long QSOs.

RF Gain Setting

When tuned to a moderate strength signal, if low level background noise is still present after setting the **FRONT END** selector, try reducing the **RF** gain control from the fully clockwise position. This reduces the signal input to the first mixer via a PIN diode attenuator

and causes the minimum S-meter reading to move up the scale, often clearing up the background noise and putting the desired signal more "in the clear". Remember, however, to return this control fully clockwise when you want to receive weak signals, or read low levels on the S-meter. See also the Note box below.

AGC (Automatic Gain Control) Selection

When tuning around the band looking for signals, the **AGC** selector is usually best kept in the **FAST** position, to allow the receiver gain to recover quickly after tuning past strong signals. However, once you have a station tuned in, SSB reception will usually be more comfortable if you switch to the **MED** or even **SLOW** position (keeping the receiver from picking up low-level noise during pauses in speech). However, for CW reception, when several signals are present in the pass-band, the **FAST** or even **OFF** positions can avoid AGC "pumping" (gain fluctuations) caused by strong undesired signals. For AM, the **SLOW** position is usually better, and for 300-baud packet and RTTY/AMTOR, the **FAST** or **OFF** positions will usually give the fewest errors/retries.

Note: The **AGC OFF** position disables the overload-protection normally provided by the AGC circuitry. If the **RF** gain control is left fully clockwise in this condition, the RF and IF amplifiers can be easily overloaded (causing distortion) when a strong signal is received. Correct the overload either by setting the **AGC** selector to another position, or by turning the **RF** control counterclockwise to manually set receiver gain to a comfortable level.

Noise Blanker Selection and Setting

The two noise blanker circuits in the FT-1000 are provided for two different types of pulse noise. The **NB** button activates the narrow pulse blanker, for short pulse noise such as from switching transients, automobile ignitions and power lines. This blanker can sometimes also reduce the level of static crashes from electrical storms. The **NB-W** button activates the wide pulse blanker, for longer duration man-made pulse noise such as the "Woodpecker" over-the-horizon radar. If you hear any of these types of noise, just press either the **NB** or **NB-W** button so that the green LED above it lights, and turn the **NB** control clockwise. If the blanker seems to distort a signal you're listening to, reduce the setting for optimum readability.

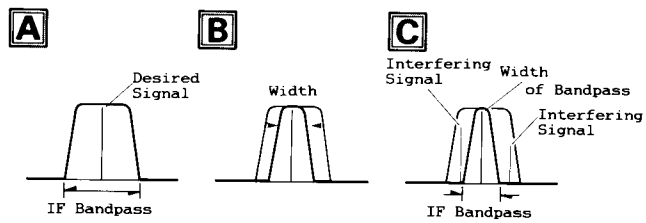
IF Bandwidth and Shift Adjustment (not used in FM mode)

Once you have tuned in a signal you are going to listen to for a while, if you hear interference from stations on nearby frequencies, use the **BANDWIDTH** buttons and then the **SHIFT** and **WIDTH** controls to suppress the interference. Their use varies somewhat from mode to mode. In general, however, you will want to press the **LOCK** button beneath the tuning knob before adjusting the **SHIFT** and **WIDTH** controls, as accidentally retuning would invalidate your settings (particularly in narrow-bandwidth modes). When you are ready to retune to a new frequency, press **LOCK** again to release it, and return the **SHIFT** and **WIDTH** controls to their default positions (centered, and fully clockwise, respectively).

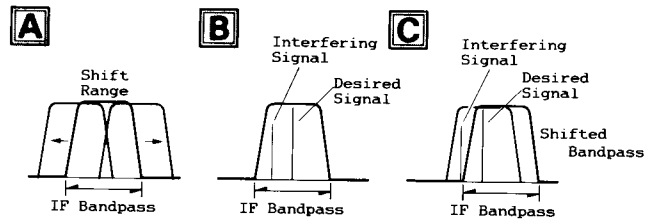
In the SSB modes, the **2.0K** bandwidth button can sharply cut interference from unwanted signals on either side of the desired signal (although with some necessary loss of fidelity). The **WIDTH** control can also be turned counterclockwise to reduce the IF bandwidth more gradually, and then the **SHIFT** control can be turned left or right from center to shift the center frequency lower or higher, as depicted at the right.

In AM mode, if the **BANDWIDTH** LEDs are all off, the 6-kHz AM wide bandwidth is selected. This gives the highest fidelity, and is best on strong AM signals (and particularly music). The effects of the **SHIFT** and **WIDTH**

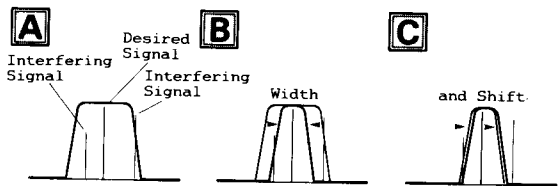
IF Width Adjustment



IF Shift Adjustment



IF Width & Shift Adjustment



MODE		BW	250Hz	500Hz	2kHz	2.4kHz
SSB, CW	Without optional Filters					
	With optional Filters					

MODE		BW	AM-W	AM-N
AM				

IF Bandwidth Filter Selections

4. Operation - Dealing with Interference

controls in this wide bandwidth are subtle, but they can be helpful in fine tuning the audio characteristics. For weaker AM signals, or where adjacent channel interference is present, the **2.4K** bandwidth offers a compromise between interference rejection and fidelity. In this case the **SHIFT** and **WIDTH** controls can be used to improve fidelity. However, even better reception of AM signals under these conditions can usually be had by switching to an SSB mode (whichever gives the clearest reception), and superb reception of weak signals is often possible using diversity reception, described on page 30.

In RTTY and AMTOR modes, the wider bandwidth selections are fine for tuning around, but the **250** or **500** (Hz) bandwidths will generally give the best copy with narrow shifts. If you have the **RTTY** DIP switches in the top panel set to match your tnc/terminal unit (see page 16) you should not need to adjust the **SHIFT** control at all, and the **WIDTH** control should only be adjusted with a great deal of care (to avoid losing the contact). See the section on digital modes later in this manual for more details.

For 300-baud packet, use the **500** (Hz) bandwidth, and make sure the **PKT** DIP switches in the top panel are set to match your tnc/terminal unit (or see the section on HF Packet on page 34). The **WIDTH** control must be set fully clockwise, and the **SHIFT** control may need to be fine tuned a few clicks either side of center for optimum copy of weak signals. Experiment with the **SHIFT** setting on a busy packet channel, and then note the optimum setting for all future hf packet operation (it will be the same unless you replace your tnc or recalibrate the input tones). If you have the BPF-1

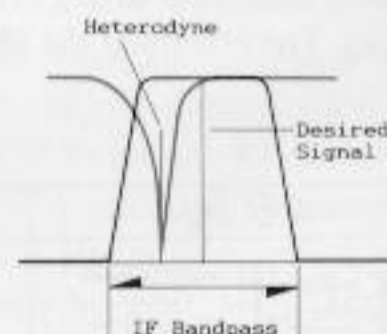
option installed and two antennas connected, you will definitely want to try diversity reception of HF packet signals (page 30).

In the CW mode, the **2.0K** or **2.4K** bandwidth is often convenient to give "a wide view" of the band when tuning around, but once a signal of interest has been found and centered in the passband, the **500** or **250** (Hz) selections are much better. Then the **APF** (Audio Peak Filter) can be activated, if needed, for even narrower (audio) bandwidth. More details of CW operation are provided in the box below, and in the next section on transmission.

IF Notch Filter (not used in FM mode)

After tuning in a desired signal and adjusting the IF bandwidth and shift, if heterodyne interference is heard, activate the IF notch filter by pressing the **NOTCH** button and adjusting the control with the same name to null the heterodyne. Note that if the interfering heterodyne is more than about 1.2 kHz away from the center of the passband, the notch filter may be unable to null it. In this case, switch the notch filter off, and readjust the IF bandwidth and shift so that the heterodyne is outside of the passband.

IF Notch Filter Adjustment



Special Tips for CW Reception: Pitch Setting and Spotting

The FT-1000 can be set for 400-, 500-, 600- or 700-Hz CW pitch, by setting the **CW PITCH** DIP switches in the top access panel. With the **CW SPOT** button pressed, set these to the tone you prefer, according to the table on page 17. This selection affects the audio frequency of the spotting oscillator, which sounds a tone in the receiver when you press the **SPOT** switch near the lower right corner of the front panel (relative tone volume can be adjusted by the **MONI** control). The frequency of this tone is also (exactly) the frequency that the IF center frequency and display are offset from the true carrier frequency during CW reception, which means that you can use this switch when tuning in another station to zero beat with him, so that when you transmit, your signal will be on exactly the same frequency as his. When you have a station tuned so that his signal produces the same audio note as the spotting oscillator, you will know that his signal is centered in your IF passband, which ensures that you will not lose track of his signal when switching to a narrower filter or activating the APF. Of course you should turn off the **SPOT** switch to copy his signal.

In addition to the spotting oscillator, the **CW TUNE** LED at the right end of the display provides a constant visual indication of any signal at the center of the IF passband (if not too weak). You can use this LED to tune in a signal just by tuning so that the LED glows in sync with the signal of interest.

Transmitting

The transmitter can be activated within the 500-kHz segment of any of the hf amateur bands, and from 28 to 30 MHz. When tuned to any other frequency, **GEN** is displayed at the left side of the display, and the transmitter is disabled. However, you are responsible to restrict your transmissions to those frequencies on which you are authorized to do so. You should also restrict transmissions to the frequencies for which your antenna is designed.

Attempting to transmit outside of an amateur band segment will cause the red **TRANSMIT** LED to the right of the meter to blink. The transmitter is also temporarily inhibited when stopping memory scanning (described later), as pressing the PTT switch while scanning just causes the scanner to stop.

Whenever the transmitter is activated, the FT-1000 automatically detects any reflected power that might appear at the main antenna jack (as a result of an impedance mismatch), and disables the transmitter if too much reflected power is found (in which case the red **HI SWR** LED at the right side of the display will be lit). Although this protection system should prevent any damage to the transceiver, we still recommend that you never activate the transmitter without having a proper antenna connected to the main **ANT** jack.

Automatic Antenna Matching

The automatic antenna tuner in the FT-1000 makes even first-time transmitter setup very simple. After you have used it once on your favorite bands, it will be able to recall previous settings from memory (the tuner has 39 of its own) during reception, whenever you tune to the same part of the band again. When you use the tuner the first time on an antenna, we recommend you set the **RF PWR** control to around the 9-o'clock position, to minimize interference you might cause others, and also to minimize stress on the tuner, feedline and antenna (in case there is a high SWR). All you have to do beforehand is to make sure of the frequency you will transmit on, and check that it is clear of other signals. Also, if you want to visually monitor the tuner's action, set the **METER** selector to the **SWR** position.

If the orange **TX** LED above the main tuning knob is not lit, press the **SPLIT** button below this knob to disable split frequency operation for now.

After making sure the channel is clear, press the **START** button near the upper right corner of the front panel. The green **TUNER** LED will come on, indicating the automatic tuner is activated, and the orange **WAIT** LED at the right end of the display will light for (up to) a few seconds while the tuner seeks the proper match-

ing settings (and, if monitoring SWR on the meter, you should see the tuner select the lowest possible reading). When the **WAIT** LED turns off, you are ready to transmit (assuming the **HI SWR** LED didn't light).

CAUTION

*If the red **HI SWR** LED lights at any time, the tuner is unable to match your antenna to the transmitter at the displayed frequency. You will have to tune to another frequency, or repair or replace your antenna or feedline.*

After using the antenna tuner, the green **TUNER** LED will remain on (unless you press the **TUNER** button to turn it off), and the orange **WAIT** LED will occasionally flash when you change frequency, indicating that the main microprocessor is reporting the frequency change to the tuner coprocessor (reception is unaffected). If the tuner coprocessor finds, by comparing the frequencies in its own memories, that you have tuned far enough to possibly require rematching, it will reset itself to the new range (if it has any previously stored settings for the new range). However, when you first connect a new antenna, the tuner will not have the correct settings stored in these memories, so you will need to "train" the tuner, by pressing the **START** button whenever you change to a new band or frequency range (for this antenna).

SSB Transmission

To transmit in LSB or USB mode:

- Make sure the appropriate mode indicator is lit, and set the **METER** selector to the **ALC** position.
- If this is the first time you are transmitting SSB with the FT-1000, preset the **MIC** and **RF PWR** controls to about the 12-o'clock position, and make sure the **VOX** is off (button out).
- Check the **RX** and **TX** LEDs above the tuning knobs to determine which frequency you're going to transmit on, and make sure the **GEN** box is not showing to the left of the main frequency display.
- To transmit, just press the PTT (push-to-talk) switch on your microphone, and talk.

To determine the optimum setting of the **MIC** control for your microphone, adjust it while speaking into the microphone (at a normal level) so that the meter deflects to about midrange on voice peaks (the upper end of the blue **ALC** range). Once found, this setting can be left as it is unless you change microphones.

4. Operation - Transmitting

You can switch the **METER** selector to the **PO** position and adjust the **RF PWR** control for more or less output, from about 20 to 200 watts (on the second meter scale from the top), as desired. However, you should always use the lowest possible power output to maintain reliable communications — not only as a courtesy to other stations, but to minimize the possibility of causing RFI and TVI, and to maximize the life of the equipment.

Transmitter Monitor

The transmitter monitor is actually a separate receiver circuit which picks up a sample of your transmitted RF signal, allowing you to hear accurately how the signal sounds. This feature is very helpful for setting up the speech processor controls, among other things. However, audio feedback of your signal from the loudspeaker to the microphone is likely if you attempt to use the monitor without headphones, so you should plug in your headphones now, if you have them.

Activate the monitor by pressing the gray **MONI** button (below the **AF** control) so that its orange LED lights, and adjusting the **MONI** control beneath the meter for comfortable volume while transmitting.

RF Speech Processor

Once the proper **MIC** control setting has been determined, you can activate the RF speech processor to increase the average power of your signal.

- Set the **METER** selector to the **COMP** (speech processor compression) position, and press the gray **PROC** button (at the left end of the row of buttons along the bottom) so that its orange LED lights.
- Now while speaking into the microphone, adjust the **PROC** control for a compression level of 5 to 10 dB on the **COMP** scale of the meter (the second scale from the bottom). If you have the monitor activated, you will be able to hear the effect of the compression on your signal. In any case, we do not recommend higher compression settings, as your signal will become less readable.
- Finally, move the **METER** selector back to the **ALC** position, and (without touching the **MIC** control setting) adjust the **DRIVE** control so that the meter reads in the upper end of the blue **ALC** scale on voice peaks.

VOX (Voice-Actuated T/R Switching)

VOX operation allows you to activate the transmitter in any voice mode merely by speaking into the microphone, without having to press the PTT switch.

For the VOX circuit to operate properly, three controls in the top access panel must be set to match your microphone and the acoustic environment of your station. Once set, these controls should not require re-

adjustment unless you change your microphone or station location.

- First make sure the receiver is set for normal volume on a clear channel, and preset the **VOX GAIN** control in the top access panel fully counterclockwise. Also preset the **ANTI-TRIP** and **DELAY** controls in the top access panel to their 12-o'clock positions.
- Set the **RF PWR** control fully CCW (to avoid creating interference while you set up the VOX controls).
- Now press the **VOX** switch near the upper left corner of the front panel, so that its green LED is lit.
- Without pressing the PTT switch, speak continuously into the microphone while slowly advancing the **VOX GAIN** control (in the top access panel) clockwise, just until your voice activates the transmitter.
- Now speak intermittently into the microphone, and note the “hang time” between the moment you stop speaking and when the receiver is reactivated. This period should be just long enough so that the transmitter remains keyed between words, but drops back to receive during pauses. Adjust the **DELAY** control, if necessary, for comfortable hang time.

The **ANTI-TRIP** control probably needs no adjustment, but if you find that, with the microphone in its normal operating position, receiver audio from the loudspeaker trips the transmitter, advance the **ANTI-TRIP** control more clockwise. On the other hand, if transmitter keying with the VOX keying seems sluggish or unstable when you speak into the microphone, try a more counterclockwise setting.

CW Transmission

There are several types of CW transmission available with the FT-1000. All require, of course, that you have a CW key or keyer paddles connected to either of the **KEY** jacks on the front or rear panel (with a 3-contact plug). Initially, you will need to set the **DRIVE** control to determine its setting for the proper ALC level, but after that you can use the **RF PWR** control to set your output power.

- Begin by setting the **METER** selector to the **ALC** position, and preset the **RF PWR** control to about 12 o'clock and the **DRIVE** control fully counterclockwise. Of course you must select the CW mode, if you haven't already, and for now, make sure the **KEYER** and **BK-IN** switches near the lower right corner of the front panel are both off (out).
- Press the **VOX** button to turn on the VOX circuit, which provides automatic transmitter activation when you close your key.

- Now close your key, and advance the **DRIVE** control so that the meter indicates center scale. This is the proper ALC level for CW operation.
- Adjust the **MONI** control, if necessary, for comfortable level on the CW sidetone.
- Now you can switch the **METER** selector to the **PO** position and adjust the **RF PWR** for the desired level. If you change it much, return the **METER** selector to **ALC** and touch up the **DRIVE** setting, if necessary, to keep the ALC reading in the safe zone.
- Release the key to return to receive.

Courtesy of the VOX circuitry, you are now using semi break-in CW, in which the transmitter remains activated except during pauses in your sending. You can set the “hang time” during which the transmitter remains on after you stop sending, by adjusting the **DELAY** control in the top access panel.

However, if you prefer full break-in (QSK) operation, in which the receiver is activated between each dot and dash, simply press the **BK-IN** switch.

Using the Internal Electronic Keyer

You will need to connect keyer paddles to one of the **KEY** jacks to use the keyer.

- Once the transceiver has been set up for CW transmission as just described, you can activate the keyer with the **KEYER** pushbutton near the lower right corner of the front panel (its green LED should light).
- Now squeeze the paddles, and adjust the **SPEED** control for the desired speed (if you are using the bug simulator mode, described in the box below, don't squeeze both paddles: just press the dit paddle).

If the dot:dash weighting is not to your preference, see the table on page 16 to set the **WEIGHT** DIP switches in the top panel. If you prefer a higher or lower sidetone pitch, see page 24 and the Pitch table on page 17.

Bug Simulation with the Internal Keyer

The internal CW speed keyer is set at the factory to the iambic keying mode, in which one keyer paddle produces dits, and the other dahs. Squeezing both produces alternating dits and dahs.

If you prefer bug operation, in which one paddle produces dits and the other is used to manually produce dahs (like a straight key), you can change the position of internal **AUTO/SEMI** switch S3002, just behind the rear panel **KEY** jack on the AF Unit. See the *Key Beeper Volume* adjustment on page 9 for details on how to gain access to the AF Unit.

You can use the keyer for both semi and full break-in keying, as described in the previous section.

AM Transmission

Transmitter setup for the AM mode is essentially the same as for LSB or USB, except that you must avoid overmodulating, and limit carrier power to 50 watts.

- With the **AM** mode selected, preset the **RF PWR** and **DRIVE** controls to the 12-o'clock position.
- If you have already set the **MIC** control as described for SSB transmission, there should be no need to readjust it. Otherwise, preset this control fully counterclockwise.
- VOX operation can be used in the AM mode, but for now, make sure the **VOX** switch is off, so as not to confuse adjustments.
- The transmit monitor is very helpful in setting the correct modulation level, and if you have headphones on, you should turn the monitor on now.
- Close the PTT switch and advance the **DRIVE** control so that the meter deflects just to midrange.
- Now, if you don't have the **MIC** control already set up, speak into the microphone while advancing this control just to the point where slight movement of the meter can be seen. Don't set it too far beyond this point or your signal will become distorted from overmodulation if the monitor is on).
- You are now ready to transmit. Switch the **METER** selector to the **PO** position, and adjust the **RF PWR** control for the desired output (but not over 50 watts!).

Note that the speech processor is disabled in the AM mode. You can, however, activate the VOX if desired.

FM Transmission

For transmission, this is the easiest mode of all. The only control on the front panel you need be concerned about is **RF PWR**. Microphone gain for FM is set the separate **FM MIC GAIN** control in the top access panel, and normally needs no adjustment after leaving the factory. If you receive signals reports of low audio with a strong carrier, you may want to increase the gain. If you notice distortion in the transmit monitor, you may want to decrease it. Otherwise, we suggest leaving it alone.

All you need to do is set the **METER** selector to the **PO** position, and adjust the **RF PWR** control for the desired output while transmitting. If you need full power, keep your transmissions to three minutes or less, with the same time for reception.

You can use the VOX circuit for t/r switching, if desired, and the transmit monitor to listen to your signal. See also the box below for FM Repeater operation.

FM Repeater Operation

The FT-1000 includes several features specifically intended for operation on FM repeaters above 29 MHz which use 100-kHz splits.

To locate these repeaters, you can ask around the calling channel (29.6 MHz), or you may want to load a block of memory channels (page 32) with 50-kHz frequency multiples from 29.61 to 29.7 MHz (and FM mode, of course). Then set the squelch so that the receiver is silent on a clear channel, and press **M SCAN** to scan the memories.

When you find a repeater, press the **RPT** button, once for “-” shift (to transmit 100 kHz below your receiving frequency). Pressing it again will select “+” shift, but this is not used above 29.6 MHz. Press it once more to return to simplex.

Try a quick identification transmission to make sure you have the shift right (the FT-1000 also automatically transmits a low-level 88.5-Hz sub-audible tone during FM Repeater transmissions, to access those repeater that require it).

Once you have made contact through the repeater, you can store the frequency, mode and repeater shift settings in memory (page 32) for later recall.

Clarifier (Rx/Tx Offset Tuning)

The three **CLAR** buttons near the upper right corner of the front panel and the control just below them are used to offset either the receive, transmit or both frequencies from their settings on the main display. The three small numbers in the center of the display (just to the right of the main frequency display) show the current clarifier offset. The clarifier controls on the FT-1000 are designed to allow you to preset an offset (up to ± 9.99 kHz) without actually retuning, and then to activate it with the clarifier's **RX** and **TX** buttons.

Perform the following steps, if you like, to familiarize yourself with the clarifier controls:

- Turn the **CLAR** knob back and forth while watching the center of the display. Notice that a minus sign appears when the offset is negative.

- Now, with a non-zero offset displayed, press the **RX** button several times while watching the display. When the clarifier is activated, **RX CLAR** appears at the top center of the display, and the main frequency display shifts by the amount displayed for the clarifier offset.
- Press the **PTT** switch and notice that the transmit frequency remains the same as the original frequency display when the receive clarifier is on.
- With the receive clarifier active, turn the **CLAR** knob again, and notice that both the main frequency and the clarifier offset displays change together.
- Now press the clarifier **CLEAR** key and observe that the offset is cleared to zero, and the main vfo frequency returns to what it was originally.

The transmit clarifier works almost the same way as the receive clarifier, by pressing the clarifier **TX** button. **TX CLAR** appears at the top center of the display when the transmit clarifier is active. The offset is only added to the displayed operating frequency, however, when you transmit.

A typical application for the clarifier is when you are in contact with a station whose transmitter drifts (or perhaps you didn't have him quite tuned in when you called him). You don't want to change your transmitting frequency, as that would force him to retune — you just want to adjust your receiver. You could proceed as follows while listening to his signal:

- Press the clarifier **CLEAR** button if the displayed clarifier offset is not zero.
- Then press the clarifier **RX** button to activate the receiver clarifier, and carefully retune his signal with the **CLAR** knob.

After you finish your conversation with him, you must remember to press the clarifier **RX** button again to turn off the clarifier. However, if you hear another station you want to call right on the frequency he was on, instead of turning off the clarifier, you can just press the **TX** clarifier button to bring your transmitter onto the same frequency, and make your call (now both the receive and transmit frequencies are offset by the displayed amount). Keep in mind, however, that you will need to press both the **RX** and **TX** clarifier buttons again to turn off the clarifier when you finish. You might also want to clear the offset when done.

The FT-1000 actually has an independent clarifier for each vfo, on every band and alternate subband, plus one on each of the 99 memories. This means that clarifier TX/RX and offset settings are not carried over when you change bands or memory channels, but rather are stored until you return to that vfo, band, subband or memory again.

Using Sub Vfo B

As you might imagine, the sub vfo works in a similar manner to the main vfo, with which you are familiar by now (if you have worked through the previous sections). The major purpose of the sub vfo is to provide simple split (transmit/receive) frequency operation via the **SPLIT** button, and more importantly, dual-channel reception via the **DUAL** button. We'll get into those in a minute, but first let's look at how to control the sub vfo.

Frequency, mode, filter bandwidth and clarifier data can be transferred from the main to the sub vfo by pressing the **A ⇄ B** button (below the mode buttons), but don't forget that this will overwrite any settings that were in the sub vfo previously. Also, the contents of the two vfos can be swapped (with no loss of data) by pressing the **A ⇄ B** button.

Most selections you can make for the main vfo can also be made for the sub vfo directly, without involving the main vfo at all: the "key" to this is the **SUB** key (white label) at the lower left corner of the keypad.

Sub vfo band (and subband), mode and filter selections can be made just by pressing this key right before pressing another keypad key to select a band, or before a mode button to change the sub vfo mode (displayed above the sub vfo frequency), or before a **BANDWIDTH** button to select another filter (only 500-Hz and 2.4-kHz filters are available for the sub vfo). When you press the **SUB** key, the entire display for the sub vfo will blink, after which you have five seconds to press another key. Note that to switch subbands in the sub vfo, you need merely press the **SUB** key followed by the key for the same band that the sub vfo is already on.

Additionally, you can enter a frequency from the keypad into the sub vfo by pressing the **SUB** key before

pressing the **ENT** key (and the digits of the new frequency you want to enter into the sub vfo, followed by **ENT** again).

Of course you can tune the sub vfo using its tuning knob, and even use coarser (x10) tuning steps by holding the **FAST** button (below the left side of the main tuning knob). You can use the large **DOWN** and **UP** keys (in both normal and 1-MHz fast steps) for the sub vfo as well, if you just press the **SUB** key first.

About the only things you cannot do with the sub vfo (that you can with the main vfo), are store it directly into a memory, and set the clarifier. For these functions you need to swap it with the main vfo first (push **A ⇄ B**, then hold the yellow **VFO-A ⇄ M** button for 1/2-second (to store it in a memory) or set the clarifier, and then press **A ⇄ B** again to return the data to the respective vfos.

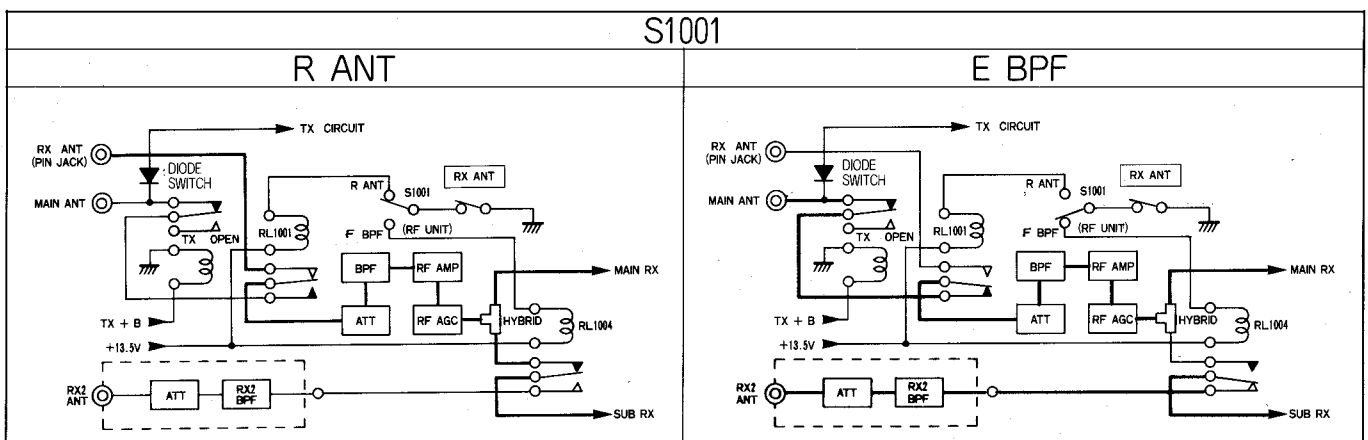
Dual-Channel Reception

By pressing the blue **DUAL** button, dual receiver operation is activated on the main (A or recalled memory) and sub vfos. **DUAL** appears in an orange box at the left edge of the display, and the green **RX** LED above the sub vfo tuning knob lights.

NOTE: If the optional BPF-1 bandpass filter option is installed in your set there is no limitation on the relative frequencies of the two vfos if you have set things up as follows:

- Internal switch S1001 must be set to the **E BPF** position (see the diagram below, and page 9),
- Connect a separate antenna to the **SUB RX ANT** jack on the BPF-1, and
- Press the **RX ANT** switch on the front panel (so its LED is on).

Effect of S1001 Selection on the RX ANT Switch



4. Operation - Using Sub Vfo B

Otherwise, the two vfos will share the same antenna and frontend bandpass filter, and so should be tuned fairly close to each other for maximum sensitivity (that is, within 500 kHz or so at low frequencies, or within several MHz at higher frequencies). Although you may be able to receive on, say, 21 and 28 MHz at the same time, you may find the sub receiver signal attenuated.

The **RX MIX** control adjusts the audio balance between the two receivers. To really take advantage of dual reception, you will want to connect the **AF OUT** jack on the rear panel to an external stereo amplifier, or stereo headphones to the **PHONES** jack, and set the **PHONE** switch in the top access panel to either the **mix** or the **st**(ereo) position. Compare these two positions with the **RX MIX** control set at 12 o'clock and both vfos tuned to signals, to select your preference. With headphones, the **st** position completely separates the two channels (main in left channel, and sub in right), while the **mix** position gives you some audio from each channel in each ear, but with the one channel emphasized in one ear, and the other emphasized in the other ear, resulting in a kind of "3-D" spatial audio effect.

If you have connected the AUX (high impedance) input of an external stereo amplifier to the **AF OUT** jack on the rear panel, the front panel **AF** and **RX MIX** controls, and the **PHONE** switch in the top access panel, will not affect your audio. Instead use the controls on your external amplifier.

Note that the **RF GAIN**, **SHIFT**, **WIDTH**, **NOTCH**, **APF** and **AGC** functions do not affect the sub receiver (AGC decay rate is automatically selected according to mode).

We'll return to discussing some special applications for dual reception in a minute, but first lets look at split operation.

Split Frequency Operation

Typical split operation is performed by receiving on the main vfo (A) or a memory channel, and transmitting on the sub vfo (B). The special case of FM repeater operation uses some features of its own, and is described in the box on page 28.

To activate split receive/transmit operation, just press the **SPLIT** button. **SPLIT** appears in a box at the left edge of the display, and the orange **TX** LED above the sub vfo tuning knob lights. With the FT-1000, we recommend that you always activate the dual receiver feature when working split, as this allows you to monitor your transmit frequency on the sub vfo (while receiving), as well as the main vfo receiving frequency, so you don't accidentally "step on" somebody.

Note: For split operation with a separate antenna, you do not need the BPF-1. In fact, if you have the BPF-1 option installed and you want to use a separate receiving antenna for split operation, you will have to set things up differently from that described on the previous page for dual reception on separate antennas:

- The receiving antenna must be connected to the **RX ANT** phono jack on the rear panel (*not* the jack on the BPF-1).
- Internal switch S1001 on the RF Unit must be set to the **R ANT** position.
- Press the **RX ANT** switch on the front panel (so its LED is on).

Keep in mind that only the main **ANT** jack can be used for transmission. During split frequency operation, since the sub vfo (B) determines the transmitting frequency, and since only the main **ANT** jack is used for transmission, the BPF-1 option is inoperative.

Diversity Reception

This is one of the most exciting types of operation offered by the FT-1000, which is capable of several types of diversity reception: sideband diversity reception of AM signals, bandwidth diversity reception of all modes except FM, and antenna diversity reception of all modes (this last requires the BPF-1 option, and of course, two antennas).

Sideband Diversity Reception of AM Signals

In this mode, you receive a single AM signal through the two receivers in the FT-1000, each receiving the opposite sideband. Skywave-propagated signals often show considerable phase distortion in this mode, but it gives you a view of the entire passband, from which you can then select the best sideband for listening (or for SWL dxing, you may want to listen to both sidebands at the same time, to get the best copy). On groundwave signals, where the phase of the sidebands is likely to be the same, there is an interesting sense of depth to the signal.

To tune in a signal using this mode, you should have stereo headphones connected to the front panel **PHONES** jack, or an external stereo amplifier connected to the rear panel **AF OUT** jack.

- Set the main vfo to either LSB or USB mode, and tune precisely for zero beat on the desired signal.
- Press the **A** \rightarrow **B** button below the main tuning knob to copy this mode and frequency into the sub vfo.
- Press the mode button to select the opposite sideband for the main vfo (A).
- If using headphones, set the **PHONE** switch in to top access panel to the **st** position.

- Press the blue **DUAL** button to activate dual reception.
- If using headphones, adjust the **RX MIX** control to balance the volume of the two receivers. If using an external amplifier, adjust its balance control.

If interference is present on one of the channels, you may have to turn the **RX MIX** control to suppress that channel. Otherwise, try moving the **PHONE** switch to the **mix** and **mono** positions, for different effects (or try settings with similar effects on your external amplifier). Although you don't get the "stereophonic" effect in the monaural mode, the two signals are still mixed, offering the potential for much better copy than in regular AM or even single-sideband ECSS modes.

Bandwidth Diversity Reception

This mode involves receiving the same signal through two different bandpass filters (the BPF-1 option is not required). The frequency and mode of each vfo is the same. The main receiver provides a narrow bandpass, and the sub receiver a wide bandpass, resulting in a spatial perception of the channel. Although any mode (except FM) can be used, CW offers the widest array of choices, and perhaps the most startling effects on crowded channels.

Stereo headphones or an external stereo amplifier are recommended for this mode. To set up the transceiver for bandwidth diversity reception:

- Select the desired mode on the main vfo, and the 2.0- or 2.4-kHz filter (or wide AM - press the **2.4K** button if it's LED is lit, so that it turns off).
- Tune to the signal of interest (if in CW mode, use the **SPOT** button to center the signal in the passband).
- Press the **A -> B** button below the main tuning knob to copy this mode and frequency into the sub vfo.
- Press one of the narrower **BANDWIDTH** selections to select a narrow filter for the main vfo (A).
- If using headphones, set the **PHONE** switch in to top access panel to the **st** position.
- Press the blue **DUAL** button to activate dual reception.
- If using headphones, adjust the **RX MIX** control to balance the volume of the two receivers. If using an external amplifier, adjust its balance control.

Notice that we selected the wider filter first, and copied that selection into the sub vfo. This allows you to take best advantage of the extra flexibility of the main vfo. For example, try the **SHIFT** and **WIDTH** controls for some interesting effects, and the **APF** if in CW mode.

Before retuning, remember to press the **DUAL** button to turn off dual reception, and also select a wide filter. When you find another signal, reselect your narrow filter after copying the new frequency into the sub vfo.

Antenna Diversity Reception

This mode offers the potential of even greater improvements in reception of any mode, but requires that the optional BPF-1 be installed in the FT-1000, and that two antennas be connected. Different results can be expected depending on the differences in antenna polarization and gain at various angles. The advantages of this mode can be particularly helpful in reducing multipath distortion, especially important for optimum AMTOR and HF packet operation, although these modes require special considerations concerning sub receiver IF bandwidth. Requirements for antenna diversity reception are:

- connect your second antenna (used only for reception) to the BPF-1.
- make sure that switch S1001 is set to the **E BPF** position (page 9).
- press the **RX ANT** switch on the front panel to activate sub vfo reception through the BPF-1 (main vfo reception will still use the main antenna).

Other than that, set up and tuning are similar to those for Bandwidth Diversity Reception, described above, except that you needn't use different bandwidths in the two vfos (although you can, and will want to for digital modes - see box below). Remember that both vfos must be set to the same mode for CW, SSB and FM reception.

At the time of this writing, the vast potential for optimizing reception of different signals using diversity reception with the FT-1000 is largely unexplored. We invite you to experiment with these modes, and we hope you will share your findings with others on the air. If you find diversity reception interesting and potentially helpful in your regular operations, you may wish to use the CAT System with an external computer to handle the somewhat complex control procedures. Using the CAT system, dual synchronous vfo tuning and activating any of the diversity reception modes (or combinations of them) can be reduced to a single key-stroke on your computer keyboard.

Digital Modes on the Sub Receiver

The 600-Hz IF bandwidth for the sub receiver can only be selected in the CW mode, so to use this filter for RTTY or Packet operation, CW mode must be selected and your modem set to decode signals within the 400 - 800 Hz CW passband. The displayed frequency will be 600 Hz above the (suppressed USB) carrier frequency, so will not correspond to the main receiver display when tuned to the same signal.

Memory Features

Memory Channel Storage

The 99 memory channels in the FT-1000 each store frequency, mode, filter selection and clarifier settings copied from the main display into the displayed memory channel number when the yellow **VFO-A ► M** button is pressed and held for 1/2-second. The data to be copied from the main display may be either in the main vfo (A), or in a memory that has been retuned.

Example: to store 14.25 MHz in memory channel 10.

- First tune the main vfo (A) to the desired frequency. To do this with the keypad (as just one of several ways it could be done), press **ENT** and then the keys with the (yellow) numbers **1 4 2 5 0 0 0**, followed by the **ENT** key once more. Also select the desired mode and **BANDWIDTH** filter.
- Next rotate the **MEM** knob until **10CH** is displayed (to select the channel number to store).
- Now just press and hold the yellow **VFO-A ► M** button for 1/2-second, until a double beep sounds from the key beeper (confirming that the memory has been stored).

If you have the clarifier set for some offset, and either receive or transmit clarifier functions activated, these settings are also stored in the memory.

Checking Stored Memories

One memory channel number is displayed at all times (just to the left of the **CH** at the right center of the display). You can change the selected channel number by rotating the **MEM** knob at the right edge of the front panel.

If you rotate this knob while receiving on a vfo or a retuned memory, **M CK** will appear blinking above the channel number, and the mode and frequency previously stored in the selected channel will be displayed in place of the sub vfo data, until a few seconds after you stop turning the knob. Try that now.

You can also view memory frequencies and modes by pressing the **M CK** button beneath the main tuning knob, in which case memory channel data (and **M CK**, non-blinking) will be displayed until you press **M CK** again to return the display to the sub vfo. Of course, if nothing has been stored in a memory, you will not see any frequency or mode displayed — just the two decimal points in place of the sub vfo display.

Also, after recalling a memory to the main display as described next, as long as you haven't retuned it, you can view the other memories by turning the **MEM** knob. In this case, however, reception will shift to each memory as it appears on the main frequency display:

Memory Channel Operation/Recall

To recall data stored in a memory channel for operation, you can either copy it into the main vfo, or you can switch operation from the main vfo to the memories.

The **M ► VFO-A** button can be used to copy the current memory channel data into the main vfo, by pressing and holding this button for 1/2-second. Pressing it only momentarily shows you the contents of the memory, without actually overwriting the vfo data. (Otherwise, when you press and hold this button, the previous contents of the vfo are lost).

In most situations, however, you may find it more convenient to simply switch operation from the main vfo to the memory, by pressing the **VFO/MEM** button to the right of the yellow button, near the lower right. This method allows you to leave any settings in the main vfo undisturbed, so you can instantly recall them just by pressing **VFO/MEM** again.

When actually operating on a memory channel, **MEM** appears at the left side of the display (instead of **VFO**), and you can rotate the **MEM** knob to select any previously-stored memory for operation.

If you change frequency, mode, filter or clarifier settings while operating on a memory, **MEM** on the display is replaced with **M TUNE**. This makes each memory just as flexible as the main vfo. If you want to save any changes you have made to a memory channel, just rotate the **MEM** knob (if you want to store the new settings into another channel), and press the yellow **VFO-A ► M** button for 1/2-second until the double beep sounds (of course you needn't turn the **MEM** knob if you want to overwrite the memory channel you're on now). Note that in this instance the labelling of the **VFO-A ► M** button is somewhat deceptive: the settings of the main vfo, which are hidden at this point, are not actually involved in this operation at all, since those of the recalled memory have taken their place.

If you just want to cancel any changes you have made to a recalled memory, press **VFO/MEM** once (**MEM** will be displayed again), and press it again if you want to return to the main vfo (A).

Dual channel reception, split operation and all types of diversity reception can be activated while operating on a memory, in which case the recalled memory simply replaces the main vfo settings.

Note: There is a "back door" feature of memory operation that does affect the main vfo — that is sub-band selection. Memories do not actually store their own subband settings like those used by the main and sub vfos (by pressing the keypad key for the band that

you are already on). However, if you do this (press the key for the current band) while operating on a memory, operation will shift to the alternate subband settings *for the main vfo!* You will be able to retune the subband settings, and change mode, filter and clarifier settings. You can even store the new settings in a memory channel, and then return to the original subband. However, when you later return to vfo operation (by pressing **VFO/MEM** once or twice), and then recall the alternate subband, its settings will be those last set on the subband while operating on the memory. If you try this, use care, as you can unwittingly erase your subband settings if you return from a memory to the vfo while having a subband selected (in memory tune mode).

Memory Scanning

You can scan any stored memories by pressing the **M SCAN** key at the upper right corner. However, for this to work, you must first adjust the **SQL** control so that the receiver is silenced (green **MAIN BUSY** LED at the right of the meter off).

During memory scanning, the scanner will pause on any channel having a signal strong enough to open the squelch, during which the two decimal points in the main frequency display will blink. Scanning resumes a few seconds later, so you may need to readjust the **SQL** control to keep the scanner from stopping on channels with high background noise.

To stop the scanner, press the PTT switch (no transmission will occur), or the **M SCAN** button again. Note

that the **FRONT END** and **RF** gain settings also affect the squelch threshold.

Memory Scan Skip

Once you have stored a lot of memories, you probably won't want to scan every one of them. You can mark some of them to be skipped during scanning. To do this, recall the channel to be skipped, and press and hold the **FAST** button below the left side of the main tuning knob while also pressing **M SCAN** momentarily.

By default, when a memory is first stored, it is set to be included in scanning (**SCAN** is displayed above the channel number). When you set the memory to be skipped, this indicator disappears from the display. If you have set a memory to be skipped, and later want to include it, just repeat the same **FAST + M SCAN** procedure.

Memory Blanking

After storing many memories, you may want to completely hide some from normal operation, to simplify selection of the others. To blank a displayed memory, while **MEM** is displayed at the left of the frequency, press and hold the yellow **VFO-A ← M** button for 1/2-second until the double beep sounds (this won't work if **M TUNE** is displayed – if you have retuned the memory, either store it again, or cancel changes by pressing **VFO/MEM** once).

As long as you don't overwrite a blanked memory, you can unblank it simply by repeating the same procedure you used to blank it.

Optional DVS-2 Digital Voice Recorder

The DVS-2 is a digital recorder designed especially for the FT-1000, which has a special jack for connection of the DVS-2 on the rear panel. It offers two independent functions: recording received signals for playback later in the loudspeaker/headphone, and recording signals by the microphone for playback later over the air (during transmission). Operating details are provided with the DVS-2, but a summary is provided here.

Receiver Recording

When used in this mode, the DVS-2 maintains a continuous recording of the last 18 seconds of audio from the main receiver. This can be particularly helpful in picking out callsigns during a pileup, as you can replay the same recording several times. As the DVS-2 uses only the main receiver audio channel, real-time action can be continually monitored on the sub vfo audio channel while playing back on the main channel.

Transmission Recording

This mode allows the DVS-2 to record either two 8-second segments or four 4-second segments of audio from the microphone, such as contest exchanges or station ids. Each can then be played back, either in a monitor mode (without transmission), or directly over the air. The 8- and 4-second segments share the same memory, so two 4-second segments can be combined into one 8-second segment. Note that the digital memory used in this mode is independent from that used for receiver recording.

Digital Modes: AMTOR, RTTY & Packet

The FT-1000 offers some special features to meet the requirements of digital modes, such as a built-in digitally-synthesized AFSK generator for RTTY and AMTOR terminal units, IF bandwidth optimization and automatic display offsets, and an 18-ms transmit-to-receive turnaround time. Antenna diversity reception, described on page 30, also has the potential to improve performance greatly in these modes. However, note that the sub receiver bandwidth is fixed at 2.4 kHz in the RTTY and PKT modes.

RTTY and AMTOR with a Terminal Unit

Connect your TU to the RTTY jack on the rear panel, as shown below. Also, set the four RTTY DIP switches in the top access panel for the Mark frequency, shift amount and usual direction you wish to use (see page 16 for the switch settings).

To operate, just press the **RTTY** mode button, once or twice to select the desired sideband for operation (which is normal will depend on your RTTY DIP switch settings — if you selected “NOR”, LSB will give normal shift). The display shows your actual Mark frequency.

For optimum signal-to-noise ratio, use the 250-Hz **BANDWIDTH** selection for 170-Hz shift, the 500-Hz selection for 450-Hz shift, or the 2.0-kHz selection for 850-Hz shift.

Before transmitting the first time, preset the **RF PWR** control fully counterclockwise, and set the **METER** selec-

tor to **ALC**. Key the transmitter (you can use the **MOX** button) and adjust the **MIC** control for mid-scale indication.

Now you can switch the **METER** selector to **P0** and set the **RF PWR** control for the desired power output.

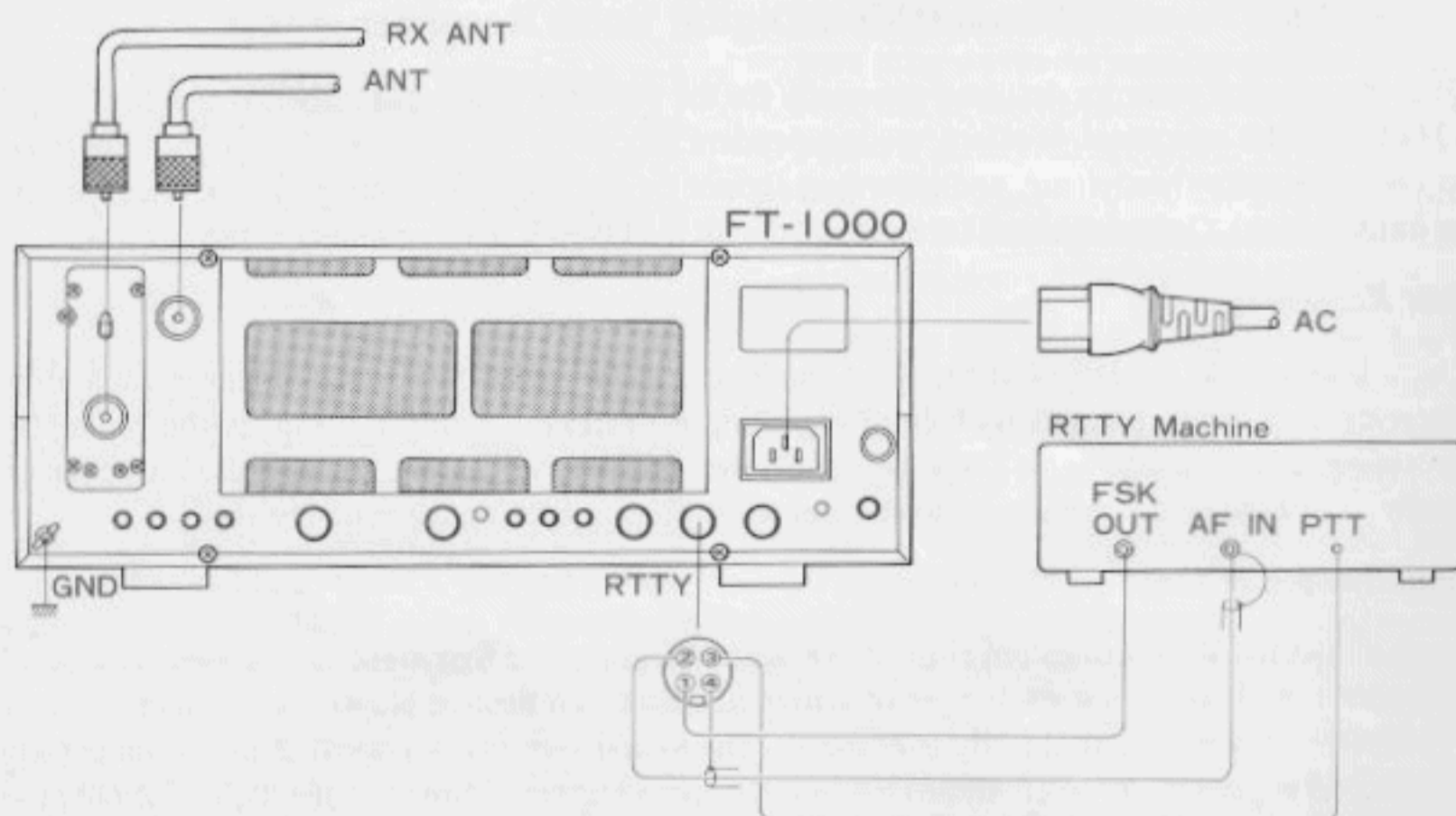
CAUTION

The FT-1000 cooling system is designed to handle continuous duty transmission at 100 watts output. If you need more power output for RTTY, you must limit the length of your transmissions (or use an external linear amplifier). At 200 watts output, RTTY transmissions must be limited to 3 minutes or less, with at least 3 minutes receive in between transmissions. In any case, place your hand on the transceiver occasionally to ensure that it's not getting too hot. The safest approach is to keep power output at 100 watts or less.

300-Baud Packet

Connect your tnc to the **PACKET** jack on the rear panel, as shown on the next page. Do *not* connect the squelch line (pin 5) for 300-baud packet operation.

Tuning is very critical for F1 packet: you should tune the transmitter and receiver within 10 Hz of a signal to minimize repeats. The FT-1000 includes a packet frequency display offset feature that allows it to



RTTY/AMTOR Terminal Unit Interconnections

display the center frequency of the two transmitted carriers, without any offset, in accordance with the latest convention. However, for this to work properly, you must set the **PKT** DIP switches in the top access panel to match the tones generated by your tnc. See the Packet DIP Settings Table on page 16.

Select the 500-Hz **BANDWIDTH** filter for 300-baud packet, and press the **PKT** mode button on the front panel once or twice, so that the green **LSB** LED indicator lights along with the orange **PKT** LED.

Transmitter adjustment is similar to SSB:

- Preset the **RF PWR** control counterclockwise, and set the **METER** selector to **ALC**.
- Now set your tnc to its "calibrate" mode, preferably with both tones alternating, and adjust the **MIC** control so that the meter deflects to mid-scale.
- Switch the **METER** selector to **PO** and advance the **RF PWR** control for the desired power output.

When tuning, bear in mind that some common hf packet channels, such as "14.103" MHz, were originally determined to correspond with an actual IF center frequency 1700 Hz lower (in accordance with an old TAPR convention). Therefore, if you have the DIP switches set to match your tnc's actual tones, the display will show 14.101.30 when you are tuned to the above frequency — which is the actual center of your receiver passband, and the frequency mid-way between the two FSK carriers you will transmit.

Initially, you may need to adjust the receiver IF shift a few clicks to the right or left to get the 500-Hz IF filters perfectly centered over incoming signals. Start

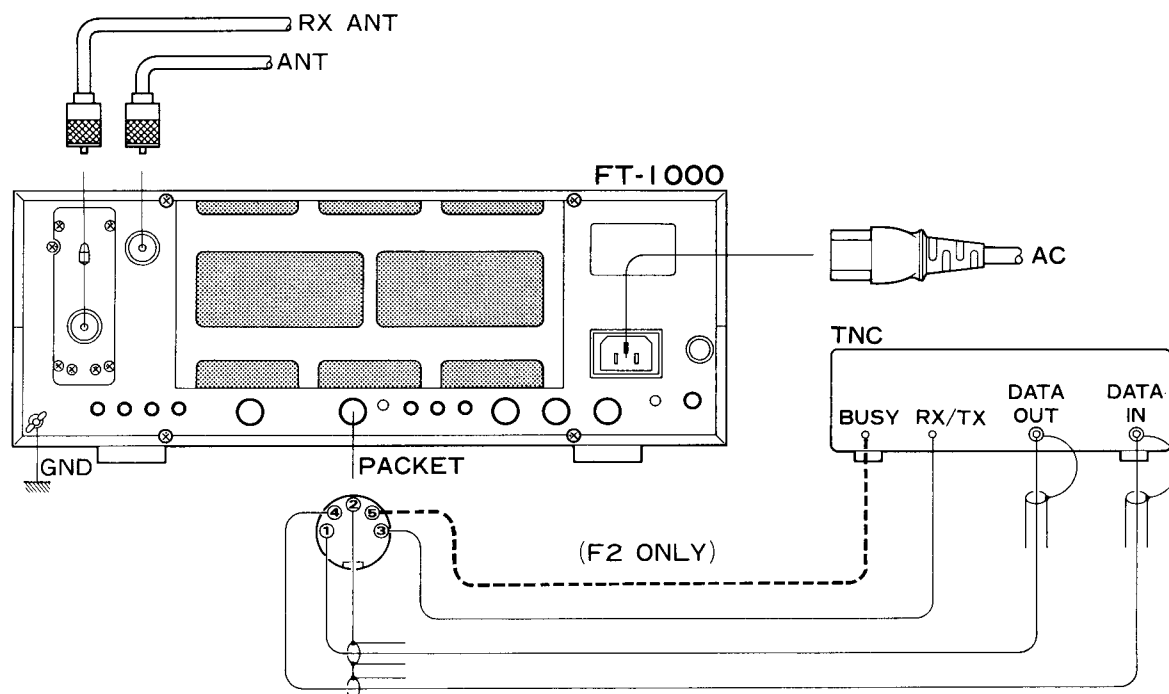
with the **SHIFT** control centered, and try to establish a connection with a moderately strong signal on a clear channel. If the connection is poor (many repeats), move the **SHIFT** control one click to the right, and see if the repeats decline. Continue in this manner until you find a "sweet spot" (with minimal repeats) for the **SHIFT** control, and make note of it. You will use this same setting for all future hf packet operation.

1200-Baud FM Packet

The equipment setup for 1200-baud FM packet (above 29 MHz) is the same as for 300-baud packet, except that you may want to connect the squelch line of the tnc to pin 5 of the **PACKET** jack if you plan to use the squelch. Press the **PKT** mode switch until both it and the green LED on the **FM** mode button are lit. Tuning is much less critical in this mode, requiring no special adjustments. Also, the **FM MIC GAIN** control in the top access panel has been preset at the factory for proper deviation with typical signal levels, so you should not need to readjust it (you should adjust the tx audio output level of your tnc, though, if your signal sounds distorted in the monitor).

To set up the transmitter for FM packet:

- Start with the **RF PWR** control counterclockwise, and set the **METER** selector to **ALC**.
- Set your tnc to its "calibrate" mode, preferably with both tones alternating, and adjust the **DRIVE** control so that the meter deflects to mid-scale.
- Switch the **METER** selector to **PO** and set the **RF PWR** control for the desired power output.

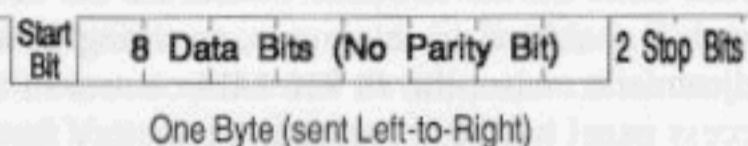


Packet TNC Interconnections

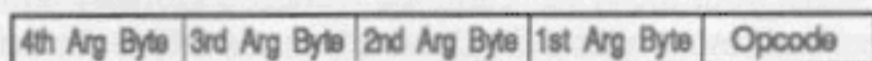
Cat System Computer Control

The CAT (Computer Aided Transceiver) System in the FT-1000 provides control of frequency, mode, vfo, memory and other settings by the operator's external personal computer. This allows multiple control operations, such as dual-channel memories and diversity reception, to be fully automated as single keystroke operations on the computer keyboard.

Serial data is passed at TTL levels (0 and +5V) via SO (serial output) and SI (serial input) pins 2 and 3 of the CAT jack on the rear panel of the transceiver at 4800 bits/s. CAT jack pinout is shown on page 7. Each byte sent consists of one start bit, 8 data bits, no parity bit and two stop bits:



All commands sent from the computer to the transceiver consist of blocks of five bytes each, with up to 200 ms between each byte. The last byte sent in each block is the instruction opcode, while the first four bytes of each block are arguments: either parameters for that instruction, or dummy values (required to pad the block out to five bytes):



5-Byte Command Block (sent Left-to-Right)

There are twenty-seven instruction opcodes for the FT-1000, listed in the table on the next page. Notice that several instructions require no specific parameters. However, every Command Block sent to the transceiver *must* always consist of five bytes.

The CAT control program in the computer must construct the 5-byte block, by selecting the appropriate instruction opcode, organizing the parameters, if any, and providing unused (dummy) argument bytes for padding (the dummy bytes can contain any value). The resulting five bytes are then sent, *opcode last*, to the SI serial input pin of the CAT jack on the transceiver.

EXAMPLE: Set main vfo (A) to 14.25000 MHz;

- First determine the opcode for the desired instruction (see the CAT Commands Table). These opcodes should be stored in the program, so they can be looked up when the user requests the corresponding command. In this case the instruction is "Set Main Vfo Freq.", so the opcode is 0Ah. Small "h"s following each byte value indicate hexadecimal (base 16) values.

- Build the four argument byte values from the desired frequency by breaking it into 2-digit blocks (BCD "packed decimal" format). Note that a leading zero is always required in the hundreds-of-MHz place (and another in the ten's-of-MHz if below 10 MHz).
- The resulting 5-byte block should now look like this (again, in hexadecimal format):

Byte Value	0Ah	01h	42h	50h	00h
Content of this byte	Set Main Vfo Freq. opcode	100's & 10's of MHz	1's of MHz & 100's of kHz	10's & 1's of kHz	100's & 10's of Hz

- Send these five bytes to the transceiver, in *reverse* order from that shown in the table above — from right-to-left (see the Basic example on page 39).

Reading Transceiver Status

The Update, Read Flags, Read Meter and Pacing commands allow the computer to obtain reports of various conditions via the SO (Serial Output) line. Update causes the transceiver to return 1,636 bytes of Status Update data, while Read Flags obtains only the first 3 bytes (the Status Flags), plus 2 extra "filler" bytes (10h and 21h), and Read Meter returns the meter deflection (0 — 0FFh) repeated in four bytes, followed by one "filler" byte (0F7h). Each byte of returned data may be delayed by an interval determined by the Pacing command (0 to 255 ms in 1-ms steps). This delay is initially zero until the Pacing command is sent.

The Pacing command allows returned data to be read and processed by even very slow computers. However, you should set it as short as your computer will accommodate, to minimize the inconvenience of the delay. Sending 1,636 bytes requires just under 4 seconds with "0"-length delay selected, but over 7 minutes if the maximum delay is selected!

Status Update Data Organization

The 1,636 bytes of Update data consists of 24 one-bit state indicator flags (3 bytes), followed by one byte indicating the current (or last selected) memory channel, followed by 102 16-byte channel records: one for the current operating parameters, one each for vfos A and B, and one for each of the 99 memories.

The Read Flags data consists of just the 24 one-bit state indicator flags (3 bytes), plus 10h and 21h, as mentioned above. These data arrangements are shown pictorially on the page after next.

CAT Commands

Legend:

Send all commands in REVERSE order from that shown! Commands that duplicate a front panel button are named with all caps. Parameter variables are named to reflect their format: eg., "CH" indicates a memory channel number, from 0 to 63h (1 to 99 decimal). "—" indicates a padding byte. Value is unimportant, but it must be present to pad the block out to five bytes. Opcodes are listed in both hex and decimal format for convenience - only one byte can be actually sent.

Command	Opcode		Parameter Bytes				Notes
	hex	(dec)	1	2	3	4	
SPLIT	01	(1)	T	—	—	—	Switch Split vfo operation ON (T=1) and OFF (T=0)
Recall Memory	02	(2)	CH	—	—	—	Recalls memory channel number CH : 0 to 63h corresponding to mems 1 to 99
VFO A → M	03	(3)	CH	P2	—	—	Copy display to channel CH (P2=0), Clear CH (P2=1) or Restore CH (P2=2)
LOCK	04	(4)	P	—	—	—	Main knob lock/unlock (P=1/0), sub knob lock/unlock (P=81h/80h)
Select vfo A/B	05	(5)	V	—	—	—	Select operation on main vfo A (V=0) or sub vfo B (V=1)
M → VFO A	06	(6)	CH	—	—	—	Copy memory channel CH (0 to 63h) to main vfo
UP	07	(7)	V	S	—	—	Step main display (V=0) or sub display (V=1) up 100 kHz (S=0) or 1 MHz (S=1)
DOWN	08	(8)	V	S	—	—	same as UP
Clarifier	09	(9)	C1	C2	C3	C4	Rx clarifier on/off (C1=1/0), Tx clarifier on/off (C1=81h/80h), or clear offset (C1=FFh). Tune clarifier up (C2=0) or down (C2=FFh) by C3 (kHz) + C4 (Hz)
Set Main Vfo Freq	0Ah	(10)	F1	F2	F3	F4	New vfo frequency in F1 – F4, in BCD format: see text for example
Select Mode	0Ch	(12)	M	—	—	—	M values for main vfo: LSB=0, USB=1, CW2.4K=2, CW500=3, AM6K=4, AM2.4K=5, FM=6 or 7, RTTY(LSB)=8, RTTY(USB)=9, PKT(LSB)=0Ah, PKT(FM)=0Bh. For sub vfo (B), bitwise OR these values with 80h.
Pacing	0Eh	(14)	N	—	—	—	Add N-millisecond (0 – 0FFh) delay between bytes of Status Update (from radio)
PTT	0Fh	(15)	T	—	—	—	Transmitter on (T=1) or off (T=0)
Update	10h	(16)	—	—	—	—	Instructs the radio to return the Status Update data to the PC (1,636 bytes)
TUNER	81h	(129)	T	—	—	—	Switch antenna tuner on (T=1) or off (T=0).
START	82h	(130)	—	—	—	—	Start antenna tuner.
DUAL	83h	(131)	T	—	—	—	Activate (T=1) or deactivate (T=0) dual reception
RPT	84h	(132)	R	—	—	—	Select simplex (R=0), -shift (R=1) or +shift (R=2)
A → B	85h	(133)	—	—	—	—	Copy main vfo (A) data to sub vfo (B)
Set Sub Vfo Freq	8Ah	(138)	F1	F2	F3	F4	New sub vfo freq in F1 – F4, in BCD format: see main vfo example in text
BANDWIDTH	8Ch	(140)	B	—	—	—	B filter selection for main vfo: 2.4-kHz=0, 2.0-kHz=1, 500-Hz=2, 250-Hz=3. For sub vfo (B), bitwise OR these values with 80h.
Memory Scan Skip	8Dh	(141)	CH	T	—	—	For channel CH (0 – 63h), skip (T=1) or include in scanning (T=0)
Step main vfo (A)	8Eh	(142)	D	—	—	—	Step main vfo frequency up (D=0) or down (D=1) minimal step (10- or 100-Hz)
Read Meter	0F7h	(247)	—	—	—	—	Instructs radio to return digitized meter indication (4 repeated bytes, and 0F7h)
DIM Level	0F8h	(248)	L	—	—	—	Set dim display brightness between L=1 and L=13h (brightest)
Rptr Offset	0F9h	(249)	00h	S2	S3	S4	Set offset for RPT shifts, valid values are 0 to 19999 Hz (BCD format, in S2 – S4). Parameter 1 must be zero
Read Flags	0FAh	(250)	—	—	—	—	Instructs radio to return the 24 1-bit Status Flags (5 bytes, see following pages)

Data Returned From FT-1000

Update Data

An overview of the data returned to the PC in response to the Update command is shown at the right. The sequence of the data stream is from top left to bottom.

The first three bytes are subdivided into 1-bit flag fields: if a bit is set (1), the function is enabled (on); and if reset (0), the function is disabled (off). These flags reflect the current states of various functions, most of which are indicated on the radio display.

Flags Byte 1

- Bit 0: Split frequency operation
- Bit 1: Dual receive operation
- Bit 2: Antenna tuner now tuning
- Bit 3: CAT System activated (after any cmd)
- Bit 4: Vfo B in use (its RX or TX lamp on)
- Bit 5: Keypad Entry in progress (digit blinking)
- Bit 6: Current memory is empty
- Bit 7: Transmission in progress (PTT closed)

Flags Byte 2

- Bit 0: Memory scanning is paused
- Bit 1: Memory checking (M CK) in progress
- Bit 2: Scanning in progress
- Bit 3: Main tuning knob locked
- Bit 4: Memory tuning (M TUNE) activated
- Bit 5: VFO operation (= left side of display)
- Bit 6: MEM operation (= left side of display)
- Bit 7: GEN operation (= left side of display)

Flags Byte 3

- Bit 0: PTT line closed by CAT command
- Bit 1: Tx inhibit (eg., out-of-band)
- Bit 2: 0.5-sec transfer key release timer active
- Bit 3: 5-sec memory check (M CK) timer active
- Bit 4: Tx inhibit from PTT during memory scan
- Bit 5: Transmit monitor
- Bit 6: Antenna TUNER on (panel LED)
- Bit 7: Sub vfo (B) tuning knob locked

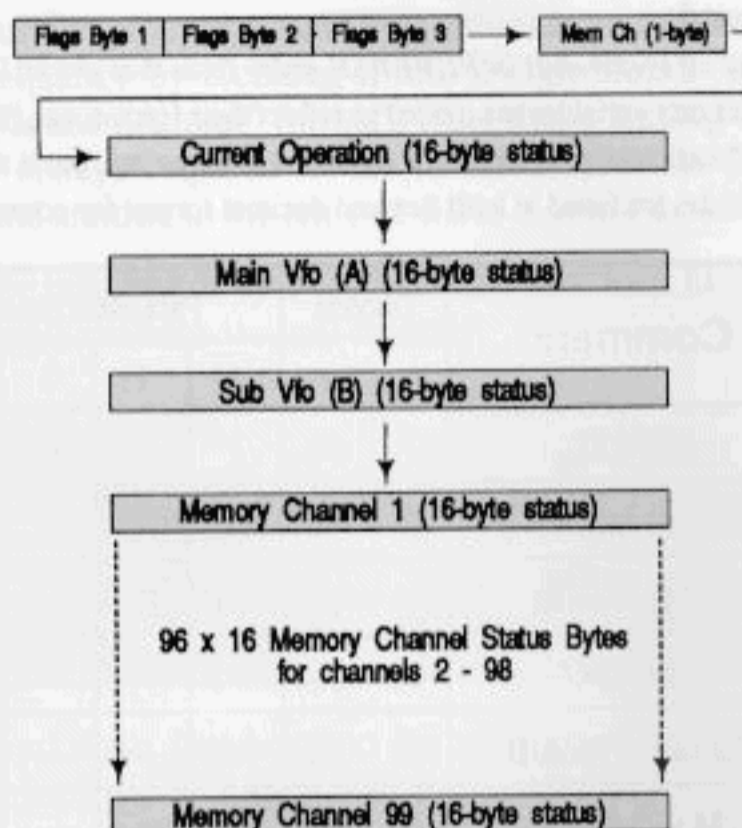
Memory Channel Byte 4

The fourth byte of Update data contains a binary value between 0 and 63h (98 decimal), indicating the current memory channel number on the display.

Note: The actual channel number is always one greater than the value of this byte: which is 0 for channel 1, and 98 for channel 99.

16-Byte Records

The rest of the data returned by the Update command consists of 16-byte record structures indicating



the vfo- and memory-specific selections. The first of these records is for the current display, followed by the two vfos, and then the 99 memory channels, from lowest to highest. Each byte in this structure is identified below by its offset from the start (base address) of the record. Notice that the first record, for the current display, is duplicated by either the main vfo (A) data, or by one of the memories, unless currently operating on a retuned memory (M TUNE displayed).

Format of 16-byte Structures in Update Data

Offset	Content & Format of Byte Field
0	BPF selection: 0 to 30h binary (bit 7=1 on a blanked memory)
1-3	Bytes 1-3: Base frequency in 10's of Hz (w/o clar/rpt offset). Binary value in range 10000-3000000. Byte 1 is MSB.
4	Clarifier/Rpt status (bit set=on, reset=off) Bit 0: Tx clarifier enabled. Bit 1: Rx clarifier enabled. Bit 2: +Rpt shift enabled. Bit 3: -Rpt shift enabled. Bits 4-7: not used
5-6	Clarifier offset. 2's complement (signed) value between -999d (FC19h) and +999d (03E7h)
7	Mode: binary, 0=LSB, 1=USB, 2=CW, 3=AM, 4=FM, 5=RTTY, 6=PKT
8	IF filter: binary, 0=2.4K, 1=2.0K, 2=500, 3=250, 4=6K(AM) (bit 7=1 for FM Packet or Reverse RTTY)
9	Last selected SSB filter (see Byte 8 format)
10	Last selected CW filter (see Byte 8 format)
11	Last selected RTTY filter (see Byte 8 format)
12	Last selected PKT filter (see Byte 8 format)
13	Last state of Clarifier/Rpt in FM mode (see Byte 4 format)
14	Bit 0 is set if this is a memory to be skipped during scanning. Bit 7 is set if AM mode last used (or is using) the 2.4K filter.
15	This byte is either 0, or 0FFh if the current AM or FM frequency is not an integer multiple of 100 Hz

Read Flags Data

The Read Flags command retrieves the three Flag Bytes (and two padding bytes) without having to read the entire 1,636-byte Update Status. The transceiver responds to the Read Flags command by returning the Flag Bytes described on the preceding page, plus two additional bytes with the constant values of 10h and 21h (in that order), as shown here:

Flags Byte 1	Flags Byte 2	Flags Byte 3	Dummy (10h)	Dummy (21h)
--------------	--------------	--------------	-------------	-------------

Read Meter Data

Sending the Read Meter command causes the computer to return a digitized meter deflection indication, between 0 and 0FFh (in practice, the highest value returned will be around 0F0h). Four copies of this value are returned, along with one padding byte (0F7h), as follows:

Meter Byte	Meter Byte	Meter Byte	Meter Byte	0F7h
------------	------------	------------	------------	------

During reception, the signal strength deflection is returned. During transmission, the parameter represented by the reading returned depends on the setting of the **METER** switch.

Coding Examples

Although Yaesu Musen Company cannot offer to provide complete CAT control programs (owing to the large variety of incompatible computers used by our customers), following are a few examples of critical CAT i/o functions, in Basic. Note that all variations of Basic may not support some of the commands, in which case alternate algorithms may need to be developed to duplicate the functions of those shown.

Sending a Command

After "opening" the computer's serial port for 4800-baud, 8 data bits and 2 stop bits with no parity, as i/o device #2, any CAT command may be sent. However, if you determine that your computer may need extra time to process data returned from the transceiver, you should send the Pacing command first. Here is an example of the Pacing command setting a 2-ms delay:

```
PRINT #2, CHR$(0);CHR$(0);CHR$(0);CHR$(2);CHR$(&HE);
```

Notice that the instruction opcode is sent last, with the first (MSB) parameter sent just before it, and the LSB parameter (or dummies) sent first. This means that the parameters are sent in the reverse order from that in which they appear in the CAT Commands table. Also note that in this and the following examples, we are

sending zeros as dummy bytes: this is not necessary, however. If you decide to send commands through a 5-byte array, they values of the dummy parameters need not be cleared.

Using the same example as on page 36, the following command could be used to set the frequency of the display to 14.25000 MHz:

```
PRINT #2, CHR$(&H00); CHR$(&H50);  
CHR$(&H42); CHR$(&H01); CHR$(&HA);
```

Notice here that the BCD values can be sent just by preceding the decimal digits with "&H" in this example. However, in an actual program, it may be preferable to convert the decimal frequency variable in the program to an ASCII string, and then to convert the string to characters through a lookup table.

If you send a parameter that is out of range for the intended function, or not among the specified legal values for that function, the FT-1000 should do nothing. Therefore, you may wish to alternate your sending regular commands or command groups with the Read Flags command (and occasionally even the Update command), allowing the transceiver to let the computer know if everything sent so far has been accepted and acted upon as expected.

Bear in mind that some commands specify "binary", as opposed to BCD formatted parameters. You can send binary parameters without going through the character/hex string conversion process. For example, the CH parameter in the Command table is a binary value. You could have the FT-1000 recall memory channel 50 (decimal) by the following:

```
PRINT #2, CHR$(0);CHR$(0);CHR$(0);CHR$(49);CHR$(2);
```

Note that we have to send 49 to get channel 50, since the channel numbers in the command start from 0, while those on the display start with 1.

Reading Returned Data

The reading process is easily done through a loop, storing incoming data into an array, which can then be processed after the entire array has been read. To read the meter:

```
FOR I=1 TO 5  
  MDATA(I) = ASC(INPUT$(1,#2))  
NEXT I
```

Recall from above that the meter data consists of four identical bytes, followed by a filler byte, so we really only need to see one byte to get all of the information this command offers. Nevertheless, we must read all five bytes (or 1,636, in the case of the Update data). After reading all of the data, we can select the bytes of interest to us from the array (MDATA, in the above example).

Installing Internal Accessories

This section contains the installation procedures for installable options available for the FT-1000.

TCXO-1 High-Stability Master Oscillator

The ± 0.5 -ppm TCXO-1 option can be installed as a replacement for the standard ± 2 -ppm module.

- Remove the three screws on each side of the transceiver, and the two along the top edge of the rear panel, as shown at the upper right. Then lift off the top cover.
- Locate the old TCXO Unit in the front right corner of the chassis (see photo at right), and pry off the connector near the front of the board (use a small screwdriver to pry up the rear edge of the connector, and avoid pulling on the wires. See below).
- Remove the four screws at the corners of the board, and remove the old board.
- Position the new TCXO-1 board so that its empty 3-pin connector is toward the front, and use the same screws just removed to affix the new board in place.
- Replace the top cover and screws removed above (unless installing other options now).



Figure 1.

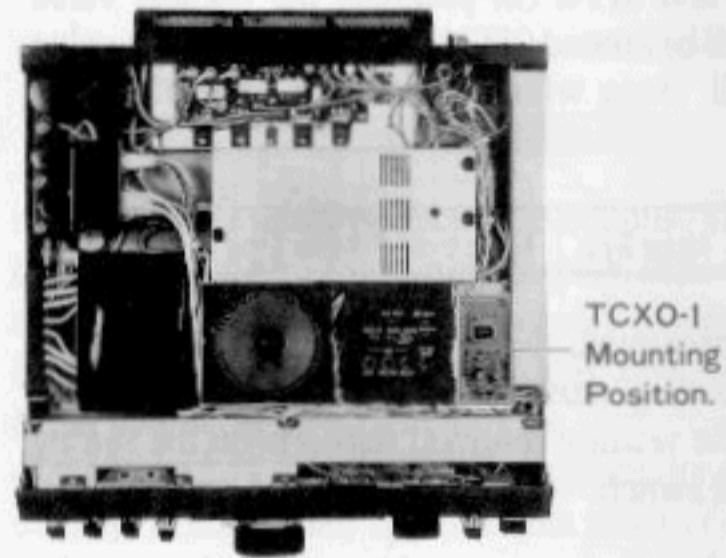


Figure 2.

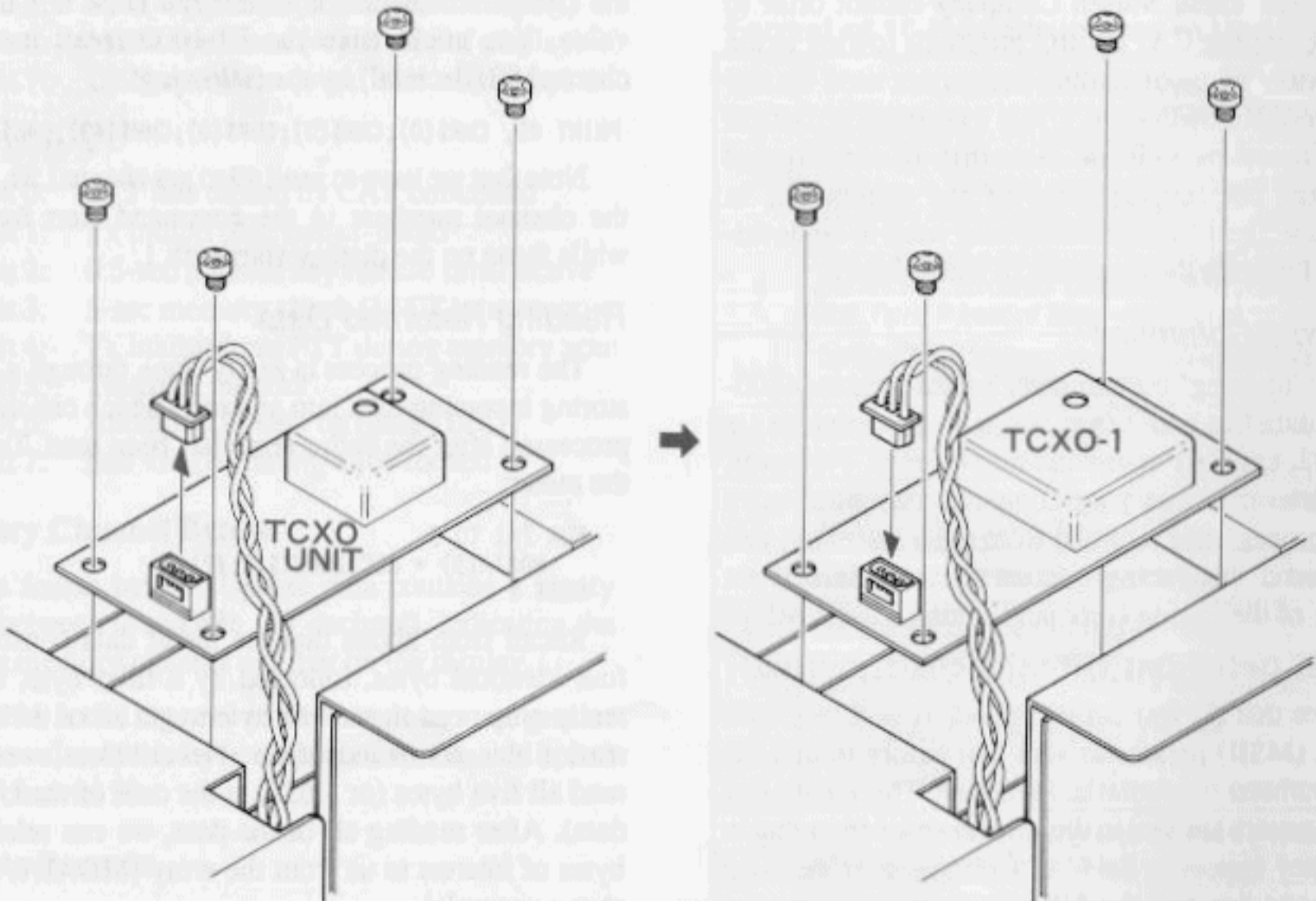


Figure 3.

Main Receiver 3rd IF Filters

These filters include small boards with connectors, so no soldering is necessary for their installation.

- Disconnect all cables from the transceiver, and place it upside-down on the work surface.
- Remove the ten screws indicated at the right, and remove the bottom cover.
- Referring to the photographs below, determine the location(s) of the filter(s) you are installing.

Except for the XF-C filter (XF-455K-262-01), which replaces the standard ceramic filter, a diode must be cut away at the new filter location, before installing the filter, as follows:

XF-D (XF-455K-202-01) 2.0-kHz BW filter: cut D2047

XF-E (XF-455K-501-01) 500-Hz BW filter: cut D2046

XF-F (XF-455K-251-01) 250-Hz CW filter: cut D2045

- Cut the diode at the filter location(s), and then position the filter so that its connectors are aligned with the mounting pins on the board, and push the filter into place.
- Replace the bottom cover and ten screws removed above (unless installing other options now).

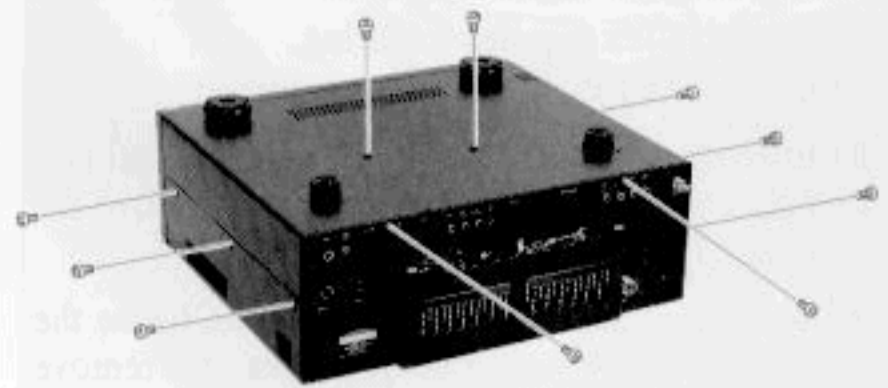


Figure 1.

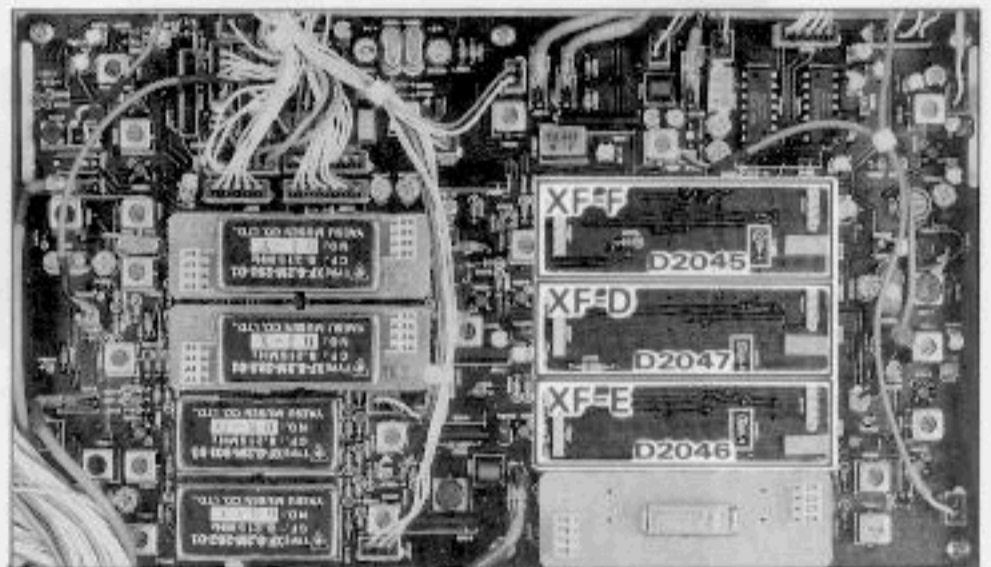
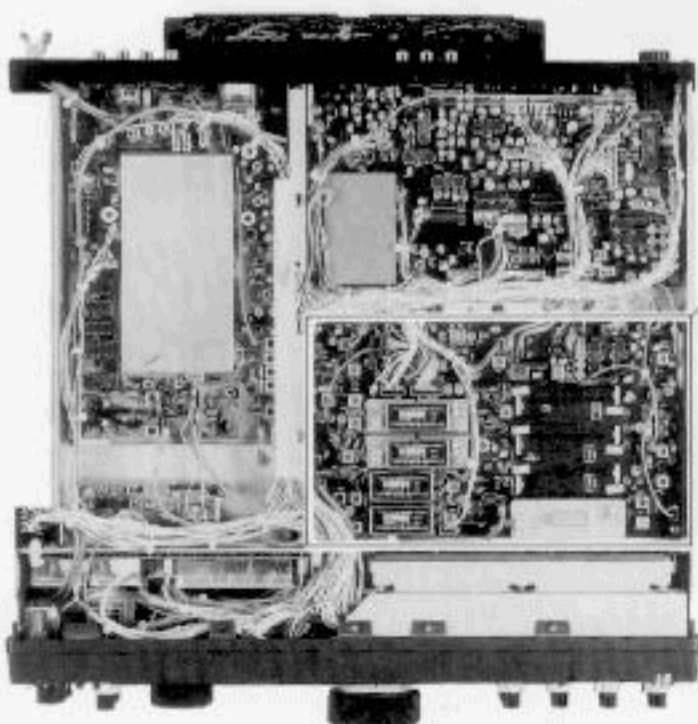


Figure 2.

6. Installing Internal Accessories - XF-455MC Sub Receiver CW Narrow Filter

XF-455MC Sub Receiver CW Narrow Filter

Installing this filter requires soldering.

- Disconnect all cables from the transceiver.
- Remove the twelve screws affixing the top and bottom covers, as shown at the right, and remove the covers.
- With the transceiver lying on its bottom, locate the RX-2 Unit on the right side of the set, and remove the seven screws indicated in the photograph below.
- Carefully pull the board out of the chassis enough to gain access to the solder side (without straining the wiring).
- Straighten the leads on the new filter, if necessary, and then line up the pins and press it into place at the upper front corner of the board.
- Solder each wire at the solder side of the board, and then clip off any excess leads. Check your solder joints carefully.
- Replace the board and its seven screws, and then replace the top and bottom covers and twelve screws.

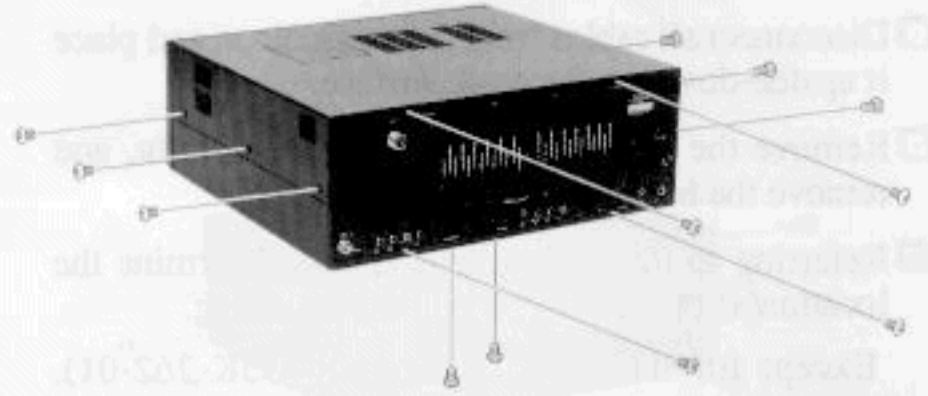


Figure 1.

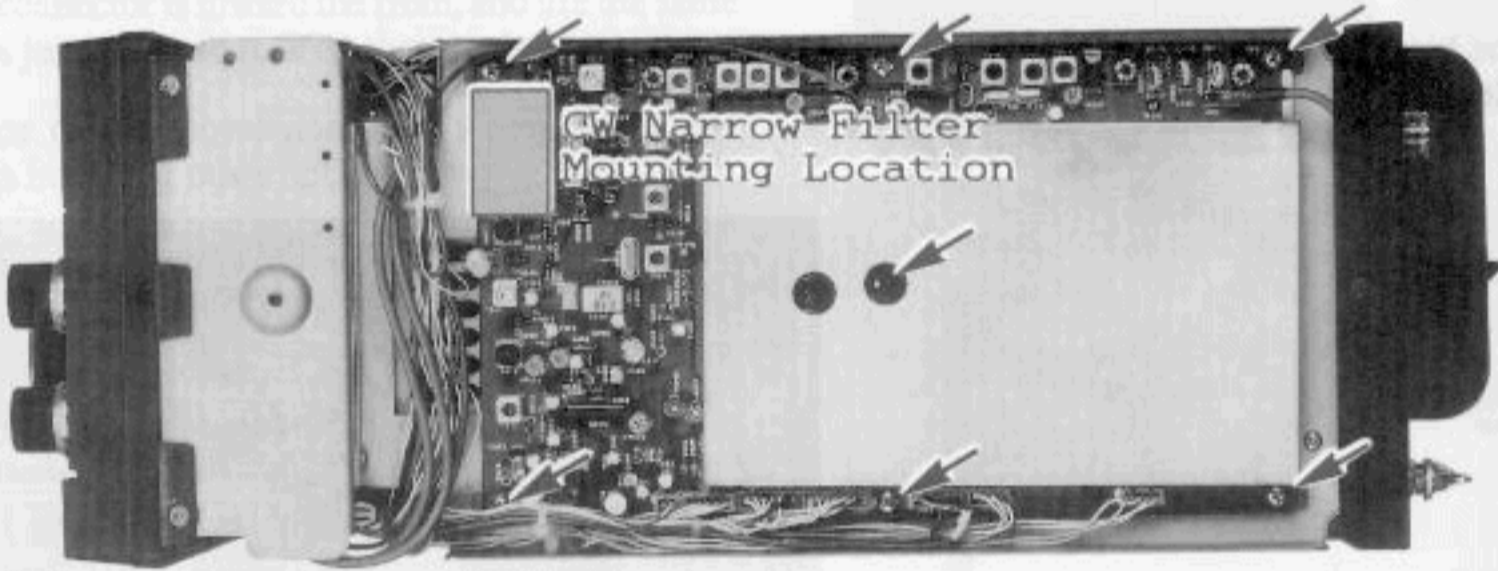


Figure 2.

BPF-1 Bandpass Filter Module

- Disconnect the power cord from the transceiver.
- Referring to the photo at the top of page 40 remove the three screws on each side, and the two at the top of the rear panel, and remove the top cover.
- Now referring to the drawing at the right, remove the four screws affixing the dummy subpanel on the rear panel, and remove the subpanel.
- Locate the three empty plugs on the cable harness inside the BPF-1 mounting hole, and hold these out of the way while sliding the BPF-1 about half way into the chassis from the rear, so you can connect the empty plugs to the BPF-1 as shown in the drawing below: each plug mates with a connector having a matching number of pins. *Note: the cables must not be routed over the top edge of the rear panel!*
- Slide the BPF-1 the rest of the way into the chassis, and affix it in place with the four screws removed above, using care not to squash any of the wires.
- Set the selector on the BPF-1 to the **FRONT** position if you wish to have the **FRONTEND** selector on the front panel control the attenuator in the BPF-1 (in tandem with the main receiver attenuator).

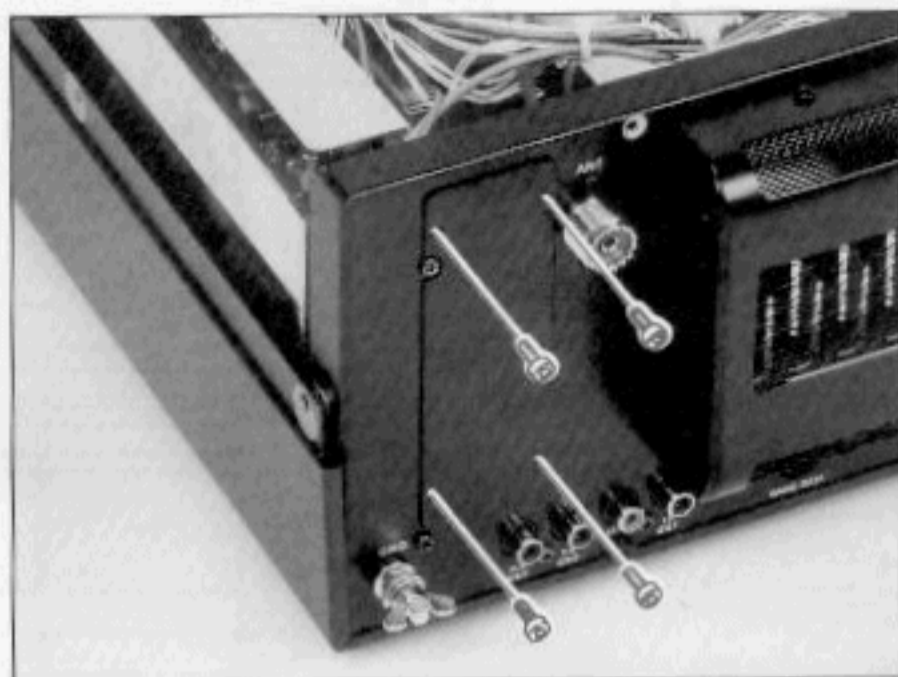


Figure 1.

- Unless you intend to operate split with a separate receive antenna, you will want the front panel **RX ANT** button to select the BPF-1 with its antenna connected to the **SUB RX ANT** coaxial jack (as opposed to the **RX ANT** phono jack). To do this, change the position of S1001 on the RF Unit, as described on page 9, before replacing the top cover and its ten screws.

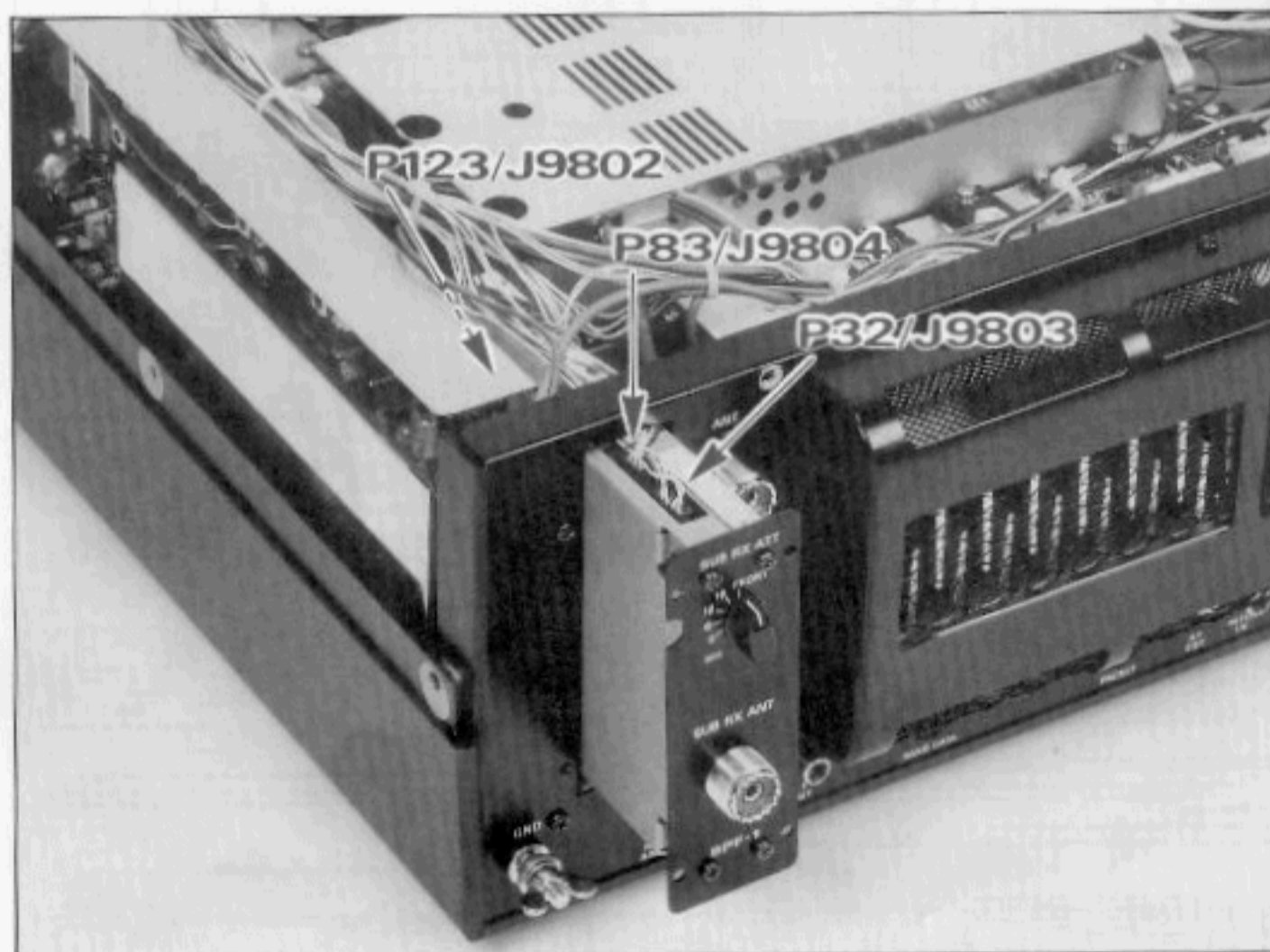
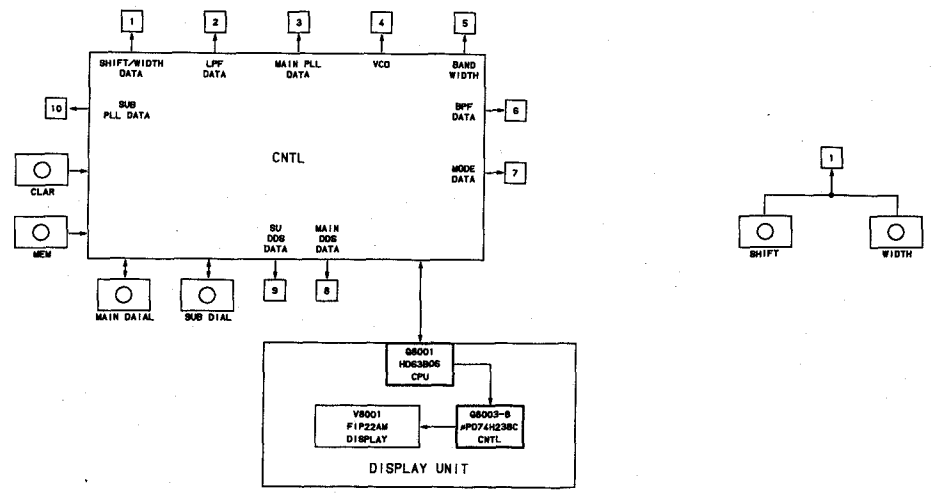
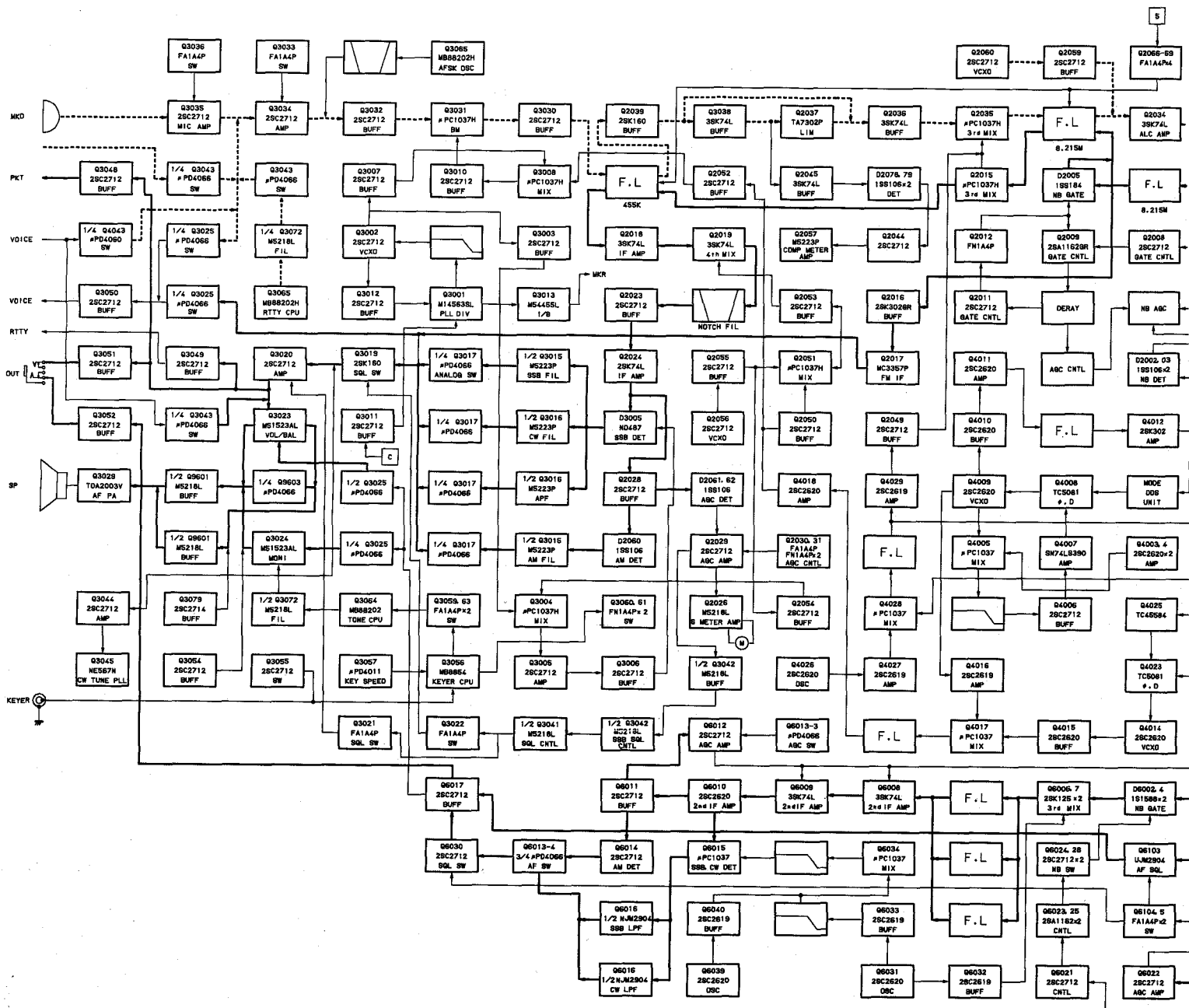
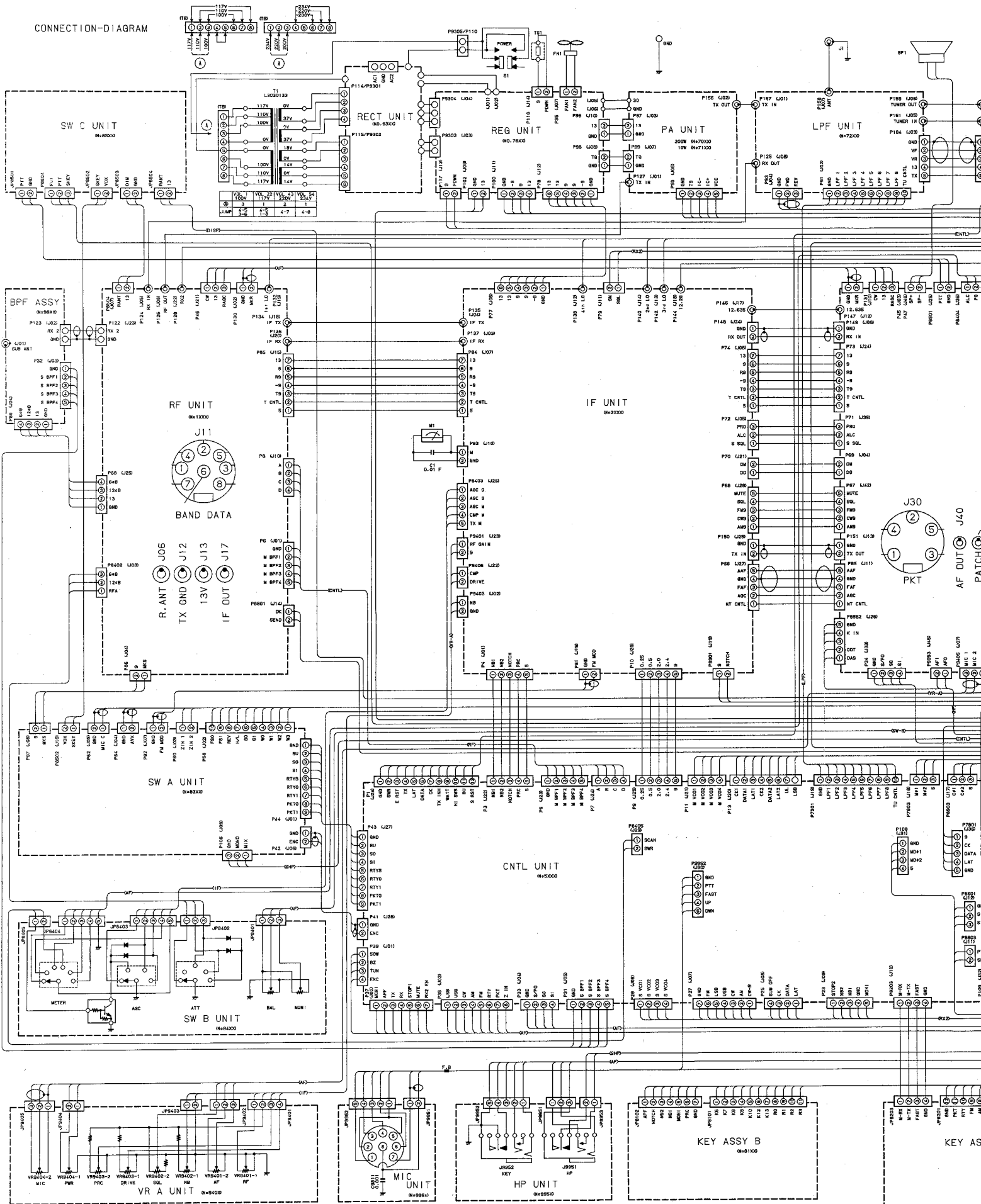


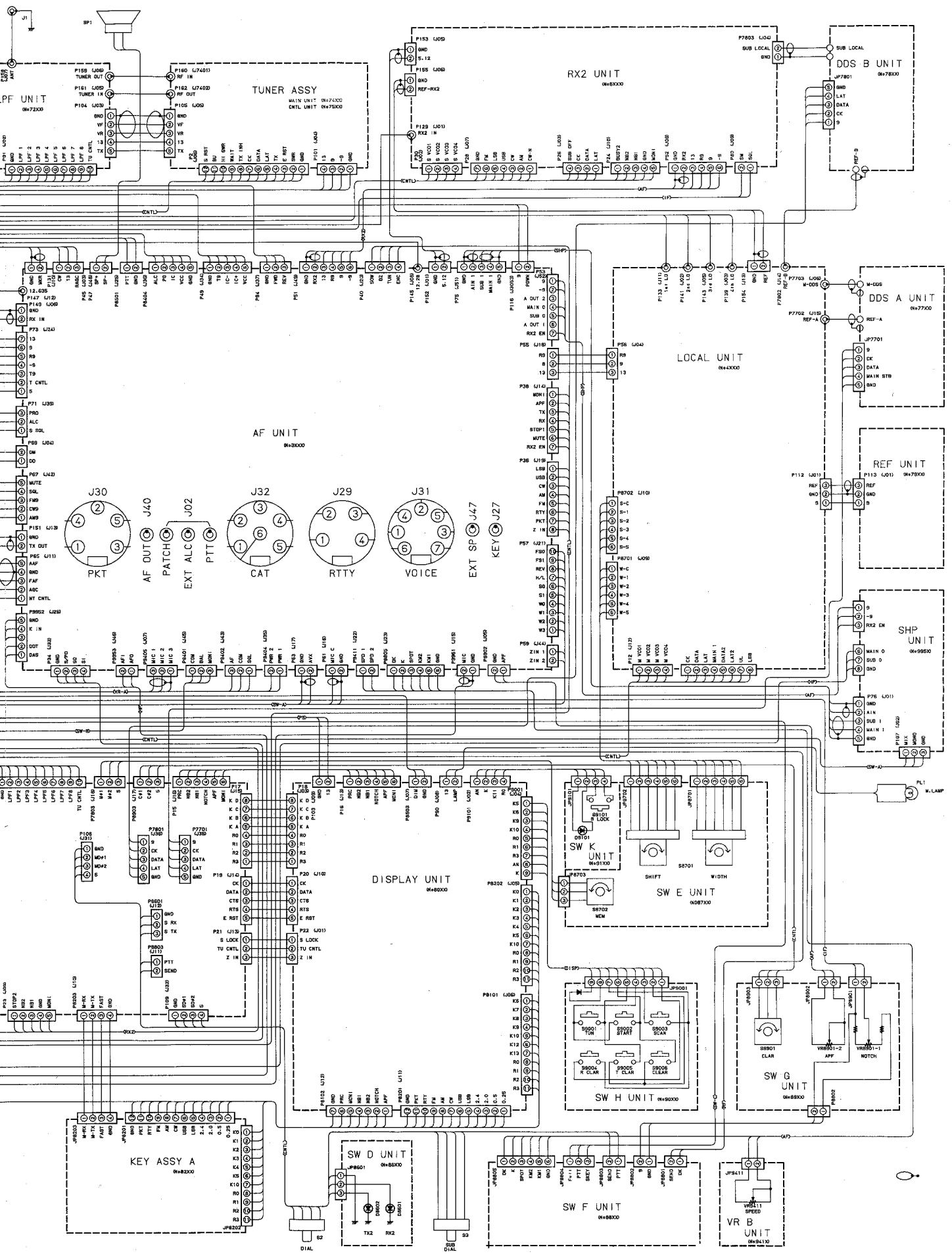
Figure 2.

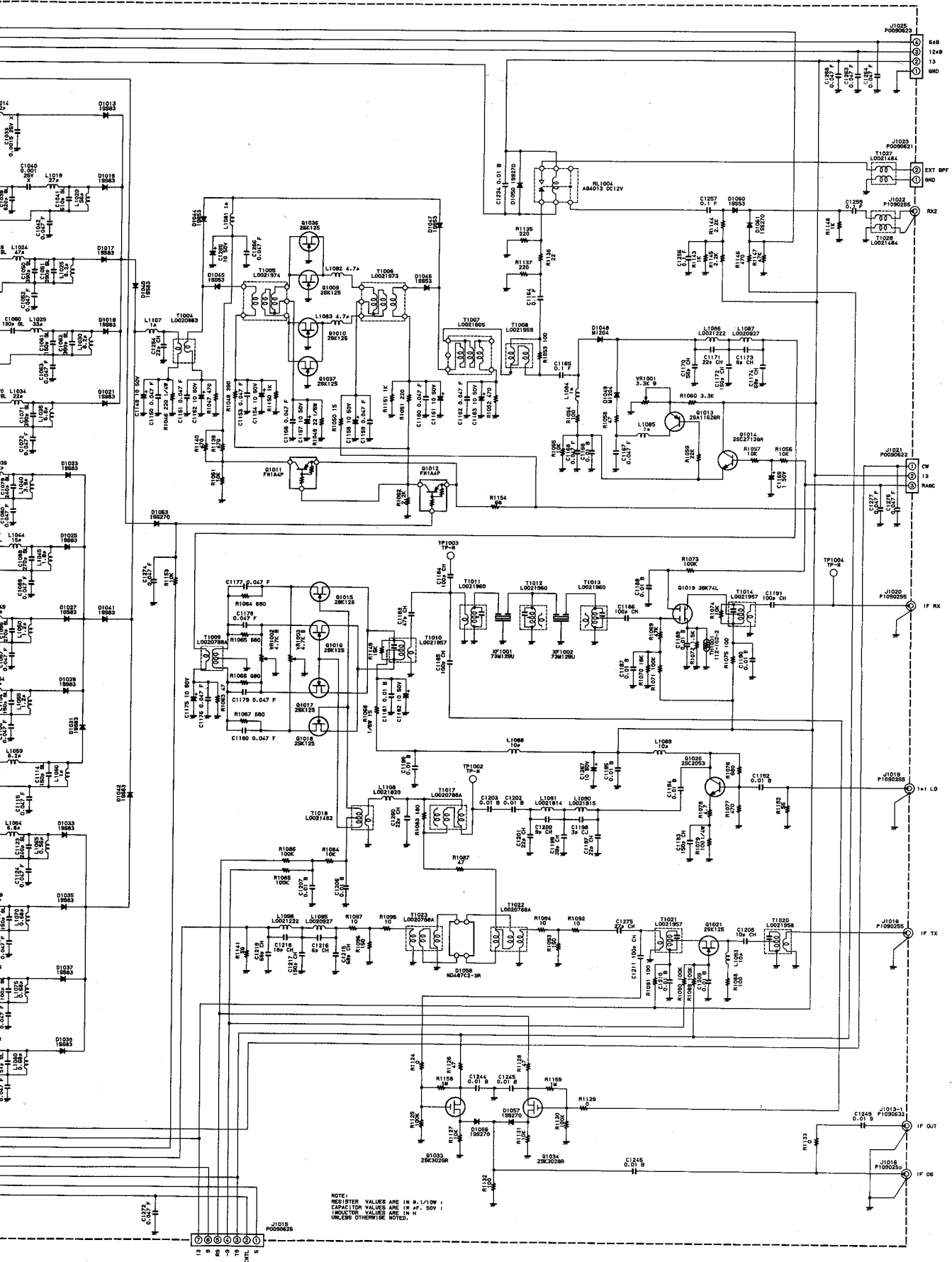


CONNECTION-DIAGRAM



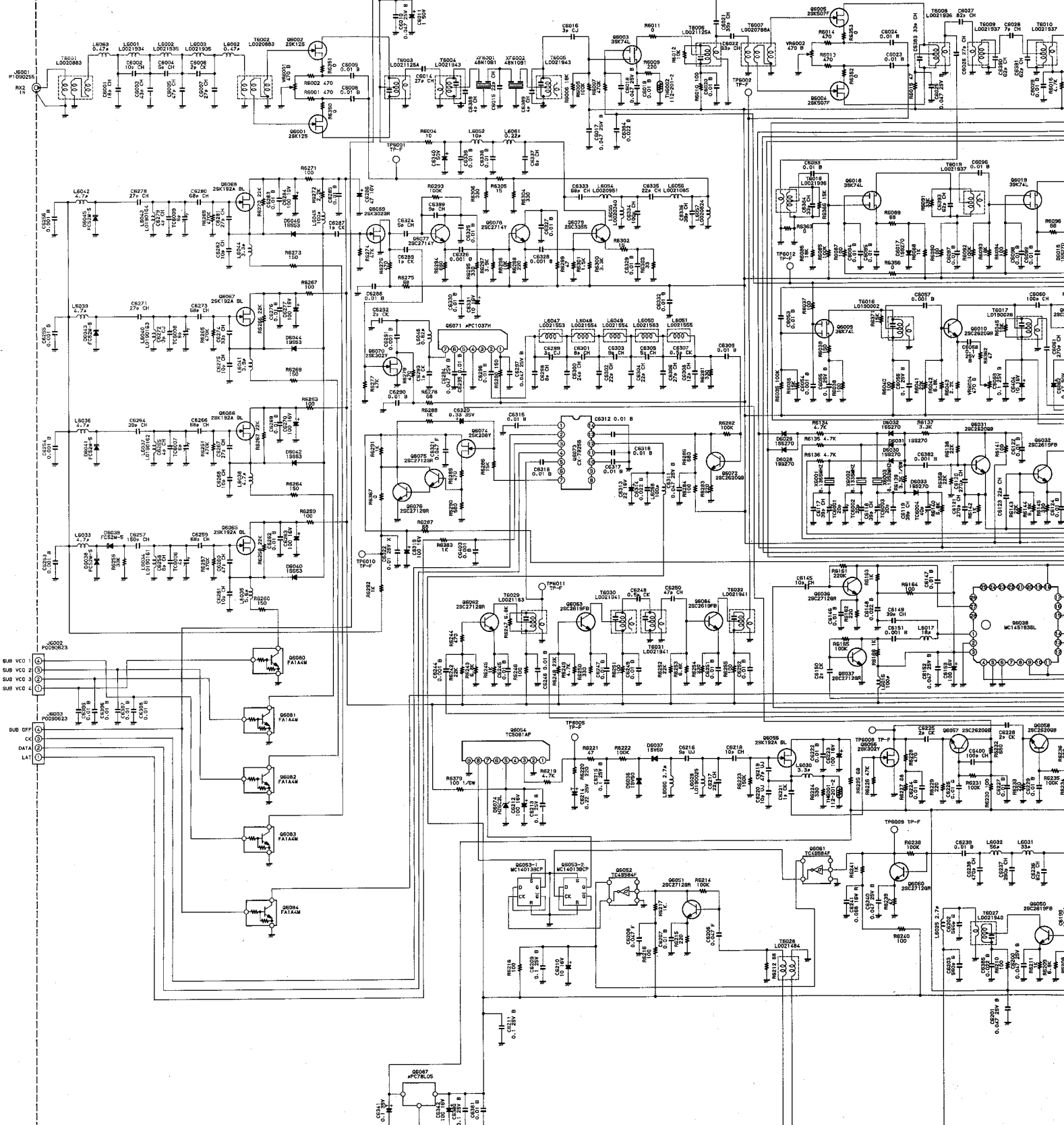
NOTE:
CAPACITOR VALUES ARE IN μ F, 50V,
UNLESS OTHERWISE NOTED.





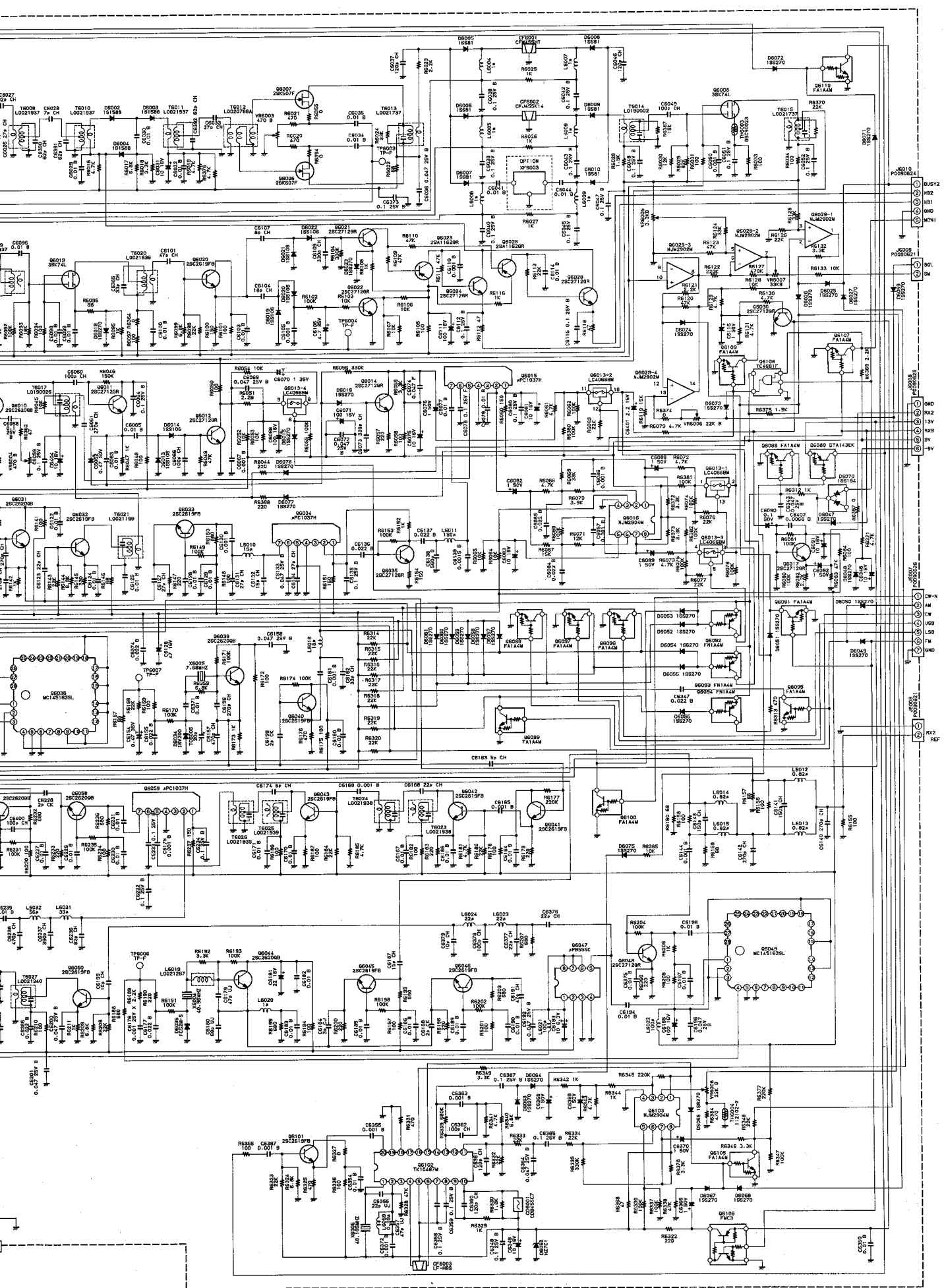
NOTE:
 RESISTOR VALUES ARE IN Ω, 1/10 Ω,
 CAPACITOR VALUES ARE IN P.F., 50V,
 INDUCTOR VALUES ARE IN μH, 50V,
 UNLESS OTHERWISE NOTED.

RX2-UNIT
F3063101F

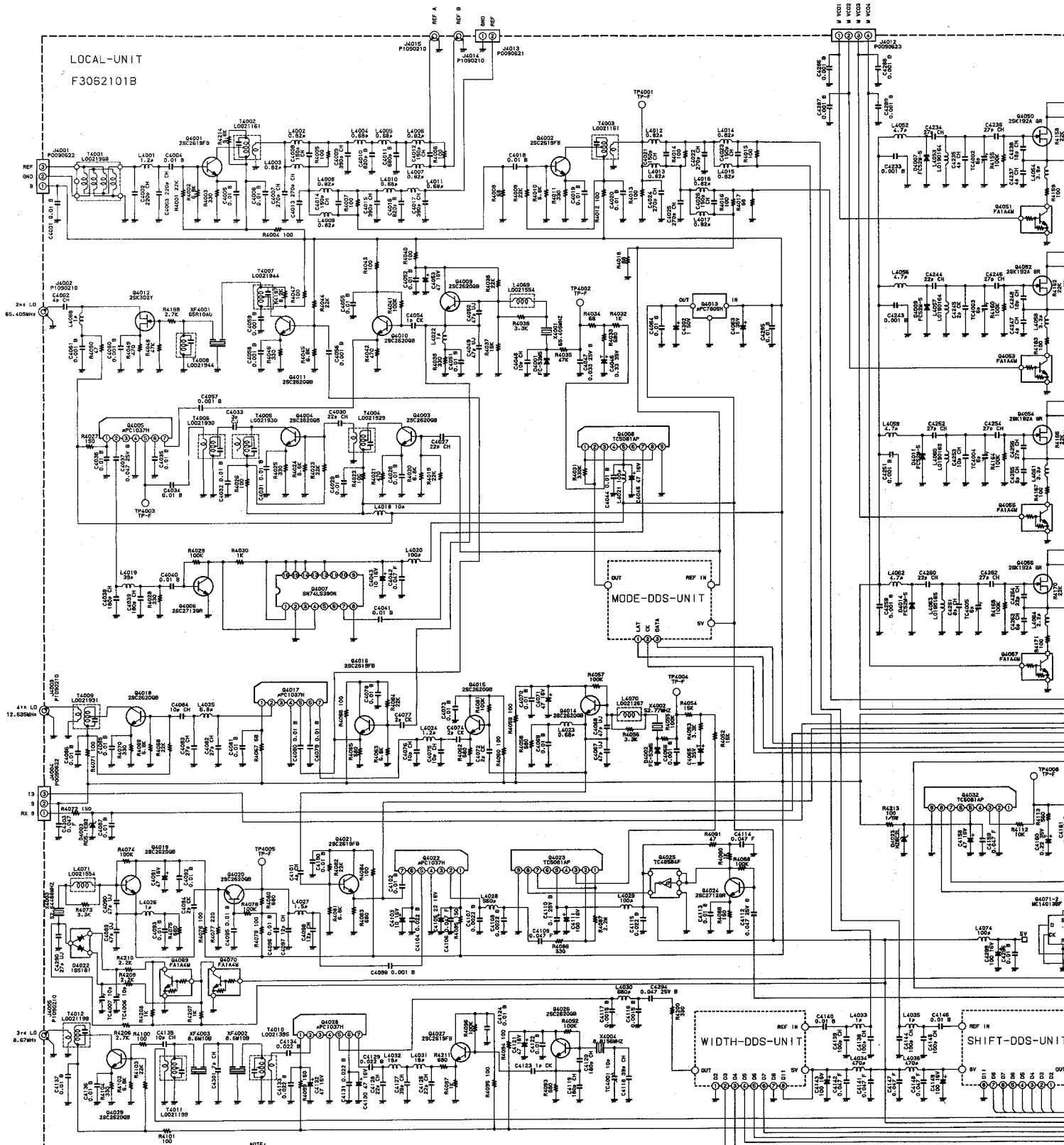


NOTE:
RESISTOR VALUES ARE IN Ω, K, M, Ω;
CAPACITOR VALUES ARE IN P, μ, M, F;
UNLESS OTHERWISE NOTED.

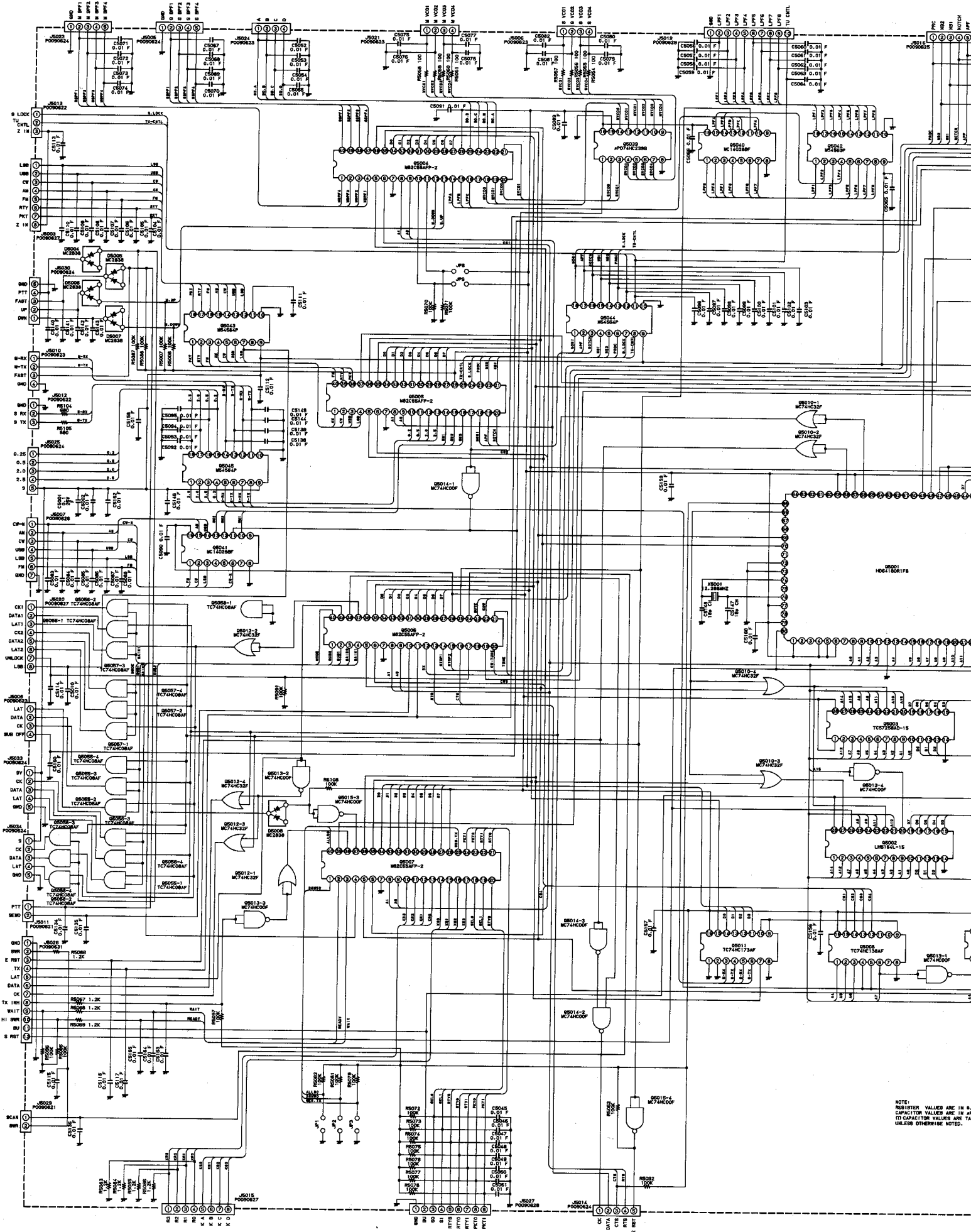
8000 P000061
8000 P000061
5.1M OUT
5.1M OUT



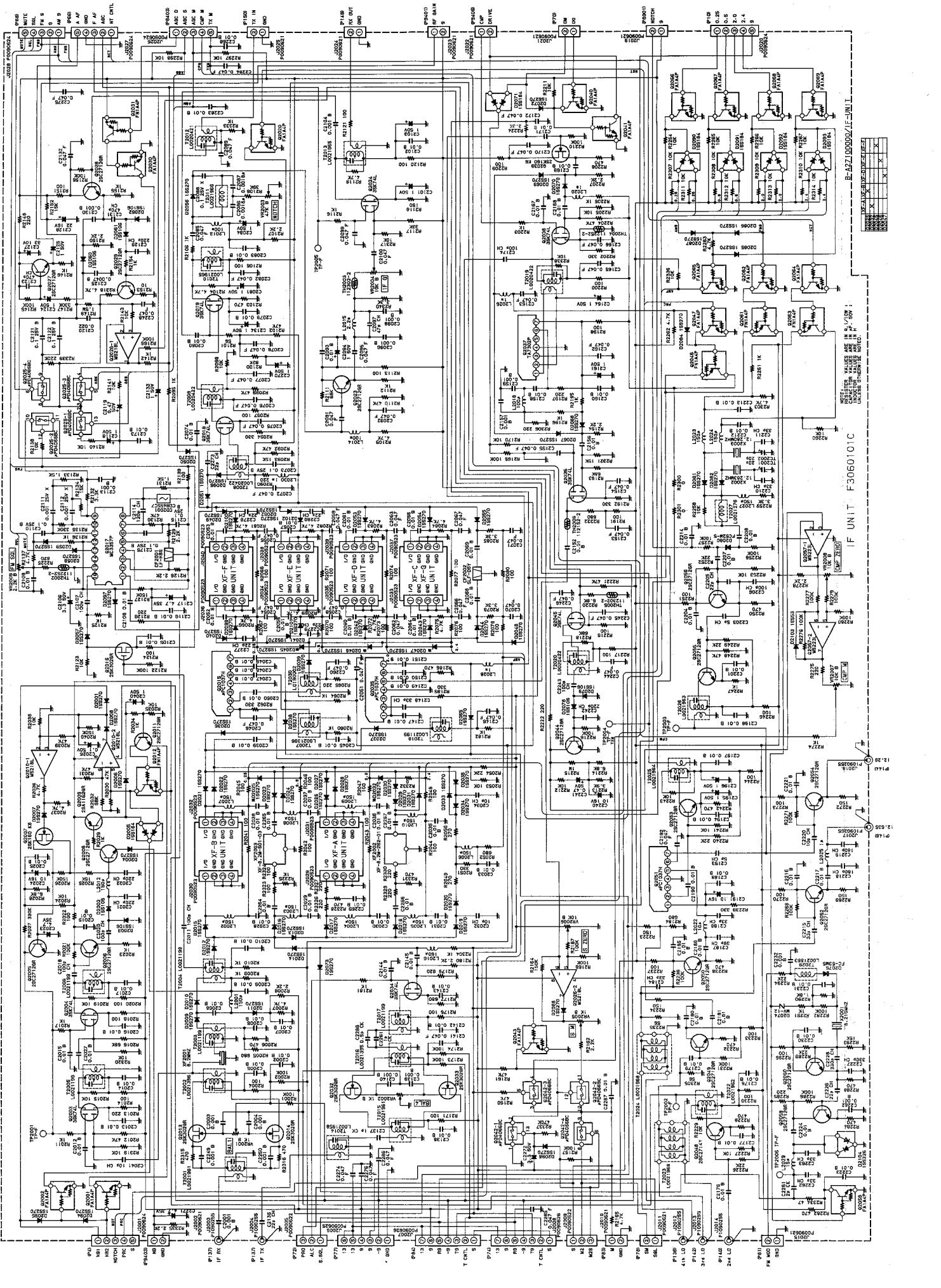
LOCAL-UNIT
F3062101B



NOTE:
RESISTOR VALUES ARE IN Ω, 1/10 Ω,
CAPACITORS VALUES ARE IN pF, 50V,
ELECTROLYTIC CAPACITORS VALUES ARE IN μF 1
(C) CAPACITORS ARE TANTALUM;
INDUCTOR VALUES ARE IN mH
UNLESS OTHERWISE NOTED.



NOTE:
 RESISTOR VALUES ARE IN Ω ,
 CAPACITOR VALUES ARE IN μ F.
 (1) CAPACITOR VALUES ARE 10%
 UNLESS OTHERWISE NOTED.



RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED

IF UNIT: F3060101C

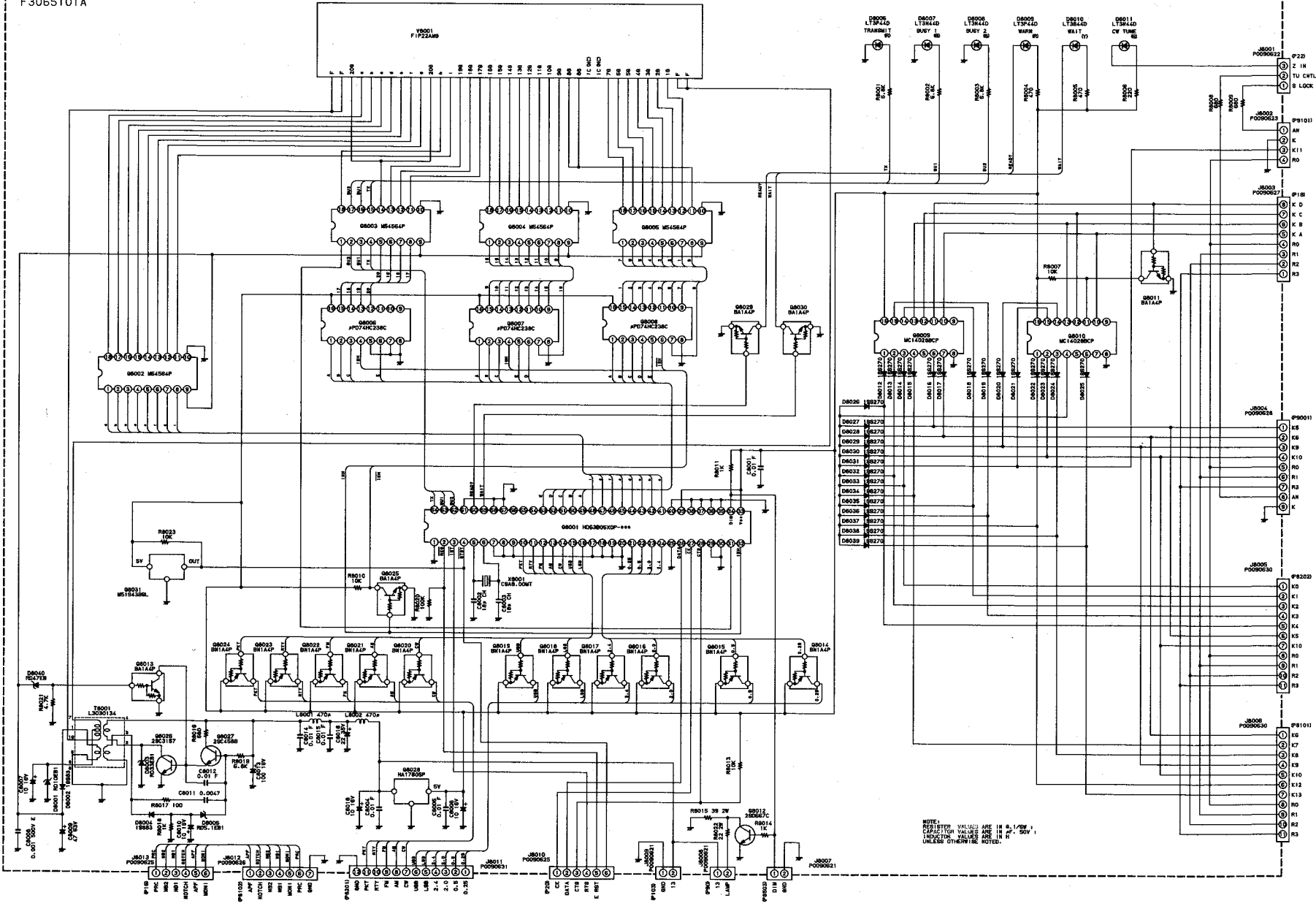
DISPLAY UNIT F3065101A

TABLE OF COMPONENT VALUES

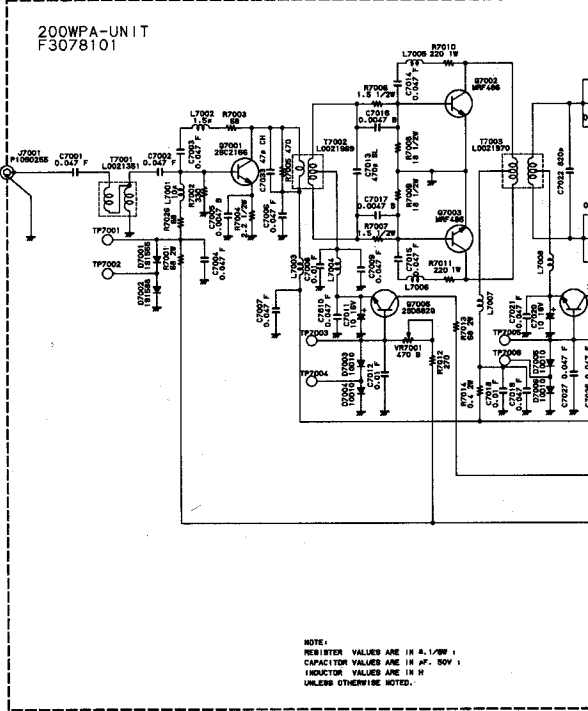
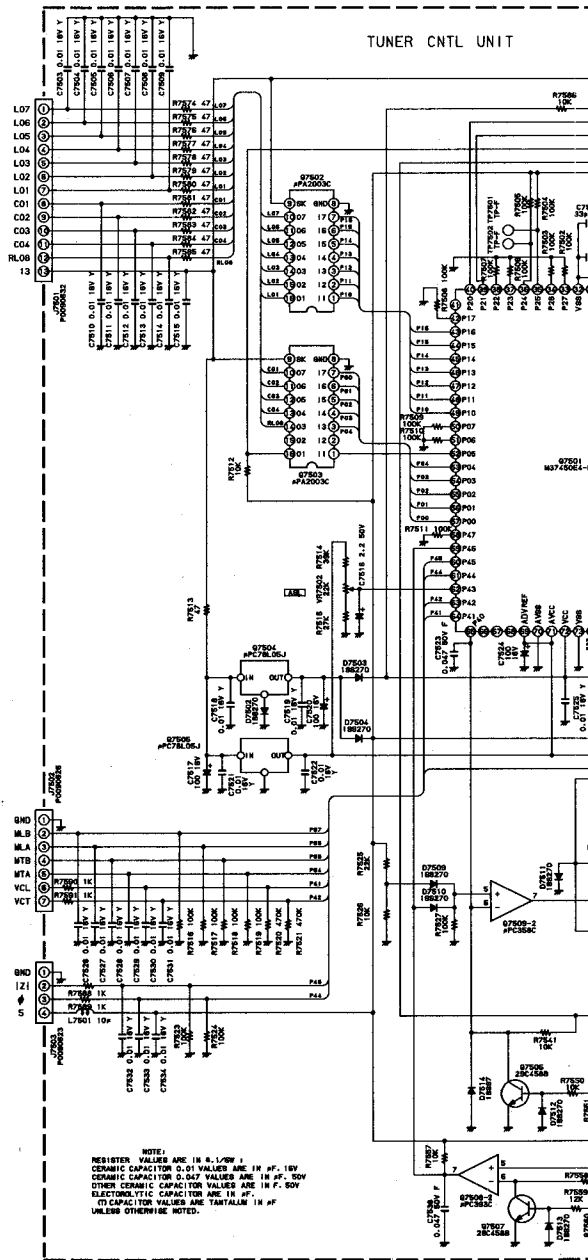
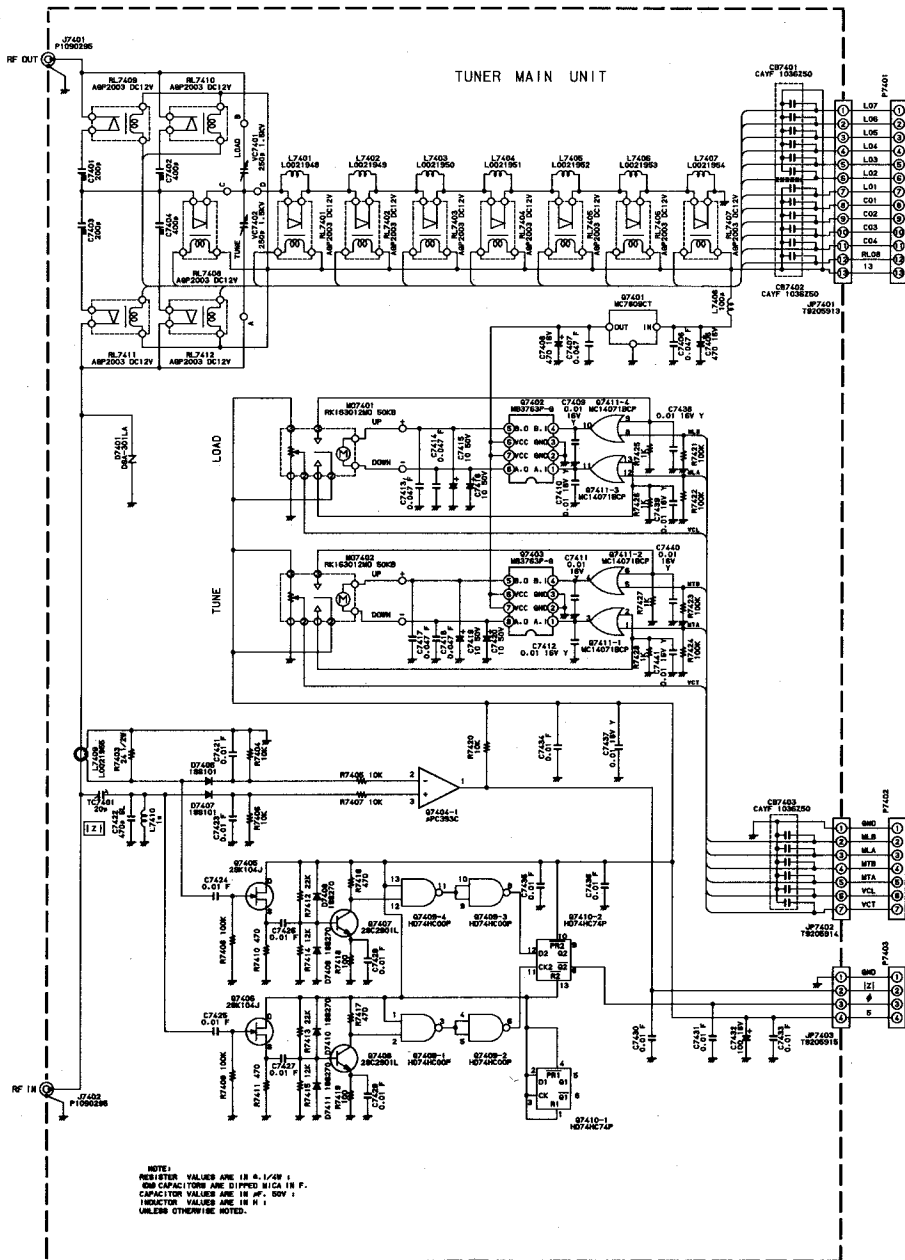
REF. NO.	VALUE	UNIT
R101	10K	RESISTOR
C101	0.001	CAPACITOR
U101	74181	IC
R201	100K	RESISTOR
C201	0.01	CAPACITOR
U201	74181	IC
R301	10K	RESISTOR
C301	0.001	CAPACITOR
U301	74181	IC
R401	100K	RESISTOR
C401	0.01	CAPACITOR
U401	74181	IC
R501	10K	RESISTOR
C501	0.001	CAPACITOR
U501	74181	IC
R601	100K	RESISTOR
C601	0.01	CAPACITOR
U601	74181	IC
R701	10K	RESISTOR
C701	0.001	CAPACITOR
U701	74181	IC
R801	100K	RESISTOR
C801	0.01	CAPACITOR
U801	74181	IC
R901	10K	RESISTOR
C901	0.001	CAPACITOR
U901	74181	IC
R1001	100K	RESISTOR
C1001	0.01	CAPACITOR
U1001	74181	IC

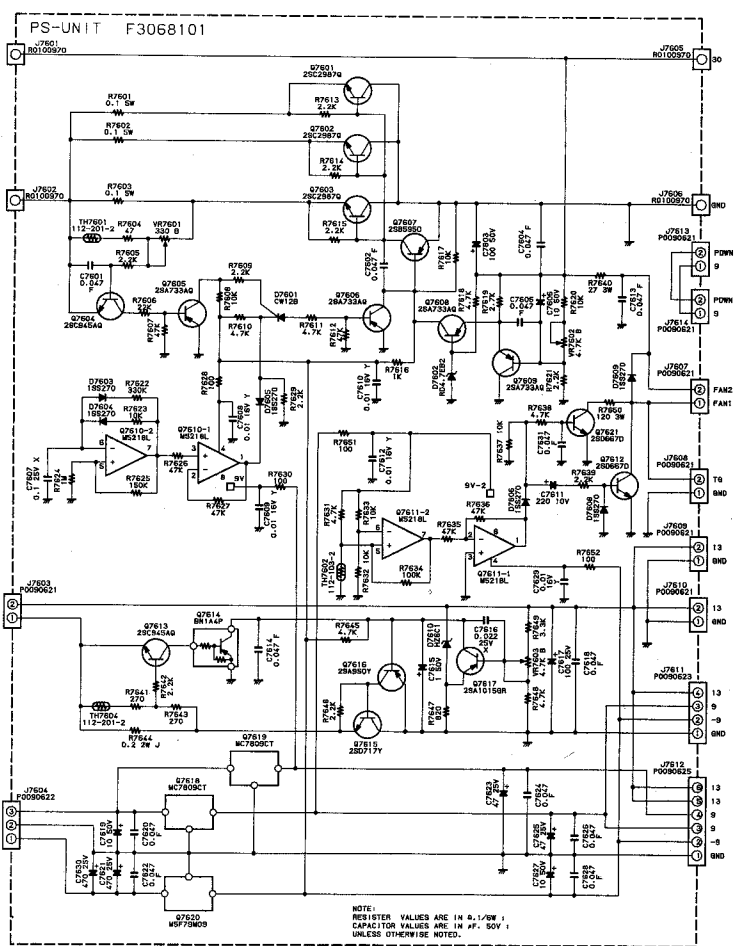
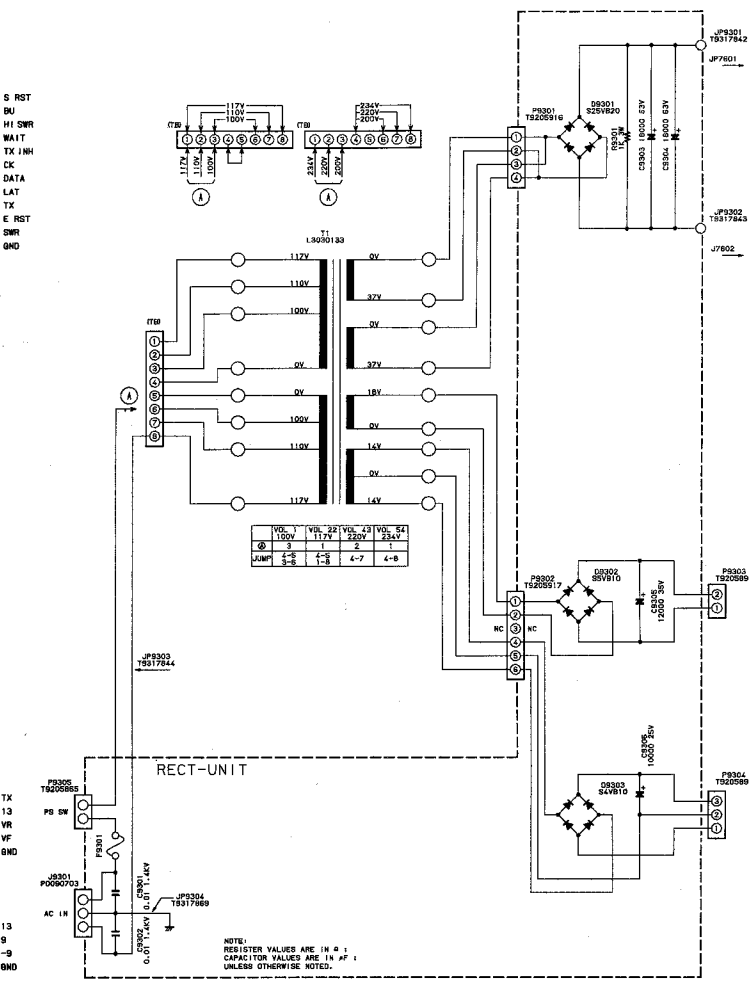
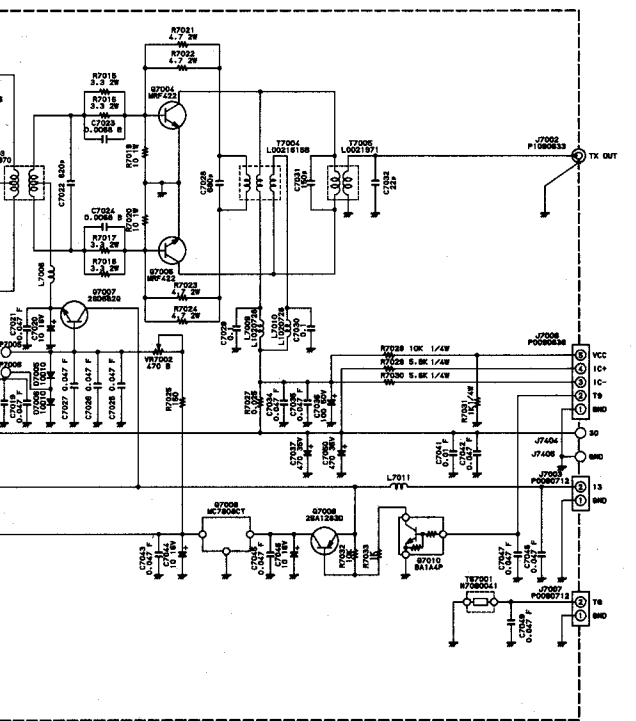
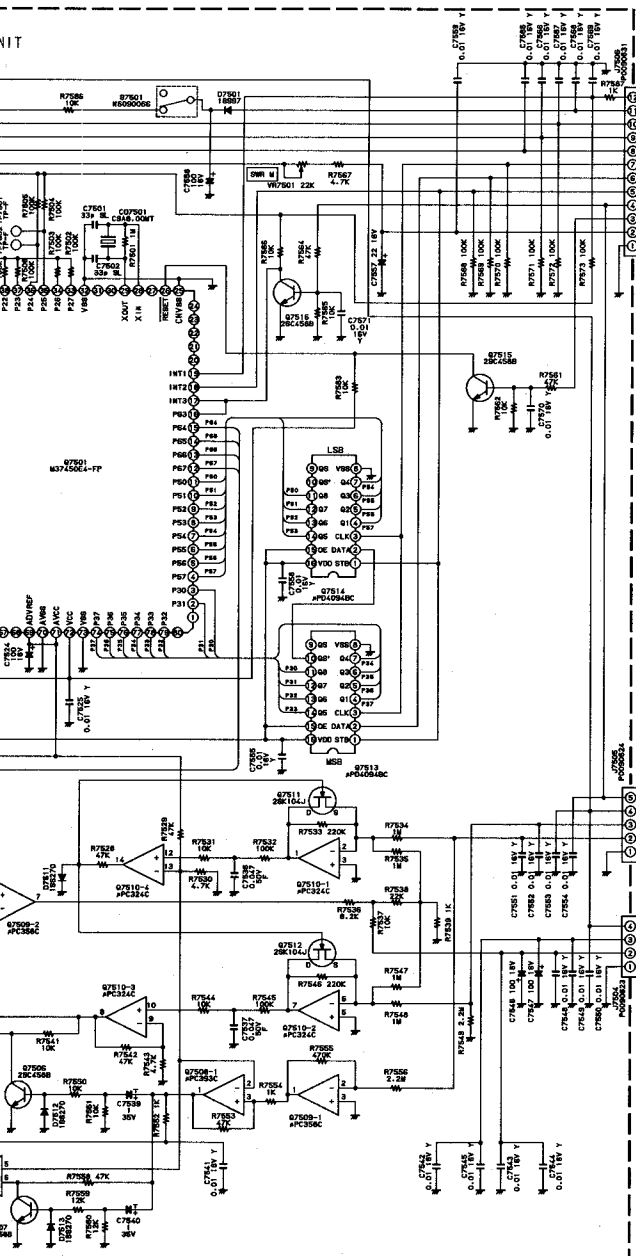
1	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X	X	X

DISPLAY UNIT
F3065101A

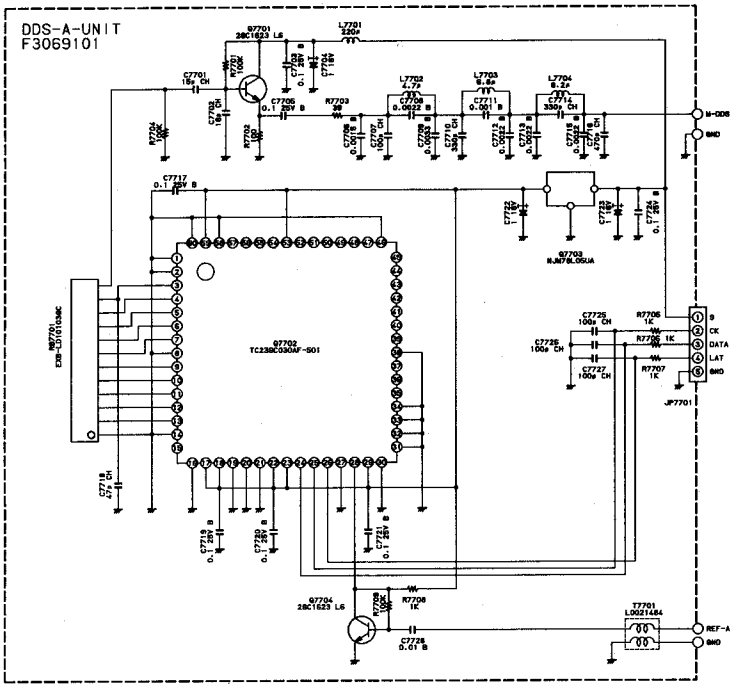


NOTE:
RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED.
INDUCTOR VALUES ARE IN HENRYS UNLESS OTHERWISE NOTED.

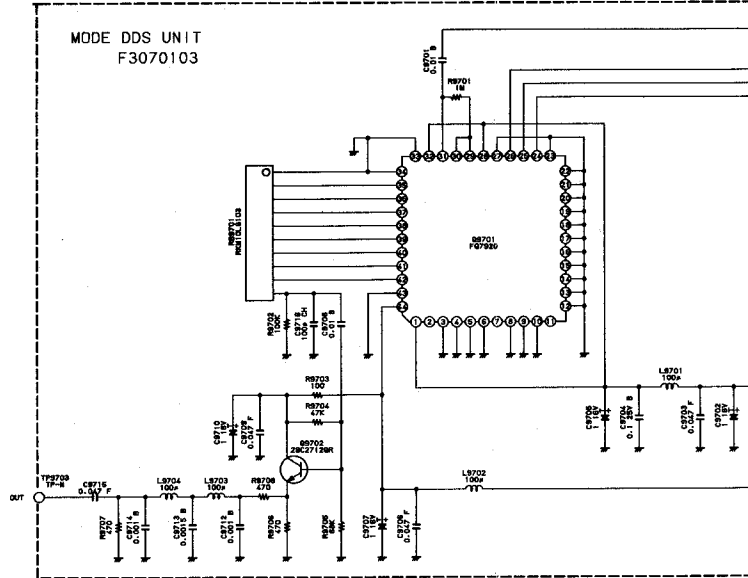




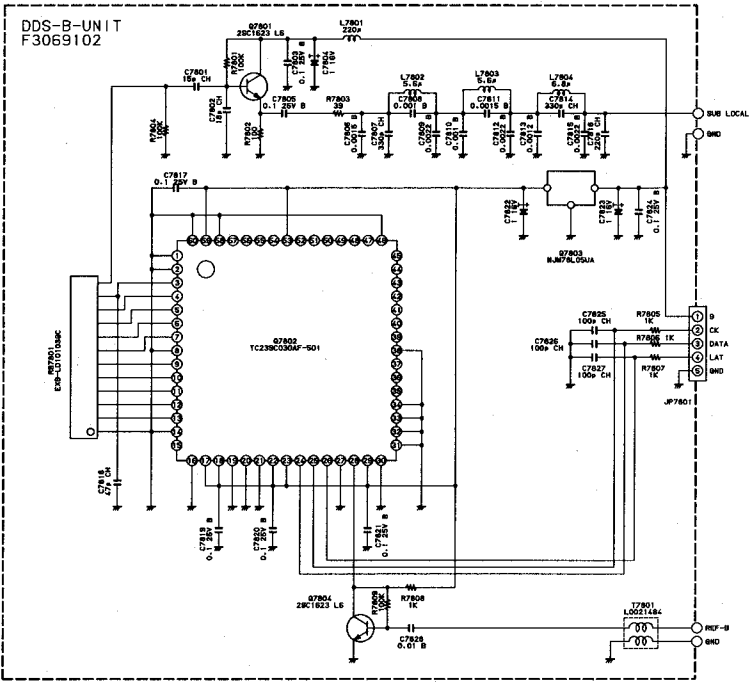
DDS-A-UNIT
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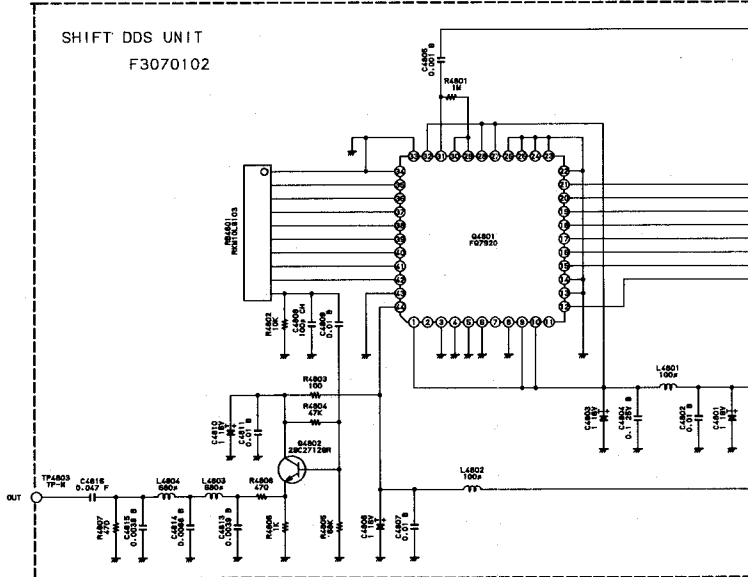
MODE DDS UNIT
F3070103



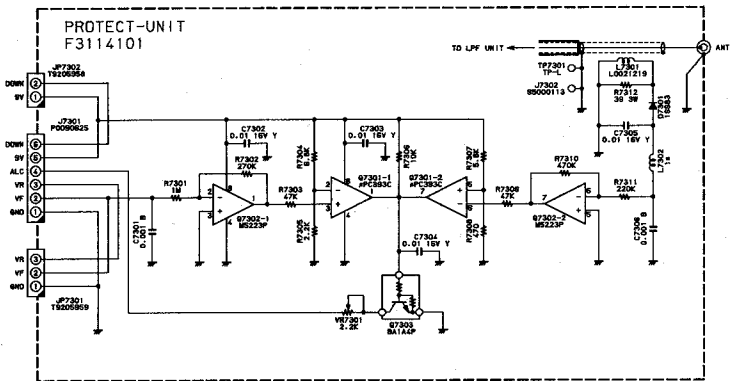
DDS-B-UNIT
F3069102



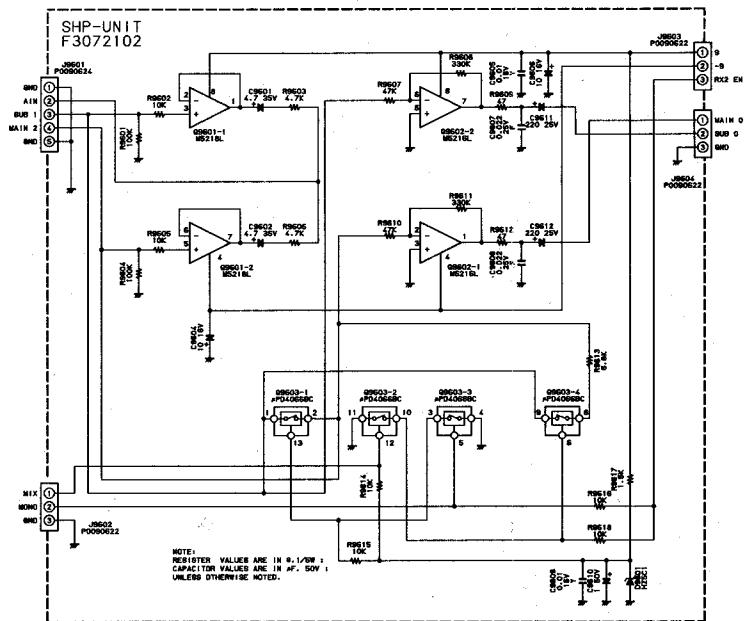
SHIFT DDS UNIT
F3070102



PROTECT-UNIT
F3114101

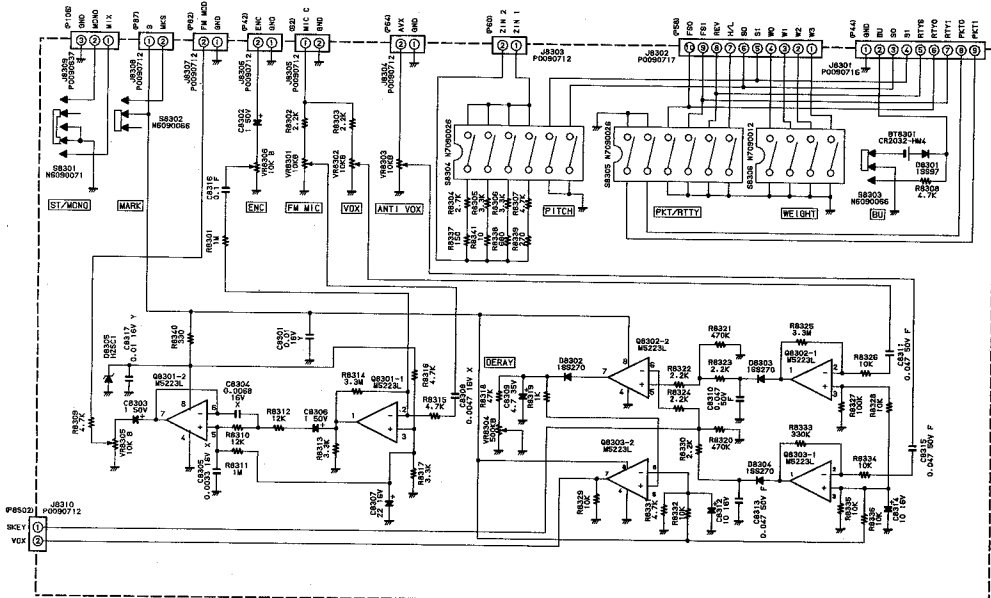


SHP-UNIT
F3072102

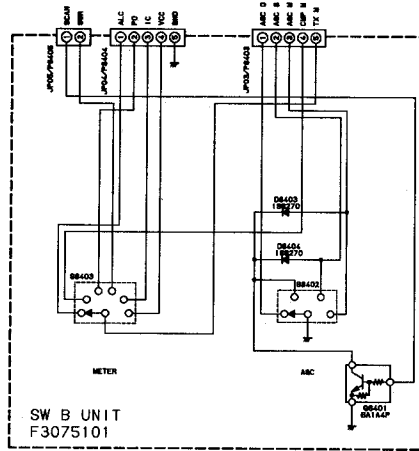


NOTE:
RESISTOR VALUES ARE IN Ω , $k\Omega$, $M\Omega$;
CAPACITOR VALUES ARE IN μF , $50V$;
UNLESS OTHERWISE NOTED.

SW-A UNIT
F3072101

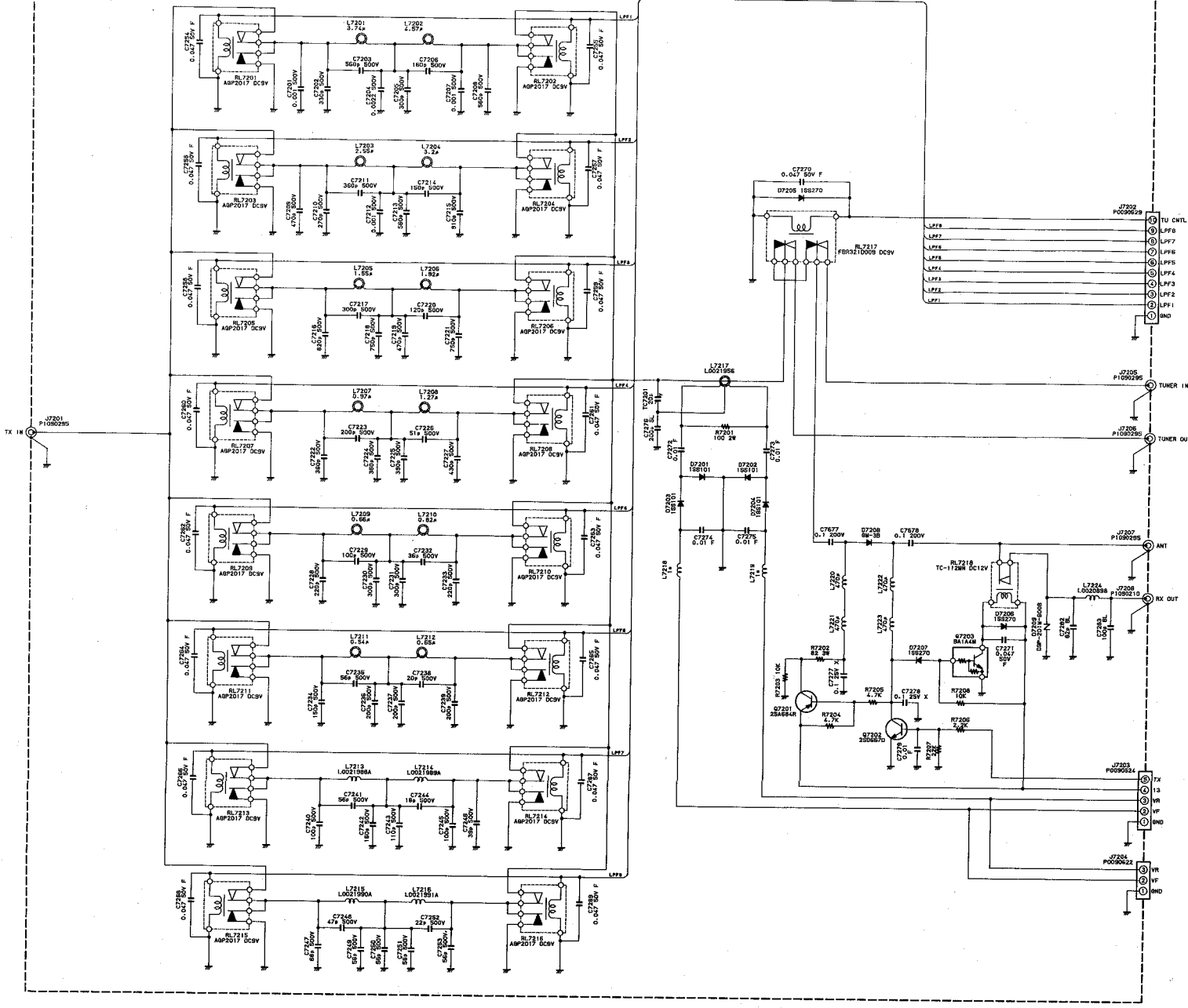


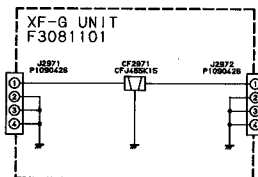
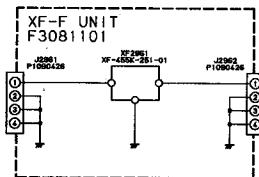
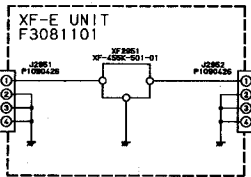
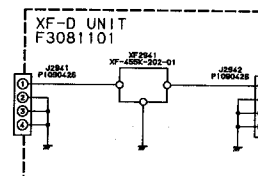
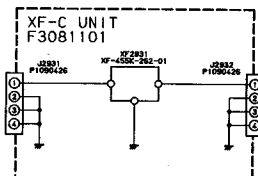
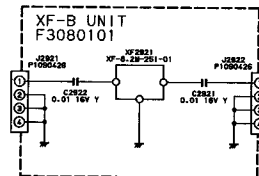
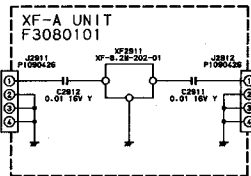
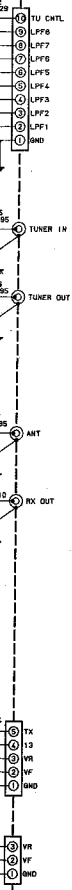
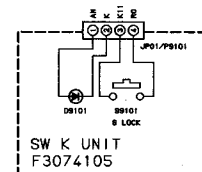
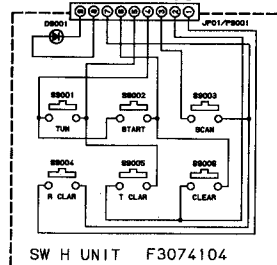
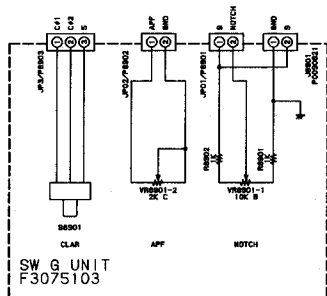
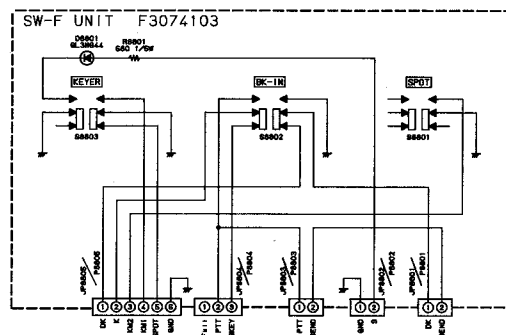
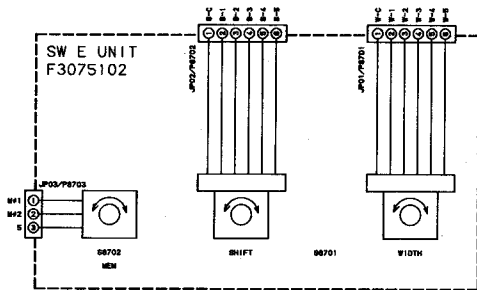
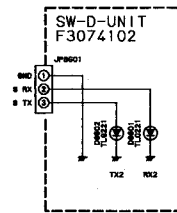
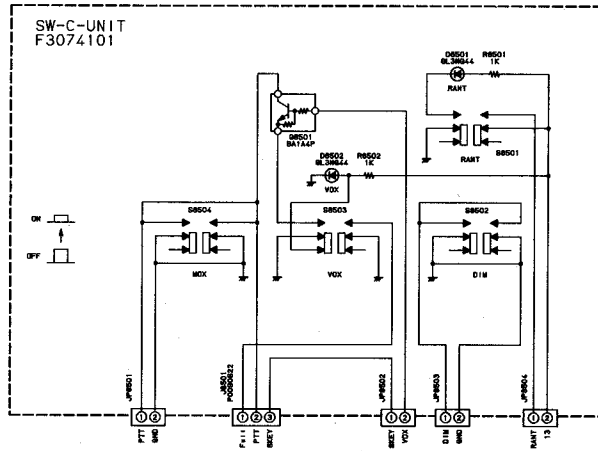
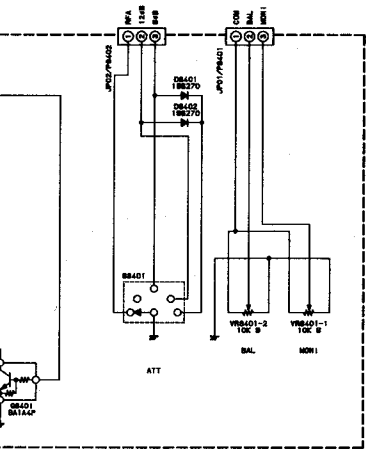
NOTE
RESISTOR VALUES ARE IN Ω , K, M, P, L, V, W, X,
CAPACITOR VALUES ARE IN P, F, M, U, V,
UNLESS OTHERWISE NOTED.



SW B UNIT
F3075101

LPF UNIT
F3082101







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