

**INSTRUCTION
MANUAL
FT-680R**

YAESU MUSEN CO., LTD.

TOKYO JAPAN

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FT-680R

MICROPROCESSOR CONTROLLED 6 METER ALL—MODE TRANSCEIVER



GENERAL DESCRIPTION

The FT-680R is a revolutionary, high performance SSB, AM, FM, and CW transceiver for the most demanding 6-meter operator. Controlled by a NMOS 4-bit microprocessor, the FT-680R features full PLL synthesis in 10 Hz, 100 Hz, 1 kHz, 20 kHz, and 100 kHz steps. The extremely compact size of the FT-680R makes this model particularly well suited for mobile use.

The microprocessor chip allows never-before-possible operating flexibility. As many as four memory channels may be programmed to your favorite frequencies, and by switching to the MEMORY SCAN position, all four memory channels will be scanned.

Digital display of the operating frequency is provided. The front panel meter consists of a string of bright LED's, for easy monitoring of the received signal strength and transmit output.

The standard microphone features the normal PTT switch, up/down scanning controls plus a tone call button for repeater operation.

Among the convenience features of your FT-680R are receiver offset tuning for CW, AM and SSB, and a digitally synthesized dual VFO system.

We recommend that you read this manual in its entirety, so as to derive maximum benefit from your new FT-680R, an exciting breakthrough from the communications experts . . . Yaesu.

SPECIFICATIONS

GENERAL

Frequency coverage:

50.00000–53.99999 MHz

Modes of operation:

SSB (USB), CW, AM and FM

Synthesizer steps:

SSB, AM, CW 10 Hz, 100 Hz, 1 kHz

FM 1 kHz, 20 kHz, 100 kHz

Power requirements:

13.8 volts DC, negative ground

Current consumption:

DC 0.5 amps receive

DC 3.0 amps transmit

Antenna impedance:

50 ohms

Case size:

60 (H) x 180 (W) x 240 (D) mm

Weight:

Approx. 2.9kg

TRANSMITTER

Power input:

SSB 20 watts PEP

FM/CW 20 watts DC

AM 8 watts DC

Carrier suppression:

Better than 40 dB

Unwanted sideband suppression:

Better than 40 dB

Spurious emission (SSB):

At least 60 dB down

Frequency response:

300–2700 Hz (–6 dB)

FM Deviation:

±5 kHz

Microphone impedance:

600 ohms

RECEIVER

Sensitivity:

SSB, CW 0.5 μ V for 20 dB S/N

FM 0.35 μ V for 20 dB QS

AM 1.0 μ V for 10 dB S/N
(@ 400 Hz, 30% MOD)

Selectivity:

SSB, CW 2.4 kHz at 6 dB down

4.1 kHz at 60 dB down

FM 14 kHz at 6 dB down

25 kHz at 60 dB down

AM 4 kHz at 6 dB down

15 kHz at 60 dB down

Image response:

Better than –60 dB

Audio output impedance:

8 ohms nominal

Audio output:

2.0 watts @ 10% THD

SEMICONDUCTORS

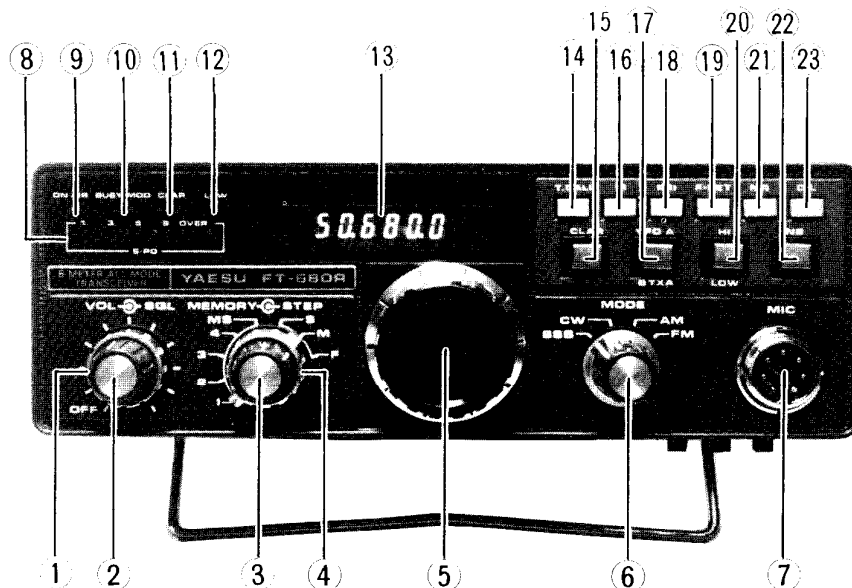
IC:		2SK19TM-GR	3		
	MC1496G	3SK30AY	1	Diode:	
	MC14011B	2SK51	1		1S188FM 18
	MC14560B	3SK59Y	2		1S1007 4
	MC14028B	3SK73Y	8		1S1555 1
	MC14069B				1S2209 14
	MC14002B				U05B 1
	μ A78L05	Transistor:			1SS53 92
	μ PC7808H	2SA715C	1		10D1 3
	μ PC577H	2SA733P/Q	20		MV104 2
	μ PC1037H	2SC535A	5		HZ11B-1 1
	μ PC2002V	2SC535B	3	LED:	
	μ PC7805H	2SC732TM-BL	1		TLG-205 2
	μ PD4094B	2SC733P	1		TLR-205 2
	μ PD1511-11	2SC945P	1		TLR-226 3
	TC9122P	2SC945Q	37		TLY-226 2
	TC5081P	2SC945K	1		TLG-226 5
	TC5082P	2SC1383R	2	FCD:	
	SN16913P	2SC1583	3		LD8231/F1P9C5 1
	SN76514N	2SC1674L	2		
	HD10551	2SC1815Y	5		
	MB8718A	2SC1815GR	3		
	TA7612AP	2SC1945	1		
		2SC2002L	1		
		2SC2053	1		
FET:		2SC2166	1		
	2SK19TM-Y	MPSA13	2		

Specifications subject to change without notice or obligation.

ACCESSORIES

1.	Microphone	(M3090028)	1 ea.
2.	Power Cord	(T9002805)	1 ea.
3.	Spare Fuses (5A)	(Q0000005)	2 ea.
4.	Stand	(R0062300A)	1 ea.
5.	Miniature Phone Plug	(P0090034)	2 ea.
6.	Mobile Mounting Bracket	(R0062900)	1 ea.
7.	TONE IN Connector	(P0090174)	1 ea.

FRONT PANEL CONTROLS AND SWITCHES



The FT-680R has been designed for ease of operation. However, the operator may not be familiar with some controls since the FT-680R utilizes modern computer technology. Be sure you thoroughly understand the function of each control and indicator before operating the equipment.

(1) SQL

The squelch control quiets the receiver in the absence of a signal on FM. It should be set to the point where the background noise just disappears, in order to provide maximum sensitivity.

(2) VOL

This control is the main ON/OFF switch for the transceiver, and it also sets the audio output level to the speaker. Clockwise rotation increases the audio output level.

(3) STEP

The 3 positions of this switch control the tuning rate of the MAIN DIAL, as shown in Table 1.

STEP SWITCH POSITION	MAIN DIAL FREQUENCY COVERAGE PER STEP	
	SSB/AM/CW	FM
S	10 Hz	1 kHz
M	100 Hz	20 kHz
F	1 kHz	100 kHz

Table 1

(4) MEMORY

This switch selects the MS mode (Memory Scan) or one of the four frequencies that the operator has programmed into memory. Memory scan control is exercised via the UP/DOWN switches on the microphone.

(5) MAIN TUNING KNOB

The tuning knob is used to control the receive and transmit frequencies over the entire 6 meter amateur band. It is activated when the DIL button is pushed.

When the transceiver is initially turned on, the display will indicate 50.000.0 MHz, and the dial may be turned from that point to the desired operating frequency.

(6) MODE

This switch selects the mode of operation: SSB (Single Sideband), AM (Amplitude Modulation), CW (code operation), and FM (frequency modulation).

(7) MIC

The MIC jack is used for the microphone input, PTT control, and scanner control lines.

(8) S/PO

A string of LEDs provides indication of signal strength and relative power output.

(9) ON AIR

This indicator lights up during transmission.

(10) BUSY/MOD

This indicator has a dual function: it will light up when the channel is occupied, or indicate modulation during FM transmissions.

(11) CLAR Indicator

This lamp lights when the clarifier switch is pushed.

(12) LOW

This lamp lights when the HI/LOW switch is in the LOW position.

(13) Digital Display

The digital display indicates the operating frequency. In the priority mode, the character "P" will be illuminated at the far right-hand side of the window. Also, memory channels will be indicated for easy frequency reference.

(14) T.CALL

When this switch is pushed, the PTT line will close, and an 1800 Hz tone will be transmitted for accessing repeaters.

(15) CLAR

The clarifier switch allows ± 10 kHz offset of the receive frequency from the dial or memory frequency. Clarifier tuning is accomplished via the main tuning dial. When the CLAR switch is pushed, the scanning step selector should be set to 10 Hz or 100 Hz; if not, control will be returned to the main dial, with the clarifier being disabled.

(16) M (Memory)

This switch is used for programming a frequency into memory.

(17) VFO A/B TXA

This switch, when pressed, allows split operation using the two internal VFOs.

(18) PRI

While operating in the dial tuning mode, the PRIORITY switch allows scanning of the main dial and one of the memorized frequencies every 5 seconds. The SCAN switch controls the stopping of the scanner on a busy or clear channel.

(19) F.SET

This switch, when pressed, clears all digits of the operating frequency below the step frequency you are using.

(20) HI/LOW

This switch, when pressed, reduces the transmitter power from 10 watts to 1 watt RF output.

(21) MR (Memory Recall)

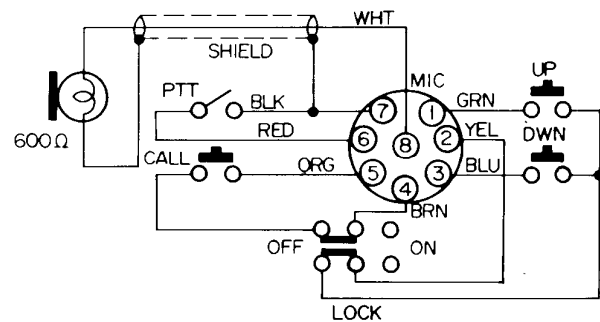
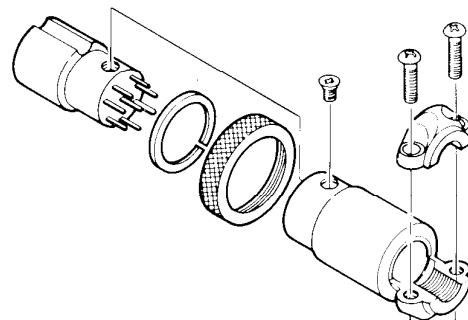
This button transfers frequency control from the main dial to the memory channels.

(22) NB (Noise Blanker)

This switch, when pressed, activates the noise blanker for minimizing pulse-type noise.

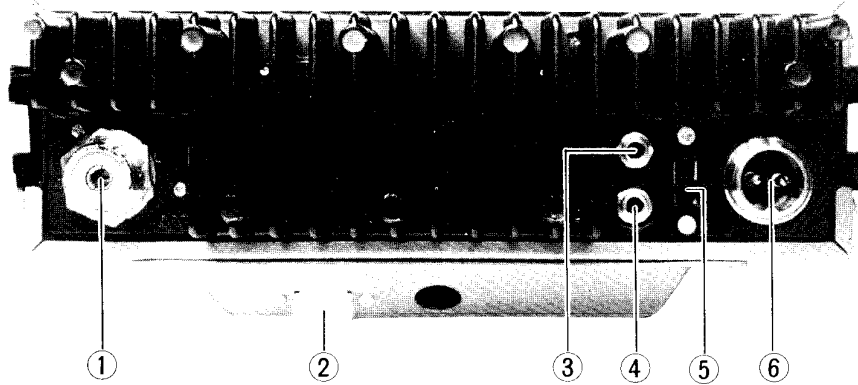
(23) DIL (Dial)

This switch, when pressed, transfers frequency control from the memory channels to the main tuning dial.



YM-40 MICROPHONE CONNECTIONS

REAR PANEL CONNECTIONS AND SWITCH



(1) ANT

This is the main antenna connector.

(2) TONE IN CONNECTOR

This connector is provided for the (optional) external FTS-64E Tone Encoder, which synthesizes 32 CTCSS or Tone-burst frequencies.

(3) KEY

This is the key jack for CW operation.

(4) EXT SP

This is a miniature phone jack for connection to an external speaker. Insertion of a plug into this jack automatically cuts off the internal speaker.

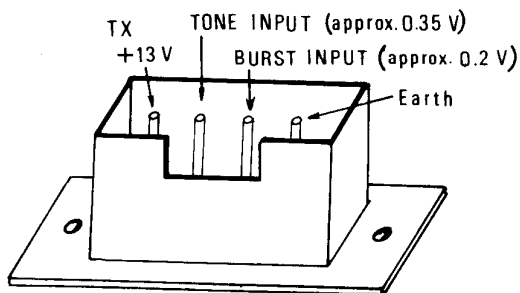
(5) BACKUP

When this switch is placed in the ON position, and DC power is still connected to the POWER connector, the memory circuit will still be held in operating condition. If DC power is removed, though, the memorized frequency will be lost.

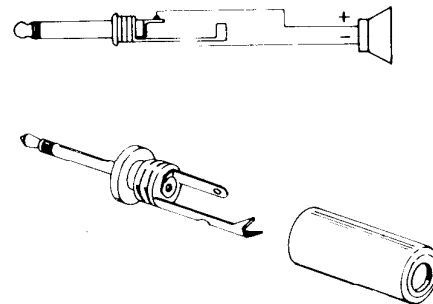
(6) POWER

This receptacle accommodates the power cord. A fuse rated at 5 amps is located in the power cord.

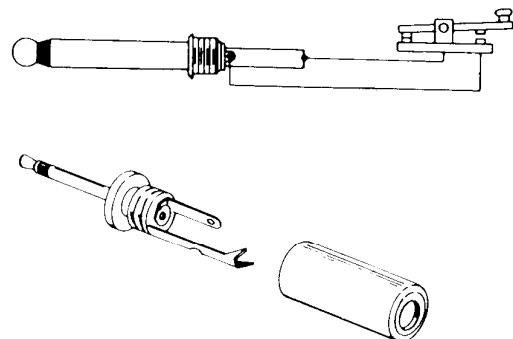
WHEN REPLACING FUSES, BE CERTAIN TO USE A FUSE OF 5 AMP RATING. OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY USE OF AN IMPROPER FUSE.



TONE IN CONNECTOR

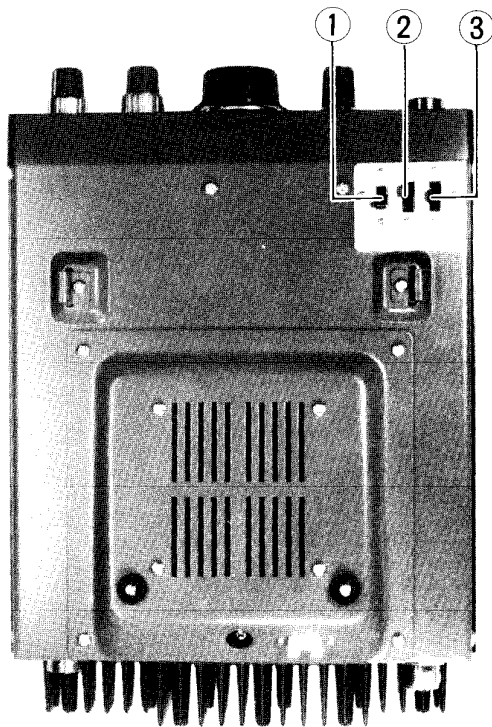


EXTERNAL SPEAKER CONNECTIONS



KEY CONNECTIONS

UNDERSIDE CABINET SWITCHES



(1) SAT (Satellite)

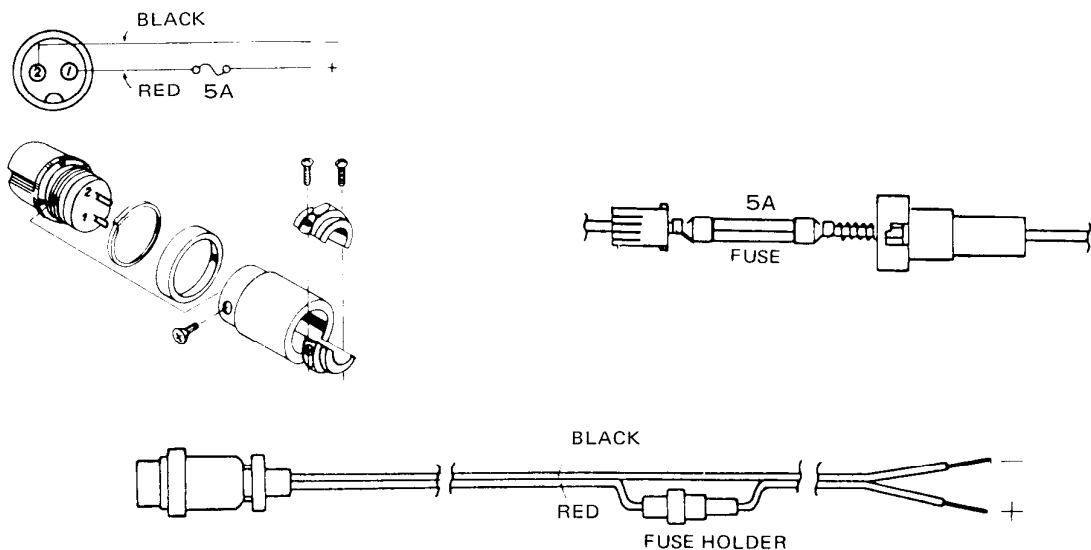
This switch allows the operating frequency to be changed while transmitting. This feature is useful especially for satellite operation, for it allows the operator to zero on the proper frequency within the satellite passband. Neither VFO A/B TXA nor the CLARIFIER function works when the SAT switch is placed in the ON position.

(2) SCAN

This switch will select scanning stop on a busy or clear channel in the FM mode. Manual scanning stop is also provided on all modes.

(3) RPT (Repeater)

The switch will shift the transmitting frequency +1 MHz or -1 MHz for repeater operation.



POWER CORD CONNECTIONS

INSTALLATION

ANTENNA CONSIDERATIONS

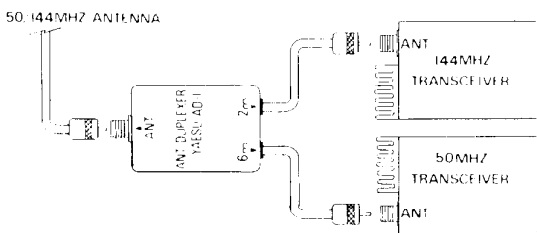
The FT-680R is designed for operation using an antenna presenting a 50 ohm resistive load. The automatic final transistor protection circuitry will reduce the power output to protect the transistors when a high antenna SWR is encountered. The SWR on the antenna should, if possible, be kept below 1.5 : 1 at all times to secure full output from the transceiver.

In most cases, coverage is a function of antenna height. The antenna for base station operation should be located as high and in the clear as possible. Vertical polarization is standard for FM communications in most areas, so be sure that your antenna is oriented appropriately. Popular antennas for base station use include the 5/8 wavelength vertical or one of the many stacked dipole arrays. For accessing repeaters a long distance away, a Yagi or other high gain directional array may be required.

Do not economize on coaxial cable, as much power can be wasted in lossy transmission line. For mobile use, the RG-58A/U type of coax may be used. To minimize loss, use the shortest length that is possible. For base stations, use type RG8A/U coaxial cable. For very long runs, type RG17A/U, aluminum-jacketed "foamflex" coax, or air dielectric "heliac" cable may be used.

The optional antenna duplexer AD-1 allows the operation on both 50 and 144 MHz using a single antenna (RSL-50 or RSL145).

See your Yaesu dealer.



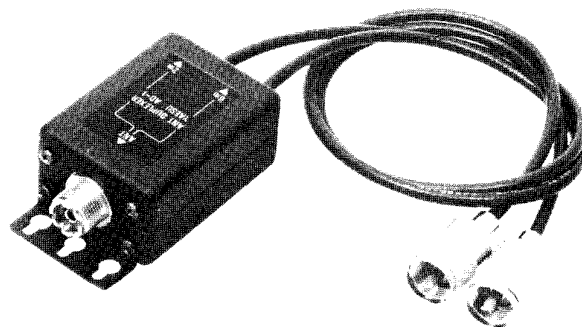
AD-1 ANTENNA DUPLEXER

MOBILE INSTALLATION

For mobile service, the FT-680R should be installed where the digital display, controls, and microphone are easily accessible for operation. The transceiver may be installed in any position without loss of performance. A suitable location would be atop the transmission tunnel. A universal bracket is supplied with your transceiver for mobile installation. Refer to Fig. 1 for mounting details.

1. Use the universal mounting bracket as a template for positioning the mounting holes. Use a 3/16" diameter bit for drilling these holes, allowing clearance for the transceiver, its cables and microphone, and its controls. Secure the mounting bracket with the screws, washers, and nuts supplied, as shown in the drawing.
2. Ease the transceiver into the guide rail, and slide it into the desired position. Tighten the knobs on the outside of the universal bracket to secure the transceiver.
3. The microphone hanger may be installed wherever convenient for access to the microphone.

Power connections should be made directly to the automobile battery. Routing through the cigarette lighter may cause the lighter fuse to blow if the fuse is not of sufficient rating. As well, connection directly to the battery allows the memory circuits to remain activated when the ignition is turned off, using the BACKUP switch.



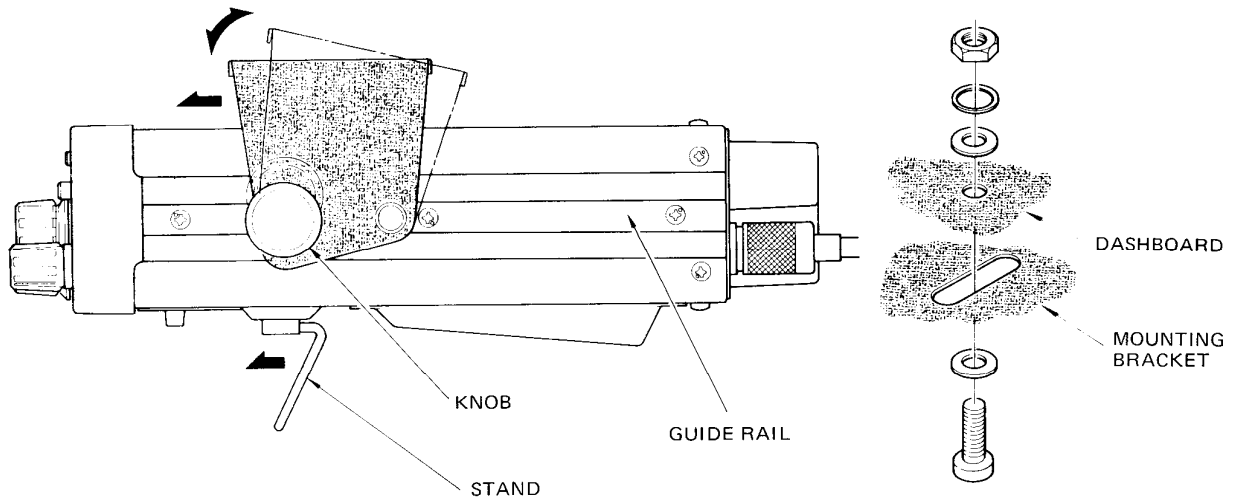


Figure 1

Connect the RED lead of the power cord to the POSITIVE (+) battery terminal, and connect the BLACK lead to the NEGATIVE (-) terminal. If it is necessary to extend the power cable, use #16 AWG insulated copper wire, and use the minimum length practicable to reduce voltage drop.

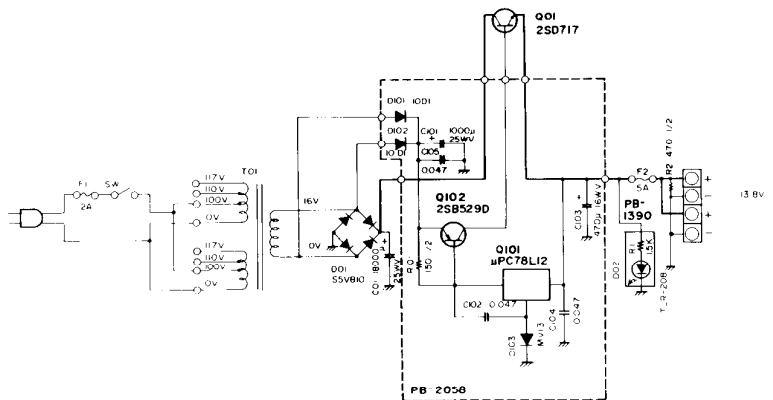
Connect the power cable to the POWER receptacle on the rear apron, connect the coaxial cable from the antenna to the rear apron ANT receptacle, and connect the microphone to the jack appropriate for the microphone in use. An external speaker may be connected to the rear apron SP jack, if desired. Use the speaker plug supplied with the transceiver. Insertion of a plug into this jack automatically cuts off the internal speaker.

WARNING

NEVER APPLY AC POWER TO THE REAR PANEL POWER JACK OF THE TRANSCEIVER. NEVER CONNECT A DC POWER SOURCE OF GREATER THAN 15 VOLTS TO THE REAR PANEL POWER JACK. ALWAYS REPLACE FUSES WITH A FUSE OF THE PROPER RATING. FAILURE TO OBSERVE THESE SIMPLE PRECAUTIONS WILL VOID ALL WARRANTIES ON THIS EQUIPMENT.

BASE STATION INSTALLATION

A base station mounting stand is supplied with your transceiver, to provide easier viewing of the display and controls. A power supply capable of supplying 5 amps at 13.8 VDC is required for operation from AC mains. The FP-80 AC power supply option provides the required 13.8 VDC for the FT-680R transceiver. See your Yaesu dealer.



FP-80 POWER SUPPLY

OPERATION

The all solid-state design of the FT-680R means that tuning procedures are very simple. The following paragraphs will describe the tuning procedures for receiver and transmitter operation.

INITIAL CHECK

Before connecting the transceiver to the power supply, be certain that a fuse of the proper rating is in use, and that a 50 ohm antenna has been connected to the antenna jack.

FREQUENCY SELECTION USING MAIN DIAL

When the transceiver is initially turned on, the digital display will read the preset frequency 50.000.0 MHz, and frequency control will be via the main tuning dial. After memory, scanning, or priority operation, pressing the DIL button will return control to the main dial. Rotate the dial to secure the operating frequency desired. Since tuning steps depend on the combination of the MODE switch and STEP switch as shown in Table 1, use the synthesizer step for easy tuning. When the upper or lower bandedge is reached the next synthesizer step will automatically be to the opposite bandedge. Thus, after 53.999.9 MHz, the next step is 50.000.0 MHz. While transmitting, the operation frequency can not be changed in any operation modes except the satellite mode.

RECEIVER OPERATION

Preset the controls and switches as follows:

MODE Desired mode
SQL Fully counterclockwise
STEP Desired synthesizer step
VFO A/B TXA . . . VFO "A" position
SCAN MAN position
RPT SIMP position
All other switches should be turned off initially.

Rotate the VOL control clockwise to turn the transceiver on and adjust for a comfortable level.

(1) SSB and AM modes

Using the main tuning dial, tune in an SSB or AM signal. The STEP switch should be set to M or F position so that you can secure the operating frequency desired in 100 Hz or 1 kHz steps. When you get close to the desired frequency, set the

STEP switch to S position for 10 Hz step in order to tune in the signal smoothly. When pulse type noise such as ignition noise is encountered, press the NB (noise blanker) switch.

(2) CW mode

With the clarifier off, tune in a CW signal. When the incoming signal is tuned to a beat note of 800 Hz, your transmit frequency will coincide with that of the other station. If another beat note is desired, or if the other station drifts, then use the clarifier function.

(3) FM mode

Using the main tuning control, tune in an FM signal for a maximum and steady S-meter reading and a clear, natural voice output from the speaker.

Set the STEP switch to the M (20 kHz) position, as almost all FM stations use 20 kHz steps. When you change the operating mode from SSB/AM/CW to FM, all the digits of the operating frequency below 10 kHz will clear by pressing the F.SET button.

When the channel is clear, rotate the SQL control to the point where the background noise is just silenced. Do not rotate the SQL control much beyond this threshold point, or else the receiver will not respond to weak signals. The BUSY/MOD lamp will light up when the squelch circuit is opened. If the S-meter wobbles, or if it is impossible to obtain clear audio, it is possible that the incoming signal is on another mode such as SSB.

TRANSMITTER

Before transmission, be certain that the frequency on which you are going to operate is clear to prevent interruption of the other station's operation. It is important that an antenna or dummy load be connected to the antenna jack at all times.

(1) SSB mode

Set the MODE switch to SSB and close the microphone PTT switch. The ON AIR lamp should light up and if you speak into microphone in a normal voice, the S.PO LEDs will light up according to the relative output power.

(2) AM mode

Set the MODE switch to AM and close the micro-

phone PTT switch, 3-4 LEDs will light up without modulation. Speak into the microphone in a normal voice and the string of LEDs will light up according to the voice signal.

(3) CW mode

Plug a key into the KEY jack on the rear panel. In the key-down condition, the 8-9 LEDs of the indicator will light up. Since the semi-break-in circuit is furnished, when the key is closed, your keying activates the transmitter, and the 800 Hz side tone will be heard from the speaker. With the HI/LOW switch pressed, the power output of 10 watts may be reduced to 1 watt, and the LOW lamp will light up.

(4) FM mode

Set the MODE switch to FM, and close the microphone PTT switch. When transmitting, 8-9 LEDs will light up to show relative output power, and BUSY/MOD lamp will be illuminated according to the voice input. On this mode, 10 watts of RF output power can also be reduced to 1 watt by pressing the HI/LOW button.

MEMORY OPERATION

A total of four memory channels are available for operation. Storage and recall of memory channels allows considerable operating flexibility. The storage and recall procedure is extremely simple.

- (1) Rotate the main tuning dial to the desired frequency, for example 50.640.0 MHz. Now rotate the MEMORY switch to position 1. Press the M button to store 50.640.0 MHz into memory channel position 1.
- (2) Now rotate the main tuning dial to another frequency (for example 50.360.0 MHz). For instant return to 50.640.0 MHz, press MR button, the 50.640.0 will be displayed on the digital readout.
- (3) To return again to 50.360.0 MHz, press DIL, and you will be operating on 50.360.0 MHz.
- (4) Memory channels 2, 3 and 4 may be programmed and recalled as above.
- (5) When you push the MR button, the far right

LED on the readout will illuminate, indicating the memory channel.

- (6) To return frequency control to the main tuning dial, push the DIL button.
- (7) Set the STEP switch to the desired step before activating the clarifier in the memory operation. Changing the synthesizer step with the CLAR switch ON will lock the operating frequency.

SCANNER OPERATION

Fingertip switches, located on the microphone, allow convenient frequency control, while driving. The simple operating procedure is described below.

- (1) Set the bottom panel SCAN switch to MAN position. Push the DIL switch to select operation on the dial frequency.
- (2) Press the microphone UP switch for an instant to shift the frequency up by one step. If you hold the UP button for more than 1/2 second, the scanner will be activated. To stop the scan, press the PTT switch or one of the scanning controls on the microphone. If you push the PTT switch, no transmission will occur; release the PTT switch, then press it again for normal transmission.
- (3) To scan lower in frequency, use the same procedure, but press the DWN button.
- (4) In the FM mode, to halt the scan automatically on a busy channel, set the bottom panel SCAN switch to BUSY. In this mode, when the scanner encounters a signal strong enough to open the receiver squelch, scanning will stop. When the bottom panel switch is placed in the CLEAR position, the scan will stop when a clear channel (one where the squelch will not open) is found.
- (5) To scan only the memory channels, rotate the MEMORY switch to MS (memory scan) position. Now press the UP or DWN switch on the microphone. The scanning rate for memory scan will be approximately two channels per second. The scan may be halted in any of the ways discussed previously. The BUSY and CLEAR positions of the SCAN

switch are particularly helpful when scanning the memory channels in the FM mode.

PRIORITY CHANNEL OPERATION

A priority channel may be used in conjunction with a memory channel for increased flexibility. Here is how to set up the FT-680R for priority operation.

- (1) First program one or more memory channels for priority use. For example, store 50.640.0 MHz into memory channel 1. Set the bottom panel SCAN switch to MAN. Rotate the main dial to the desired frequency (for example 50.360.0 MHz).
- (2) Now set the MEMORY switch to 1 and push MR to recall 50.640.0 MHz and then push the PRI (priority) switch. The display will indicate 50.360.0 P, and every 5 seconds the display will switch to 50.640.0 MHz allowing you to check it for activity.
- (3) If you have other frequencies stored in memory, you may rotate the MEMORY switch to select one for use with the priority channel.
- (4) In the FM mode, you may use the SCAN switch to good advantage during priority operation, as described in SCANNER OPERATION.
- (5) If you wish to return to normal operation from the priority mode, push the DIL button. Now control is shifted back to the main dial.

REPEATER OPERATION

- (1) Repeater shifts of +1 MHz, and -1 MHz are built into the FT-680R. To select these shifts, set the bottom panel RPT switch to the + or - position respectively.
- (2) To cover unusual repeater splits, you can use the VFO A/B TXA feature.
Example: receive frequency 50.640 MHz with 1.2 MHz split. Rotate the main tuning dial to the 51.840 MHz and press the VFO A/B TXA button on the front panel; now the

transmit frequency, 51.840 MHz, is memorized. Rotate the main tuning dial to 50.640 MHz for receiving. If you close the PTT switch, your transmit frequency will be shifted to 51.840 MHz.

- (3) An 1800 Hz tone generator is included with your transceiver for accessing a repeater requiring such a tone. When the T.CALL switch is pushed, a tone will be superimposed on your transmitted signal. This switch also activates the PTT function, and transmits the access tone, for as long as the switch is held. An external tone or burst generator, optional FTS-64E may be connected through the rear panel TONE IN CONNECTOR.

INITIALIZING FREQUENCY/BACKUP FEATURE

The FT-680R includes a backup feature which will hold all memory frequencies, as well as dial frequency, when the front panel power switch is turned off. So long as the DC power to the rear apron power jack is not interrupted, these frequency will be held. When the power is again turned on, the frequency and mode (memory priority, dial, etc.) last used will be recalled, but *scanning mode is automatically reset to dial mode*. However, if the power cord is connected to 13.8 VDC circuit that is switched off along with the automobile ignition, all memory channels as well as the dial frequency will be reset to the preset frequency.

CIRCUIT DESCRIPTION

The block diagram, and circuit description to follow will provide you with a better understanding of this transceiver. Please refer to the block and schematic diagram for specific circuit details.

RECEIVER

The RF signal from the antenna jack is applied to the MAIN UNIT through a low pass filter and the antenna relay, RL₂₀₀₁. The signal is amplified by Q₁₀₀₁ (3SK59Y), a dual gate MOS FET with excellent rejection of cross modulation and inter-modulation. The amplified signal is fed to the 1st mixer, Q₁₀₀₂ (3SK51-03), where the RF signal is mixed with a local signal delivered from the PLL UNIT, resulting in a 10.81 MHz first IF signal.

The first IF signal is passed through a monolithic crystal filter, XF₁₀₀₁ (108M30B), which has ±15 kHz bandwidth, and amplified by Q₁₀₀₃ (3SK73Y), which acts as a switch driven by the NB (noise blanker) circuit. The amplified signal from Q₁₀₀₃ is fed to IF amplifiers for each mode.

FM and AM mode signals are fed to 2nd mixer Q₁₀₀₅ (2SC535B), where the signal is mixed with an 11.265 MHz local signal, resulting in a 455 kHz 2nd IF signal. The 2nd IF signal is passed through a ceramic filter, CF₁₀₀₁, which has a ±4.5 kHz bandwidth, and then fed to the FM or AM mode IF amplifier.

In the FM mode, the filtered signal is amplified by Q₁₀₀₆ and Q₁₀₀₇ (2SC945Q) and passed through CF₁₀₀₂, which has a ±7.5 kHz bandwidth. The filtered FM signal is amplified by Q₁₀₀₈ (μPC577H) and demodulated by CD-1 and D₁₀₁₀, D₁₀₁₁. The demodulated FM signal is amplified by Q₁₀₁₂ (2SC1815GR) and then fed to the AF amplifier.

In the AM mode, the filtered signal is again passed through a ceramic filter CF₁₀₀₃ which has a ±2 kHz bandwidth and amplified by Q₁₀₂₃ (2SK73Y) whose gain is controlled by AGC circuit, and further amplified by Q₁₀₂₄ (2SC945Q). The amplified signal is AM-detected by D₁₀₃₃, and the detected signal is amplified by Q₁₀₂₅ (2SC945Q) and fed to the AF amplifier.

SSB and CW mode signals from the Q₁₀₀₃ are passed through a crystal filter, XF₁₀₀₂, which has a very high shape factor, to improve adjacent fre-

quency selectivity. The filtered SSB signal is amplified by Q₁₀₁₄ and Q₁₀₁₅ (3SK73Y), and then fed to the balanced demodulator, Q₁₀₁₆ (μPC1037H), where a carrier signal is applied from the carrier oscillator Q₁₀₄₁/Q₁₀₄₂ (2SC945Q); the detected audio output is then fed to the AF amplifier.

The audio signals from each demodulator are passed to the active lowpass filter, which consists of Q₁₀₂₇ and Q₁₀₂₈ (2SC945Q) to eliminate the unwanted noise portion of the signal. The audio signal is then fed, through the AF gain control, to the audio output amplifier, Q₁₀₂₉ (μPC2002V), providing about 2 watts of audio output to the speaker.

S-METER CIRCUIT

A portion of the amplified IF signal is fed to Q₁₀₁₇ (2SC535B), a buffer amplifier, through C₁₀₈₀. The amplified signal is then applied to the AGC detector, D₁₀₂₅/D₁₀₂₆. The rectified signal is amplified by DC amplifier Q₁₀₁₈ (2SC1815Y) for AGC control. This AGC voltage is delivered to the front panel S.PO indicator to illuminate LEDs according to the input signal strength.

SQUELCH CIRCUIT

A portion of the demodulated FM signal from the ceramic discriminator (CD₁, D₁₀₁₀, D₁₀₁₁) is fed to noise amplifiers Q₁₀₀₉ and Q₁₀₁₀ (2SC945Q) through VR₁₀₀₂ and the SQ Control (VR₁₆), and then rectified by D₁₀₁₂ and D₁₀₁₄, a voltage doubling circuit. The rectified signal is fed to the base of Q₁₀₁₁ (2SC1815), the squelch control circuit.

When no carrier is present, the rectified DC voltage is applied to the base of Q₁₀₁₁, to turn Q₁₀₁₂ (2SC1815GR) on. With conduction of Q₁₀₁₁, the base of Q₁₀₁₂ is grounded, squelching the audio amplifier.

When a carrier is present, the rectified DC voltage is reduced, the audio amplifier Q₁₀₁₂ then recovers to normal operation. The BUSY lamp switch, Q₁₀₁₃ (2SC945Q), is also activated by the rectified voltage from the demodulator to illuminate the BUSY lamp when a carrier is present.

NB (Noise Blanker) CIRCUIT

A portion of the IF signal from monolithic filter XF₁₀₀₁ is amplified by Q₁₀₄₇ (2SC535B), Q₁₀₄₈, Q₁₀₄₉, and Q₁₀₅₀ (2SC1583). The output signal is rectified by D₁₀₅₉ and D₁₀₆₀, producing a DC voltage. This DC voltage is amplified by Q₁₀₅₂ (MPSA13) and fed to gate 2 of Q₁₀₀₃, the noise blanker gate. A portion of the DC voltage is amplified by Q₁₀₅₁, and then fed to Q₁₀₄₈, Q₁₀₄₉ (2SC1583) as a noise blanker AGC voltage. When impulse-type noise is received, the induced DC voltage reduces the gain of Q₁₀₀₃, and blocks the signal path momentarily. The noise AGC control voltage is not induced by such impulse-type noise, because the time constant of C₁₂₄₃/R₁₂₇₃ is long. Normal signals, though, induce the noise blanker AGC voltage, and reducing the gain of the noise amplifier, allowing normal signal path at Q₁₀₀₃.

TRANSMITTER

The discussion of the signal flow on transmit will be on a mode by mode basis.

SSB

The audio input signal from the microphone is amplified by Q₁₀₃₀ (2SC1815GR) and Q₁₀₃₉ (2SC1815Y). The audio level is adjusted to the proper level by VR₁₀₀₇, and is applied through an active low-pass filter, Q₁₀₄₀ (2SC945Q), to the ring modulator, D₁₀₅₃–D₁₀₅₆. Here the audio signal modulates the 10.81 MHz carrier signal delivered from the carrier oscillator Q₁₀₄₁ (2SC945Q) and buffer Q₁₀₄₂ (2SC945Q), resulting in a 10.81 MHz double-sideband signal. The signal is amplified by Q₁₀₄₃ (2SK19TMGR) and fed to XF₁₀₀₂, a crystal filter, where the unwanted sideband is sliced out. The SSB signal is then fed to mixer Q₁₀₃₆ (MC1496G) and mixed with a local signal from the PLL Unit, resulting in a 50–54 MHz SSB signal.

The SSB signal is passed through T₁₀₁₀–T₁₀₁₄, which are tuned exactly to the operating frequency by varactor diodes, thus minimizing spurious radiation. The signal is then amplified by Q₁₀₃₇ (3SK70), and Q₁₀₃₈ (2SC2053) to the proper level for driving the power amplifier circuit.

FM

The output audio signal of Q₁₀₃₀ is amplified by

Q₁₀₃₁ (2SC1815GR) and Q₁₀₃₂ (2SC945Q) and fed to IDC circuit, consisting of D₁₀₃₇ and D₁₀₃₈, which clips both positive and negative peaks to control the maximum possible deviation; the clipped signal is then passed through an active low-pass filter to eliminate harmonics above the speech range caused by clipping. The output signal is amplified by Q₁₀₃₄ (2SC945Q) to a sufficient audio level and applied to the FM modulation module XM-1 for modulation, and the maximum deviation is adjusted by VR₁₀₀₆ prior to delivery to Q₁₀₁₄. The signal path is then identical to that of the SSB signal.

AM

The output audio signal from Q₁₀₄₀ is further amplified by Q₁₀₄₅, Q₁₀₄₆ (2SC945Q) and fed to Q₂₀₀₃ (2SA715C) in the Power Amplifier Unit, which controls the collector voltage of Q₂₀₀₁ and produces an amplitude modulation signal. As on the other modes, the produced AM signal is amplified by Q₂₀₀₂ to the desired power.

The carrier for AM is generated by Q₁₀₄₄ (2SC945Q), oscillating at 10.8107 MHz, and amplified by buffer Q₁₀₃₅ (2SC945Q) and fed to IF amplifier Q₁₀₁₄. The signal path is then identical to that of the SSB signal.

CW

For CW, the 10.8107 MHz carrier signal is generated by Q₁₀₄₄ (2SC945Q), amplified by Q₁₀₃₅ (2SC945Q), and fed to IF amplifier Q₁₀₁₄. The signal path is then identical to that of the SSB signal.

The key line is connected to switching transistor Q₁₀₆₂ (2SC945Q) through inverter Q₁₀₆₁ (MC14011B), which controls the gate voltages at Q₁₀₁₄ (3SK73) and Q₁₀₃₇ (3SK59Y), and thus turning the RF signal on and off.

An RC circuit connected to the base of Q₁₀₆₂ produces an ideal keying waveshape for click-free CW operation. The key line is also connected to side tone oscillator Q₁₀₆₁ (MC14011B) for monitoring of the code signal during CW operation. In order to operate on semi-break-in, the Schmitt trigger and delay circuit at Q₁₀₆₀ (MC14011B) activates the RX-TX changeover relay.

POWER AMPLIFIER CIRCUIT

The RF signal from the Main Unit is amplified by Q₂₀₀₁ (2SC2166) and Q₂₀₀₂ (2SC1945) in the Power Amplifier Unit, delivering approximately 10 watts of RF output to the antenna through a lowpass filter.

POWER CONTROL CIRCUIT

When the HI/LOW switch is set to the LOW position, the base of Q₁₀₄₆ is grounded through VR₁₀₁₂, and the collector current of Q₁₀₄₆ is decreased. Because the output power of Q₂₀₀₁ is controlled by Q₂₀₀₃, the drive level to Q₂₀₀₂ is decreased, thus reducing the RF output power to approximately 1 watt.

TONE BURST CIRCUIT

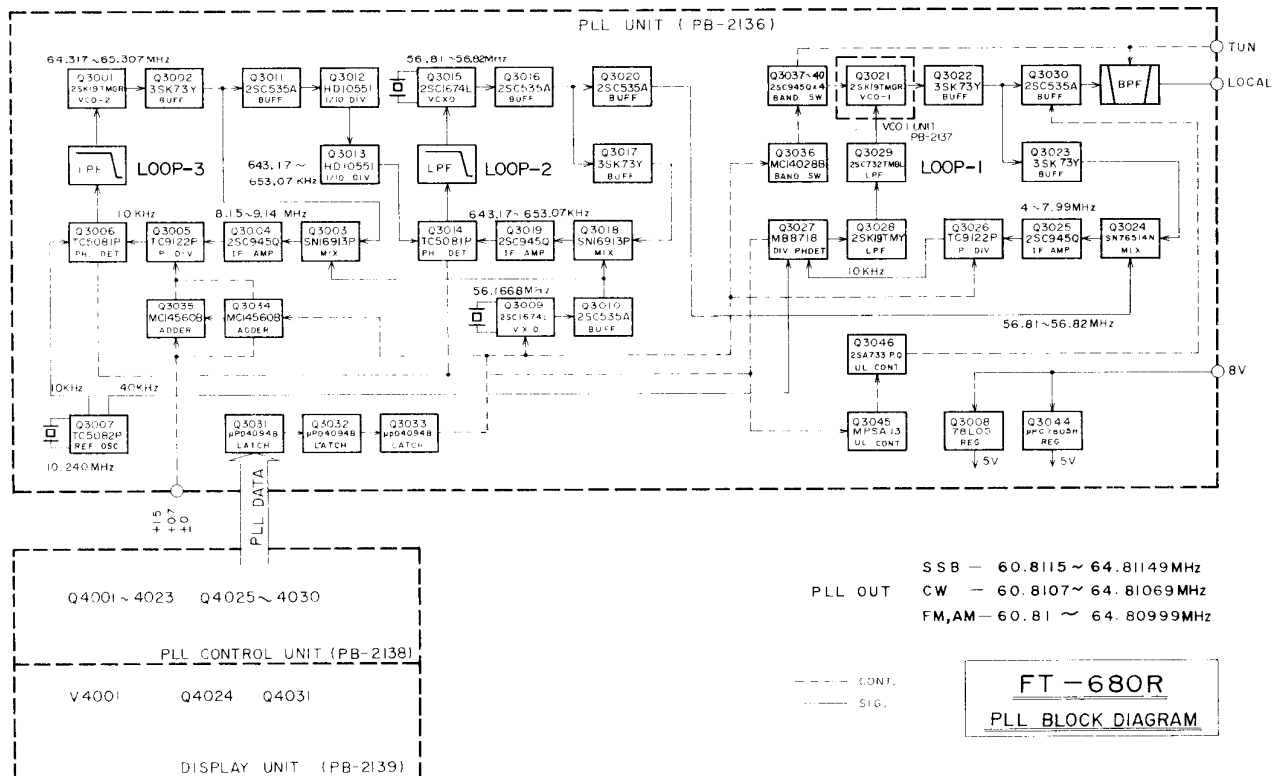
When the T.CALL switch is pressed, the base of Q₁₀₅₈ (2SA733P) is grounded, and DC voltage is applied to tone burst oscillator Q₁₀₅₇ (TC5082P) to generate an 1800 Hz tone signal. The tone is superimposed on the transmit signal as long as the switch is held.

ALC (Automatic Level Control) CIRCUIT

A portion of the output power from Q₂₀₀₂ is applied through C₂₀₂₀ to rectifiers D₂₀₀₁ and D₂₀₀₂ producing a DC voltage. The DC voltage is amplified by DC amplifier Q₁₀₁₈ (2SC1815Y) and fed to gate 2 of Q₁₀₁₄ to control its gain, and thus preventing overdrive. The ALC level is adjusted by VR₁₀₀₃ for proper drive level to Q₂₀₀₂.

AFP (Automatic Final Protection) CIRCUIT

If the transmitter is activated without an antenna being connected, or if a high VSWR is present at the antenna jack, the reflected power is detected through T₂₀₀₁ and D₂₀₀₃. The detected AFP voltage is applied through VR₂₀₀₂ to Q₁₀₆₃ (2SC1815Y) in the Main Unit. As the reflected power increases, the AFP voltage also increases, and consequently Q₁₀₆₃ conducts. The voltage at gate 2 of Q₁₀₁₄ (3SK73Y) then decreases, resulting in lower output power. When the transceiver is correctly matched to an antenna, full power output will be obtained.



PLL CIRCUIT

The PLL circuit is comprised of three PLL oscillators each consisting of a reference crystal oscillator, a programmable divider, a prescaler, and a phase comparator. The PLL produces local signals for the receiver and transmitter stages, using a synthesis scheme which produces 10 Hz steps.

PLL Circuit Configuration

The local signal 60.81000 MHz – 64.80999 MHz is generated by Q₃₀₂₁ (2SK19TMGR) VCO-1 in the PLL Loop 1, amplified by buffers Q₃₀₂₂ (3SK51) and Q₃₀₃₀ (2SC535A), and passed through BPF circuit to eliminate spurious radiation. The signal is then coupled to the Main Unit.

A portion of the signal from the buffer Q₃₀₂₂ is amplified by Q₂₀₂₃ (3SK51) and applied to the mixer Q₂₀₂₄ (SN76514N), where the signal is mixed with a heterodyne signal of 56 MHz from PLL Loop 2, and its frequency is divided by programmable divider Q₃₀₂₆ (TC9122P). The digital phase comparator Q₃₀₂₇ (MB8718) compares the phase of signal from the programmable divider with that of 40 kHz reference frequency obtained from crystal oscillator Q₃₀₀₇ (TC5082P) (via a 1/4 divider), producing an error-correction DC voltage. The output DC voltage is passed through an active lowpass filter consisting of Q₃₀₂₈ (2SK19TMY) and Q₃₀₂₉ (2SC732TMBL), and fed to the VCO-1 to control its oscillation frequency.

In PLL Loop 2, a 56 MHz signal generated by the VCXO Q₃₀₁₅ (2SC1674L) is amplified by buffer amplifiers Q₃₀₁₆ and Q₃₀₂₀ (2SC535A) and fed to the mixer in PLL Loop 1. A portion of the output from Q₃₀₁₆ is further amplified by Q₃₀₁₇ (3SK73Y) and applied to a mixer Q₃₀₁₈ (SN16913P), where the signal is mixed with a 56 MHz signal generated by VXO Q₃₀₀₉ (2SC1674L), resulting in a 600 kHz signal. The 600 kHz signal is amplified by Q₃₀₁₉ (2SC945Q) and fed to phase comparator Q₃₀₁₄ (TC5081P), which compares the phase of signal with that of the 600 kHz signal from PLL Loop 3, producing an error-correction DC voltage. The DC voltage is passed through a low-pass filter and fed to the VXCO to control its oscillation frequency.

In PLL Loop 3, a 60 MHz signal is generated by VCO-2 Q₃₀₀₁ (2SK19TMGR) and applied through buffers Q₃₀₀₂ (3SK73Y) and Q₃₀₁₁ (2SC535A) to prescalers, Q₃₀₁₂/Q₃₀₁₃ (HD10551), which divides its frequency by 1/100, thus producing a 600 kHz signal. A portion of the output of Q₃₀₀₂ is fed to a mixer Q₃₀₀₃ (SN16913P), where the signal is mixed with a 56 MHz signal which is generated by Q₃₀₀₉ (2SC1674L), and applied through a programmable divider to phase comparator Q₃₀₀₆ (TC5081P) which compares the phase of the signal with that of 10kHz signal which is generated by Q₃₀₀₇ (TC5082P), and produces an error-correction DC voltage. The DC voltage is passed through a lowpass filter and fed to the VCO-2 Q₃₀₀₁ to control its oscillation frequency.

The frequency control signal from the PLL Control Unit is fed to Serial/Parallel converters Q₃₀₃₁ – Q₃₀₃₃ (μ PC4094B) and converted into BCD code to control the dividing ratio of the programmable dividers and the oscillating frequency of VCO and VXCO in each PLL loops.

When any VCO is unlocked, an unlock signal from the phase comparator is fed to the unlock control circuit consisting of Q₃₀₄₅ (MPSA13) and Q₃₀₄₆ (2SA733), which controls buffer Q₃₀₃₀ (2SC535A) to mute the output from the PLL oscillator to prevent spurious radiation.

PLL Control Circuit

In the PLL Control Unit, a 4-bit parallel processing CPU is used to control the operating frequency, UP/DOWN scanning, priority channel, or memory channel selections. The CPU has one input port, three I/O ports and four output ports. The CPU processes input data by means of the main dial or other control switches in accordance with the program stored in an ROM for control of the PLL frequency, indication of the operating frequency, or memory channels on digital display. The CPU is also furnished with a function to halt transmission when any VCO is unlocked, resulting in a fail-safe system.

MAINTENANCE AND ALIGNMENT

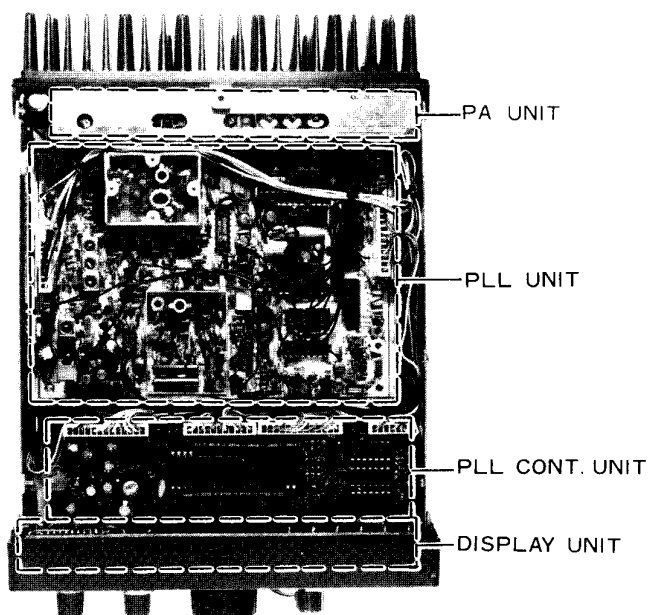
This equipment has been carefully aligned and tested at the factory prior to shipment. If the instrument is not abused, it should not require other than the usual attention given to electronic equipment.

Service or replacement of a major component may require considerable realignment. Under no circumstances, though, should realignment be attempted unless the operation of the transceiver is fully understood, the malfunction has been carefully analyzed, and the fault has definitely been traced to misalignment rather than part failure. Service work must only be performed by experienced personnel using the proper test equipment.

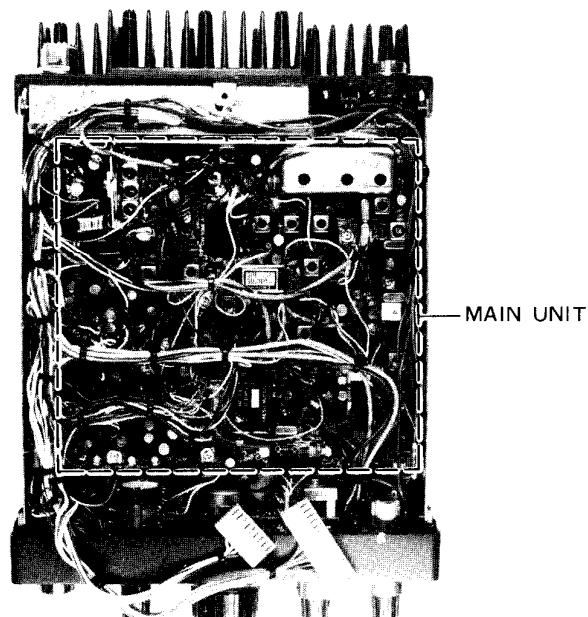
Never align this transceiver without having a 50 ohm dummy load connected to the antenna jack, unless otherwise noted. Troubleshooting using an antenna can result in misleading indications on test equipment.

EQUIPMENT REQUIRED

- (1) RF Signal Generator: Hewlett-Packard Model 8640B or equivalent, with one volt output at 50 ohms, and frequency coverage to 150 MHz.
- (2) Vacuum Tube Voltmeter (VTVM): Hewlett-Packard Model 410B or equivalent, with an RF probe good to 150 MHz.
- (3) Dummy Load/Wattmeter: Yaesu Model YP-150Z or equivalent.
- (4) AF Signal Generator: Hewlett-Packard Model 200AB or equivalent.
- (5) IF Sweep Generator: capable of output at 10.81 MHz.
- (6) RF Sweep Generator: capable of output at 49–55 MHz.
- (7) Oscilloscope: Hewlett-Packard Model 1740A or equivalent.
- (8) FM Deviation Meter
- (9) Precision Frequency Counter: Yaesu Model YC-500 or equivalent, with resolution to 0.01 kHz and frequency coverage to 150 MHz.



Top View



Bottom View

UNIT LOCATIONS

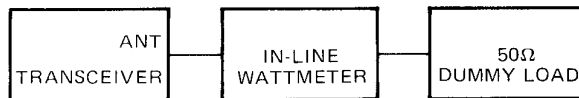
PERFORMANCE CHECKS

Make all performance checks at 13.8 VDC under load.

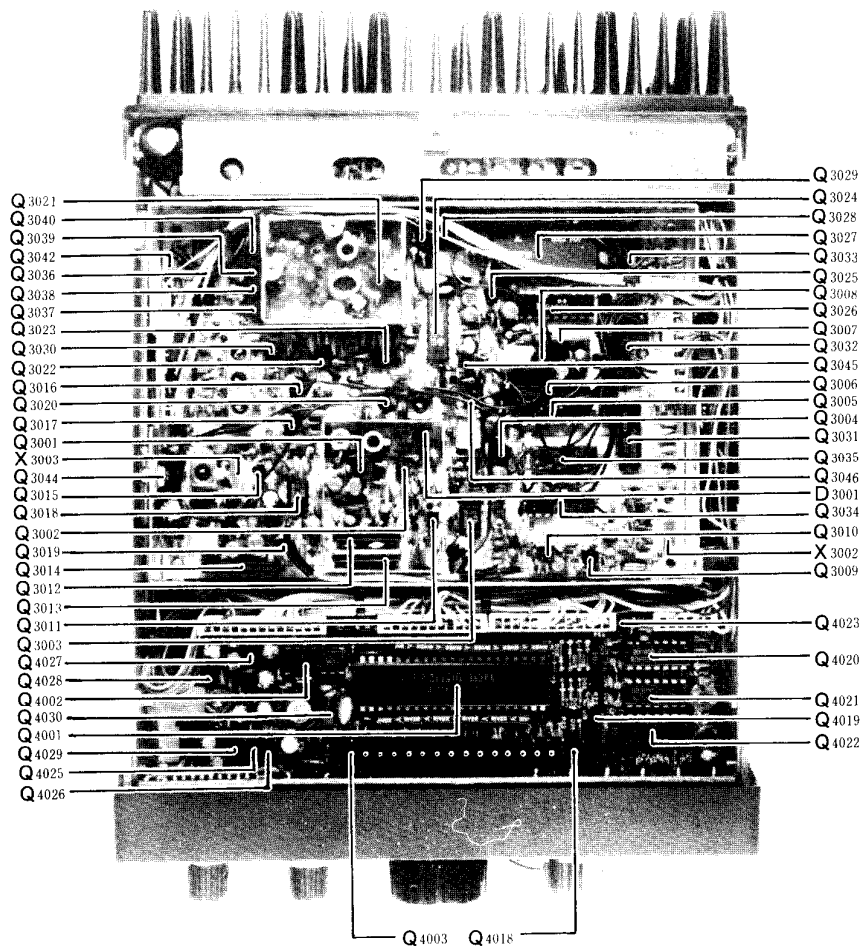
Check the transmitter power output as follows:

- (a) Connect a suitable dummy load/wattmeter to the antenna jack.
- (b) Set the MODE switch to the FM position, and key the transceiver while observing the power output, which should be approximately 10 watts. At full power output, 8–9 LED's will light up on the S/PO indicator.

- (c) Set the MODE switch to SSB, and key the transmitter. Speak in a normal voice into the microphone, 8–9 LED's should light up.



Bird Model 43 or equiv.
PO TEST SETUP



PART LOCATIONS (Top View)

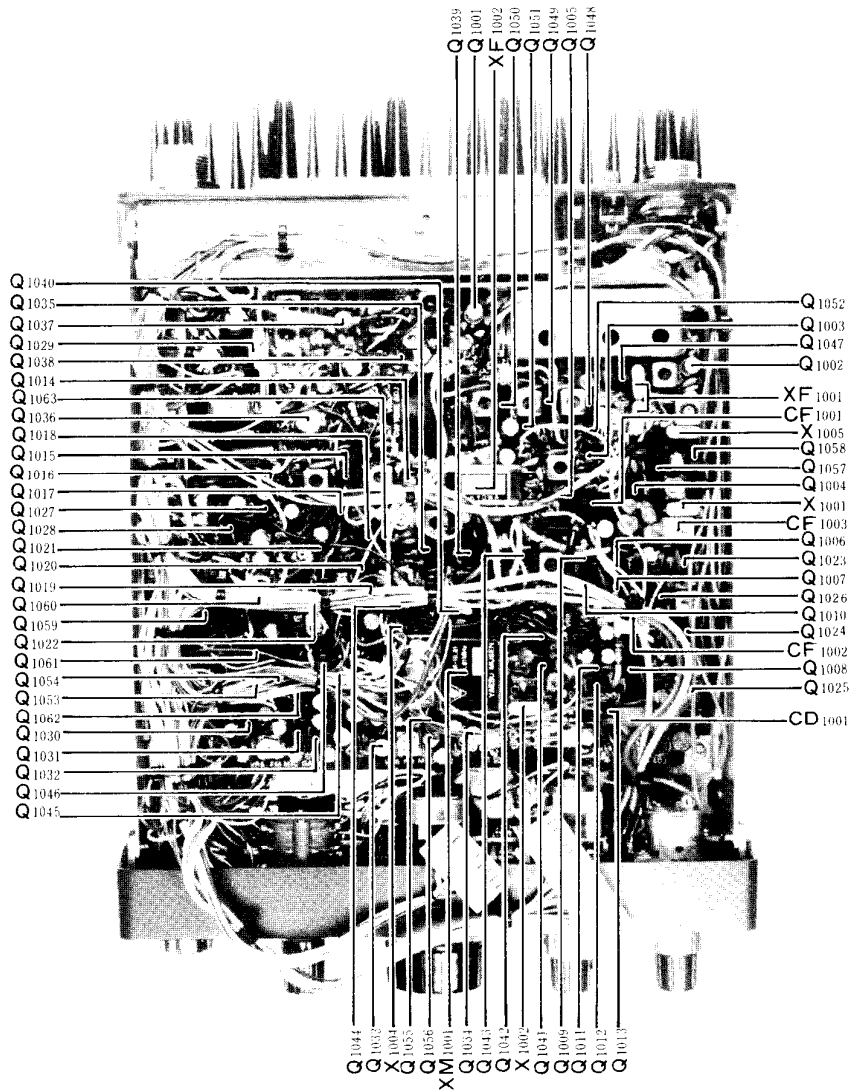
Check the receiver sensitivity as follows:

- (a) Connect an AC VTVM to the SP jack. Set the MODE switch to the FM position and rotate the SQUELCH control fully counterclockwise.
- (b) Connect the RF output of a precision VHF signal generator to the antenna jack and note the VTVM reading with no signal input. Adjust the AF GAIN control and the VTVM range, as required, to obtain full scale VTVM reading. DO NOT change the setting of the AF GAIN control after this calibration has been made.



RX SENSIVITY TEST SETUP

- (c) Set the signal generator to the receiver frequency of the transceiver, and adjust the output amplitude of the signal generator until the VTVM reads 20 dB (1/10 voltage) below the reading in step (b). The signal generator output voltage at this point is the 20 dB quieting sensitivity, and it should be approximately 0.35 μV.



PART LOCATIONS (Bottom View)

- (d) Set the MODE switch to SSB and connect the AC VTVM to the speaker output. Apply an unmodulated $0.5 \mu\text{V}$ signal from the signal generator, and tune the transceiver main dial for a maximum VTVM reading.
- (e) Adjust the AF GAIN control for a reading of 450 mV on the VTVM.
- (f) Reduce the signal generator output and read the VTVM: the VTVM reading should be 45 mV for a 20 dB S/N ratio.

If the above check indicates a need for realignment, it is recommended that the unit be returned to the dealer for servicing. The sophisticated CPU and control circuitry, in particular, are so critical that they should not be touched by other than an experienced technician. Attempts to realign the transceiver tuned circuits without the proper equipment may result in degraded transceiver performance.

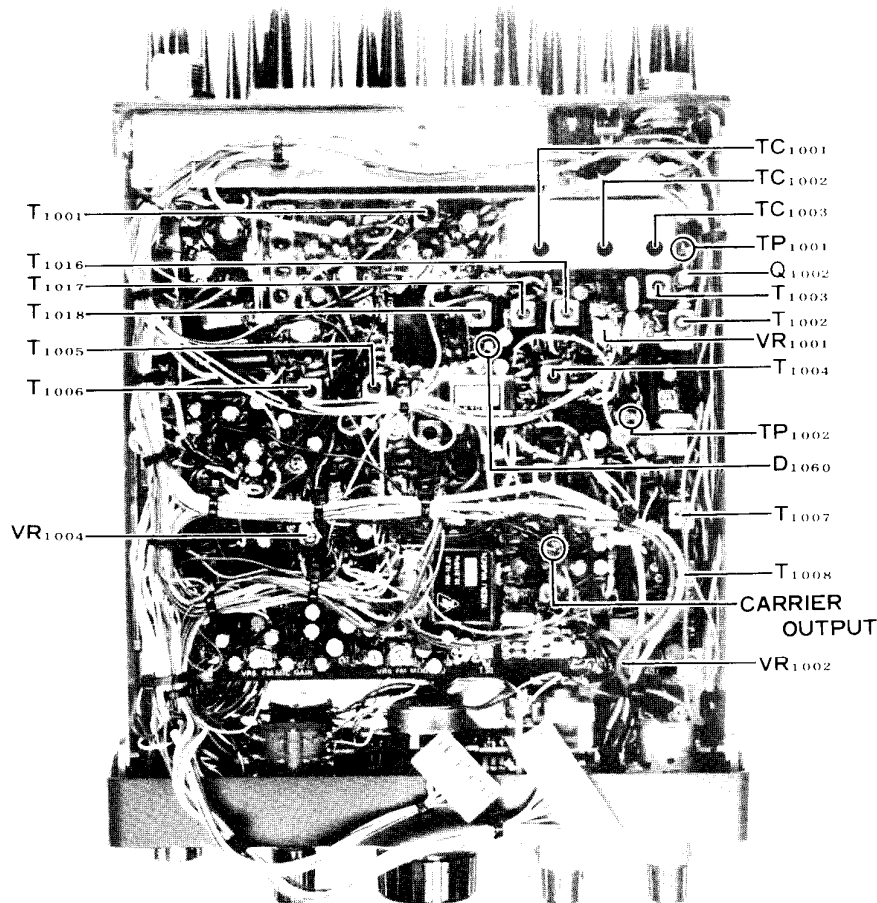
RECEIVER SECTION

(1) 2nd Local Oscillator

- a) Set the MODE switch to FM, and connect the RF probe of a VTVM to TP₁₀₀₂.
- b) Measure the RF injection voltage. A nominal value is 0.5 V – 0.7 VRMS.
- c) Connect a frequency counter to TP₁₀₀₂ and check to see that the oscillation frequency is correct: 11.265 MHz.

(2) 1st IF Amplifier

- a) Set the MODE switch to FM, and adjust VR₁₀₀₁ to the fully counterclockwise position.



ALIGNMENT AND TEST POINTS FOR RECEIVER

- b) Connect a sweep generator to gate 1 of Q_{1002} (TP_{1001}). Connect an oscilloscope, through a detector, to the secondary winding of T_{1004} .
- c) Set the frequency of the sweep generator to 10.81 MHz, and apply output from the generator.
- d) Adjust T_{1003} and T_{1004} until the scope pattern illustrated in Fig. 2 is obtained.

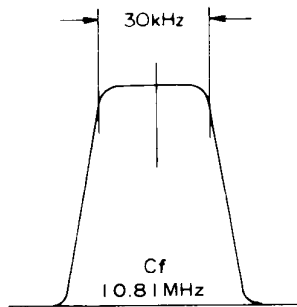


Figure 2

(3) SSB Carrier Oscillator

- a) Set the MODE switch to SSB.
- b) Connect the RF probe of the VTVM to the CARRIER OUTPUT terminal on the Main Unit (where C_{1212} and a shielded cable are connected), and measure the oscillation level. A nominal value is 170–230 mV RMS.

(4) SSB IF Circuit

- a) Set the mode switch to SSB.
- b) Connect a signal generator to TP_{1001} , and set its output level to 15 dB μ (5.62 μ V) at 10.81 MHz.
- c) Peak T_{1004} , T_{1005} , and T_{1006} for a maximum S.PO indication.

(5) AM IF Circuit

- a) Set the MODE switch to AM.
- b) Connect an AC VTVM to the external speaker terminals in parallel with an 8 ohm resistor or speaker.
- c) Connect a signal generator to the antenna jack, and set its output level and frequency to approximately 10 dB μ (3.16 μ V) with 30% modulation (1 kHz) at 52.0 MHz.
- d) Tune the receiver frequency to 52.0 MHz, and adjust T_{1007} , T_{1008} for a maximum reading on the AC VTVM.

(6) RF Amplifier

- a) Set the receiver frequency to 50.50 MHz, and generator to 10 dB μ (3.16 μ V) at 50.50 MHz.
- b) Set the receiver frequency to 146 MHz, and adjust T_{1001} , T_{1002} , TC_{1001} – TC_{1003} for a maximum S.PO indication.

(7) S-Meter Full Scale Setting

- a) Rotate VR_{1004} fully clockwise to make sure that six LED's on the S-meter scale are illuminated.
- b) Set VR_{1004} to the point where all the LED's go off.
- c) Apply a 4 dB μ (1.584 μ V) signal from the signal generator and adjust VR_{1001} so that only one LED is illuminated.

(8) Noise-Blanker Adjustment

- a) Set the MODE switch to SSB.
- b) Set the receiver frequency to 52.00 MHz.
- c) Adjust the output level and frequency of the signal generator to 5–10 dB μ (1.78 μ V–3.16 μ V) at 52.00 MHz. Temporarily connect TP_{1002} to ground with a clip lead, in order to disable the 2nd local oscillator.
- d) Connect a voltmeter (full scale: 2.5V) to the cathode of D_{1060} and ground. Adjust T_{1016} , T_{1017} , and T_{1018} for a maximum reading on the voltmeter scale.

(9) Squelch Adjustment

- a) Set the MODE switch to FM.
- b) Set the front panel SQL control to the 9 o'clock position.
- c) Adjust VR_{1002} so that the receiver is just muted. Now apply a signal from the signal generator. A signal of approximately –13 dB μ (0.224 μ V) with ± 3.5 kHz deviation at 1 kHz should be required to trip the squelch.

TRANSMITTER SECTION

Unless otherwise indicated, always perform transmitter alignment with a dummy load connected to the antenna jack. If the AFP circuits are being aligned, an improper load impedance at a critical time could result in the destruction of the final transistors.

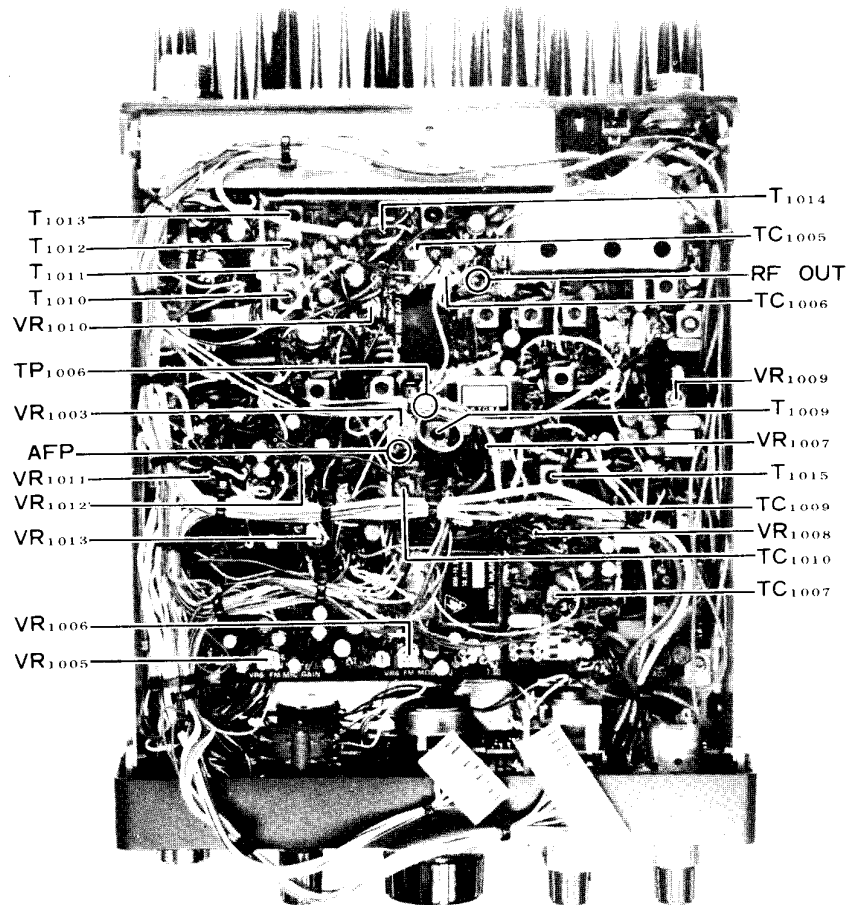
(1) TX Strip Trimmer Adjustment

- a) Set the MODE switch to FM, and the transmitter frequency to 52.00 MHz.
- b) With a dummy load/wattmeter connected to the antenna jack, advance VR₂₀₀₁ and VR₁₀₀₃ fully counterclockwise.
- c) Squeeze the microphone PTT switch, and adjust TC₂₀₀₁–TC₂₀₀₄* for maximum power output as indicated on the wattmeter.

* TC₂₀₀₁–TC₂₀₀₄ require no realignment unless final transistors are replaced.

(2) Mixer/Interstage Alignment

- a) Temporarily disconnect the RF OUT cable from the Main Unit.
- b) Terminate the RF OUT terminals with a 50 ohm resistor, and connect the RF probe of a VTVM to the RF OUT terminals.
- c) Set the transmitter frequency to 51.5 MHz, MODE to FM, and key the transceiver.
- d) Adjust T₁₀₁₀–T₁₀₁₄, TC₁₀₀₅, and TC₁₀₀₆ for a maximum reading on the VTVM.



ALIGNMENT AND TEST POINTS FOR TRANSMITTER

(3) CW/AM Carrier Oscillator

- a) Set the MODE switch to CW.
- b) Connect the RF probe of a VTVM to TP₁₀₀₆ and key the transceiver.
- c) Adjust T₁₀₀₉ for a reading of 100 mV RMS on the VTVM.
- d) Connect a frequency counter to TP₁₀₀₆, and adjust TC₁₀₁₀ for a reading of exactly 10.8093 MHz on the counter.

(4) ALC/PO Adjustment

- a) Set the MODE switch to FM.
- b) With a dummy load/wattmeter connected to the antenna jack. Key the transceiver.
- c) Adjust VR₁₀₀₃ for an output of 10 watts on the wattmeter.
- d) Adjust VR₂₀₀₃ so as to illuminate 9 LED's on the S.PO indicator.

(5) AFP Adjustment

- a) Connect a DC voltmeter to the AFP terminal on the Main Unit and ground.
- b) Rotate VR₂₀₀₂ fully counterclockwise.
- c) Set the MODE switch to FM.
- d) Adjust VR₂₀₀₂ for minimum indication on the DC voltmeter.
- e) Disconnect the 50 ohm dummy load, and connect a 165 ohm, 10 watt dummy load to the antenna jack. Key the transceiver.
- f) Adjust VR₂₀₀₁ so as to illuminate 8 LED's on the S.PO indicators.
- g) Remove the dummy load from the antenna jack, and check to see that the current consumption is less than 2 amps.

(6) Low Power Output Setting

- a) Set the HI/LOW switch to the LOW position, and key the transmitter in the FM mode.
- b) Adjust VR₁₀₁₂ for an output of 1 watt on the wattmeter.

(7) FM Modulator Adjustment

- a) Refer to Fig. 3, and set up the transceiver and test equipment as shown.
- b) Set VR₁₀₀₅, located on the Main Unit, to the center of its range, and apply a 1 kHz, 15 mV signal from the audio generator to the mic jack.
- c) Adjust VR₁₀₀₆ for a deviation of ± 4.5 kHz while observing the signal waveform on the scope.
- d) Now reduce the audio generator output level to 1.5 mV, and adjust VR₁₀₀₅ for a deviation of ± 3.5 kHz. Check to see that the waveform on the scope is not distorted.
- e) Turning the audio generator on and off, make sure that the BUSY/MOD indicator illuminates along with the changing audio input.

(8) Tone Burst Adjustment

- a) Set up the test equipment as specified in Fig. 3.
- b) Set the MODE switch to FM, and push the front panel T.CALL switch.
- c) Adjust VR₁₀₀₉ for a deviation of ± 3.5 kHz on the deviation meter.
- d) Connect a frequency counter to the detector output terminal of the deviation meter, and confirm that the burst signal is of the proper frequency (1800 Hz for the USA model, etc.).

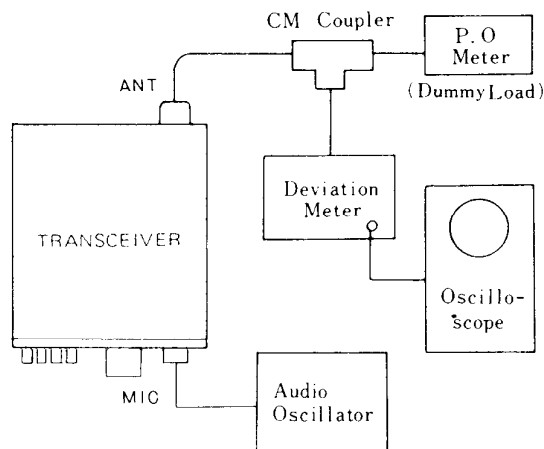


Figure 3

(9) SSB Modulator Adjustment

(A) Balanced Modulator Output Transformer Adjustment

- a) With a dummy load/wattmeter connected to the antenna jack, set the MODE switch to SSB.
- b) Set VR₁₀₀₇ to the center of its range, and apply a 1 kHz, 1 mV signal from the audio generator to the mic jack.
- c) Adjust T₁₀₁₅ for maximum power output.

(B) SSB Carrier Point Adjustment

- a) Apply a 1 kHz, 1.2 mV signal from the audio generator to the mic jack, and adjust VR₁₀₀₇ for an output of 8 watts.
- b) Set the frequency of the audio generator to 300 Hz. Adjust TC₁₀₀₇ for an output of 2 watts.

(C) Carrier Balance Adjustment

- a) Temporarily short the mic input terminal of the mic jack (pin 8) to ground with a clip lead.
- b) While monitoring the carrier on a monitor receiver, adjust VR₁₀₀₈ and TC₁₀₀₉ for a minimum S-Meter reading (or minimum signal level if no S-Meter reading occurs).

(10) AM Modulator Adjustment

- a) Set the MODE switch to AM.
- b) Adjust VR₁₀₁₃ for an output of 2.5 watts without modulation.
- c) Since the microphone gain adjustment is identical to that of the SSB modulator, refer to the SSB Modulator Adjustment step (B) of this section.

(11) CW Side Tone Frequency/Semi-break-in Delay Adjustment

- a) Adjust VR₁₀₁₀ for the desired monitoring level on CW operation.
- b) Adjust VR₁₀₁₁ for the desired CW VOX relay hang time.

PLL SECTION

NOTE: The PLL circuit is very critical in its adjustment. Alignment must only be performed by an experienced technician. All alignment should be performed at a temperature within the range 15°–30°C, preferably near the center of this range.

(1) VCV Line Adjustment

(A) PLL 1 Adjustment

- a) Set the STEP switch to “M,” the MODE switch to FM, and tune the transceiver to 51.9900 MHz.
- b) Connect the DC probe of the VTVM to TP₃₀₁₂, and adjust TC₃₀₀₄ for a reading of exactly 6.5 V.

(B) PLL 2 Adjustment

- a) Set the STEP switch to “M,” the MODE switch to SSB, and tune the transceiver to 51.0099 MHz.
- b) Connect the DC probe of the VTVM to TP₃₀₀₉, and adjust L₃₀₁₇ to secure a reading of 4 V.

(C) PLL 3 Adjustment

- a) Set the STEP switch to “M,” MODE switch to SSB, and tune the transceiver to 51.0099 MHz.
- b) Connect the DC probe of the VTVM to TP₃₀₀₁, and adjust TC₃₀₀₁ to secure a reading of 3.5 V.

(2) Buffer Stage Adjustment

- a) Set the STEP switch to “M,” the MODE switch to SSB, and tune the transceiver to 51.0099 MHz.
- b) Connect the RF probe of the VTVM to TP₃₀₁₄, and adjust T₃₀₀₁ for a maximum reading on the VTVM.

(3) PLL Output Bandpass Filter Adjustment

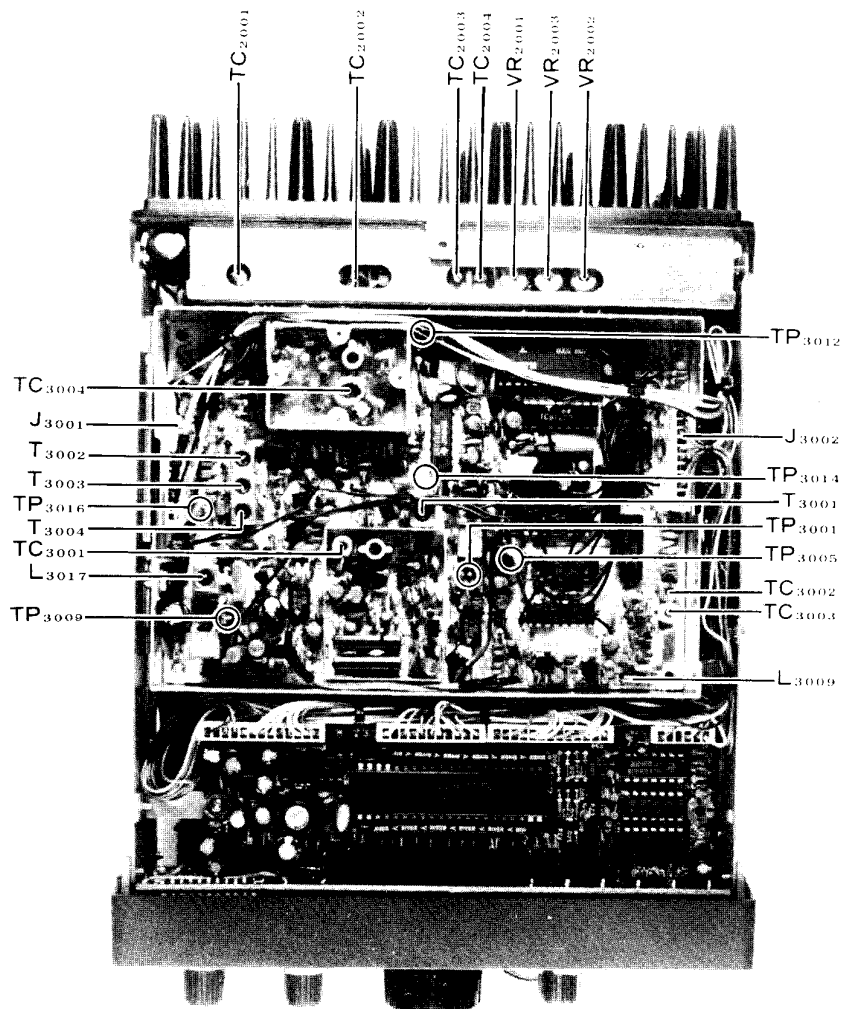
- a) Set the STEP switch to "F," the MODE switch to FM, and tune the transceiver to 51.4000 MHz.
- b) Connect the RF probe of the VTVM to TP₃₀₁₆, and peak T₃₀₀₂, T₃₀₀₃, and T₃₀₀₄ for a maximum meter reading.

(4) PLL Local Frequency

- a. Connect a frequency counter to TP₃₀₁₆.
- b) Set the STEP switch to "S," the MODE switch to SSB, and tune the transceiver to 50.00000 MHz.
- c) Adjust TC₃₀₀₂ for a reading of exactly 68.81150 MHz on the frequency counter.

- d) Change the transceiver display frequency to 50.00009 MHz, using the Main Dial.
- e) Adjust TC₃₀₀₃ for a reading of exactly 68.81159 MHz on the frequency counter.
- f) Repeat steps (b), (c), (d) and (e) several times to ensure complete frequency adjustment.

NOTE: In order to achieve the specified frequencies for the above alignment steps, some presetting of the display will be required (because the 10 Hz digit is not displayed). Push the F.SET button, then switch to SSB. Set the STEP switch to "S." The precise frequency may then be set using the main dial.



ALIGNMENT AND TEST POINTS FOR PLL

MEMO

PARTS LIST

MAIN CHASSIS			MAIN UNIT		
Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
PB-2143	F0002143	Printed Circuit Board (for S03)	PB-2135	F0002135	Printed Circuit Board
				C0021350	PCB with Components
PB-2132	F0002132	Printed Circuit Board (for J08)			
					IC
Q01	G1090294	IC μPC7808H	Q1008	G1090072	μPC577H
			Q1016	G1090101	μPC1037H
			Q1029	G1090284	μPC2002V
			Q1036	G1090061	MC1496G
D01	G2090034	DIODE U05B	Q1060,1061	G1090068	MC14011B
			Q1057	G1090239	TC5082P
					POTENTIOMETER
VR01 (with S09)	J62800084	DM11A5M1112			
					FET
			Q1001,1037	G4800590Y	3SK59Y
			Q1002	G4800510C	3SK51-03
R01	J02245103	RESISTOR Carbon film 1/4W SJ 10kΩ	Q1003,1014,1015, 1023	G4800730Y	3SK73Y
R02	J02245104	" " " " 100kΩ			
			Q1021	G3800301Y	3SK30AY
			Q1043	G3090035	2SK19TMGR
					CAPACITOR
C01,02	K40170105	Electrolytic 50WV 1μF (50RL1)			
C03	K40129006	" 16WV 470μF (16RE470)	Q1004,1006,1007, 1009,1010,1013, 1019,1024-1028, 1032-1035, 1040-1042, 1044-1046,1054, 1056,1059,1062	G3309450Q	2SC945Q
					SPEAKER
SP01	M4090047	SS-77KYH			
					SWITCH
S01	N0190066	SBU-2045	Q1005,1017,1047	G3305350B	2SC535B
S02	N0190067	SRN-3094N	Q1011,1018,1039, 1053,1063	G3318150Y	2SC1815Y
S03	Q9000083A	EWT-XD2 S3550B	Q1012,1030,1031	G3318150G	2SC1815GR
S03 (with Board)	C0021430		Q1020,1022,1058	G3107331P	2SA733 P or Q
S04,08	N6090004	SSF-22-08B	Q1038	G3320530	2SC2053
S06,07	N6090002	SSH-23-08	Q1048,1049,1050	G3315830	2SC1583
			Q1051	G3309450P	2SC945P
			Q1055	G3313830R	2SC1383R
			Q1052	G3090005	MPSA13
J01	P0090158	FM-214-8SS			
J02	P0090010	FM-142S			
J03	P1090028	MBR06D			
J04	P1090005	SG8050			
J06,11	P0090054	5048-07A	D1002,1006,1008, 1009,1015, 1016-1024, 1027-1029,1031, 1032,1036-1043, 1049,1050,1057, 1058,1061-1065, 1067-1072, 1074-1076,1079, 1081-1083	G2090027	DIODE 1SS53
J07,09,10	P0090036	5048-14A			
J08	P0090173	EMCS0450M			
J08 (with Board)	C0021320				
					PLUG
P01	T9203130B	5208-07			
P02	T9203140B	5208-10	D1010-1012,1014, 1025,1026,1030, 1033-1035, 1044-1048,1059, 1060	G2001880F	1S188FM
P03	T9203150A	5208-12			
P04	T9203160A	5208-04			
P06	T9203170	5208-12			
P07	T9203180	5208-5	D1013	G2015550	1S1555
P08	T9203340A	5208-07	D1001,1003-1005, 1007,1044-1048	G2022090	1S2209
P09	T9203230B	5208-14			
P10	T9203290A		D1053-1056	G2010070	1S1007
P11	T9203300A		D1066	G2090001	10D1
P12	T9203280A				
					CRYSTAL
			X1001	H0101100A	11.265 MHz
			X1002	H0100992	10.8115 MHz
			X1004	H0100993	10.8107 MHz
			X1005	H0101983	7.3728 MHz

		CRYSTAL FILTER	R1251,1254,1308	J02245222	Carbon film	1/4W SJ	2.2k Ω
XF1001	H1102021	108M30B	R1035,1036,1050, 1052,1086,1105, 1131,1143,1166, 1186,1289,1298, 1302	J02245332	"	"	3.3k Ω
XF1002	H1102022	10F-2D					
		CERAMIC FILTER					
CF1001	H3900220	LF-H12S	R1209,1216	J02245392	"	"	3.9k Ω
CF1002	H3900030	LF-B15	R1018,1032,1118, 1136,1146,1218, 1305-1307,1329	J02245472	"	"	4.7k Ω
CF1003	H3900020	LF-B4					
		CERAMIC DISCRIMINATOR					
CD1001	H7900040	455-DW-8	R1023,1029,1030, 1045,1046,1053, 1100,1152,1159, 1163,1181,1277, 1283,1299,1310, 1327	J02245562	"	"	5.6k Ω
		MODULATOR MODULE					
XM1001	H9500390	XM-10.81					
			R1016,1088	J02245682	"	"	6.8k Ω
		RESISTOR	R1148	J02245822	"	"	8.2k Ω
R1141	J02245010	Carbon film	R1026,1055,1079, 1093,1094,1096, 1104,1119,1125, 1134,1135,1137, 1154,1177,1180, 1229,1232,1243, 1265,1269,1275, 1279,1282,1284, 1293,1303,1304, 1311,1322	J02245103	"	"	10k Ω
R1140	J02245229	" " " " 2.2 Ω					
R1211	J02245100	" " " " 10 Ω					
R1025	J02245223	" " " " 47 Ω					
R1007,1013,1017, 1078,1084,1204, 1207	J02245560	" " " " 56 Ω					
R1063	J01245560	" " " TJ 56 Ω					
R1173	J02245680	" " " SJ 68 Ω					
R1188	J02245820	" " " " 82 Ω					
R1028,1044,1085, 1097,1112,1117, 1175,1179,1190, 1231,1235,1236, 1242,1245,1257, 1260,1263,1267	J02245101	" " " " 100 Ω	R1126,1219,1233	J02245123	Carbon film	1/4W SJ	12k Ω
			R1286,1290	J02245153	"	"	15k Ω
			R1114,1169	J02245183	"	"	18k Ω
			R1031,1047,1048, 1171,1220,1246, 1264,1272,1276, 1278,1287,1309	J02245223	"	"	22k Ω
R1024,1064,1065, 1073,1182,1183, 1326,1333	J01245101	" " " TJ 100 Ω	R1144,1162,1164	J02245273	"	"	27k Ω
R1005,1021,1076, 1083,1109,1147	J02245151	" " " SJ 150 Ω	R1176,1248,1268, 1291	J02245333	"	"	33k Ω
R1139,1172,1234, 1237,1238	J02245221	" " " " 220 Ω	R1004,1020,1075, 1080,1108,1202, 1324	J02245393	"	"	39k Ω
R1060	J01245471	" " " " 330 Ω					
R1059	J02245391	" " " " 390 Ω	R1011,1025,1058, 1151,1228,1247, 1280,1281	J02245473	"	"	47k Ω
R1066,1193,1240, 1253,1266,1322	J02245471	" " " " 470 Ω					
R1330	J01245471	" " " TJ 470 Ω	R1056,1168,1252	J02245563	"	"	56k Ω
R1070,1178,1323	J02245561	" " " SJ 560 Ω	R1113,1127,1128, 1145,1158	J02245683	"	"	68k Ω
R1012	J02245681	" " " " 680 Ω					
R1185	J02245821	" " " " 820 Ω	R1133	J02245823	"	"	82k Ω
R1006,1022,1027, 1033,1062,1071, 1072,1077,1082, 1087,1090,1091, 1110,1123,1130, 1149,1157,1174, 1184,1192,1208, 1213,1241,1244, 1250,1256,1258, 1259,1261,1262, 1274,1325,1331	J02245102	" " " " 1k Ω	R1001,1003, 1008-1010,1014, 1019,1074,1081, 1095,1107,1111, 1116,1124,1127, 1132,1138,1150, 1156,1161,1170, 1194-1199,1201, 1206,1270,1273, 1292	J02245104	"	"	100k Ω
R1212	J10246102	" composition " GK 1k Ω	R1318	J10246104	" composition	1/4W GK	100k Ω
R1115	J02245122	" film " SJ 1.2k Ω	R1332	J01245104	" film	1/4W TJ	100k Ω
R1054,1102,1103, 1121,1191,1205, 1210,1217,1230	J02245152	" " " " 1.5k Ω	R1057,1155,1160, 1215	J02245124	"	"	120k Ω
			R1038,1040,1049, 1051	J02245154	"	"	150k Ω
R1061,1121	J02245182	" " " " 1.8k Ω	R1089,1214,1255	J02245184	"	"	180k Ω
R1015,1034,1037, 1039,1041-1043, 1067-1069,1099, 1106,1129,1165, 1187,1221,1249	J02245222	" " " " 2.2k Ω	R1200	J02245224	"	"	220k Ω
			R1239,1294	J02245334	"	"	330k Ω
			R1120	J02245394	"	"	390k Ω
			R1271,1297	J02245564	"	"	560k Ω

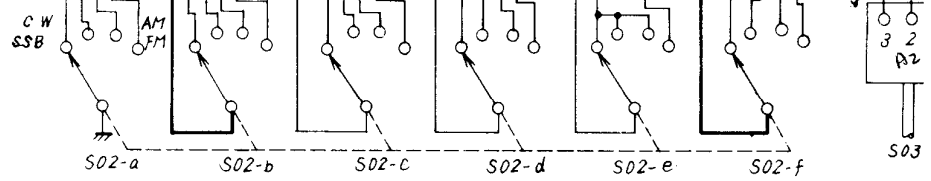
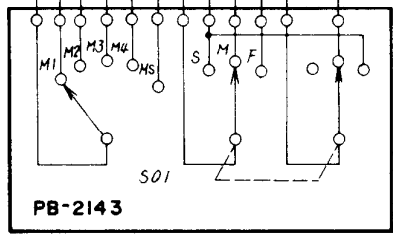
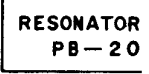
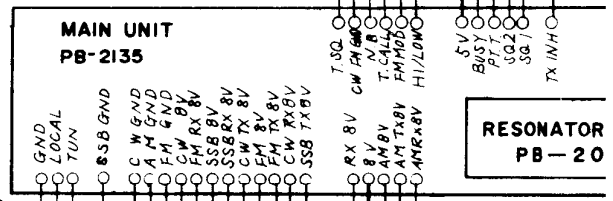
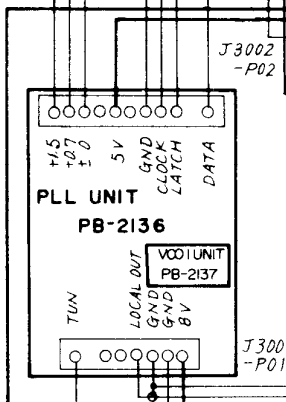
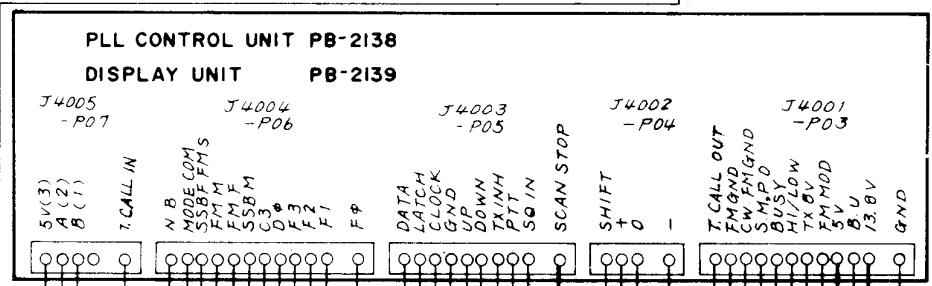
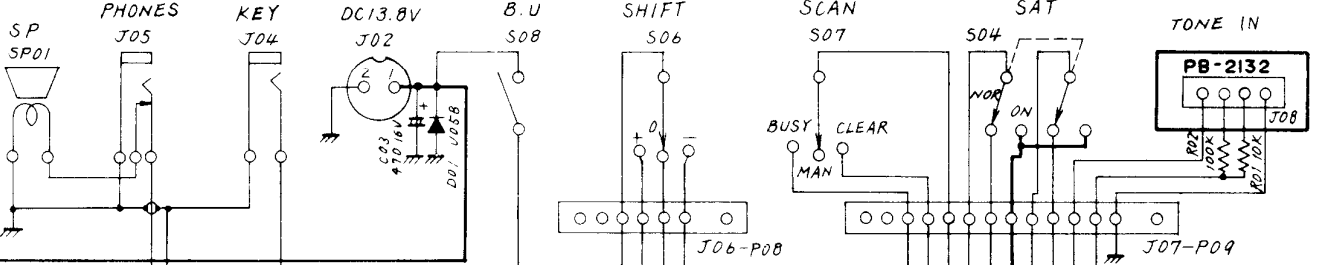
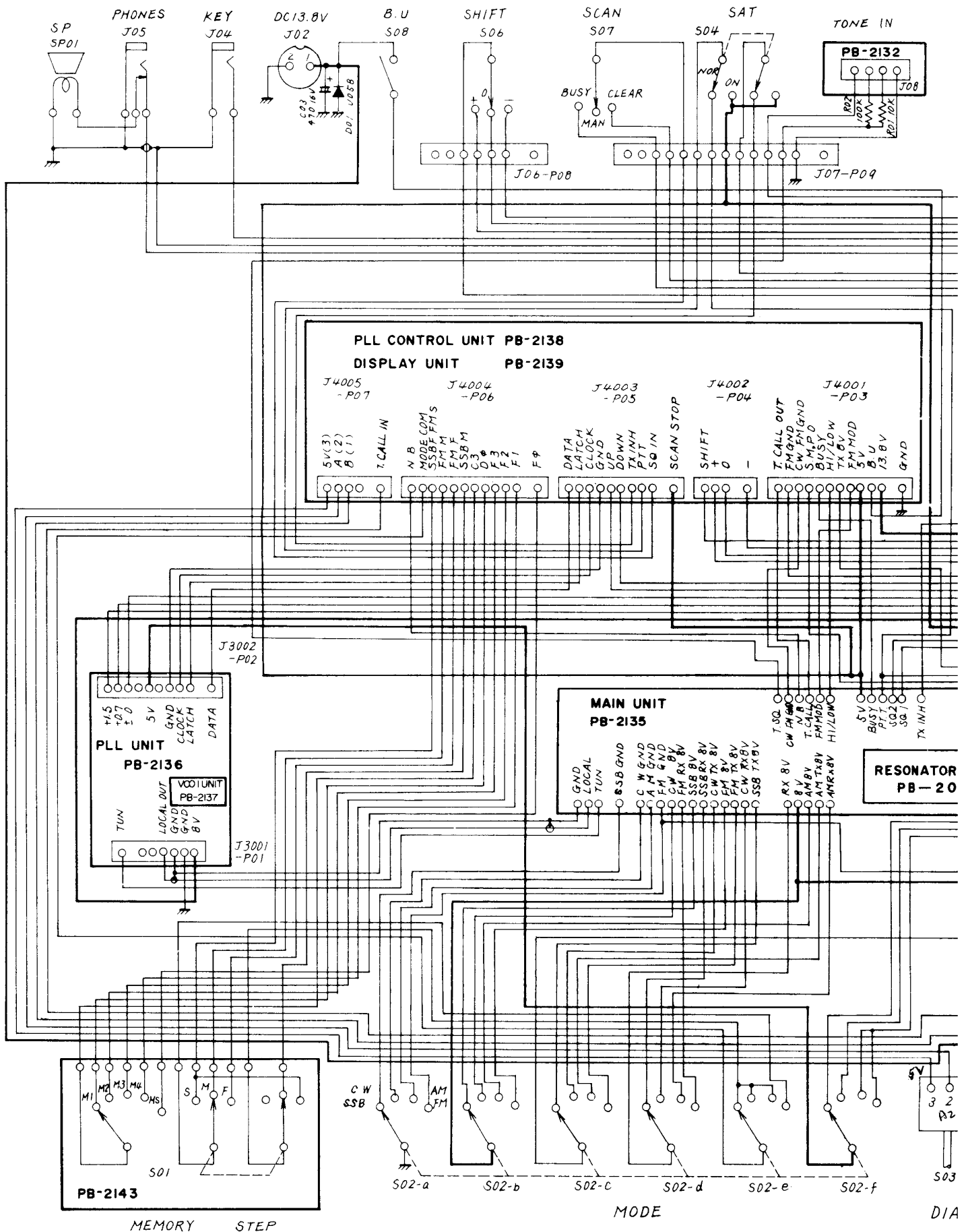
R1288	J02245684	Carbon film	1/4W SJ	680kΩ	C1204	K02179011	Ceramic	50WV CH27pF
R1285,1296	J02245824	"	"	820kΩ			(DD104CH270J50V02)	
R1098,1295,1101,1300	J02245105	"	"	1MΩ	C1181,1220,1241,1248,1249	K00175330	"	SL 33pF
R1092,1301	J02245155	"	"	1.5MΩ			(DD104SL330J50V02)	
R1002	J02245225	"	"	2.2MΩ	C1002,1174,1176,1180,1186	K06175330	"	UJ 33pF
							(DD104UJ330J50V02)	
					C1034	K00175390	"	39pF
							(DD104SL390J50V02)	
		THERMISTOR						
TH1001	G9090001	SDT-250			C1059	K00175470	"	47pF
							(DD104SL470J50V02)	
		POTENTIOMETER						
VR1001	J51730222	P6-S3NA	2.2kΩ		C1217	K02175470	"	CH47pF
							(DD106CH470J50V02)	
VR1002-1006,1009,1010,1013	J51730103	P6-S3NA	10kΩ		C1010,1011,1012	K06175470	"	UJ 47pF
							(ECC-D1H470UJ2)	
VR1007,1012	J51730223	P6-S3NA	22kΩ		C1167,1168	K06175680	"	UJ 68pF
							(ECC-D1H680JU2)	
VR1008	J51737221	3321P	220Ω		C1015-1017	K02175820	"	CH82pF
							(DD107CH820J50V02)	
VR1011	J51730104	P6-S3NA	100kΩ					
VR1014	J51729503	RV8-FAN	50kΩ		C1077,1093,1094,1113,1189,1234,1271	K00175101	"	SL 100pF
							(DD105SL101J50V02)	
		CAPACITOR						
	K00179001	Ceramic	50WV SL	0.5pF	C1157,1159	K00175221	"	220pF
							(DD104SL0R5C50V02)	
C1175	K00172010	"	"	1pF	C1242	K00175331	"	330pF
							(DD104SL010C50V02)	
	K00172020	"	"	2pF	C1158	K00176471	"	470pF
							(DD104SL020C50V02)	
C1020	K02179003	"	"	CH2pF	C1003,1004,1006,1019,1023,1026,1033,1065,1071,1085,1124,1131,1132,1151,1183,1190,1193,1218,1228,1230,1245,1261,1264,1266,1273,1274	K13170102	"	0.001μF
							(DD104CK020C50V02)	(DB200YF102Z75L2)
C1224	K00172030	"	"	SL 3pF				
							(DD104SL030C50V02)	
	K00172040	"	"	4pF				
							(DD104SL040C50V02)	
C1032	K00172050	"	"	SL 5pF				
							(DD104SL050C50V02)	
C1187	K02172050	"	"	CH5pF	C1005,1007,1008,1009,1014,1022,1024,1025,1030,1037,1066-1068,1073,1076,1082-1084,1086-1088,1090,1092,1098,1100,1127,1152,1154,1155,1156,1169,1160-1165,1171,1182,1185,1188,1191,1192,1199,1200,1206,1209,1211,1213,1214,1215,1219,1223,1229,1251,1263	K13170103	"	0.01μF
							(DD104CH050C50V02)	(DB201YF103Z5L5)
	K06173060	"	"	UJ 6pF				
							(ECC-D1H060DV)	
	K00173060	"	"	SL 6pF				
							(DD104SL060D50V02)	
C1269	K00173070	"	"	SL 7pF				
							(DD104SL070D50V02)	
	K06173080	"	"	UJ 8pF				
							(DD104UJ080D50V02)	
C1069	K02173080	"	"	SL 8pF				
							(DD104SL080D50V02)	
C1080	K00173100	"	"	10pF				
							(DD104SL100D50V02)	
C1001,1166,1179,1216	K02173100	"	"	CH10pF	C1027,1042,1043,1051,1072,1109,1145,1197,1252	K19149026	(UAT04V102K-L05AE)	25WV 0.001μF
							(DD104CH100D50V02)	
C1021	K00175120	"	"	SL 12pF	C1078,1110,1120,1270	K19149005	(UAT04X222K-L05AE)	25WV 0.0022μF
							(DD104SL120J50V02)	
C1173,1177	K02175120	"	"	CH12pF	C1136,1144,1196	K19149007	(UAT05X332K-L05AE)	25WV 0.0033μF
							(DD104CH120J50V02)	
C1038,1153,1276	K00175150	"	"	SL 15pF	C1055,1056,1060,1070,1096,1101,1105,1111,1119,1232,1235,1237,1239,1257	K19149013	(UAT05X103K-L05AE)	25WV 0.01μF
							(DD104SL150J50V02)	
	K02175150	"	"	CH15pF				
							(DD104CH150J50V02)	
	K02175180	"	"	18pF	C1146	K19149015	(UAT08X153K-L45AE)	25WV 0.015μF
							(DD104CH180J50V02)	
C1210,1212	K00175220	"	"	SL 22pF	C1052-1054,1246	K19149017	(UAT04X223K-L05AE)	25WV 0.022μF
							(DD104SL220J50V02)	
C1172,1178	K00175270	"	"	27pF	C1028,1029,1031,1039-1041,1044-1050,1074	K19149021	(UAT08X473K-L45AE)	25WV 0.047μF
							(DD104SL270J50V02)	

C1075,1079,1081,1102-1104,1106,1107,1114,1227,1233,1236,1238,1240,1253,1254,1279	K19149021	(UAT08X473K-L45AE) 25WV 0.047μF	T1008	L0020422	
			CH1001	L2030067	CHOKE COIL FR14/7/5-2001F
C1058,1063,1129	K19149025	(UAT13X104K-L46AE) 25WV 0.1μF			RELAY
			RL1001	M1190006	FBR221D012
		Electrolytic			
C1258	K40179005	50WV 0.47μF (50RC2-R4)		L9190001	Ferrite Beads RI 3x3-1
C1091,1097,1116-1118,1121,1123,1133,1137,1138,1140,1141,1143,1147,1148,1150,1194,1225,1243,1247,1256,1260	K40170105	" 1μF (50RL1)		Q5000026	Terminal TP-E
C1268	K40179001	" 1μF (50RC2-1)			
C1255	K40149001	25WV 4.7μF (25RE4R7)			
C1061,1062	K40149011	" 4.7μF (25RC2-4R7)			
C1250,1262,1265	K40120106	16WV 10μF (16RL10)	Symbol No.	Part No.	Description
C1115	K40129004	" 10μF (16RE10)	PB-2140	F0002140	Printed Circuit Board
C1184	K40120226	" 22μF (16RL22)		C0021400	PCB with Components
C1108,1112	K40129002	" 47μF (16RE47)			
C1064,1089,1134,1135,1139,1142,1149,1195,1198,1226,1244,1259	K40109002	10WV 47μF (10RE47)	Q2001	G3321660	2SC2166
			Q2002	G3319450	2SC1945
			Q2003	Q3107150C	2SA715C
C1122	K40109001	" 100μF (10RE100)			DIODE
C1125	K40109007	" 220μF (10RE220)	D2003-2007	G2001880F	Germanium 1S188FM
C1128	K40129001	16WV 330μF (16RE330)	D2001,2002	G2090001	Silicon 10D1
C1130	K40129003	" 1000μF (16RL1000 KOHO)			
		Tantalum			RESISTOR
C1201	K70167474	35WV 0.47μF (CS15E1VR47)	R2009	J01245220	Carbon film 1/4W TJ 22Ω
C1099	K70127225	16WV 2.2μF (CS15E1C2R2M)	R2001	J02245470	" " " SJ 47Ω
		Styrol	R2003,2006	J10276560	" composition 1/2W 56Ω
C1036,1208,1222	K51176101	50WV 100pF (50SU101K)	R2002	J10276221	" " 1/2W 220Ω
C1035,1207,1221	K51176221	" 220pF (50SU221K)	R2007	J10246271	" " 1/4W 270Ω
			R2008	J02245222	" film " SJ 2.2kΩ
			R2010	J01245104	" " " TJ 100kΩ
		TRIMMER CAPACITOR			
TC1001-1003,1007,1009,1010	K91000075	20pF (TZ03T200A)			POTENTIOMETER
			VR2002	J50716201	RV8FAS 200Ω
			VR2003	J50716502	" 5kΩ
TC1005,1006	K91000076	40pF (TZ03R450E)	VR2001	J50716503	" 50kΩ
		INDUCTOR			CAPACITOR
L1010,1011	L1190006	(FL4H1R2M 1.2μH) 1.2μH	C2012	K00179001	Ceramic 50W SL 0.5pF (DD104SL0R5C50V02)
L1004,1009	L1190035	(FL7H392J) 3.9μH			
L1016	L1190013	(FL4H6R8K 6.8μH) 6.8μH	C2025,2027	K00172010	" 50W SL 1pF (DD104SL010C50V02)
L1001	L1190070	(FL4H8R2M 8.2μH) 8.2μH			
L1003	L1190117	(S4-150) 15μH	C2001	K00175220	" " " 22pF (DD104SL220J50V02)
L1007,1008,1014,1015,1017	L1190016	(FL5H101K) 100μH	C2002	K00175270	" " " 27pF (DD104SL270J50V02)
L1005,1006	L1190040	(S-4 1mH) 1mH			
L1012	L0020826		C2018,2020-2022,2029,2032	K00175470	" " " 47pF (DD104SL470J50V02)
L1013	L0020827				
L1002	L0020586		C2017	K00175560	" " " 56pF (DD104SL560J50V02)
		TRANSFORMER			
T1001,1002,1010-1014	L0020825		C2007,2016	K00175820	" " " 82pF (DD104SL820J50V02)
			C2019,2030,2031	K00175101	" " " 100pF (DD105SL101J50V02)
T1003,1005,1006,1015	L0020187		C2006	K00175151	" " " 150pF (DD104SL151J50V02)
T1004,1009,1016-1018	L0190001		C2008	K00175221	" " " 220pF (DD107SL221J50V02)
T1007	L0020420				

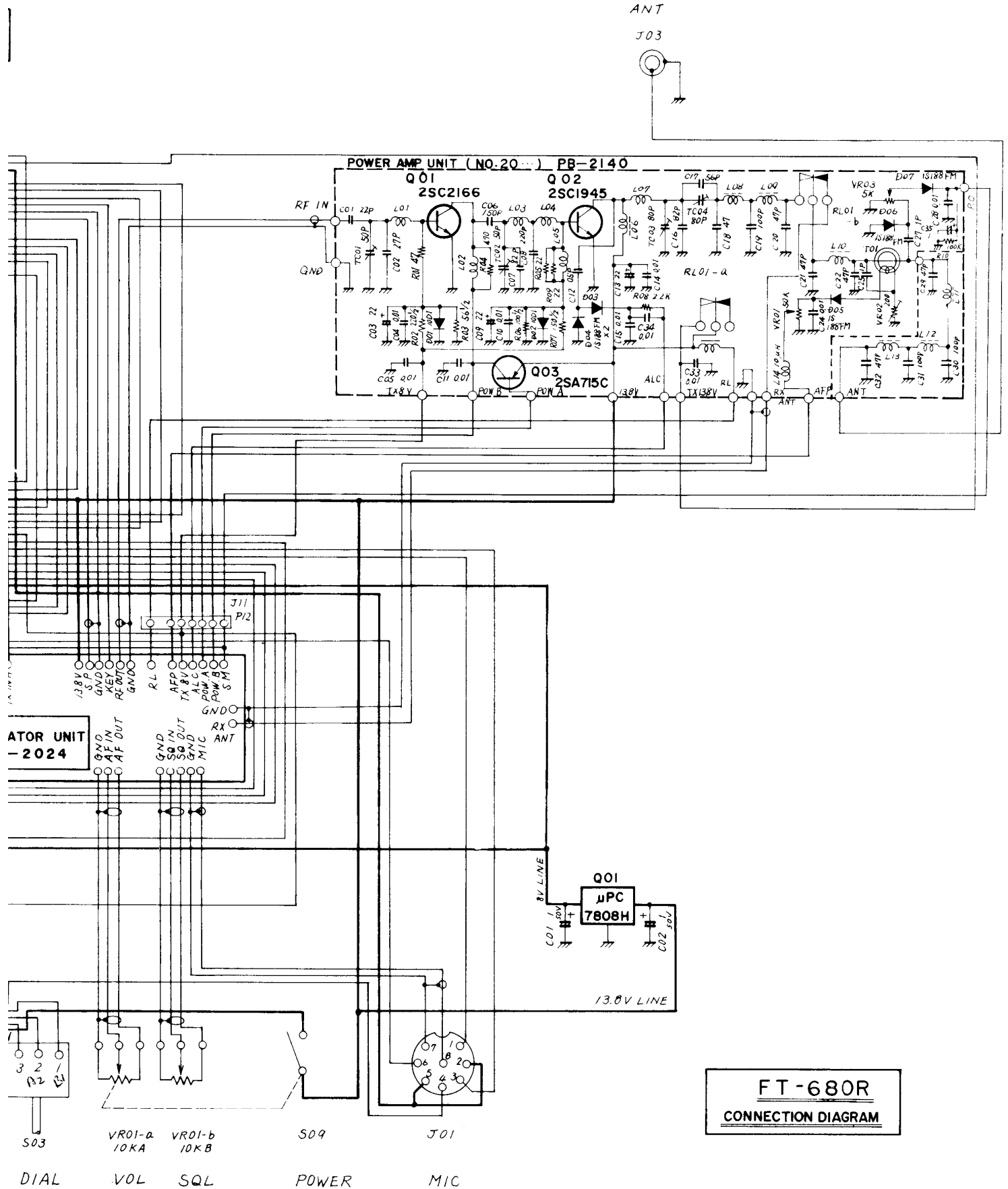
C2004,2005,2010, 2011,2014,2015, 2024,2028,2033	K13170103	Ceramic 50WV 0.01μF (DB201YF103Z5L5)	Q3046	G3107331P /Q	Tr	2SA733 P or Q
			Q3045	G3090005	"	MPS-A13
C2034	K19149013	(UAT05X103K-L05AE) 25WV 0.01μF				
			Electrolytic	QS3001	P3090034	IC SOCKET 116-24-30-114
C2035	K40170105	50WV 1μF (50RL1)				
C2003,2009,2013	K40129016	16WV 22μF (16RE22)				
			TRIMMER CAPACITOR	D3002-3007, 3019-3022,3015	G2090027	Silicon 1SS53
TC2001,2002	K91000023	ECV-1ZW 50x40 50pF	D3001	G2090043	Varactor	MV104
TC2003,2004	K91000058	2222-808-61809 80pF	D3016-3018,3008	G2022090	"	1S2209
		INDUCTOR				CRYSTAL
L2001	L0020823		X3001	H0100910		10.240 MHz
L2002	L1020469		X3002	H0102292		56.1668 MHz
L2003,2004	L0020674		X3003	H0102290		56.81 MHz
L2005	L0020828					
L2006,2008-2013	L0020824					RESISTOR
L2007	L0020678		R3011,3056,3077	J02245100	Carbon film	1/4W SJ 10Ω
L2014	L1190014	FL-4H 100K 10μH	R3005,3009,3012, 3018,3028,3046, 3054,3057,3063, 3073,3081,3083, 3090,3098	J02245101	" "	" " 100Ω
		TRANSFORMER				
T2001	L0020584		R3087	J02245151	" "	" " 150Ω
		RELAY	R3031,3036,3049, 3062,3096	J02245221	" "	" " 220Ω
RL2001	M1190006	FBR221-D012				
		Terminal TP-E	R3004	J02245331	" "	" " 330Ω
	Q5000016		R3027,3045	J02245471	" "	" " 470Ω
			R3016,3116	J02245681	" "	" " 680Ω
			R3014,3015,3039, 3059,3085,3089, 3102-3104,3129, 3130	J02245102	" "	" " 1kΩ
PLL UNIT			R3075,3118	J02245122	" "	" " 1.2kΩ
Symbol No.	Part No.	Description	R3038,3088	J02245152	" "	" " 1.5kΩ
PB-2136C	F0002136C	Printed Circuit Board		J02245182	" "	" " 1.8kΩ
	C0021360	PCB with Components	R3091	J02245222	" "	" " 2.2kΩ
			R3120	J02245272	" "	" " 2.7kΩ
		IC, FET and TRANSISTOR	R3092	J02245332	" "	" " 3.3kΩ
Q3003,3018	G1090012	IC SN16913P		J02245392	" "	" " 3.9kΩ
Q3005,3026	G1090247	" TC9122P	R3017,3042	J02245472	" "	" " 4.7kΩ
Q3006,3014	G1090048	" TC5081P	R3093	J02245562	" "	" " 5.6kΩ
Q3007	G1090239	" TC5082P		J02245822	" "	" " 8.2kΩ
Q3008	G1090084	" μPC78L05	R3019-3022,3024, 3029,3035,3040, 3044,3048,3061, 3076,3095,3101, 3128	J02245103	" "	" " 10kΩ
Q3012,3013	G1090296	" HD10551				
Q3024	G1090062	" SN76514N				
Q3027	G1090153	" MB8718				
Q3031-3033	G1090297	" μPD4094B	R3122	J02245183	" "	" " 18kΩ
Q3034,3035	G1090298	" MC14560B	R3023,3025,3043, 3086,3105,3106, 3108-3110, 3113-3115,3117, 3119,3121,3127	J02245223	" "	" " 22kΩ
Q3036	G1090088	" MC14028B				
Q3044	G1090299	" μPC7805H				
Q3001	G3090035	FET 2SK19TMGR				
Q3022,3023	G4800510C	" 3SK51-03	R3111	J01245223	" "	" TJ 22kΩ
Q3002,3017,	G4800730Y	" 3SK73Y	R3030,3034,3047, 3060,3094	J02245333	" "	" SJ 33kΩ
Q3028	G3090034	" 2SK19TMY				
Q3004,3019,3025, 3037-3040	G3309450Q	Tr 2SC945Q	R3001-3003, 3006-3008,3041, 3051-3053, 3070-3072, 3078-3080,3097, 3099,3100	J02245104	" "	" " 100kΩ
Q3009,3015	G3316740L	" 2SC1674L				
Q3010,3011,3016, 3020,3030	G3305350A	" 2SC535A				
	G3307100	" 2SC710				
Q3029 3023	G3307320G	" 2SC732TMBL	R3013,3058,3084	J02245184	" "	" " 180kΩ

MEMO

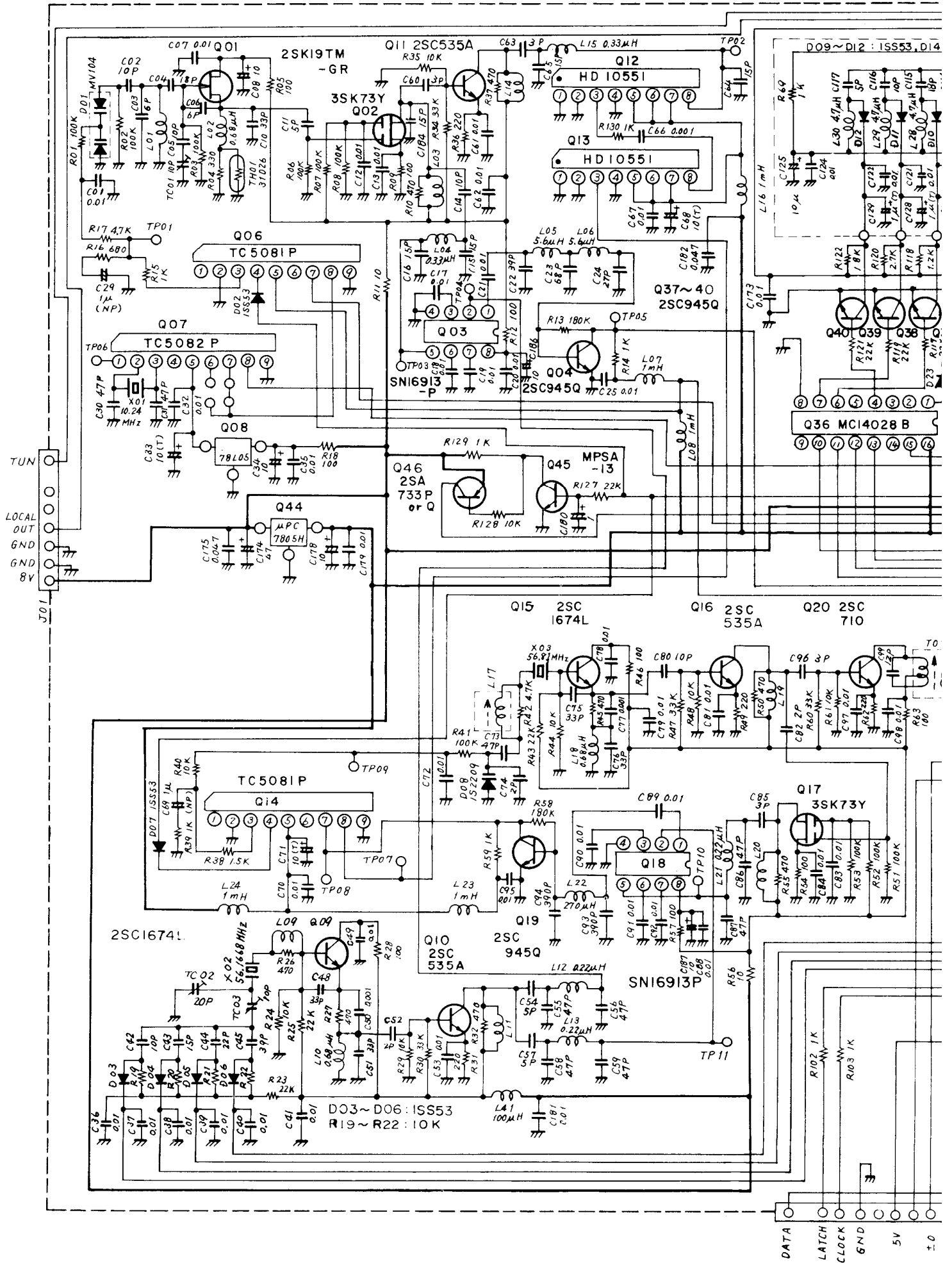


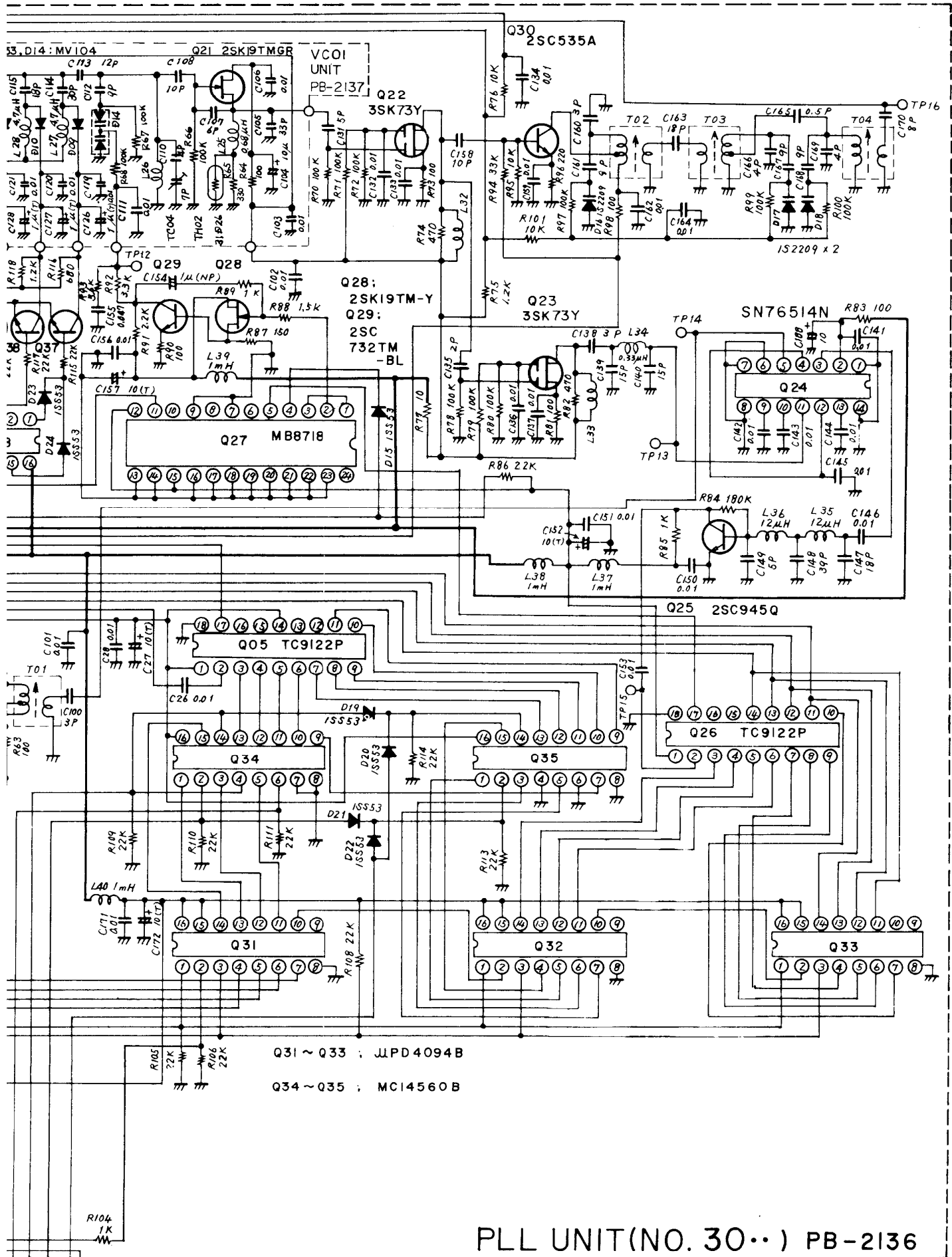


DIA



FT-68OR
CONNECTION DIAGRAM





PLL UNIT(NO. 30..) PB-2136

±0
+0.7
+1.5

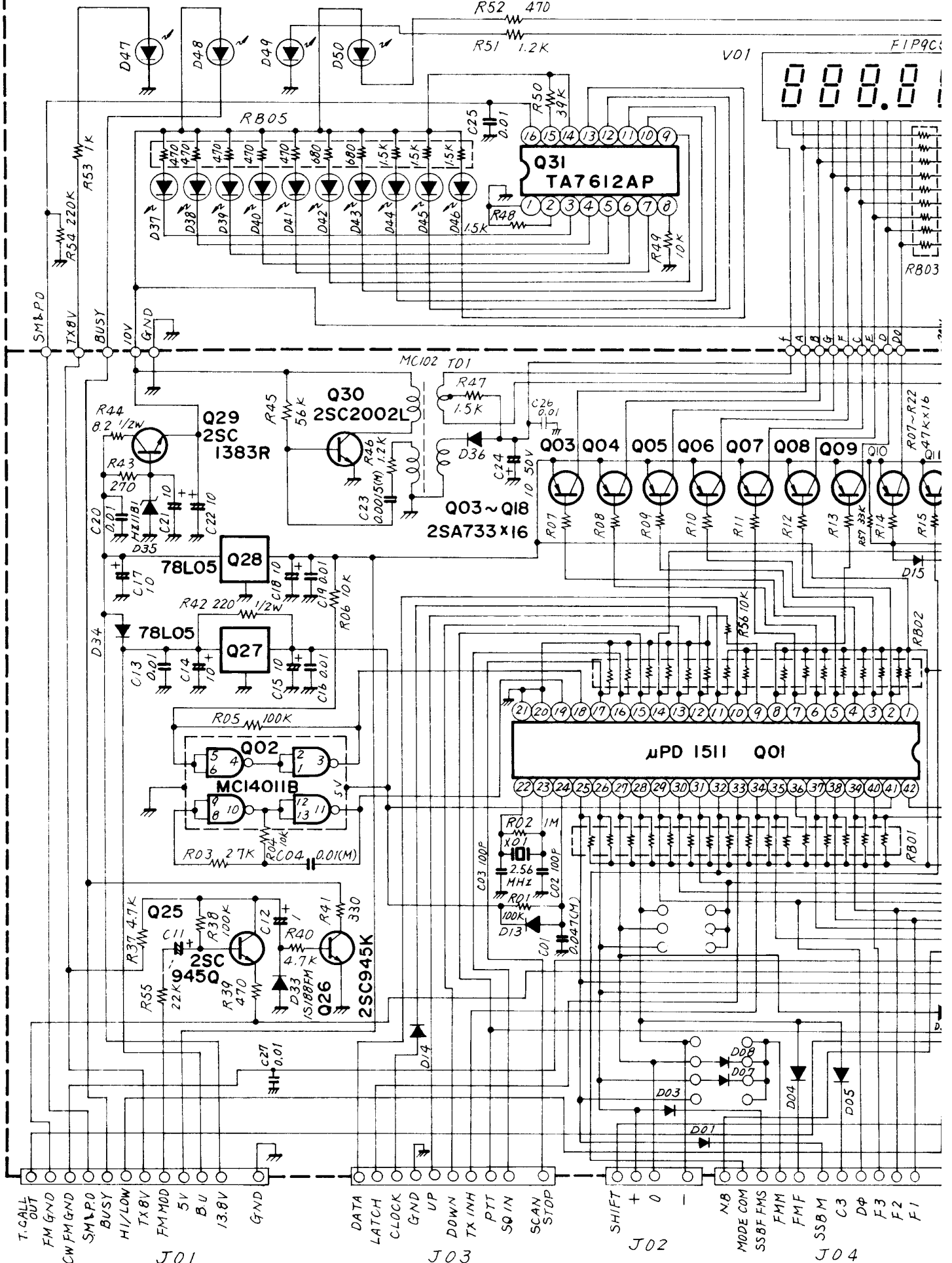
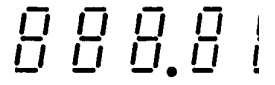
J02

DISPLAY UNIT (NO. 40...) PB-2139

ON AIR BUSY/MOD CLAR LOW

V01

FIP9C



J01

J03

J02

J04

