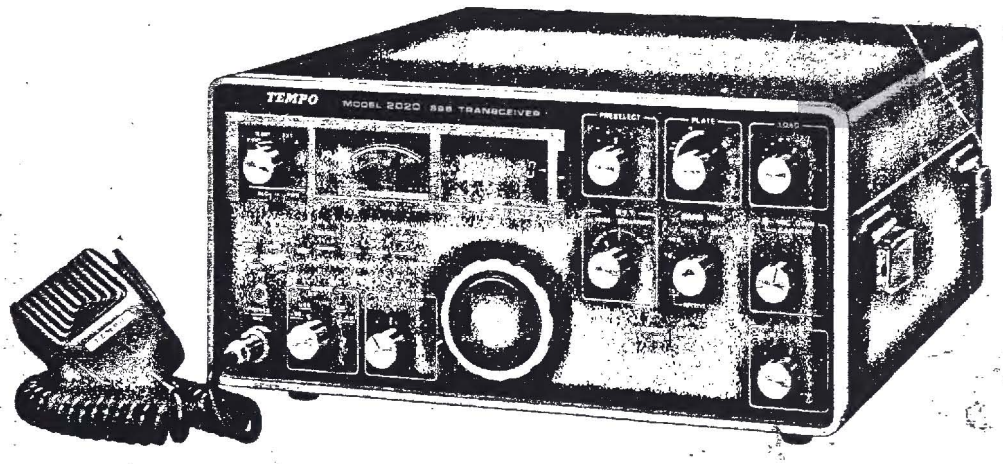
INSTRUCTION MANUAL

• Tempo

MODEL 2020



Henry Radio

MODEL 2020 OPERATING MANUAL

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TEMPO 2020 AMATEUR RADIO TRANSCEIVER

DISTRIBUTED BY: HENRY RADIO
11240 West Olympic Boulevard
Los Angeles, California 90064

SPECIFICATIONS

FREQUENCY RANGE:	80 meter band —	3.5 to 4.0 MHz
	40 meter band —	7.0 to 7.5 MHz
	20 meter band —	14.0 to 14.5 MHz
	15 meter band —	21.0 to 21.5 MHz
	10 meter band —	28.0 to 28.5 MHz (A)
		28.5 to 29.0 MHz (B)
		29.0 to 29.5 MHz (C)
		29.5 to 30.0 MHz (D)
	WWV —	15.0 to 15.5 MHz (receive only)
	11 meter band —	27.0 to 27.5 MHz (receive only)

MODE: USB, LSB, CW or AM.

POWER REQUIREMENTS: 100/110/117/200/220/234 VAC, 50/60 Hz or 13.8 VDC ±10%.

Receive:	100 watts (heaters on)
	28 watts (heaters off)
*Transmit:	305 watts (maximum)

PLATE POWER INPUT: More than 180 watts PEP for SSB operation.
More than 180 watts DC for CW operation.
More than 90 watts DC for AM operation.

POWER OUTPUT: 120 watts nominal PEP into 50 ohms for SSB operation.
100 watts nominal DC into 50 ohms for CW operation.
25 watts nominal DC into 50 ohms for AM operation.

AUDIO INPUT IMPEDANCE: 50 K ohms (high impedance).

AUDIO OUTPUT IMPEDANCE: 4 ohms (speaker or headphones).

AUDIO OUTPUT: More than 2.5 watts (with less than 10% distortion) into a 4 ohm load.

RF OUTPUT IMPEDANCE: 50 ohms with SWR less than 3:1.

FREQUENCY STABILITY: Within 100 Hz during any 30 minute period after warmup.
Within 300 Hz during the first hour after 1 minute of warmup.

CALIBRATION ACCURACY: Within 1 KHz across the VFO frequency range after calibration at zero.

KEYING: Break-in CW with sidetone provided.

AUDIO FREQUENCY RESPONSE: 300 to 2700 Hz, within —6 db.

CARRIER SUPPRESSION: Carrier better than 50 db down from the output signal.

SIDEBAND SUPPRESSION: Unwanted sideband is better than 50 db down from the output signal at 1000 Hz.

IMAGE RATIO: Image frequency is better than 50 db down from the output signal.

HARMONIC RADIATION: Better than 40 db down from the output signal.

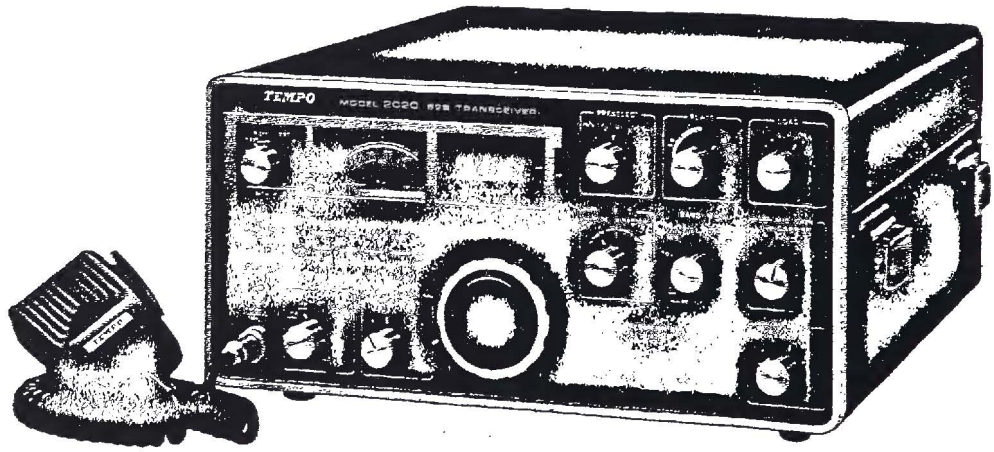
IF REJECTION: First IF frequency is 50 db or more down from the output signal.

RECEIVER SENSITIVITY: Better than 0.3 microvolts for a 10 db (signal + noise)/noise ratio at 14 MHz for SSB and CW operation.

Better than 1.0 microvolt for a 10 db (signal + noise)/noise ratio at 14 MHz for AM operation.

RECEIVER SELECTIVITY:	SSB —	2.4 KHz bandwidth (— 6 db down)
		4.0 KHz bandwidth (—60 db down)
	CW —	0.6 KHz bandwidth (— 6 db down)
		1.5 KHz bandwidth (—60 db down)

CALIBRATOR:	Built-in 25 KHz crystal oscillator.
TYPE OF MODULATION:	SSB — Balanced modulation. AM — Low power modulation.
RIT:	The receiver incremental tuning control can vary the receive frequency (without changing the transmit frequency) ±5 KHz or more in the RIT's wide position, and ±1 KHz in the RIT's narrow position.
NOISE BLANKER:	The built-in noise blanker is desinged to reduce impulse type (ignition) noises.
METERING:	ALC (Automatic Level Control) — Recommended range (transmit) or IK (Plate Current) — 0 to 350 ma (transmit) or PWR (Relative Power Output) — No scale. S-meter during receive.
VOX:	The 2020 has a built-in VOX circuit with adjustable VOX gain and delay.
MODULAR CONSTRUCTION:	All major electronic circuits are built onto separate plug-in printed circuit boards.
TUBE COOLING:	The 2020 has a built-in cooling fan to cool the final RF section.
TUBE AND SEMICONDUCTOR COMPLEMENT:	3 Tubes — 6146B (x2) and 12BY7A. 18 IC's 52 Transistors 154 Diodes.
DIMENSIONS:	350 mm (14.75") wide x 165 mm (6.5") high x 333 mm (13.25") deep.
WEIGHT:	Unpacked — Approximately 18 Kg (39.6 lbs.) Shipping — Approximately 21 Kg (46.5 lbs.).
MICROPHONE:	A hand-held, high impedance microphone with coil cord is included.
SPEAKER:	A built-in 2.5 watt 4 ohm speaker is provided.



SECTION 1. INTRODUCTION

1.1 TEMPO 2020

The 2020 is a sophisticated solid state amateur radio transceiver employing only three vacuum tubes. Operating on all amateur bands between 3.5 and 30.0 MHz, this unit offers many advanced, modern features. Its entire construction is modular, with all major electronic circuits built on plug-in circuit boards. The 2020 includes many built-in features found as extras on other transceivers. Included in the equipment are a VOX circuit, a 25 KHz crystal calibrator, an RIT circuit with narrow and wide ranges, and a very effective noise blanker. The 2020 also includes automatic gain control (AGC), automatic level control (ALC), provisions for break-in CW with sidetone, PLL oscillator circuit design and built-in power supplies.

Other special features offered by the 2020 include a hybrid digital readout, rugged 6146B final output tubes, and complete separation of the transmit and receive circuits. The 2020 is totally self-contained including AC and DC power supplies, a microphone, a cooling fan, and a speaker. It is ready to use with the addition of a proper antenna.

Designed for operation on SSB, CW, or AM the 2020 delivers more than 120 watts PEP output for CW and SSB, and more than 25 watts output for AM. The low power consumption of the 2020, resulting from its solid state design, makes the transceiver ideal for portable and mobile operation. Any complicated electronic equipment will be damaged if it is operated incorrectly, and this transceiver is no exception. Please read all of the operating instructions before putting the 2020 on the air.

1.2 REQUIREMENTS FOR OPERATION

1.2.1 AC OPERATION

The 2020 requires no external power supply for operation. For fixed station operation, the 2020 operates from any 100/110/117/200/220/234 VAC, 50/60 Hz power source capable of supplying 305 watts or more. The transceiver has a built-in 4 ohm speaker.

1.2.2 DC OPERATION

The 2020 has a built-in DC-DC converter for operation from a 13.8 VDC negative ground power souce capable of supply at least 22 amps of current.

1.2.3 ANTENNA

FIXED STATION ANTENNAS — Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the 2020, provided the input impedance of the transmission line is not outside the capability of the pi-output matching network. The transmission line should be of the coaxial cable type. An antenna system which shows a standing wave ratio of less than 2:1 when using 50 or 75 ohm coaxial transmission line, or a system that results in a transmission line input impedance that is essentially resistive, and between 15 and 200 ohms will take power from the transceiver with little difficulty. If open wire or balanced type transmission line is used with the antenna, a suitable antenna tuner is recommended between the transceiver and the feed line. Methods of construction and operation of such tuners are described in detail in the ARRL Antenna Handbook, and similar publications. For operation on the 75 and 40 meter bands, a simple dipole antenna, cut to resonance in the most used portion of the bands, will perform satisfactorily. For operation of the transceiver on the 10, 15, and 20 meter bands, the efficiency of the station will be greatly increased if a good directional rotary antenna is used. Remember that even the most powerful transceiver is useless without a proper antenna.

MOBILE ANTENNAS — Mobile antenna installations are critical, since any mobile antenna for use on the high frequency bands represents a number of compromises. Many amateurs lose the efficiency of their antenna through improper tuning. Remember the following points when using the 2020 with a mobile antenna.

The "Q" of the antenna loading coil should be as high as possible. There are several commercial models available which use high "Q" coils.

The loading coil must be capable of handling the power of the transceiver without over heating. In the CW mode the power output of the transceiver will exceed 100 watts.

The SWR bridge is a useful instrument, but unfortunately it is quite often misunderstood, and overrated in importance. Basically, the SWR bridge will indicate how closely the antenna load impedance matches the transmission line. With long transmission lines, such as will be used in many fixed station installations, it is desireable to keep the impedance match fairly close in order to limit power loss. This is particularly true at the higher frequencies. The longer the line, and the higher the frequency, the more important SWR becomes. However, in moblie installations the transmission line seldom esceeds 20 feet in length, and an SWR of even 4:1 adds very little to the power loss. The only time SWR will idicate a low figure is when the antenna presents a load close to 50 ohms, but many moblie antennas will have a base impedance as low as 15 or 20 ohms at their resonant frequency. In such a case, SWR will indicate 3 or 4 to 1, and yet the system will be radiating efficiently.

The really important factor in your mobile antenna is that it should be carefully tuned to resonance at the desired frequency. The fallacy in using an SWR bridge lies in the fact that it is sometimes possible to reduce the SWR reading by detuning the antenna. Field strength may actually be reduced in an effort to bring SWR down. Since field strength is the primary goal, we recommend a field strength meter for antenna tuning.

For antenna adjustments, the transceiver may be loaded lightly, using the TUNE position instead of operating at full power output. This will limit tube dissipation during adjustments, and will also help to reduce interference on the frequency. In any case, do not leave the transmitter on for very long at one time. Turn it on just long enough to tune, load, and get a field strength reading. Start out with the antenna whip at about the center of its adjustment range. Set the VFO to the desired operating frequency and then adjust the PLATE control for a dip, and then the LOAD control. Then observe the field strength reading. The field strength meter may be set on top of the dash, on the hood, or at an elevated location some distance from the car.

Change the whip length a half inch, or so at a time, retune the finals each time, and again check the field strength at the antenna. Continue this procedure until the point of maximum field strength is found. This adjustment will be most critical on 75 meters, somewhat less critical on 40, until on 10 meters the adjustment will be quite broad. After tuning the antenna to resonance, the finals can be loaded to full power.

MARINE ANTENNAS — For most applications requiring the use of a 2020 on a boat, it has been found that a long wire with an antenna tuner offer the most efficient antenna system. The length of the wire should be at least ¼ of the wavelength of the lowest frequency to be used.

Tuned vertical antennas can also be used on boats, but are more expensive to purchase, less likely to withstand the harsh marine environment, and require good grounding.

1.2.4 MICROPHONE

The microphone input is designed for high impedance (50 K ohms) microphones. A hand held, high impecance microphone is included with the 2020. The choice of microphone is important for good speech quality, and should be given serious consideration. The circuits in the transceiver provide all of the limiting and amplification necessary on audio response, and further restriction (or amplification) is not required. It is more important to have a microphone with a smooth, flat response throughout the speech range.

If a different microphone is used, the microphone manufacturer's instructions should be followed in connecting the microphone cable to the plug. With many microphones the push-to-talk button must be pressed to make the microphone operative. For VOX operation, this feature may be disabled, if desired, by opening the microphone case and permanently connecting the contacts which control the microphone.

1.2.5 EXTERNAL SPEAKER OR HEADPHONES

Receiver audio output from the 2020 is 2.5 watts at 4 ohms. The 2020 has a built-in speaker. However, if an external speaker is desired for fixed station or mobile operation, simply connect it to the EXT. SP. jack on the rear panel. The speaker may be any good 4 ohm permanent magnet type in the 4 inch or larger size. TheTempo 8120 is a matching external speaker for the 2020.

Headphones should also be 4 ohms impedance. When the headphones are connected to the front panel PHONES jack the speaker is disabled.

8010 REMOTE VFO

The 8010 is a remote external VFO designed to be used with the 2020. The 9138 to 9038 KHz output allows split frequency operation with the 2020, and the 10 fixed crystal positions allow 10 additional fixed frequency channels. The 8010, like the 2020 has a hybrid digital readout and a dual range RIT circuit.

Dimensions: 205 mm (8.125") wide x 165 mm (6.5") high x 333 mm (13.25") deep.

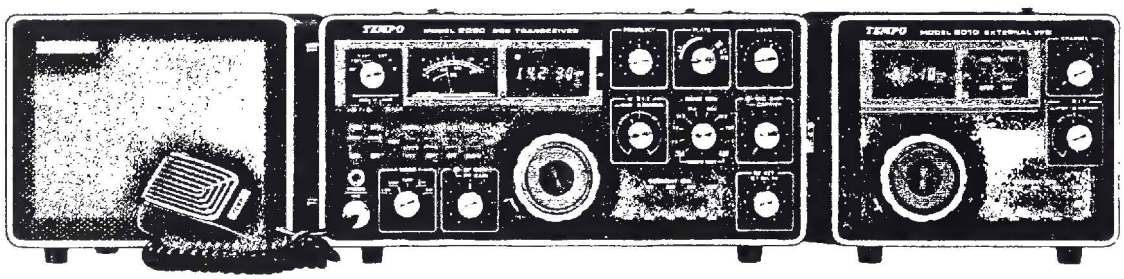
Weight: 3 kg (6.6 pounds).

8120 EXTERNAL SPEAKER

The 8120 is a 15 x 10 cm oval speaker mounted in a cabinet which matches the 2020. The impedance is 4 ohms.

Dimensions: 205 mm (8.125") wide x 165 mm (6.5") high x 333 mm (13.25" deep.

Weight: 1.5 kg (3.3 pounds).



External Speaker model 8120 SSB Transceiver model 2020 Remote VFO model 8010

SECTION 2. INSTALLATION

2.1 UNPACKING

Remove the 2020 carefully from its shipping box and packing material and examine it for visible damage. Check all of the controls for normal operation, and check for internal damage, or loose parts. If the equipment has been damaged in shipment, do not put it into operation, but save the boxes and packing material and notify the transportation company immediately. It is a good idea to save the boxes and packing in any case because they are very useful for shipping or moving the equipment.

CAUTION: Be certain to check the cooling fan very carefully to make certain that is operating properly. Damage to the fan's cover can keep it from rotating, causing the final section to overheat, resulting in extensive damage.

The following accessories should be included with the transceiver:

- 1 Operating Manual and warranty card.
- 1 Microphone with coil cord and connector.
- 1 Extra microphone connector.
- 2 RF type RCA phono plugs for external receiver and transverter jacks.
- 6 RCA phono plugs.
- 2 Alignment tools.
- 2 Plastic extension feet to change the viewing angle of the transceiver (with screws).
- 1 4-pin accessory plug.
- 1 6 foot AC power cord and connector.
- 1 10 foot DC power cord with connector and fuse.
- 1 Headphones plug.
- 1 Coax connector, type PL-259.
- 2 3 AG, 5 amp fuses.
- 2 3 AG, 3 amp fuses.
- 2 30 amp DC fuses.

2.2 OPERATING LOCATION

As with any solid state electronic equipment, the 2020 should be kept from extremes of heat and humidity. Choose an operating location that is dry and cool, and avoid operating the transceiver when it is setting in direct sunlight. Also, allow at least 3 inches clearance between the back of the equipment and any object. This space allows an adequate air flow from the ventilating fan to keep the transceiver cool.

2.3 CABLING

The following wiring must be done before the 2020 can be operated. The connectors and controls are described in greater depth in Section 3.

2.3.1 FRONT PANEL CONNECTIONS

HEADPHONES — If desired, connect the headphone plug to a set of 4 to 16 ohm headphones and plug them into the PHONES jack. CAUTION: Insert the headphone plug completely into the jack. Otherwise the audio attenuator which provides proper headphone output may not work causing an unattenuated (too loud) output.

MICROPHONE — Use the supplied hand held microphone, or attach the extra microphone connector to another suitable microphone as shown in Figure 1. Be certain that the PTT switch of the microphone is separate from the microphone circuit if VOX operation is desired.

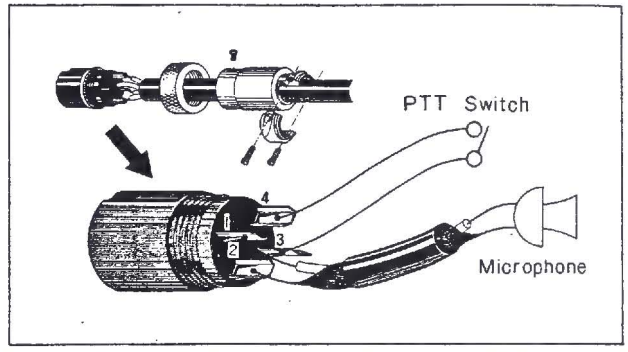


Fig. 1 Microphone plug connections

2.3.2 REAR PANEL CONNECTIONS

POWER CONNECTIONS — Make sure the PWR switch is turned off and the MAN/VOX/PTT switch is in the PTT position. Connect the AC or DC power cord to an appropriate external power source. For distribution in the United States the transceiver is normally supplied with the power transformer wired for operation from a 117 VAC power source. Instruction for rewiring the transformer are given in Section 5.

ANTENNA — Connect a 50 ohm antenna feedline from an appropriate high frequency antenna to the coaxial ANTENNA connector on the rear panel.

GROUND — Connect a wire from a good earth ground to the GROUND stud on the back of the transceiver. If a good earth ground is not available and the 2020 is operated from an approved three-wire electrical system in the United States, the third or neutral wire will normally supply an adequate ground. The transceiver should be grounded to prevent accidental operator shock as well as to prevent TVI type interference.

KEY — If CW operation is desired, connect a key to the KEY jack. The keying is done by shorting the —50 volt blocking bias, so choose an appropriate type of key or electronic keyer. CAUTION: Please be careful! There is —50 volts output at this terminal.

These are all of the connections necessary for operation. Figures 2 and 3 show cabling connections for other accessories. These connections will be described in more detail in Section 3.

FIGURE 2. Connections of the 2020 to its accessories.

NOTE 1: An external stand-by switch or foot switch will only work when the MANU./VOX/PTT switch on the front panel is in the PTT position.

NOTE 2: The audio output impedance is 4 ohms. When the external speaker is connected, the built-in speaker is automatically disconnected.

NOTE 3: The anti-trip input for the VOX is obtained from the speaker voice coil of the separate receiver.

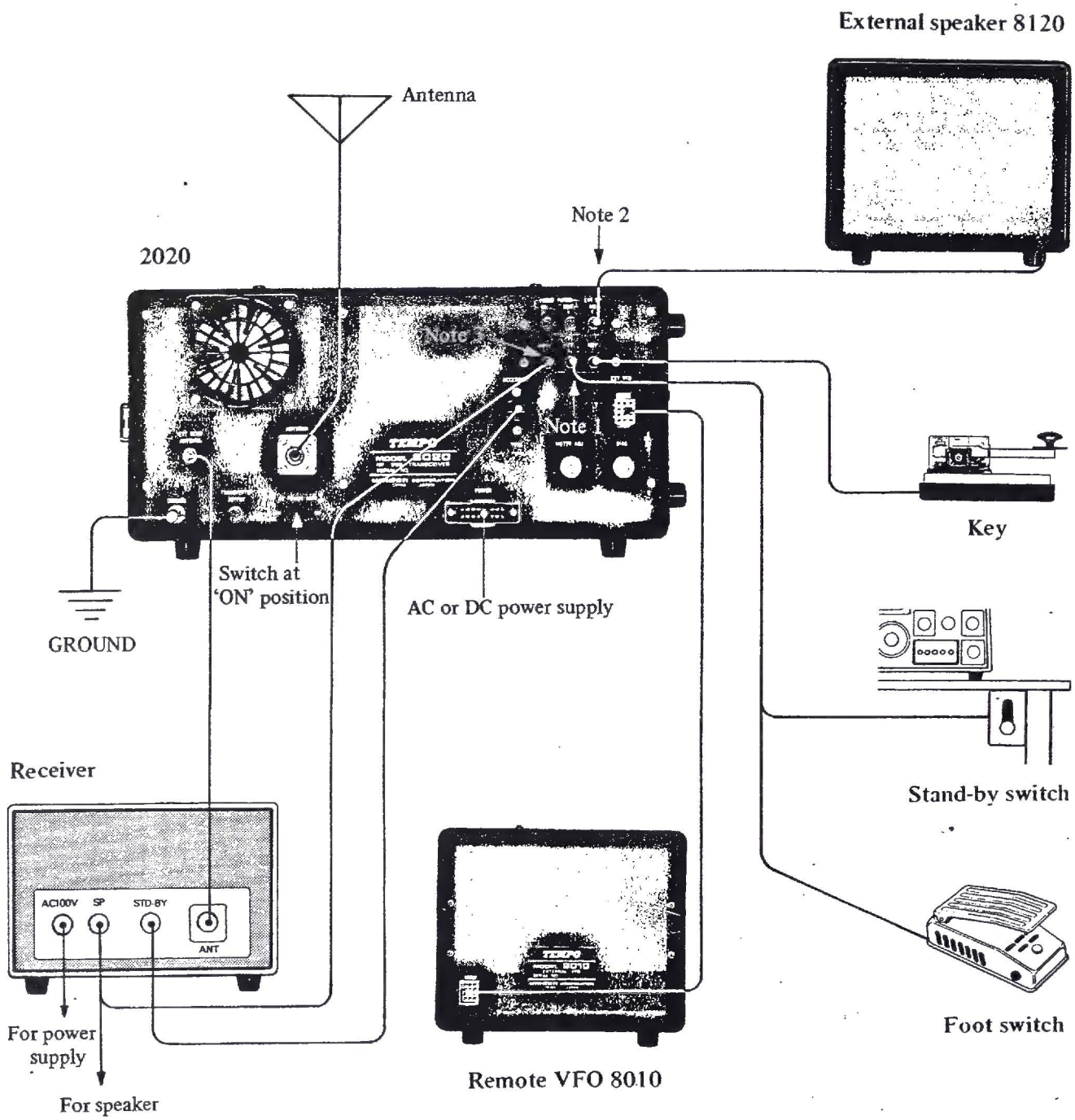
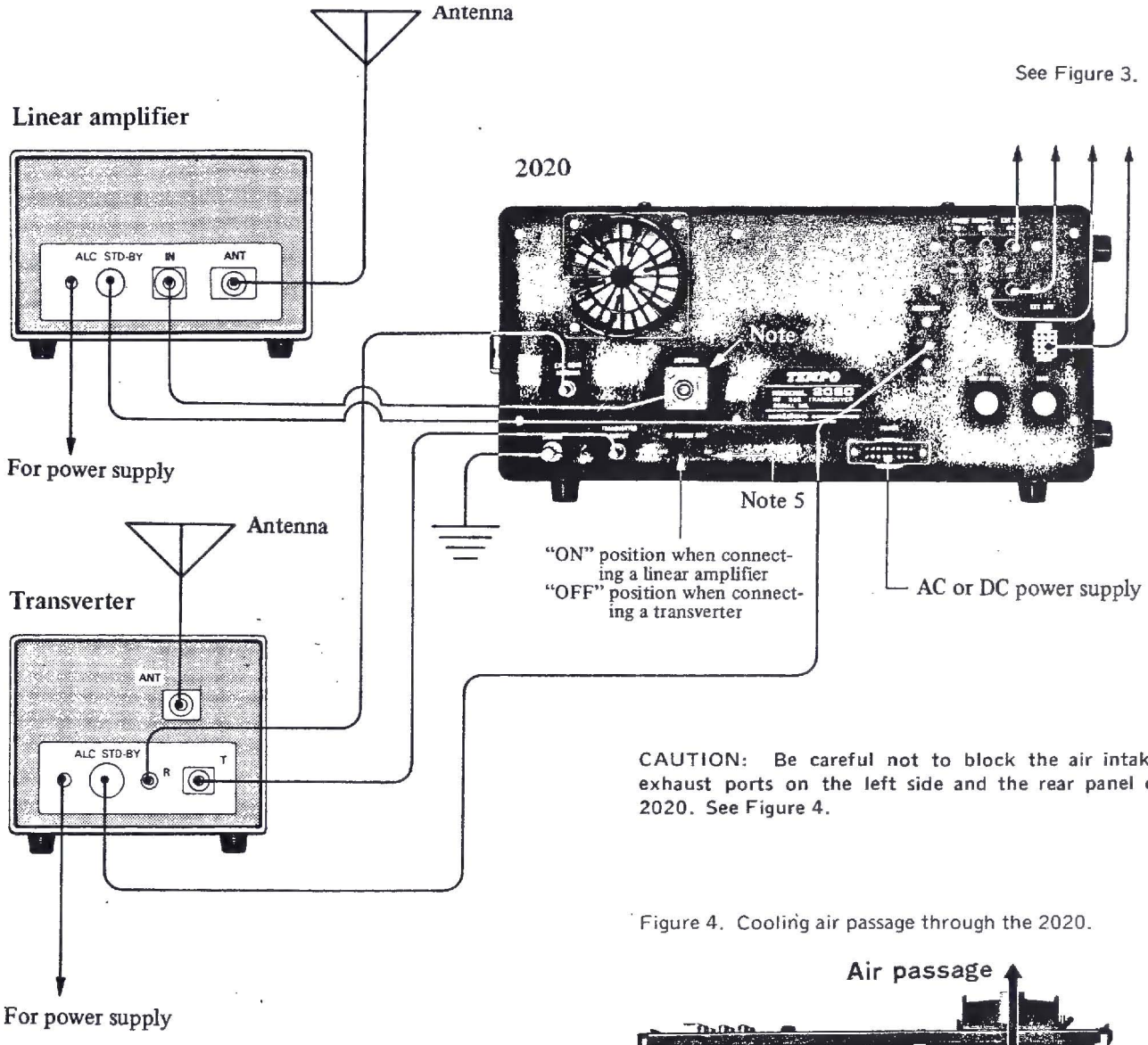


FIGURE 3. Connections of the 2020 to its accessories (2).

NOTE 4: For transverter operation, the high frequency antenna should be disconnected.

NOTE 5: The RF POWER AMP switch on the back of the 2020 should be in the OFF position when using a transverter and should be in the on position during normal operation. With the switch in the OFF POSITION the RF output is switched to the TRANSVERTER OUTPUT jack and the final amplifier tubes and blower are disconnected.

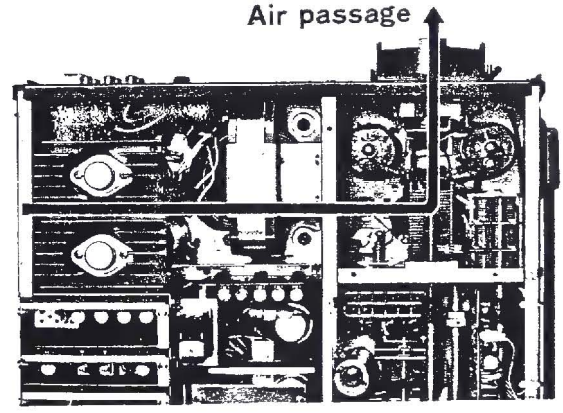
CAUTION: The 2020 can only be operated from a negative ground DC system. Be certain of the polarity of the connections. Reversed polarity may cause serious damage to the transceiver.



See Figure 3.

CAUTION: Be careful not to block the air intake and exhaust ports on the left side and the rear panel of the 2020. See Figure 4.

Figure 4. Cooling air passage through the 2020.

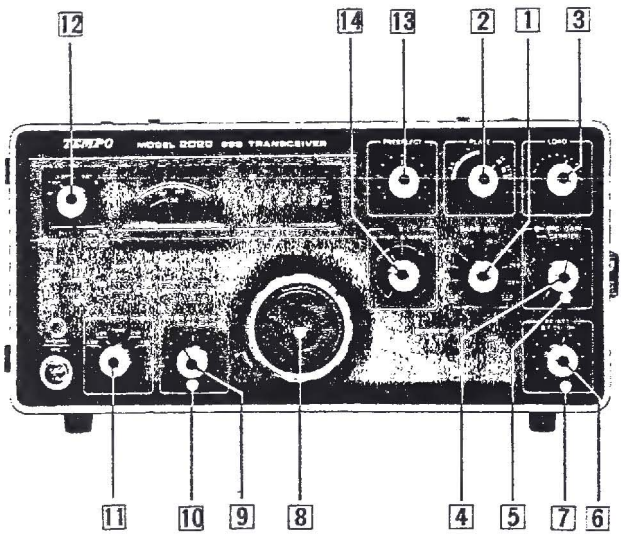


SECTION 3. OPERATING CONTROLS

You should read this section very carefully and try to completely understand the function of each of the controls before beginning to operate the transceiver.

3.1 FRONT PANEL CONTROLS (See Figure 5)

FIGURE 5. Front Panel Controls (Part 1).



3.1.1 BAND MHZ SWITCH

This 10 position rotary switch selects all of the necessary circuits to tune the transceiver to the desired 500 KHz band. The band numbers printed in red (3.5, 28.5 and 29.5) correspond to the red numbers below the 100 KHz segment buttons (500, 600, 700, 800, and 900).

3.1.2 PLATE CONTROL

This control adjusts the plate tuning circuit of the final amplifier tubes.

3.1.3 LOAD CONTROL

This control tunes the output circuit of the final section's pi-network to match the circuit to the antenna's impedance.

3.1.4 MIC GAIN CONTROL

This control adjusts the gain of the microphone amplifier to control the audio level from the microphone during SSB operation.

3.1.5 CARRIER CONTROL

This potentiometer adjusts the output carrier level when the transceiver is operating in the CW, AM, or TUNE mode.

3.1.6 RF ATTENUATOR CONTROL

The RF attenuator can be used to adjust the level of a received signal to minimize interference from strong local signals.

3.1.7 F. CAL ON SWITCH

When the RF ATTENUATOR knob is pulled out, the transceiver's calibrator circuit generates a marker signal at every 25 KHz for normal calibration of the built-in VFO.

3.1.8 MAIN TUNING KNOB

This control tunes the VFO through its 100 KHz range to determine the exact frequency of operation. The operating frequency is determined by the setting of the BAND MHZ switch, the selection of the SEGMENT KHZ buttons, and the setting of the VFO. The control covers the 100 KHz at a 4:1 ratio (the knob turns four times to cover 0 to 100 KHz).

3.1.9 AF GAIN CONTROL

This control adjusts the gain of the receiver's audio amplifier. The audio volume of the received signal increases as the control is turned clockwise. The control adjusts the audio output of the internal speaker, as well as at the external speaker jack and at the headphones jack.

3.1.10 RF GAIN CONTROL

The RF gain control is the outside portion of the AF GAIN/RF GAIN control. The lever adjusts the gain of the receiver section's RF and IF amplifiers. Turn the knob fully clockwise for maximum gain and for a correct S-meter reading. Turn the control counter-clockwise to reduce the gain.

3.1.11 MODE SWITCH

This 5-position rotary switch selects all of the necessary circuits for the desired mode of operation – LSB, USB, TUNE, CW or AM. NOTE: International amateur practice dictates using the following modes on each band.

3.5 to 4.0 MHz	LSB
7.0 to 7.5 MHz	LSB
14.0 to 14.5 MHz	USB
21.0 to 21.5 MHz	USB
28.0 to 30.0 MHz	USB
WWV Band	AM
27.0 to 27.5 MHz	AM

3.1.12 FUNCTION SWITCH

This 6-position rotary switch selects one of the following transceive functions.

INT.— In this position, the 2020's internal VFO controls the transmit and receive frequencies.

T.EXT. — In this position, the 2020's internal VFO controls only the receive frequency and the transmit frequency is controlled by the 8010 remote VFO.

R. EXT. — In this position, the 2020's internal VFO controls only the transmit frequency and the receive frequency is controlled by the 8010 remote VFO.

EXT. — In this position the receive and transmit frequency are both determined by the 8010 remote VFO.

A or B — In this position the receive and transmit frequencies of the transceiver are determined by a crystal which has been installed inside the 2020 for fixed frequency operation.

3.1.13 PRESELECT CONTROL

The PRESELECT tuning control tunes the plate tank circuit of the 12BY7A driver as well as the receiver's antenna and mixer coils. In receive the PRESELECT control is tuned for maximum sensitivity (maximum S-meter deflection). In transmit the PRESELECT control is tuned for a maximum scale reading on the ALC meter. When the control is correctly tuned for transmission it will be correctly tuned for reception.

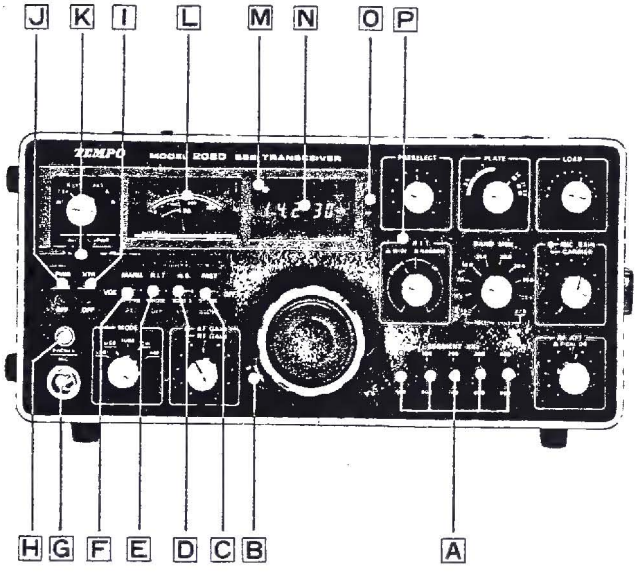
3.1.14 RIT (RECEIVER INCREMENTAL TUNING)

The RIT control tunes the 2020's receive frequency, without changing the transmit frequency. With the knob pushed in the RIT control is in its WIDE position and will tune the receiver ±5 KHz from the transmit frequency. With the knob pulled out the RIT control is in its NARROW position and will tune the receiver ±1 KHz from the transmit frequency. The RIT switch turns the circuit on and off and the RIT LED indicates when the RIT circuit is turned on. CAUTION: Be certain that you are transmitting on the desired frequency when the RIT circuit is turned on.

3.2 FRONT PANEL CONTROLS (Continued)

(See Figure 6)

FIGURE 6. Front Panel Controls (Part 2).



3.2.A SEGMENT KHZ BUTTONS

These push buttons are used to select the 100 KHz portion of the band in which you wish to operate. These buttons, along with the BAND MHZ switch and the VFO determine the operating frequency of the transceiver. The numbers in white refer to the bands printed in white on the BAND MHZ switch, and the numbers printed in red refer to the bands printed in red on the BAND MHZ switch. The number printed on the panel indicates the bottom frequency of the segment (for example the number 0 indicates a frequency range of 0 to 100 KHz and the number 500 indicates a frequency range of 500 to 600 KHz).

3.2.B TIGHT LEVER CONTROL

This lever adjusts the tension on the main tuning knob. A tighter tension is generally more desireable for mobile operations so that the main tuning dial is not bounced off frequency. The smoother tension is more desireable for base operation.

3.2.C FAST/OFF/ SLOW AGC SWITCH

This lever switch controls the AGC (Automatic Gain Control) circuit giving the operator three choices:

OFF — It may be desireable to turn the AGC off when attempting to receive a very weak signal.

FAST — The fast action of the AGC is designed for use in receiving CW and AM signals.

SLOW — The slow action of the AGC is designed for use in receiving SSB signals.

3.2.D N.B./OFF SWITCH

This lever switch turns the built-in noise blanker circuit on and off. The noise-blanker is designed to reduce pulsating ignition type noises. When the lever switch is flipped up, the circuit is turned on.

3.2.E R.I.T./OFF SWITCH

This lever switch turns the RIT circuit on and off. When the RIT is turned on (the switch is in the up position) the RIT LED will light to indicate that the circuit is working. The RIT circuit will only work when the 2020's internal VFO or fixed frequency crystal is controlling the receive frequency. Therefore the RIT circuit will only work when the function switch is in the INT., T.EXT, A, or B position.

3.2.F MANU./VOX/PTT SWITCH

This three position lever switch selects the way that the 2020 is keyed into transmit. There are three choices.

MANU. (Manual) — With the switch in this position the 2020 is keyed into transmit and remains keyed until the switch is moved out of this position.

VOX (Voice Operated Transmit) — With the switch in this position, the VOX circuit is turned on for voice operated transmitter keying on SSB or AM and for semi-automatic break-in operation on CW.

PTT (Push-To-Talk) — With the switch in this position, the transceiver is switched into transmit or receive by the PTT switch on the microphone, or by an external PTT switch which is connected to the rear panel PTT jack.

3.2.G MIC JACK

This 4-pin microphone connector is used for audio input from a microphone and for PTT relay keying of the 2020. Figure 1 shows the pin connections for the connector.

3.2.H PHONES JACK

This is a ¼" phone type jack for connecting a 4 to 16 ohm pair of headphones to the transceiver. When the plug is inserted in the jack the internal speaker is disconnected.

3.2.I HTR/OFF SWITCH

This lever switch turns the filaments of the three tubes on and off. The filaments (or heaters) are on when the switch is in the up position. The tubes require about 30 seconds of warm-up before transmitting. The heaters should be turned on only when you are going to transmit, especially when operating from a DC source. The 2020 consumes approximately 70 watts of power less during receive with the heaters off.

3.2.J PWR/OFF SWITCH

This lever switch turns the transceiver on and off for AC and DC operation. The 2020 is on when the switch is in the up position.

3.2.K ALC/IK/PWR SWITCH

The meter slide switch selects the mode of the meter during transmit. Each mode is described in detail under the description of the meter (Section 3.2.L).

3.2.L METER

The function of the meter during transmit is determined by the ALC/IK/PWR slide switch. During receive the meter acts as an S-meter. The S-meter is adjusted to read S-9 with an input signal of 34 dBu. The meter scale is calibrated at ever 10 dB above S-9, and is calibrated at every 4 dB below S-9.

ALC — With the meter switch in the ALC position the meter indicates the ALC action of the 2020 during voice transmission. The scale on the meter shows the acceptable ALC range.

IK (Plate Current) — With the meter switch in the IK position, the meter indicates the plate current of the final amplifier tubes on a scale from 0 to 350 ma. There is a green ▵ on the dial scale to show the recommended idle current of the 6146B final amplifier tubes. The bias is adjusted by a rear panel control and usually needs adjustment only once at a new power source.

3.2.M VFO LED

This light emitting diode is lighted whenever the 2020's internal VFO is controlling the operating frequency. If the frequency is being controlled by the external VFO then the LED will not be lighted.

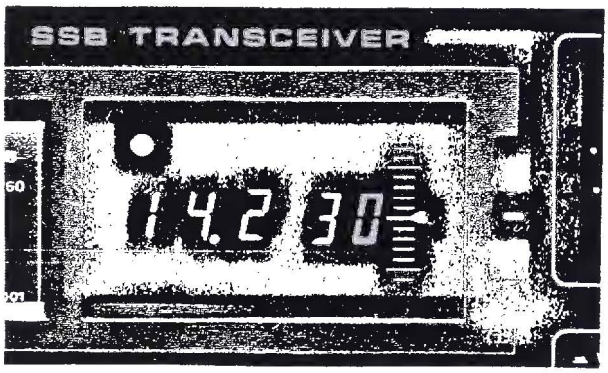
3.2.N DIAL SCALE

The 2020 uses a hybrid digital/analog dial scale. The digital portion shows the MHz and 100 KHz reading and the analog portion of the dial shows the frequency between 0 and 100 KHz. The MHz portion of the dial is switched by the BAND MHZ switch and the 100 KHz portion of the dial is switched by the SEGMENT KHZ buttons. The 100 KHz drum is turned with the main tuning dial as the VFO is tuned. See Figure 7.

3.2.O DIAL SET LEVER

The dial set lever moves the frequency pointer to calibrate the 2020. The crystal calibrator gives a marker signal every 25 KHz to calibrate the dial scale with this lever. The calibration is described in Section 4.

FIGURE 7. The Dial Scale.



3.2.P RIT LED

This LED indicates when the RIT circuit is turned on. If the LED is lighted you should be very careful that you are transmitting and receiving on the desired frequency because your transmit and receive frequencies may be different.

3.3 REAR PANEL CONTROLS (See Figure 9)

3.3.1 POWER CONNECTOR

This connector receives power from the AC or DC power source for operation of the 2020. Plug wiring for AC and for DC wiring is given in Figure 8 below. The transceiver is wired for operation from 117 VAC and from 13.8 VDC (Negative Ground!). Be certain to observe proper polarity for DC operation.

FIGURE 8. Power Plug Wiring.

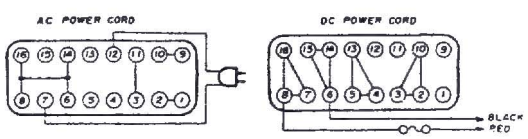
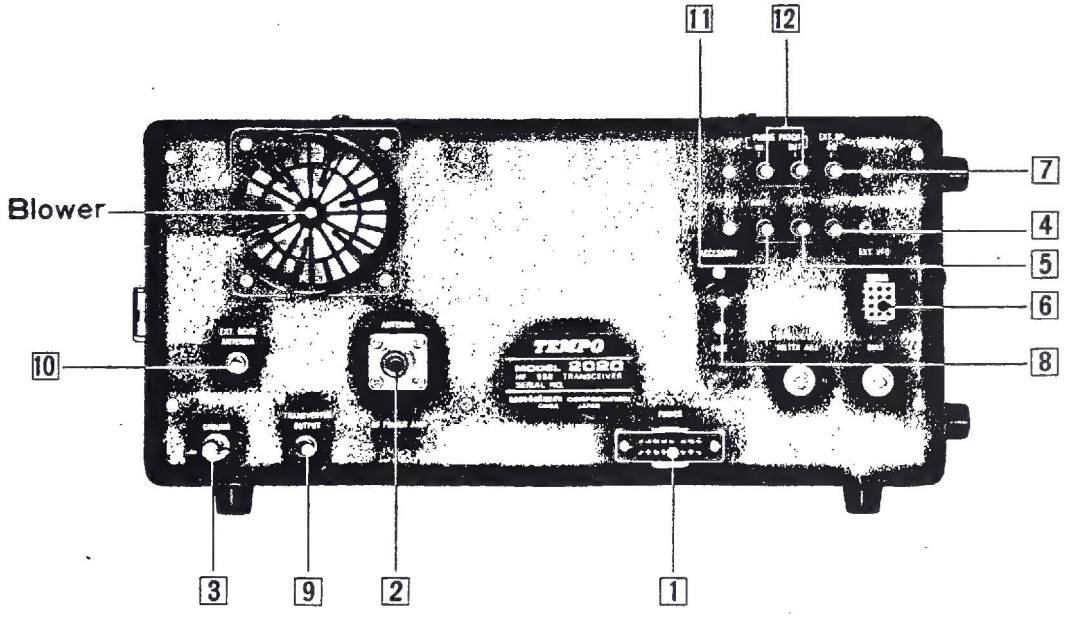


FIGURE 9. Rear Panel Controls (Part 1).



3.3.2 ANTENNA CONNECTOR

This SO-239, UHF type, coax connector should be attached to a suitable antenna for transmitting and receiving. See Section 1.2.3 for a discussion of an appropriate antenna.

3.3.3 GROUND LUG

To prevent accidental shocks from the chassis, as well as to reduce RF interference, connect a good earth ground to this lug.

3.3.4 KEY JACK

Connect a key to this ¼ inch phone type jack for CW operation. The keying is done by shorting the —50 volt blocking bias so be certain to choose an appropriate key or keyer. CAUTION: There is a —50 volt potential across this jack, so be careful not to expose yourself to it.

3.3.5 PTT JACK

An external stand-by or foot switch can be placed across this jack to control PTT transmitter keying. The external switch will only operate when the front panel MANU./VOX/PTT switch is in the PTT position. This jack is an RCA type phono jack.

3.3.6 EXT. VFO CONNECTOR

This 12-pin connector provides means for interconnecting the 2020 and the 8010 external VFO. The interconnecting cable is provided with the 8010. The function of each pin is listed below.

Pin 1 — VFO signal coax shield.
Pin 2 — VFO signal.
Pin 3 — Ground.
Pin 4 — 6V.
Pin 5 — 13 V during transmit.
Pin 6 — 12 V during transmit.
Pin 7 — 5V.
Pin 8 — 100 KHz segment and local osc. signal.
Pin 9 — 100 KHz segment and local osc. signal.
Pin 10 — PLL control signal.
Pin 11 — PLL control signal.
Pin 12 — PLL control signal.

3.3.7 EXT. SP. JACK

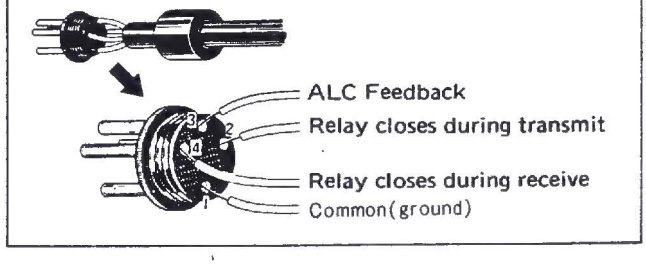
The receiver audio output can be connected through this RCA type phono jack to the 8120 or another external 4 ohm speaker. The internal speaker is disconnected when an external speaker is connected. CAUTION: A short circuit of this jack could cause failure of the 2020's audio IC.

3.3.8 ACCESSORY CONNECTOR

The ACCESSORY connector is a 4-pin socket for use in interconnecting the 2020 with a linear amplifier, transverter, receiver, or other accessory. Figure 10 shows a diagram of the plug. The function of each pin is as listed.

Pin 1 — Ground.
Pin 2 — Relay control open during receive.
Pin 3 — ALC feedback.
Pin 4 — Relay control open during transmit.

FIGURE 10. Accessory plug connections.



3.3.9 TRANSVERTER OUTPUT JACK

This RF type RCA phono jack provides a low power output (approximately 2 watts) when the RF POWER AMP slide switch is in the OFF position. This low power output is generally used to drive an accessory transverter.

3.3.10 EXT. RCVR ANTENNA JACK

This RF type RCA phono jack is used for a separate receive antenna when an external receiver is being used with the 2020.

3.3.11 ANTI JACK

This RCA phono jack accepts audio feedback from an external accessory receiver to prevent the VOX from being activated by the audio from the speaker of the receiver. It serves the same function as the ANTI-VOX adjustment of the 2020.

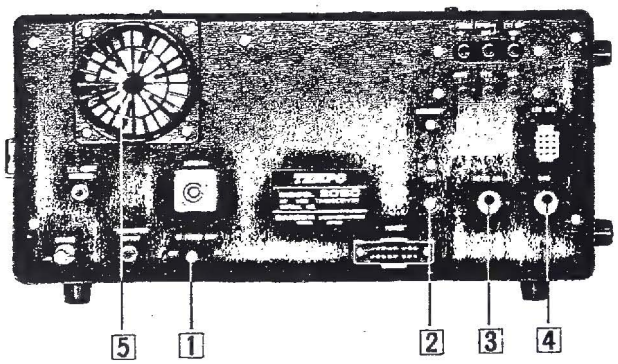
3.3.12 PHONE PATCH JACKS

PHONE PATCH IN — This RCA phono jack is for the connection of a 50 K ohm input from an accessory phone patch.

PHONE PATCH OUT — This RCA phono jack is for the audio output (at 4 ohms) from the 2020 to an accessory phone patch.

3.4 REAR PANEL CONTROLS (Continued) (See Figure 11)

FIGURE 11. Rear Panel Controls (Part 2).



3.4.1 RF POWER AMP. ON/OFF SWITCH

This slide switch switches a low power output from the driver stage to the TRANSVERTER OUTPUT jack at the same time it turns off the heaters to the two final tubes. The switch also turns off power to the blower.

3.4.2 FUSE

This fuse is a 3 AG, 5 amp (3 amp for 234 VAC operation) which protects the power supply of the transceiver against short circuits. Never use a higher amperage fuse than the one specified. An improper fuse can cause extensive damage to the 2020. When the fuse blows out, try to determine the cause before replacing it.

3.4.3 METER ADJ. CONTROL

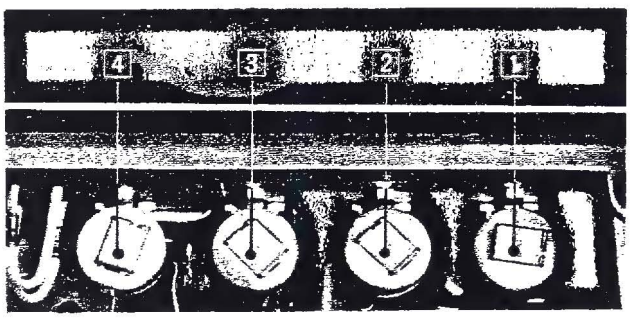
Use this control to adjust the sensitivity of the PWR (relative power output) function of the meter. Adjust the control so that full output from the transceiver reads approximately 2/3 scale on the meter (with the meter switch in the PWR position) during CW transmission.

3.4.4 BIAS CONTROL

The BIAS control adjusts the bias current of the two 6146B final amplifier tubes so that they operate linearly and have proper plate dissipation. Turning the control clockwise increases the idling plate current of the tubes. The control is adjusted so that the meter (with the meter switch in the IK position) indicates a plate current where the needle is on the green triangle on the meter scale (approximatly 60 ma). Adjustment of the bias is described in Section 4. The bias will normally only need adjustment when the 2020 is being set up in a new operating location, or when the final tubes have been replaced.

3.5 INTERNAL CONTROLS (See Figure 12)

FIGURE 12. Internal Operating Controls.



3.5.1 VOX CONTROL

This small potentiometer adjusts the sensitivity of the VOX circuit by adjusting the gain of the VOX amplifier. With the MANU./VOX/PTT switch in the VOX position, adjust this control until your normal speaking voice keys the 2020 into transmit. This control may also have to be adjusted when operating semi-automatic break-in CW.

3.5.2 DELAY CONTROL

The DELAY control adjusts the holding time of the VOX circuit for VOX or beak-in CW operation. The control will have to be adjusted to the preference of the operator so that the circuit does not drop out between words.

3.5.3 ANTI CONTROL

This control adjusts the level of the anti VOX signal fed from the 2020's audio circuits to the VOX circuit. Set the AF gain of the transciever to its normal listening level and adjust the ANTI control to the minimum point that will prevent the audio from the speaker from tripping the VOX circuit.

3.5.4 TONE CONTROL

The level of the CW sidetone is adjusted by this control.

SECTION 4. OPERATING INSTRUCTIONS

4.1 INITIAL CONTROL SETTINGS

Before beginning operation of the 2020 be sure to complete all of the required cabling, as described in Section 2. The 2020 must be operated into a 50 ohm antenna or dummy load with an SWR less than 3:1. Random length antennas or light-bulb dummy loads cannot be used. Conventional half-wave dipoles and beam antennas should only be used at or near their resonant frequency. Operating the 2020 into an SWR greater than recommended can damage the components in the output stage of the transceiver. Make a small investment in a good SWR meter and be certain of a good antenna before damaging the 2020.

With a suitable antenna and a microphone (or key) connected to the transceiver, set the 2020 controls to the positions described below.

4.1.1 FRONT PANEL CONTROLS

BAND MHZ Switch . . . . . Desired band
PLATE CONTROL . .Middle of the range
. . . . . for the selected band.
LOAD CONTROL. . . . . Centered.
MIC GAIN CONTROL.Counterclockwise.
CARRIER CONTROL.Counterclockwise.
RF ATTENUATOR CONTROL. . . . . .
. . . . . Clockwise.
F. CAL ON SWITCH . . . . . .Off.
MAIN TUNING KNOB. . . . . .
. . . . . .Desired Frequency.
AF GAIN CONTROL. . . . . .
. . . . . Counterclockwise.
RF GAIN CONTROL. . . . . Clockwise.
MODE SWITCH . . . . . Desired mode.
FUNCTION SWITCH. . . . . INT.
PRESELECT CONTROL . . . . Centered.
RIT CONTROL . . . . . Centered.
SEGMENT KHZ BUTTONS . . . . . .
. . . . . .Desired KHz range.
TIGHT CONTROL . . . . Desired tension.
FAST/OFF/SLOW SWITCH . . . . . .
.FAST or SLOW per mode selected.
N.B./OFF SWITCH . . . . . .Off.
R.I.T./OFF SWITCH . . . . . .Off.
MANU./VOX/PTT SWITCH . . . . . PTT.
HTR/OFF SWITCH. . . . . .Off.
PWR/OFF SWITCH. . . . . .Off.
ALC/IK/PWR SWITCH. . . . . .ALC.
DIAL SET LEVER . . . . . Centered.

4.1.2 REAR PANEL CONTROLS

RF POWER AMP SWITCH . . . . . On.

4.2 RECEIVER TUNING

After the controls have been set as described in Section 4.1, turn the 2020 on using the PWR/OFF switch. Check that the dial scale and meter are lighted and that the blower is operating properly. Check all of the BAND MHZ positions and each of the SEGMENT KHZ buttons to make certain that the dial is reading properly. Turn the RIT/OFF switch on and check that the RIT LED is operating. And check that the VFO LED lights properly when the function switch is in the INT. and T.EXT. positions.

With the transceiver turned on you are ready to receive. The receiver section is fully solid state and requires no warm-up and will operate with the HTR./OFF switch off.

As an example, select a frequency of 14.150 MHz for reception. All of the controls are still as they were initially set-up and the BAND MHZ switch is turned to 14, the SEGMENT KHZ button labeled 100 is selected and the main tuning knob is turned so that 50 shows on the dial.

Advance the AF GAIN control clockwise until some receiver noise is heard in the speaker. Adjust the main tuning knob until a signal is heard. Tune the signal for the clearest possible reception, and then adjust the PRESELECTOR control for maximum deflection of the S-meter.

The RF GAIN control varies the AGC feedback voltage which effects the S-meter reading. With the RF GAIN control fully clockwise, the S-meter gives a proper signal strength reading. Turning the control counter-clockwise reduces the RF gain, reducing signal strength and band noise.

4.3 READING THE OPERATING FREQUENCY

The 2020's unique hybrid frequency display offers the advantages of a digital readout and a dial readout. There is never any question of the exact operating frequency because the digital portion of the dial reads the exact MHz and 100 KHz frequency while the analog portion (dial drum) reads out the frequency down to a 1 KHz calibration.

4.4 CALIBRATION

4.4.1 NORMAL TRANSCEIVER CALIBRATION

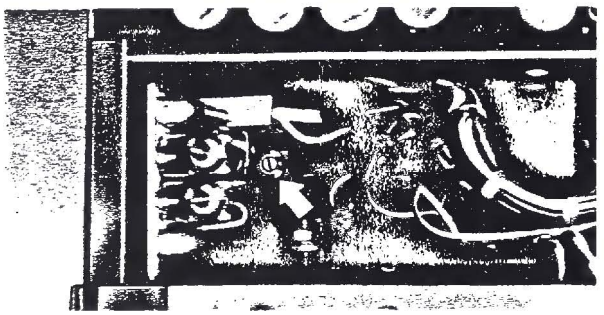
Pull the F. CAL knob out to turn on the built-in 25 KHz calibrator circuit. Be sure that the R.I.T./OFF switch is in the OFF position. Turn the main tuning knob to receive one of the marker signals which is generated at 00, 25, 50, 75, and 100 on the analog portion of the dial scale. For greatest accuracy, choose the calibration frequency closest to your operating frequency.

Zero beat one of the calibrator signals in any mode and adjust the dial set lever so that the dial pointer is pointing to the exact frequency marking (00, 25, 50, 75, or 100). The 2020 is unique in its circuit design in that the carrier frequency is always 6187 KHz regardless of the selected mode. By using separate USB, LSB, and CW filters, and by using the USB and LSB filters together for AM operation, the 2020 need not be recalibrated for different modes.

4.4.2 CALIBRATOR OSCILLATOR ADJUSTMENT

To check that the marker signals from the calibrator circuit are exactly on frequency beat the calibrator signal against WWV at 15.0 MHz. Receive WWV at 15 MHz as described in Section 4.5. Turn the calibrator on. The calibrator signal and WWV signal should overlap and zero beat at the zero marking on the dial scale. If they do not, remove the top cover of the 2020 and locate the calibrator adjustment trimmer just below the fixed frequency crystals (See Figure 13). Turn the MODE switch to AM and use a plastic screw driver to precisely adjust the marker signal to zero-beat the WWV signal at zero on the dial scale.

FIGURE 13. Trimmer Capacitor for Adjusting the Marker Oscillator.



4.5 WWV RECEPTION

The 2020 receives the WWV time signal at 15 MHz when the bands switch is turned to WWV, the SEGMENT KHZ button labeled 0 is selected, and the VFO is tuned to 00. Receive the WWV signal in the AM mode as you would receive any other signal, except the receiver RF circuits are pretuned and the PRESELECTOR control has no effect.

4.6 NOISE BLANKER

The 2020 has an effective built-in noise blanker designed to reduce ingition type impulse noises. The noise blanker is particulary important for mobile operation. When necessary, activate the noise blanker circuit by setting the N.B./OFF switch in the up position.

4.7 AGC (Automatic Gain Control)

Set the FAST/OFF/SLOW AGC switch to the position appropriate for the received signal. Generally for SSB reception set the AGC switch to SLOW, for AM and CW reception set the AGC switch to FAST, and for reception of a very weak signal the switch may be set to off.

4.8 RIT (Receiver Incremental Tuning)

With the R.I.T./OFF switch turned off the 2020 receives and transmits at the same frequency. At times the received signal may drift off frequency and become less intelligible. When this happens, flip the R.I.T./OFF switch up to activate the RIT circuit and return the received signal to an intelligible state using the RIT control. A unique feature of the 2020 is its dual position RIT control. When the knob is pushed in the RIT control can change the receive frequency more than ±5 KHz. When the knob is pulled out the RIT control can change the receive frequency more than ±1 KHz for fine tuning. When the RIT circuit is turned on the RIT LED is lighted. The RIT circuit has no effect on the transmit frequency. Be careful to turn the RIT circuit off when returning to normal transceive operation to prevent unintentionally transmitting and receiving on different frequencies.

4.9 TRANSMITTER TUNING

Connect the 2020 to a 50 ohm dummy load or a 50 ohm antenna with an SWR of less than 2:1 before making any transmitter adjustments. The life of the final tubes is directly related to the SWR of the antenna and to the length of tuning periods.

Section 4.1 lists the initial set-up procedure for the 2020. Begin with the controls in the described positions. Turn the tube filaments on by setting the HTR/OFF switch in the up position and allow approximately 30 seconds of warm-up for the tubes. For an example we will choose an operating frequency of 14.250 MHz. The BAND MHZ switch will be at 14, the SEGMENT KHZ button labeled 200 will be selected and the MODE switch will be in the USB postion.

4.9.1 PLATE IDLING CURRENT ADJUSTMENT

The BIAS adjustment usually need be made only when the 2020 is being set up in a new station, or after the final tubes have been replaced. But it should be checked periodically.

CAUTION: If the plate current is very much higher than the recommended level, do not leave the 2020 in transmit for more than a few seconds. Excessive plate current shortens the life of the final tubes.

At 14.250 MHz, in USB, set the MANU./VOX/PTT switch to the MANU. postion and check the plate current (the meter switch must be put in the IK position). The needle should be positioned over the green triangle on the IK scale. If the BIAS current is incorrect, adjust the rear panel BIAS control until the reading is on the triangle (about 60 ma). Return the MANU./VOX/PTT switch to PTT.

4.9.2 TUNE-UP PROCEDURE

Switch the meter switch back to ALC and switch the MODE switch to the TUNE postion. Key the 2020 by setting the MANU./VOX/PTT switch to MANU. position and adjust the CARRIER control until the ALC meter reading just reaches the top of the marked ALC scale. Adjust the PRESELECT control to peak the ALC reading (maximum meter deflection) and then readjust the CARRIER control until the ALC reading is just at the top of the ALC scale.

Set the meter switch to PWR and alternately adjust the PLATE and LOAD control for the maximum relative power output.

CAUTION; You should complete this procedure in less than 30 seconds.

TABLE 1. Summary of Transmitter Tuning Procedures.

MODE Switch	Meter Switch	MANU./VOX/PTT Switch	Procedure
USB or LSB	IK	MANU.	Adjust the BIAS control for proper idling current.
TUNE	ALC	MANU.	Adjust CARRIER control for a reading at top of ALC scale.
TUNE	ALC	MANU.	Peak the ALC reading with the PRESELECTOR control.
TUNE	ALC	MANU.	Readjust CARRIER control for reading at top of ALC scale.
TUNE	PWR	MANU.	Peak RF output by alternately adjusting the PLATE and LOAD controls.
TUNE	IK	MANU.	Check for 240-250 ma of plate current then reduce CARRIER control to minimum. DIP PLATE

Set the meter switch to the IK position and check for a plate current reading of approximately 240 to 250 ma. Return the CARRIER control to its minimum (counter-clockwise) position.

When selecting a different SEGMENT KHZ button the tuning procedure must be repeated.

CAUTION: The SEGMENT KHZ switches must be pushed one at a time, otherwise the frequency reading on the dial scale will be meaningless.

4.10 SSB OPERATION

4.10.1 PTT OPERATION

Tune the 2020 as described in Sections 4.1 through 4.9. Select your desired operating frequency and set the mode switch to USB or LSB. Connect the microphone to the front panel MIC connector.

NOTE: International amateur practice dictates using USB on amateur bands above 10 MHz and LSB on amateur bands below 10 MHz.

With the MANU./VOX/PTT switch in the PTT position, key the 2020 by pushing the PTT switch on the microphone and speak into the microphone with the tone of voice normally used in operation. Adjust the MIC GAIN control clockwise until your voice peaks are just within the top limit of the ALC range printed on the meter scale. (The meter switch is in the ALC position.) If the transmitter section is driven beyone this range, the transmitted signal will be distorted.

An external foot switch or PTT switch can be attached to the rear panel PTT jack if desired.

4.10.2 VOX OPERATION

Adjust the transceiver as described in the previous paragraph. Set the MANU./VOX/PTT switch to VOX and close talk into the microphone, increasing the internal VOX gain control until the VOX just operates. For VOX operation it is desireable to close talk the microphone to prevent background noises from tripping the 2020 into transmission.

Check that the ALC reading for voice peaks is still within the ALC range on the meter. If necessary, readjust the MIC GAIN control for a proper ALC reading.

If the VOX circuit is activated by speaker noise, adjust the internal ANTI control as necessary to prevent the feedback.

Do not use more VOX gain or more ANTI VOX gain than necessary to control VOX operation. If the VOX circuit drops out between words, or holds too long, adjust the release time constant by turning the internal DELAY control for the desired performance.

4.11 CW OPERATION

4.11.1 MANUAL OPERATION

Tune and load the 2020 as described in Section 4.1 through Section 4.9, except do not reduce the CARRIER control after finishing the tuning. There are several alternatives for keying the 2020 in CW operation. You can leave the MANU./VOX/PTT switch in the PTT position and key the transceiver by pushing the PTT button on the microphone or by pushing a foot switch or external PTT switch. You can also key the 2020 by putting the MANU./VOX/PTT switch into the MANU. position when you wish to transmit. The plate current reading in CW operation should be between 200 and 250 ma.

The 2020 offers a side-tone feature for monitoring your CW operation. The level of the side-tone is adjusted by the internal TONE control.

4.11.2 SEMI-AUTOMATIC BREAK-IN CW

You can also key the 2020 into transmit during CW operation by placing the MANU./VOX/PTT switch into the VOX position. The side-tone will then automatically key the VOX circuit. The VOX control can be adjusted by holding the key down and adjusting the control until the side-tone just breaks the VOX circuit. As with SSB VOX operation the DELAY control can be adjusted so that the VOX circuit will not drop out between letters and words.

4.12 AM OPERATION

Tune and load the 2020 as described in Sections 4.1 through 4.9 except instead of reducing the CARRIER control to its minimum position, reduce it until the IK meter reading is between 110 and 120 ma. Adjust the MIC GAIN control so that the plate current increases slightly as you speak into the microphone.

The PTT and VOX functions are the same as described in Section 4.10.

4.13 RECOMMENDED METER POSITIONS

The position of the meter switch during transmitting depends on the mode used. For SSB operation, the recommended meter function is the ALC reading. For proper operation the voice peaks should just be within the top of the marked ALC scale. For CW operation, the recommended meter function is the IK reading. For proper operation the plate current should be between 200 and 250 ma. For AM operation, the recommended meter function is the IK reading. For proper operation the plate current should peak just over 120 ma while the operator is speaking.

4.14 OPERATION WITH A LINEAR AMPLIFIER

Tune and load the 2020 as described in Sections 4.1 through 4.9 and adjust the transceiver for the selected mode.

The 4-pin ACCESSORY connector on the back panel is provided for interconnections with an amplifier. Figure 3 shows a diagram of the necessary interconnections. See the instruction manual of the amplifier to determine whether the linear requires a normally open (during receive) or a normally closed (during receive) relay contact for keying control. Connect either pin 2 (normally open to ground during receive) or pin 4 (normally closed to ground during receive) of the ACCESSORY connector to the relay control jack of the amplifier. Connect the ALC feedback from the amplifier to pin 3. The output of the 2020 is quite adequate to drive most amplifiers to full rated output.

4.15 OPERATION WITH A RECEIVER

To operate the 2020 with an external receiver, connect the mute connection of the receiver (see the receiver's instruction manual) to the appropriate relay contact (normally open or normally closed during receive) at the ACCESSORY connector of the transceiver.

If the 2020 is used with both an external receiver and a linear amplifier which require the same type of relay contact, an external relay may be required. In this case choose a relay that can be controlled by the opposite relay connection of the transceiver. Figure 2 shows the necessary interconnections. The 2020 also has provisions for ANTI VOX feedback from the receiver's speaker jack.

4.16 CHANGING THE BAND COVERAGE

The 2020 is supplied for amateur band use. However, in cases where the owner is willing to sacrifice one or more of the standard frequency ranges, he can substitute an adjacent special range by changing the appropriate high frequency crystal.

The transition is easiest for frequencies very close to the amateur band, such as MARS frequencies. You can achieve coverage of these frequencies by replacing the appropriate HF crystal (not to be confused with fixed frequency operation). The crystals are located on Local Oscillator Unit (PC-092). You must remember that the dial scale will still read the old fequency range. The transceiver will have to be realigned when these crystals are installed, and the procedure should only be done by a competent technician.

The band crystals provided with the 2020 are as follows:

WWV	— 15.0 MHz is 37.025 MHz
80 meter band	— 3.5 MHz is 25.525 MHz
40 meter band	— 7.0 MHz is 29.025 MHz
20 meter band	— 14.0 MHz is 36.025 MHz
15 meter band	— 21.0 MHz is 43.025 MHz
10 meter band	— 28.0 MHz is 50.025 MHz
	— 28.5 MHz is 50.525 MHz
	— 29.0 MHz is 51.025 MHz
	— 29.5 MHz is 51.525 MHz
11 meter band	— 27.0 MHz is 49.025 MHz

Crystal Frequency =
22.025 MHz + Lowest Freq. desired
Crystal type: HC-25/U

The band coverage will change exactly the same amount as the band crystal is changed. For example if you replace the 3.5 MHz crystal (25.525 MHz) with a 26.025 MHz crystal, the transceiver would cover 4.0 to 4.5 MHz.

4.17 FIXED FREQUENCY OPERATION

The 2020 has a built-in 2-position crystal controlled oscillator for fixed frequency operation. This feature is most useful for commonly used frequencies, nets or any situation where crystal controlled operation is required. To use the fixed frequency oscillator, turn the function switch to the A or B position. If an accessory fixed frequency crystal has been installed the 2020 would be tuned and operated the same as if it were operated normally (as described in Sections 4.1 through 4.9). Because the fixed frequency crystal replaces the VFO, it will operate at each BAND MHZ and SEGMENT KHZ postion. Therefore each fixed frequency crystal operates at 50 different frequencies in the 2020 (10 BAND MHZ positions and 5 SEGMENT KHZ positions).

4.17.1 CRYSTAL FREQUENCIES

The 2020's VFO operates in the 9138 to 9038 KHz range so the fixed frequency crystal will also be in that range.

The crystal frequency f(x) is determined by the following formula:

$$f(x) = 9138\ KHz - (f(F) - f(Fr))$$

where f(F) = the desired operating frequency
where f(Fr) = the nearest whole 100 KHz below the desired operating frequency.

Example: Desired Frequency = 21,335 KHz

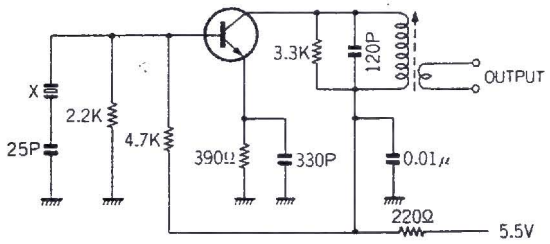
Crystal Frequency =
9,138 KHz — (21,335 — 21,300) KHz

Crystal Frequency = 9138 KHz — 35 KHz
Crystal Frequency = 9103 KHz 9003

NOTE: These fixed frequency crystals are for frequencies within the normal operating bands of the 2020. The crystals can not give frequencies outside the normal operting range of the transceiver.

Figure 14 shows the type of oscillator circuit for ordering the crystals and the crystal type is HC-25/U.

FIGURE 14. Fixed Frequency Crystals Oscillator Circuit.

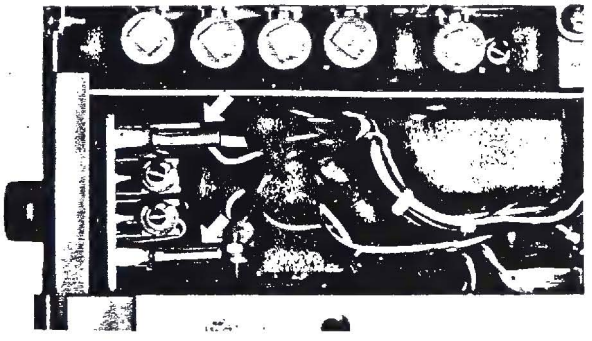


4.17.2 FIXED FREQUENCY CRYSTAL INSTALLATION AND OPERATION

Once you have received the correct crystal, you must plug it into either the A or B position as shown in Figure 15. Each crystal socket has a trimmer to net the crystal onto frequency. The crystal board is located at the top left, front corner of the transceiver. With the crystal installed, select the band desired, and the 100 KHz segment desired, and put the function switch into the A or B position. Then operate the 2020 as described earlier.

NOTE: The 9103 KHz crystal described above will not only work at 21,335 KHz but also 3.535, 3.635, 3,735, 3.835, 3.935, 7.035 MHz, etc., etc.

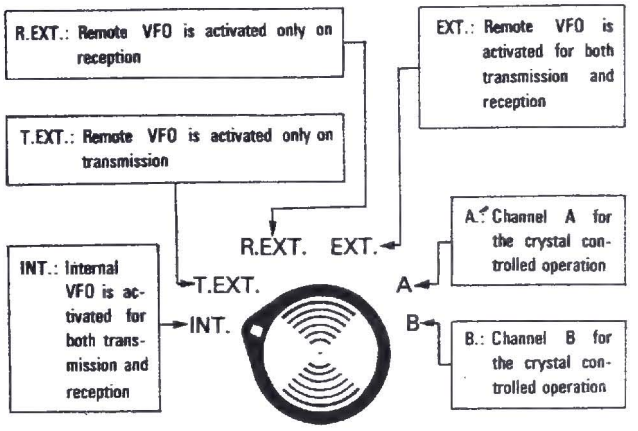
FIGURE 15. Fixed Frequency Crystal Installation.



4.18 OPERATION WITH A REMOTE VFO

When the 2020 is operated with the 8010 remote VFO the function switch on the transceiver determines which VFO is controlling what function. Figure 16 shows the function switch. The VFO LED above the dial scale helps by showing when each VFO is functional. The 8010 also has such a VFO LED. When the LED is lighted, the VFO is operating

FIGURE 16. Function Switch.



4.19 MOBILE OPERATION

The compact size and solid state design of the 2020 make it very useful for mobile or portable operation. Be certain that the mobile antenna meets the requirements described in Section 1.

The normal operating procedures, described previously, also apply to mobile operation. The noise blanker should be used to reduce ignition and impulse noises for clear reception. Remember that during transmission the transceiver draws more than 20 amps so be careful not to drain the car's battery.

4.20 OPERATION WITH A PHONE PATCH

The 2020 has rear panel jacks to accept the leads to and from a phone patch. The PHONE PATCH IN jack accepts an audio input impedance of 50 K ohms, and the PHONE PATCH OUT jack delivers an audio output at 4 ohms.

4.21 SSTV OPERATION

The 2020 will adapt well to slow scan television operation. The easiest way is to use the PHONE PATCH IN and PHONE PATCH OUT jacks as described in Section 4.20. Be careful to keep the input power of the 2020 down to a safe level with the MIC GAIN control. If you exceed the plate power dissipation capability of the tubes, they will be damaged.

4.22 NOVICE OPERATION

The plate power input to the 2020 can be reduced for novice CW operation by adjusting the CARRIER control for about 90 ma of plate current.

SECTION 5. CIRCUIT DESCRIPTION

INTRODUCTION

The 2020 is constructed with fifteen separate sections, called units. Most of them are built onto plug-in type modules or circuit boards. The transceiver has been engineered for easy acess and fast servicing. The front panel pivots easily away from the frame, as shown in Figure 17. Refer to Figure 20, the Block Diagram for a circuit description. The large, main schematic is really a wiring diagram between sections, with component listings for the parts which are not included in one of the 15 main sections. For details on any one of the 15 main sections, refer to the appropriate paragraph in Section 5.

The Local Oscillator Unit employs a unique circuit design employing a PLL (Phase Lock Loop) programmed oscillator. The block diagram of the Local Oscillator Unit is included with Section 5.10.

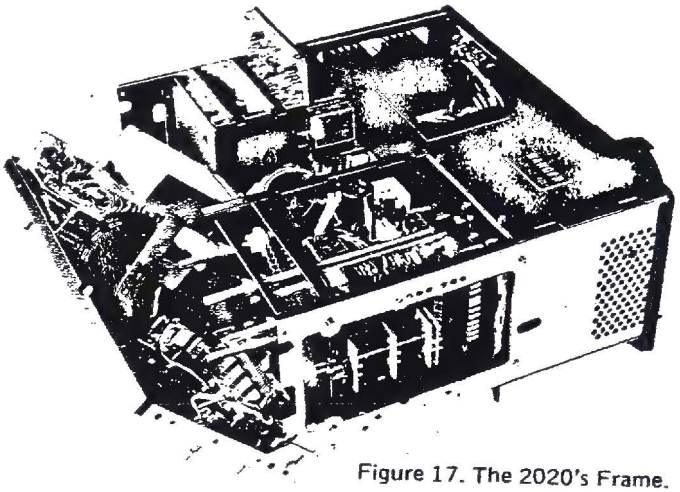
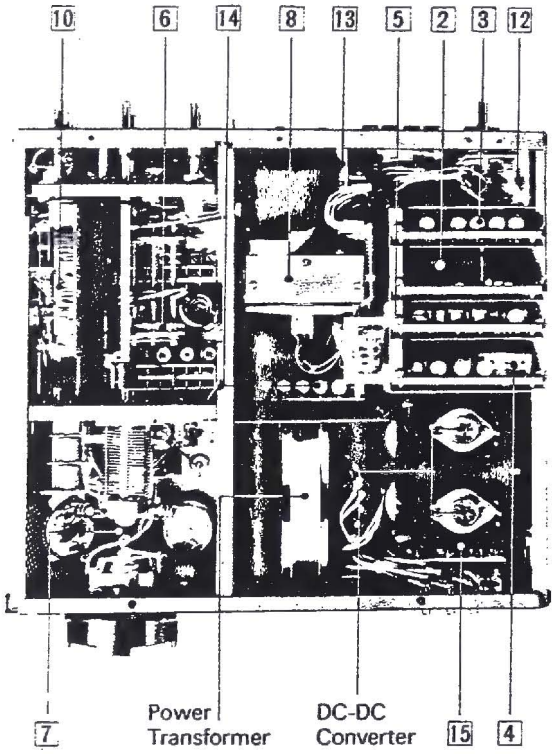


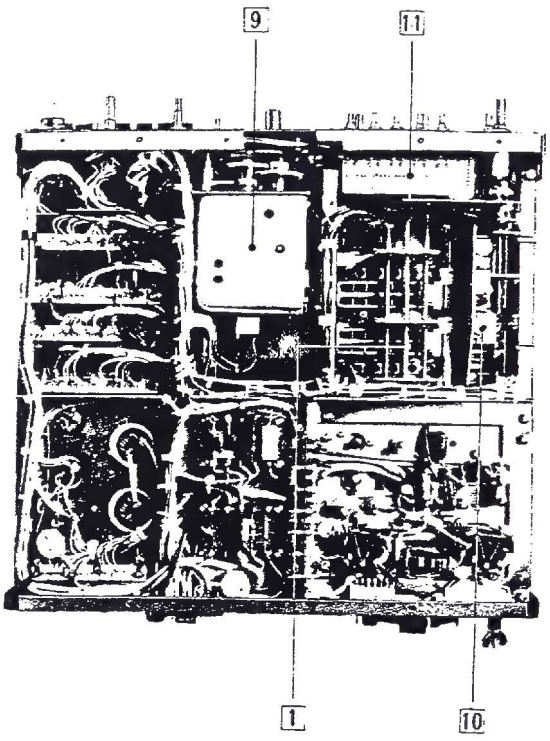
Figure 17. The 2020's Frame.

FIGURE 18. 2020 Module Locations, Top View.



2. Filter Unit (PC-077)
3. IF Unit (PC-078)
4. AF Unit (PC-079)
5. Generator Unit (PC-080)
6. Transmitter RF Unit (PC-076)
7. Transmitter Power Amplifier Unit
8. PLL Unit (PC-086 and PC-087)
12. Operation Unit (PC-085)
13. Display Unit (PC-088 and PC-089)
14. AVR Unit (PC-082)
15. Rectifier Unit (PC-081)

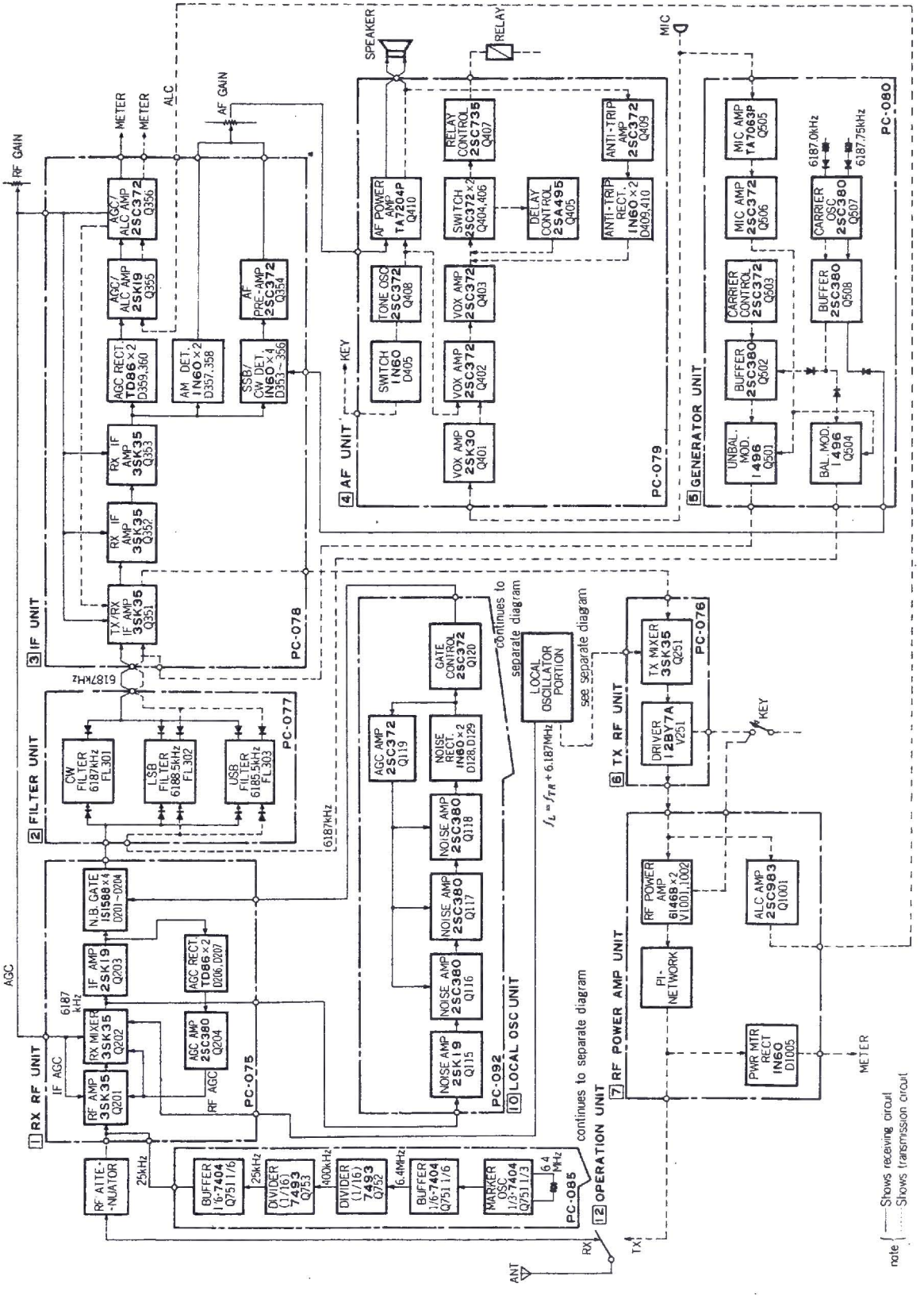
FIGURE 19. 2020 Module Locations, Bottom View.



1. Receiver RF Unit (PC-075)
9. VFO Unit (PC-083 and PC-084)
10. Local Oscillator Unit IPC-092)
11. Segment Unit (PC-090

FIGURE 20. BLOCK DIAGRAM OF THE 2020.

(The block diagram of the local oscillator section is in Section 5.10)



* Features and specifications subject to change without notice.

5.1 RECEIVER RF UNIT (PC-075)

This circuit board holds all band receiver RF amplifier Q201 (3SK35), all band mixer Q202 (3SK35), and the noise blanker gate (D201 through D204).

Q204 (2SC380) is the AGC amplifier and D206 and D207 (TD86x2) are the AGC rectifiers. Tuning capacitors C209 and C224) are controlled by the front panel PRE-SELECT control. The WWV circuits are pre-tuned and the PRESELECT control has no effect.

The receiver amplifier is electrically independent from the transmitting section, providing simple, stable tuning. The receiver circuit uses a single conversion design with a fixed IF output at 6,187 KHz.

FIGURE 21. Receiver RF Unit (PC-075) Schematic.

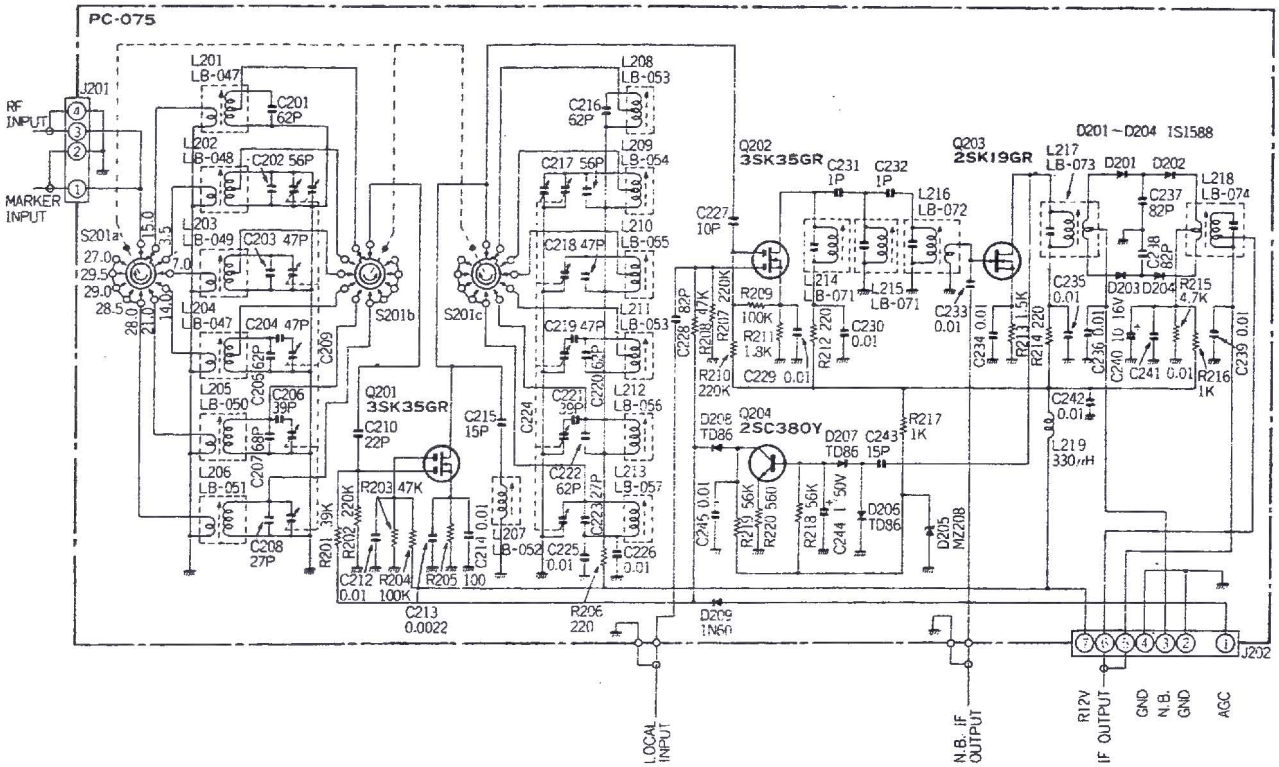
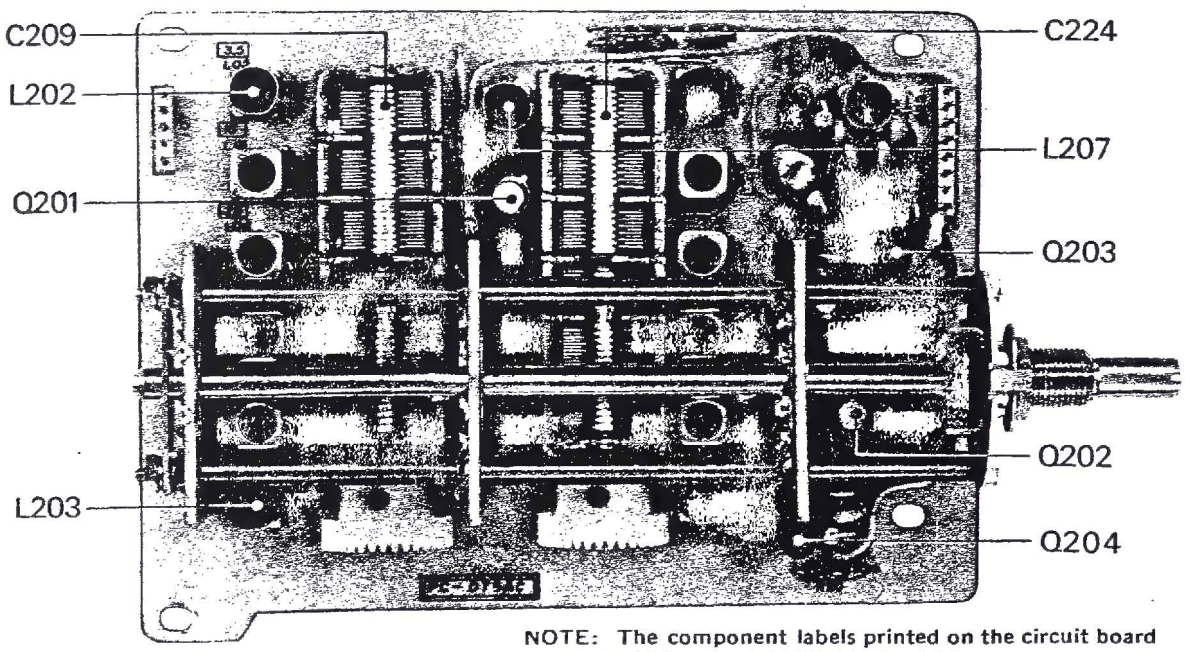


FIGURE 22. Receiver RF Unit (PC-075) Circuit Board.



NOTE: The component labels printed on the circuit board delete the 100 digit. L202 is labeled L02.

5.2 FILTER UNIT (PC-077)

This plug-in circuit board holds the three crystal filters used in the 2020. By using a separate filter for USB, LSB, and CW, the 2020 avoids the problem of a carrier shift for different modes. The carrier frequency is 6,187 KHz. FL301 is the CW filter (6,187 KHz) with a bandwidth of 600 Hz. FL302 is the LSB filter (6,188.5 KHz) and FL303 is the USB filter (6,185.5 KHz) and each have a bandwidth of 2.1 KHz.

The filters are selected with diodes connected to the front panel MODE switch. The USB filter is used for AM operation. Figure 24 shows the filter characteristics of the SSB filters.

FIGURE 23. Filter Unit (PC-077) Schematic.

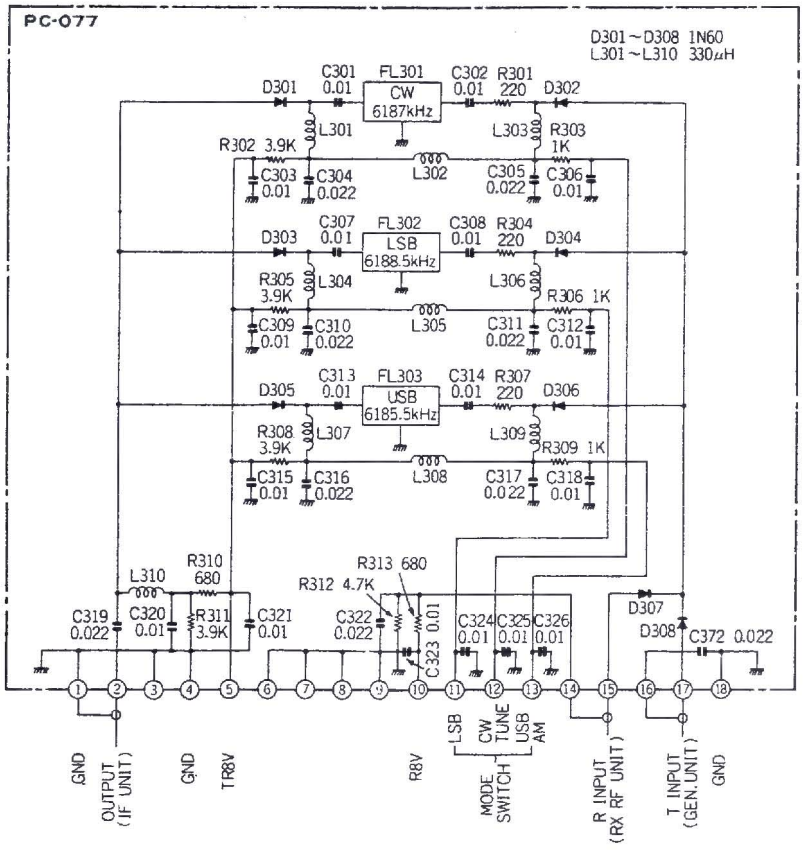


FIGURE 24. SSB Filter Characteristics.

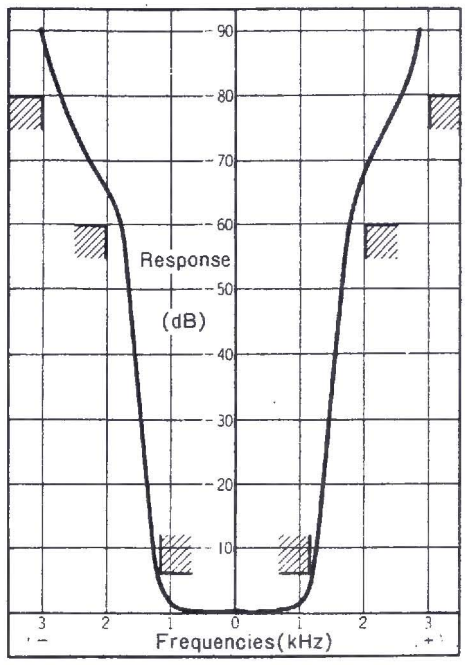
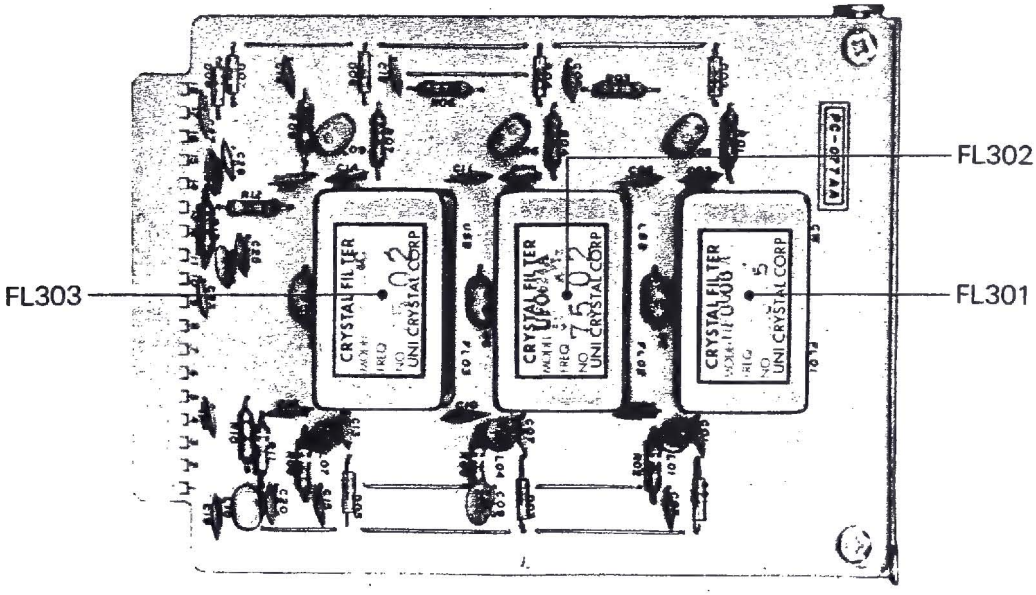


FIGURE 25. Filter Unit (PC-077) Board.



5.3 IF UNIT (PC-078)

The IF circuit board includes Q351 (3SK35) an IF amplifier for receive and transmit, and two independent receiver IF amplifiers Q352 (3SK35) and Q353 (3SK35). D357 and D358 (1N60) are the AM detector, and D353 through D356 are the SSB/CW detector. D359 and D360 (TD86 x 2) are AGC rectifiers feeding into AGC/ALC amplifiers Q355 (2SK19) and Q356 (2SC372). Q354 is an AF preamplifier. All of the IF amplifiers are FET's to insure linear amplification and good AGC/ALC action.

FIGURE 26. IF Unit (PC-078) Schematic.

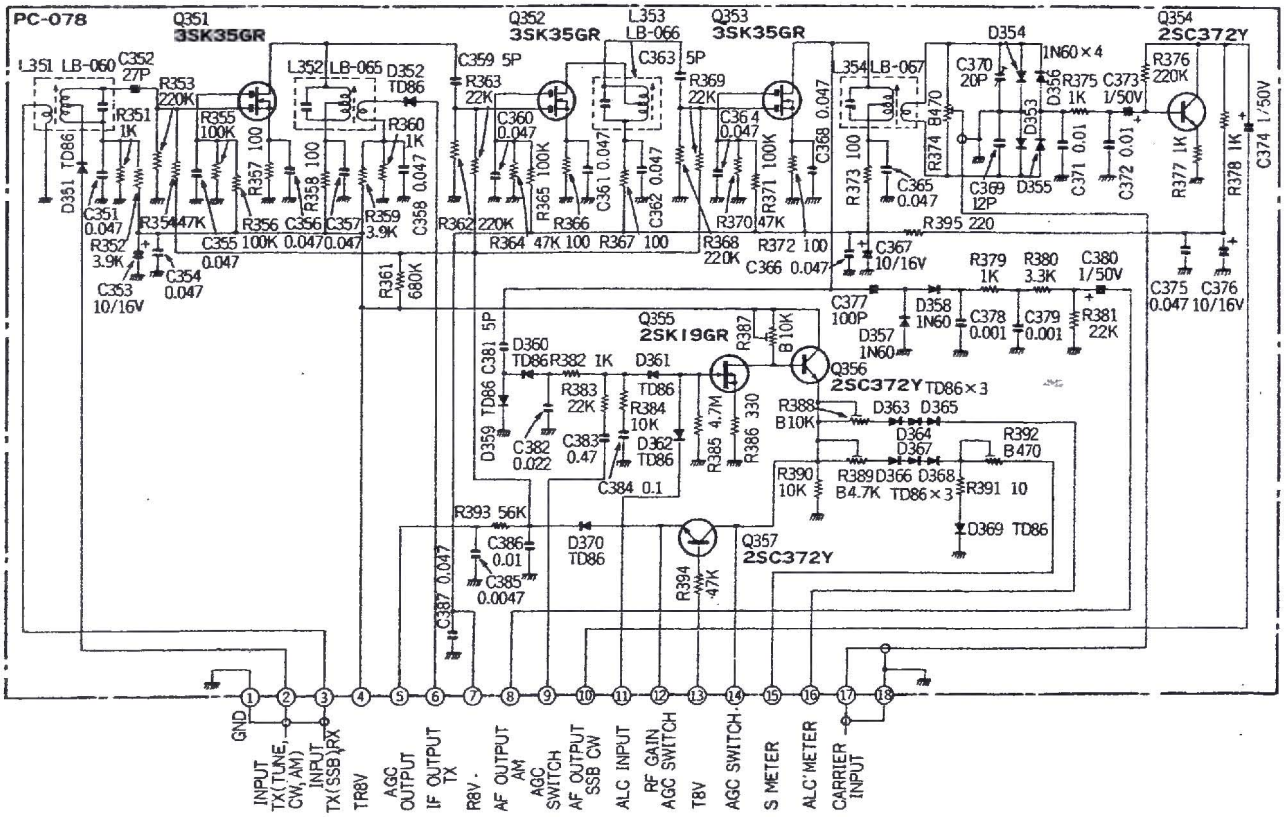
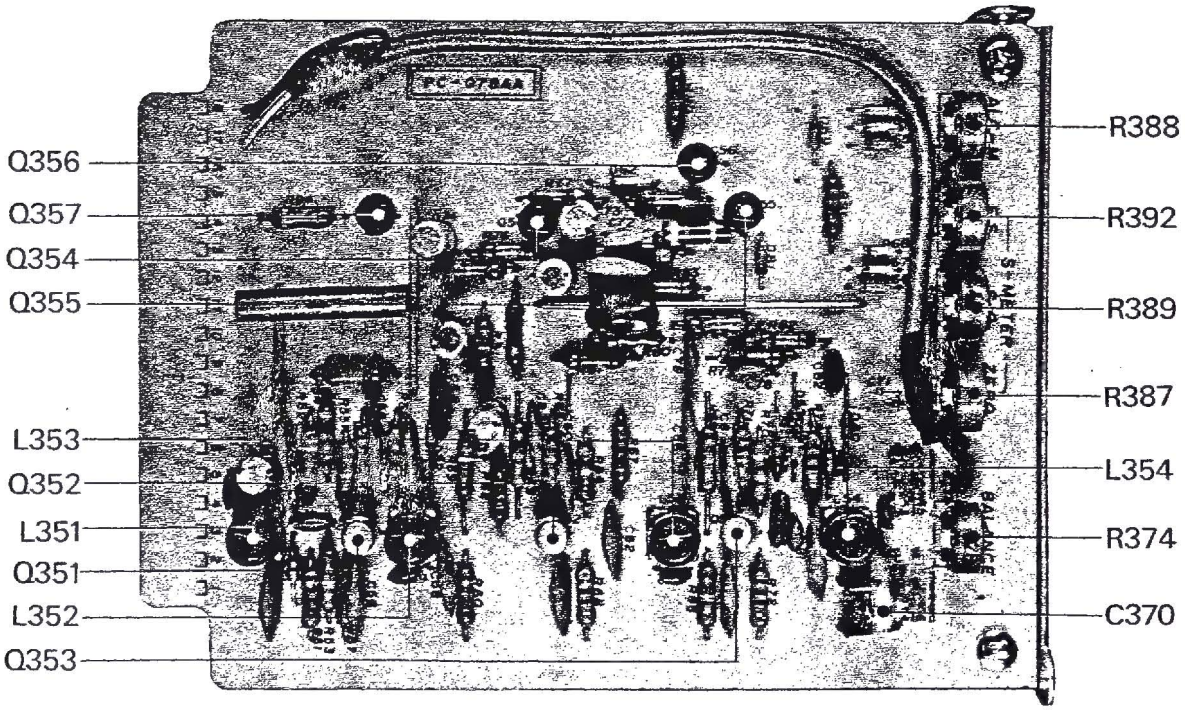


FIGURE 27 IF Unit (PC-078) Board.



5.4 AF UNIT (PC-079)

This plug-in circuit board includes audio amplifier Q410 (TA7204P), a tone oscillator for the CW sidetone Q408 (2SC372), and all of the VOX circuits. Q401 (2SK30), Q402 (2SC372) and Q403 (2SC372) are VOX amplifiers. Q404 and Q406 (2SC372 x 2) form the VOX switch, and Q405 (2SA495) is the delay control. Q409 (2SC372) is the ANTI VOX amplifier, and D409 and D410 (1N60) are the ANTI VOX rectifiers.

The audio amplifier circuit design is a SEPP-OTL to insure good tone and adequate audio output.

FIGURE 28. AF Unit (PC-079) Schematic.

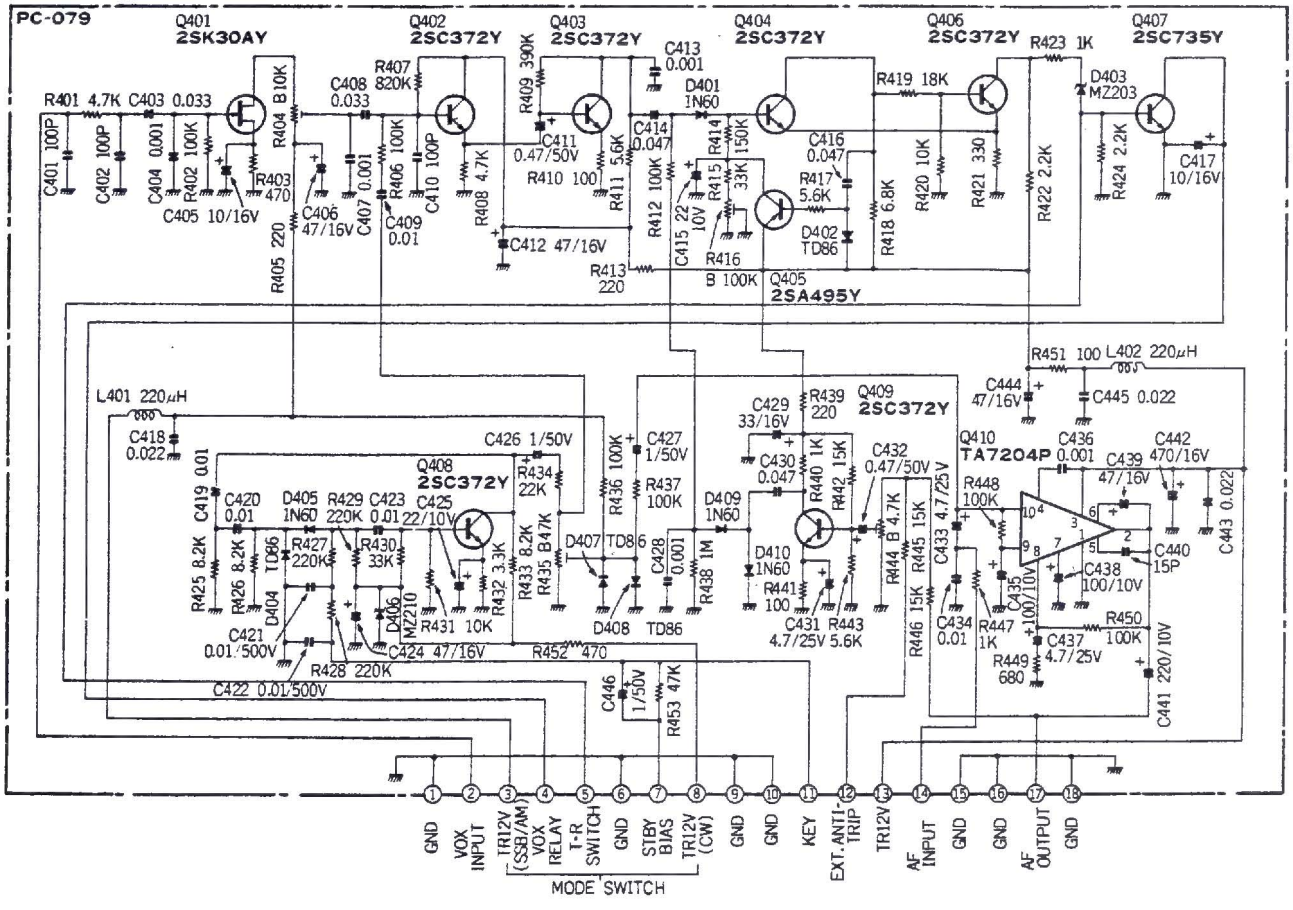
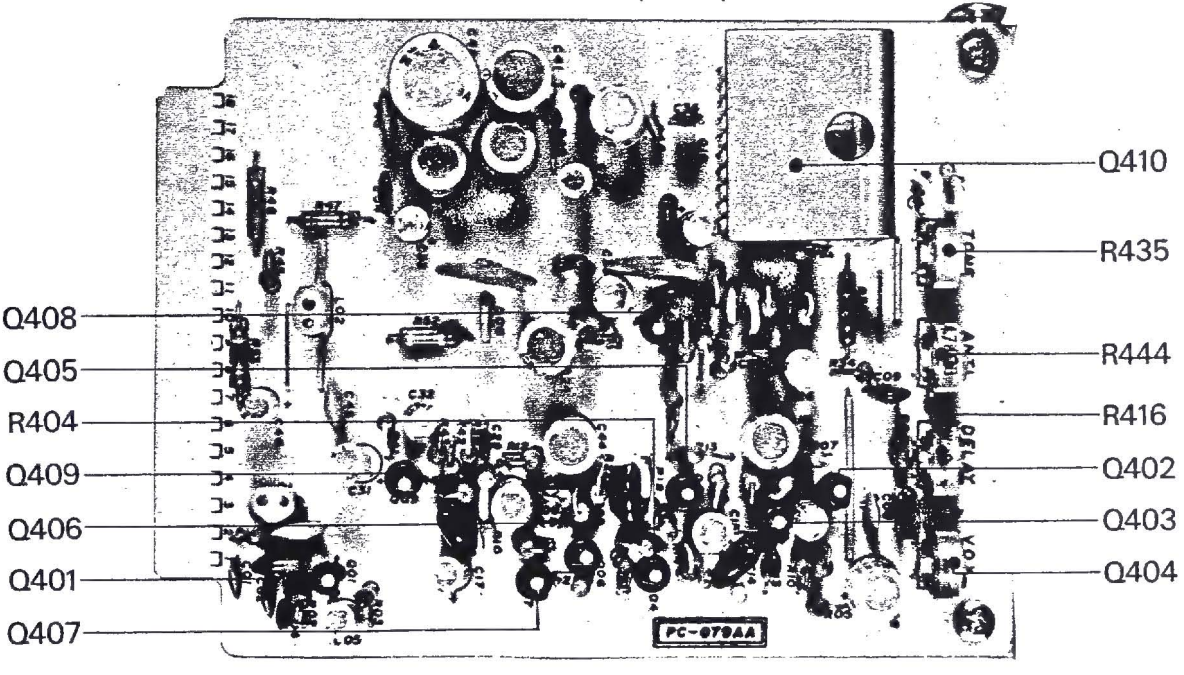


FIGURE 29. AF Unit (PC-079) Board.



5.5 GENERATOR UNIT (PC-080)

The SSB, CW, and AM carriers (6187 KHz) are generated on this plug-in circuit board. Q507 (2SC380) is the carrier oscillator, and IC Q504 (I496) is a dual balanced modulator circuit to provide maximum carrier supression. Q501 (IC I496) is an unbalanced modulator for AM operation. Q505 (IC TA7063P) and Q506 (2SC372) are microphone amplifiers. X501 (6187.0 KHz) is the carrier crystal for transmit on all modes, and X502 (6187.75 KHz) is the carrier crystal for CW reception.

5.6 TRANSMITTER RF UNIT (PC-076)

This circuit board holds the heterodyne mixers for transmit on all bands. Q251 (3SK35) is the transmitter mixer. V251 (12BY7A) is the 2020's driver tube. The transmitter RF circuits are tuned independently from the receiver's RF circuits for maximum stability.

FIGURE 30. Generator Unit (PC-080) Board.

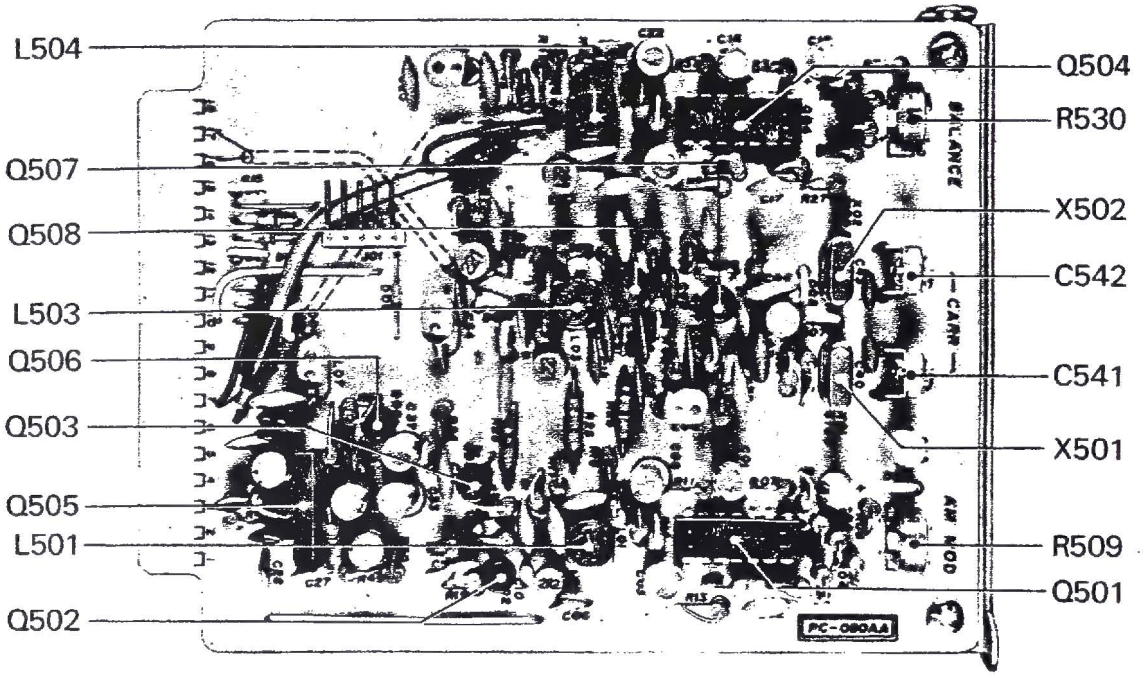


FIGURE 31. Transmitter RF Unit (PC-076) Board.

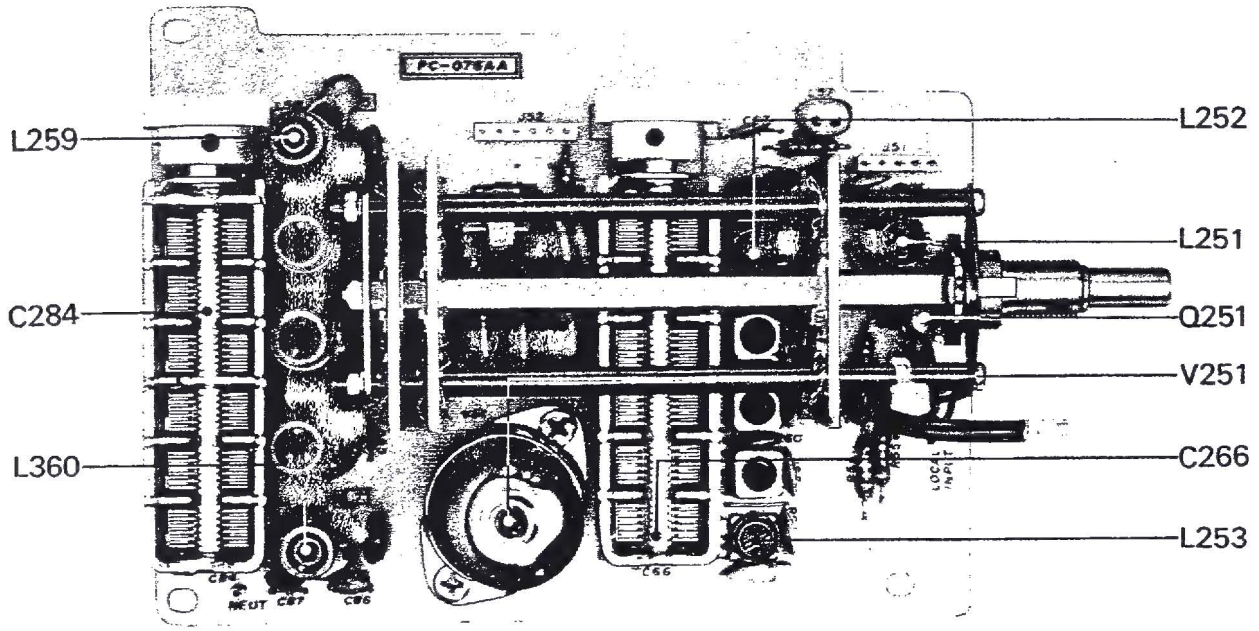


FIGURE 32. Generator Unit (PC-080) Schematic.

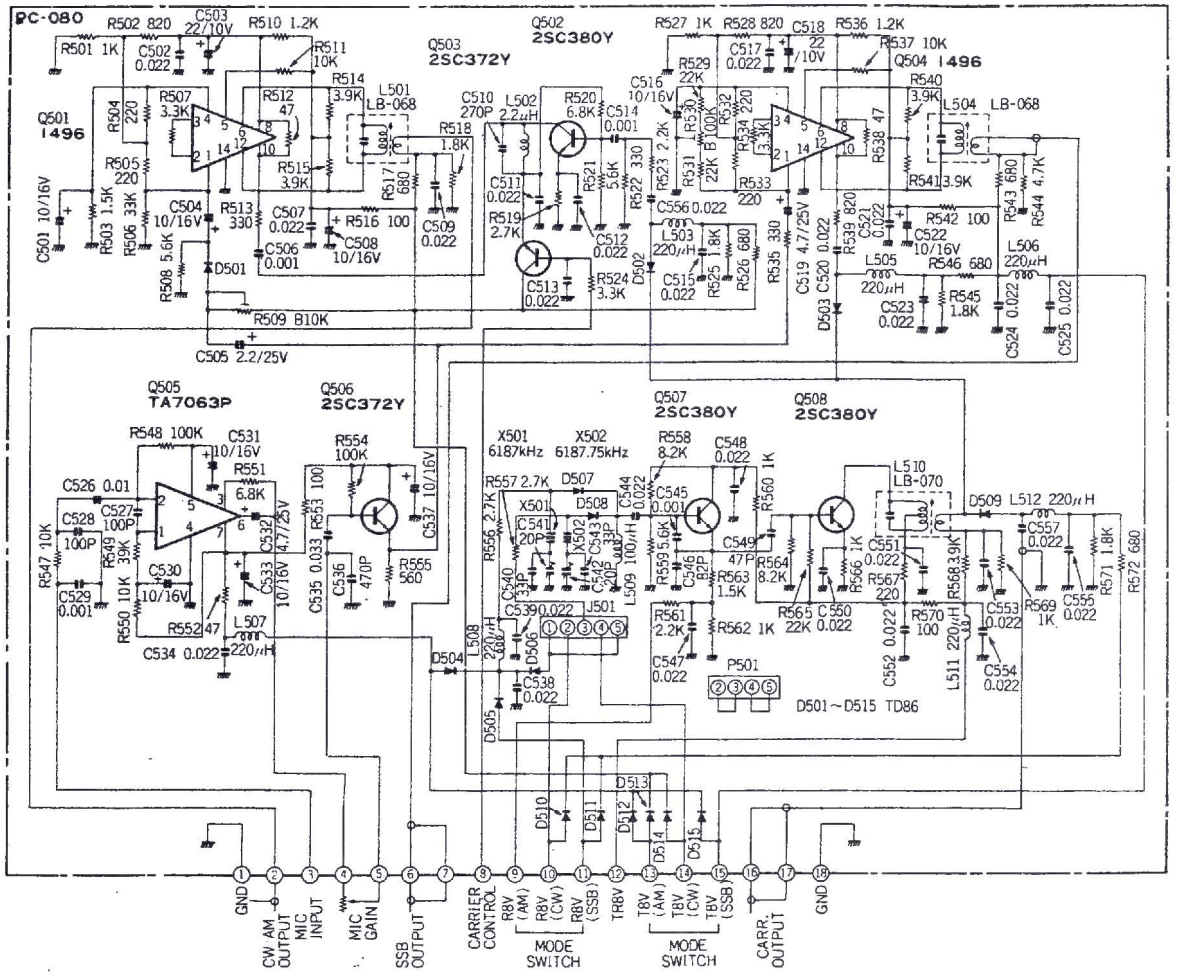
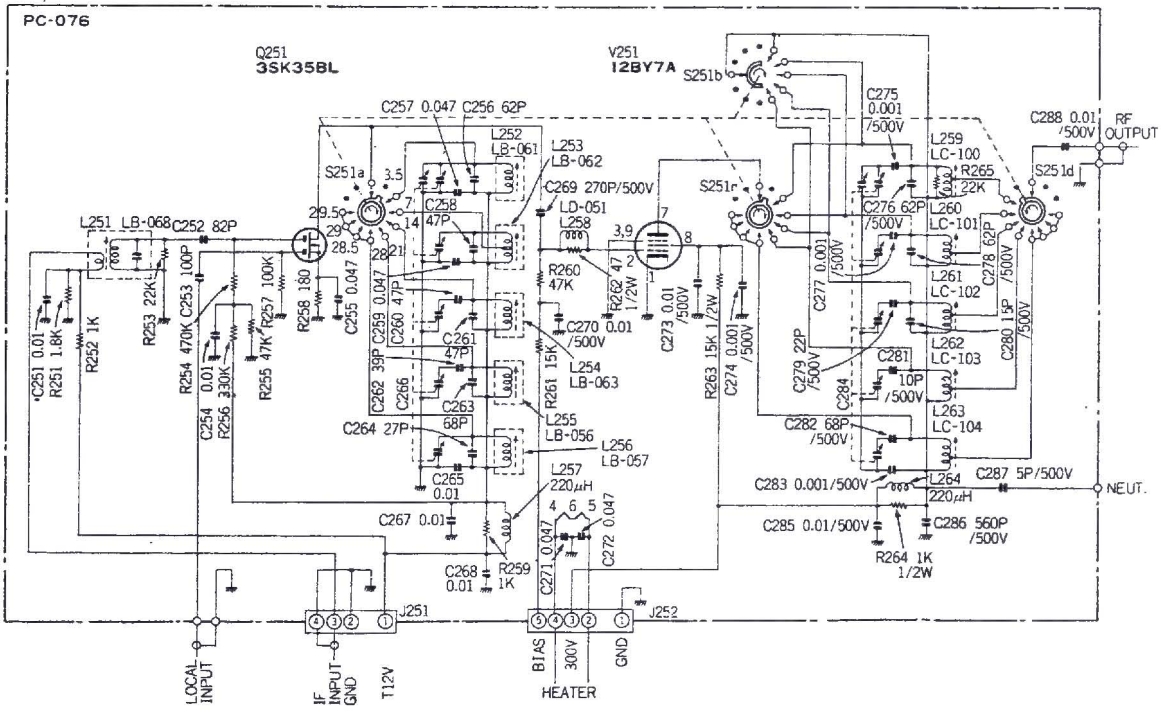


FIGURE 33. Transmitter RF Unit (PC-076) Schematic.



5.7 TRANSMITTER POWER AMPLIFIER UNIT

The final amplifier section is built onto the 2020's chassis. V1001 and V1002 (6146B x 2) are the final tubes and Q1001 (2SC9830) is the ALC amplifier. Zener diodes D1003 and D1004 (TD86 x 2) stabilize the screen grid voltage to the 6146B's to insure maximum linearity.

FIGURE 34. TRANSMITTER Power Amplifier Unit.

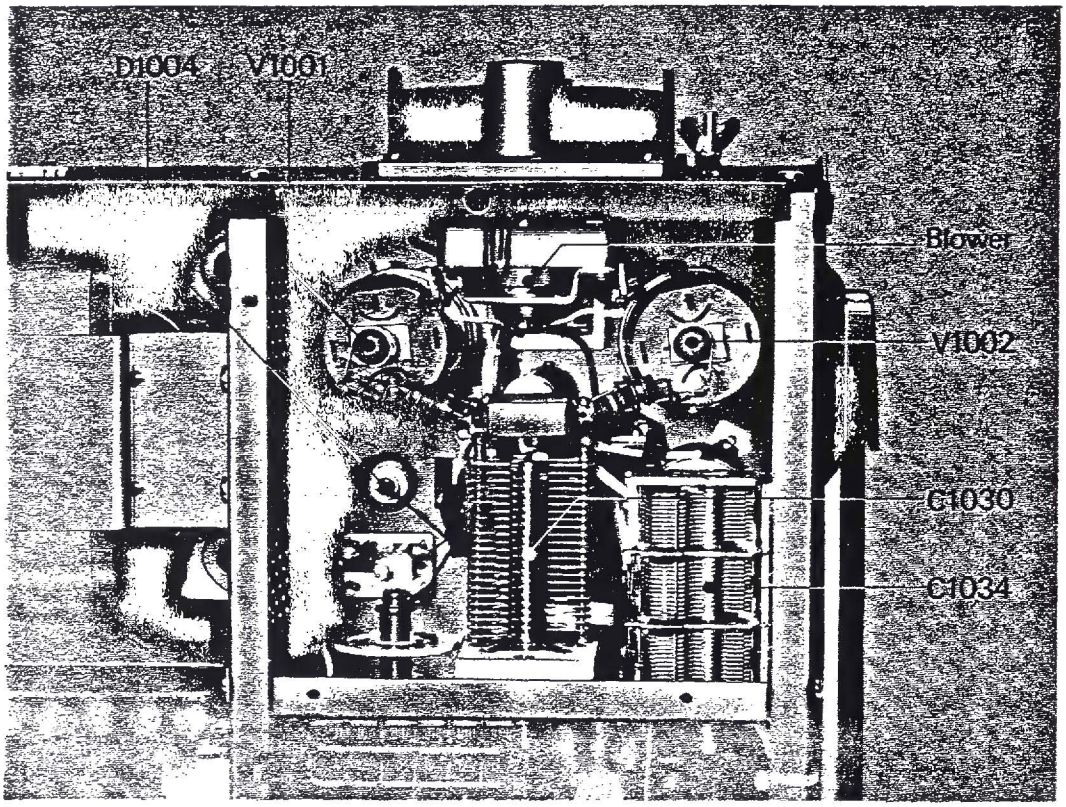
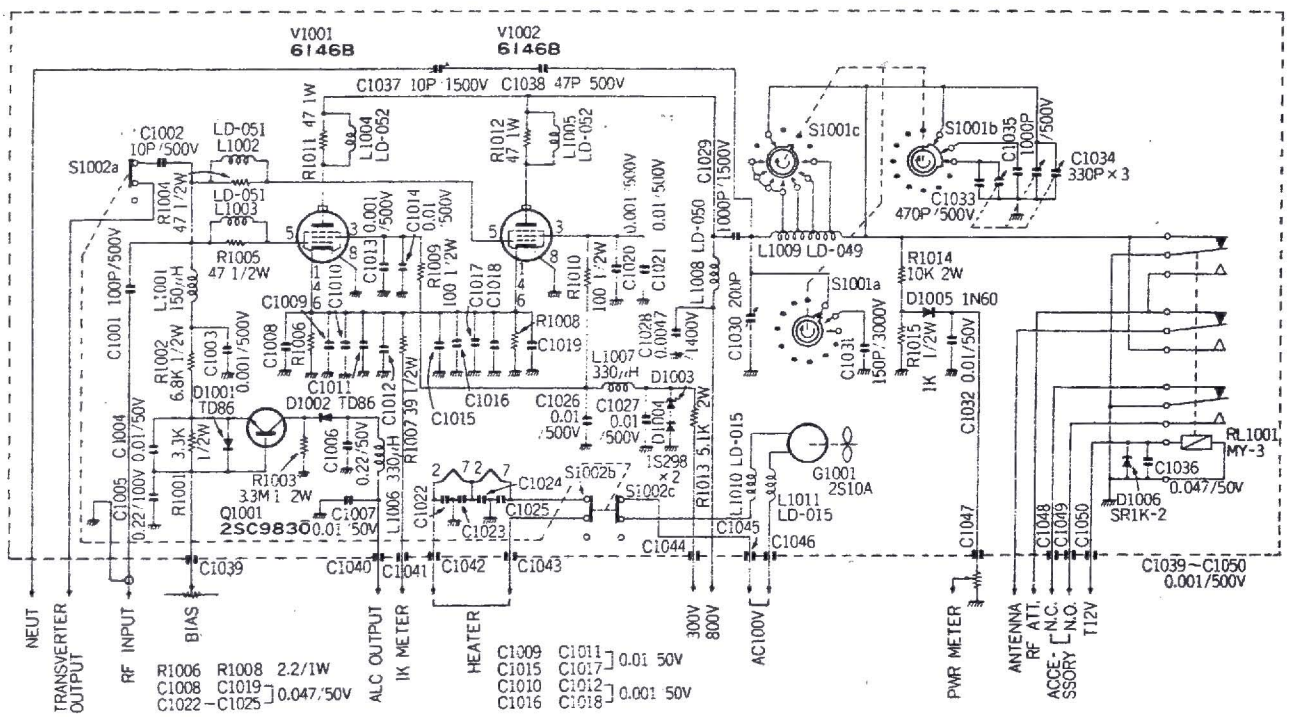


FIGURE 35. TRANSMITTER Power Amplifier Schematic.



5.8 PLL UNIT (PC-086 and PC-087)

See Figure 41 for a circuit description of the PLL section. The PLL circuit generates IF frequencies at 6.3 MHz, 6.4 MHz, 6.5 MHz, 6.6 MHz, or 6.7 MHz (as selected by the SEGMENT KHz buttons). See Table 2 for information on frequency determination in the 2020.

PLL-1 (PC-086) holds the main PLL circuits and PLL-2 (PC-087) holds the program selector circuits. When the VFO frequency is heterodyned with the IF frequencies in this circuit the output from the section is between 15.838 MHz and 15.338 MHz.

FIGURE 36.
PLL Unit (PC-086) Board.

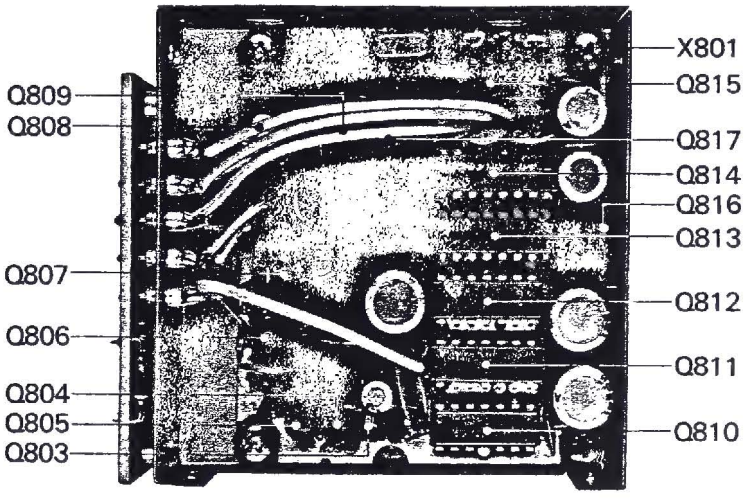


FIGURE 37. PLL Unit (PC-087) Board.

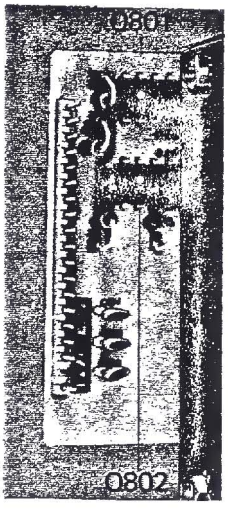
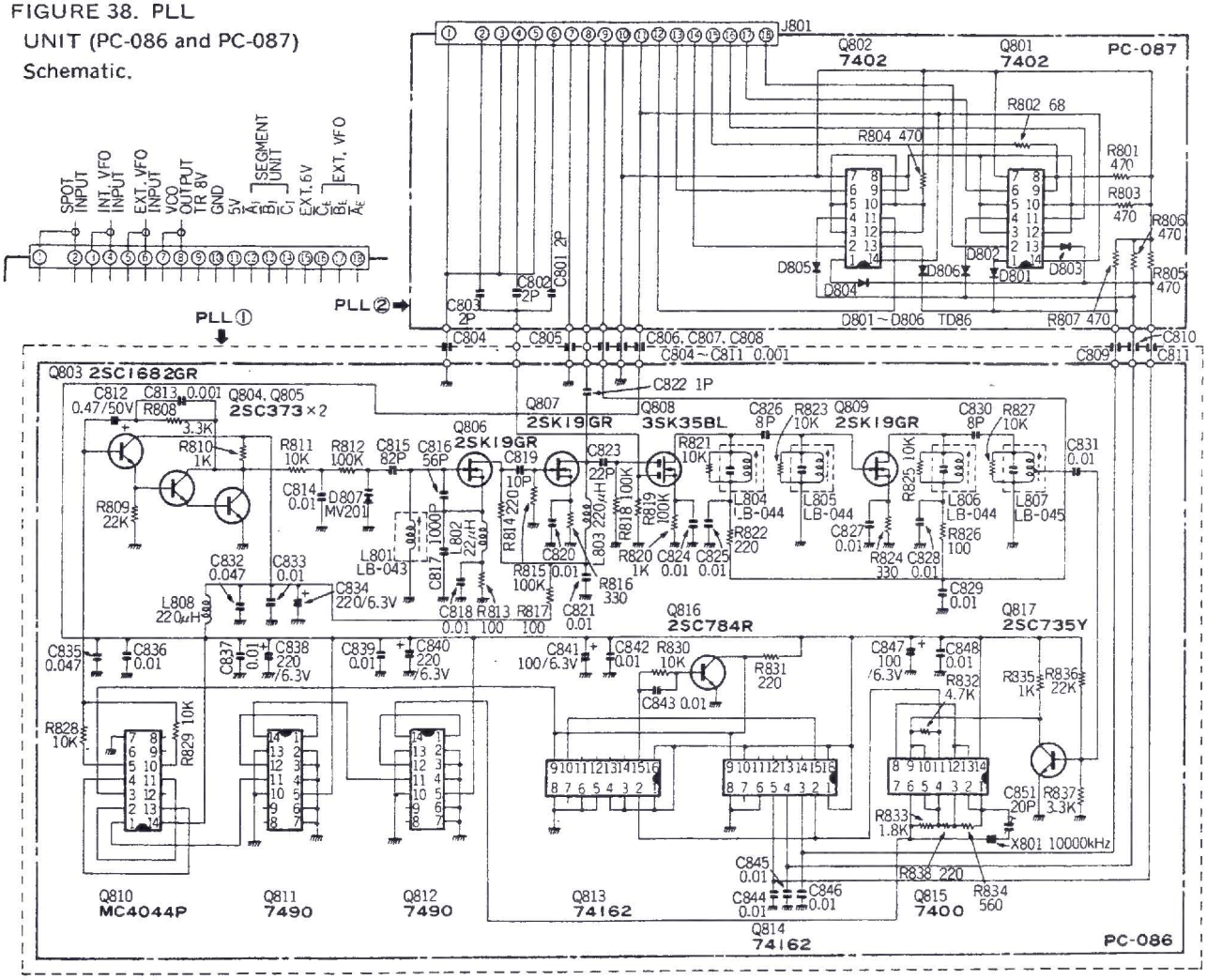


FIGURE 38. PLL UNIT (PC-086 and PC-087) Schematic.



5.9 VFO UNIT (PC-083 and PC-084)

The inherent frequency stability and readout accuracy of the 2020 results from the care and quality of the design and components of the VFO (Variable Frequency Oscillator). The 2020 uses a unique 100 KHz VFO for nearly drift-free, stable operation. The oscillator frequency ranges from 9138 to 9038 KHz. One revolution of the main tuning knob tunes through 25 KHz of the band. Buffers Q702 (2SK19) and Q703 (2SC380) help avoid load fluctuations.

FIGURE 39. VFO Unit (PC-083 and PC-084) Schematic.

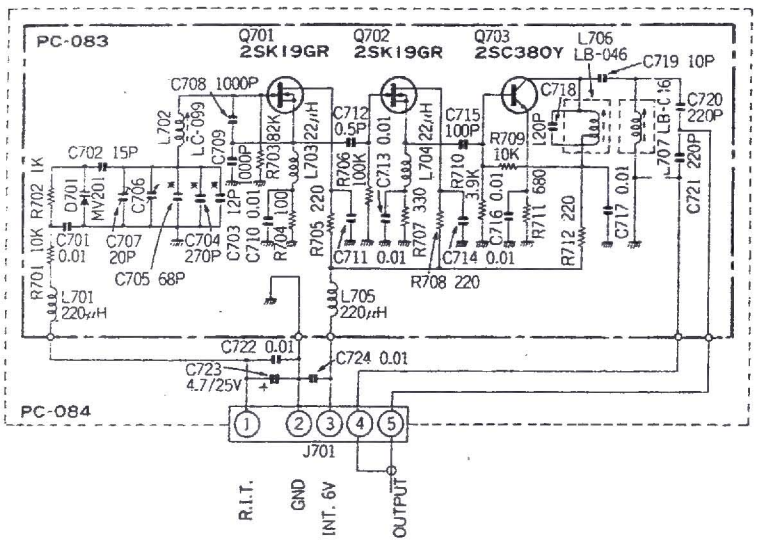


FIGURE 40. VFO Unit (PC-083 and PC-084) Board.

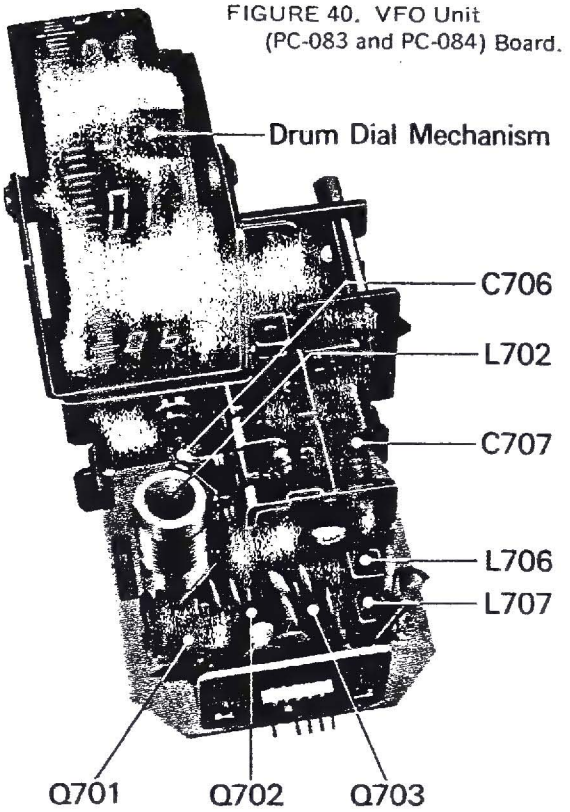
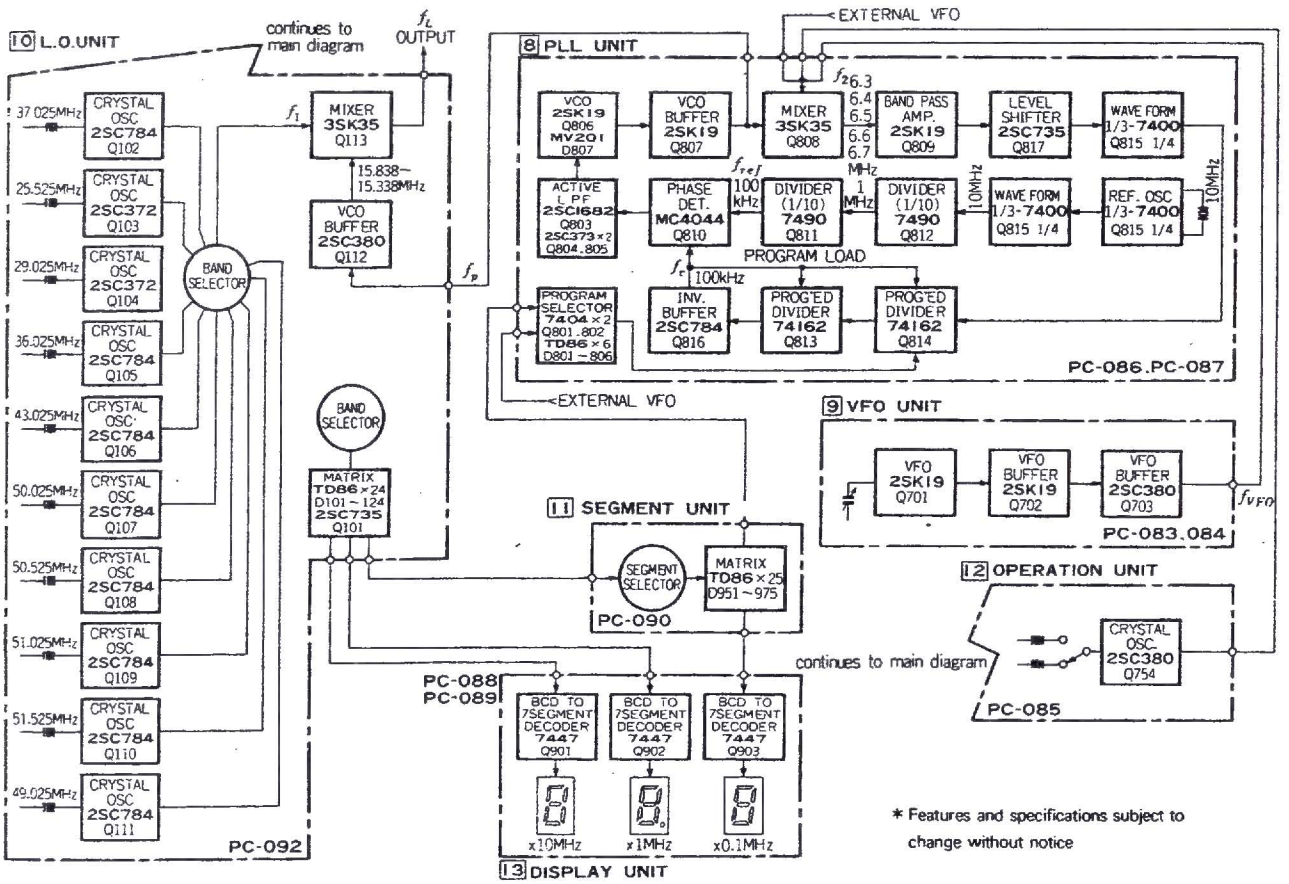


FIGURE 41. Local Oscillator Block Diagram.

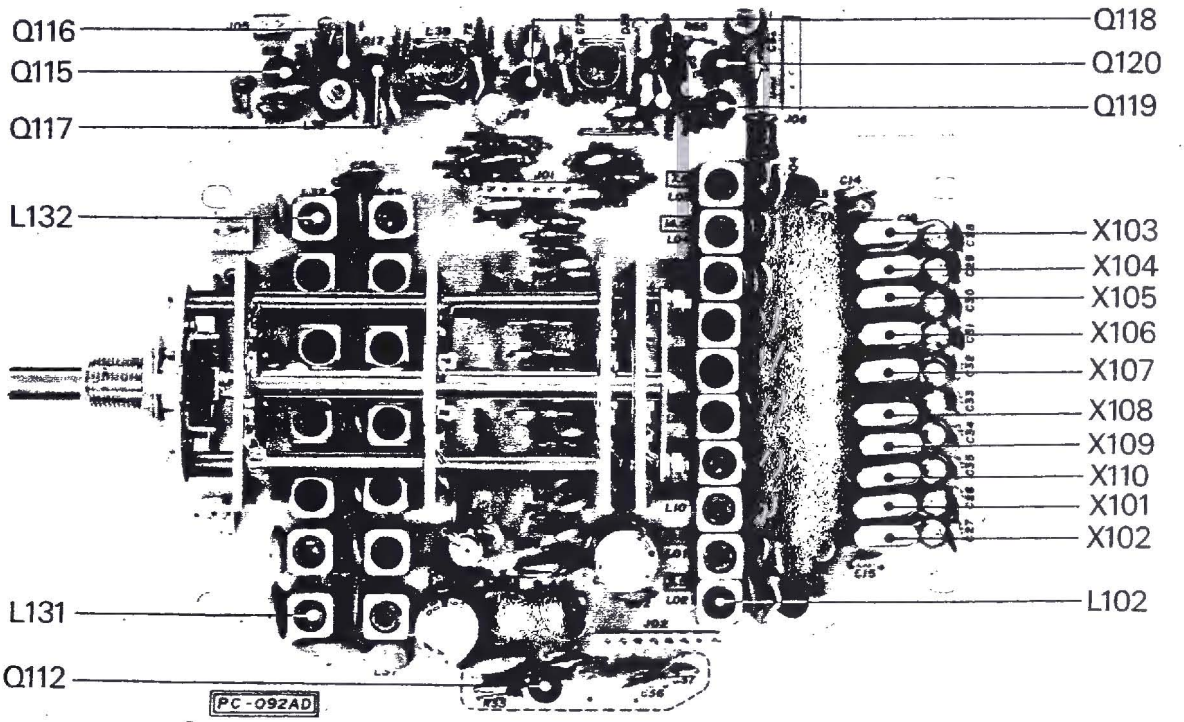


5.10 LOCAL OSCILLATOR UNIT (PC-092)

This circuit board holds the BAND MHZ switch and the 10 separate local heterodyne oscillators which determine the operating frequency of the 2020. Q113 (3SK35) is an all-band mixer to premix the local oscillator frequency with the 15.338 MHz to 15.838 MHz signal from the PLL unit. Each local oscillator employs separate transistors (Q102 to Q111) for equally stable output on each band. A dual tuned circuit for the pre-mix output reduces spurious radiation. The diode matrix circuits for the MHz dial display are also on this board.

The Local Oscillator board also holds the noise blanker circuit. Q115 (2SK19) and Q116 to Q118 (2SC380 x 3) are noise amplifiers and Q120 (2SC372) is the gate control.

FIGURE 42. Local Oscillator Unit (PC-092) Board.



5.11 SEGMENT UNIT (PC-090)

This small circuit board holds the SEGMENT KHZ buttons and the diode matrix circuit which determines the correct 100 KHz display.

FIGURE 43. Segment Unit (PC-090) Schematic.

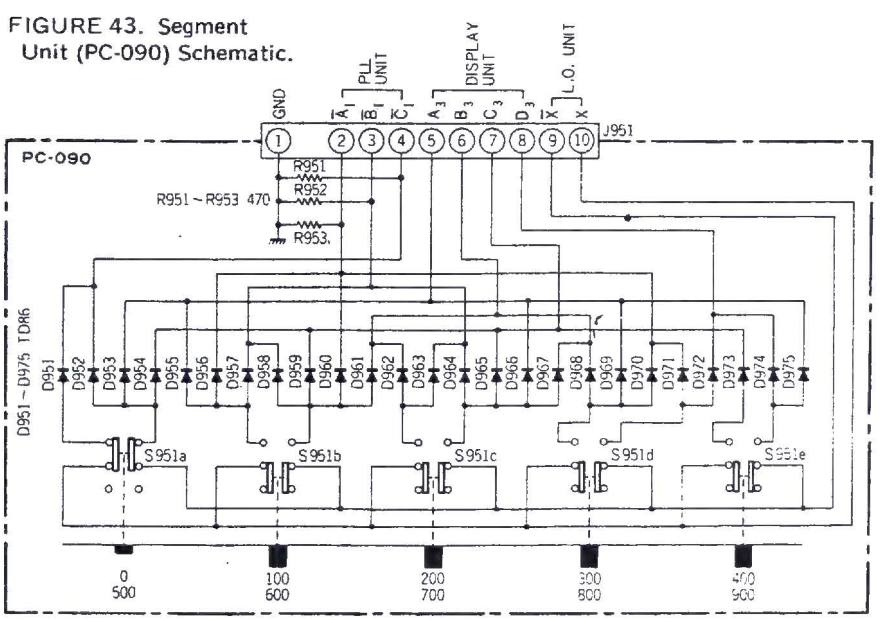


FIGURE 44. Segment Unit Board.

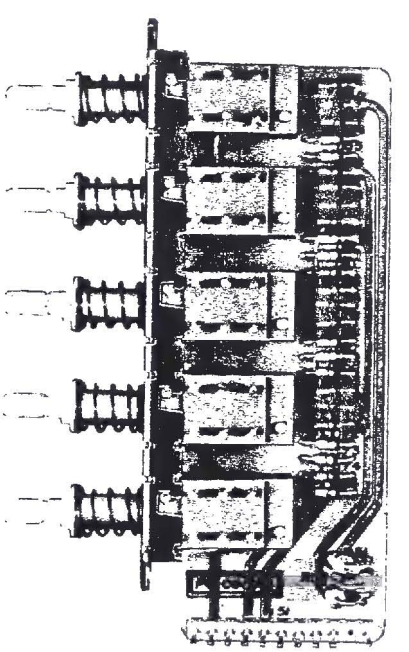
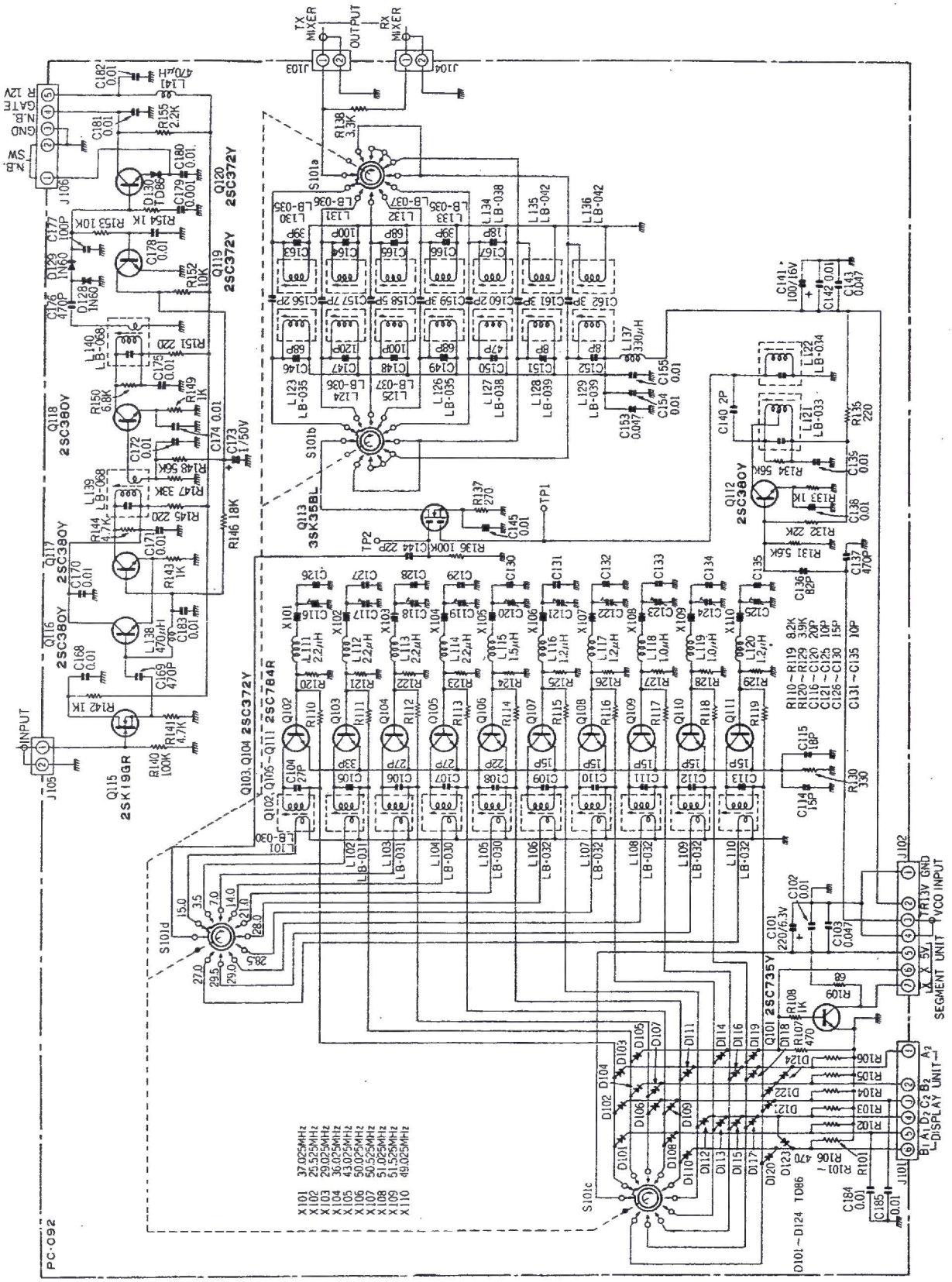


FIGURE 45. Local Oscillator Unit (PC-092) Schematic.



* Features and specifications subject to change without notice.

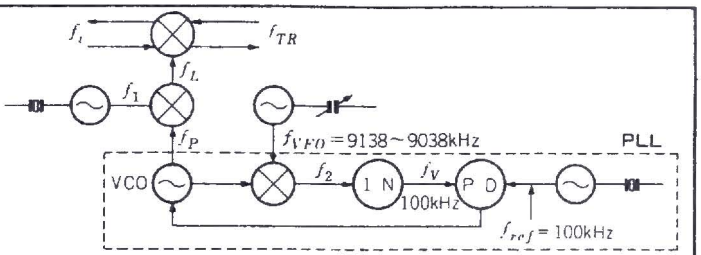
TABLE 2. FREQUENCY DETERMINATION IN THE 2020.

The operating frequency of the 2020 is determined by 4 different sources.

Operating frequency = Local Oscillator frequency — (PLL heterodyne frequency + VFO frequency) — Carrier frequency

For example: 3.5 MHz = 25.525 MHz — (6.700 MHz + 9.138 MHz) — 6.187 MHz

fTR — Transmitting & receiving frequency
fi — Intermediate frequency
fL — Local oscillator frequency
fl — Crystal oscillator frequency
fp — PLL output frequency
f2 — PLL heterodyne output frequency



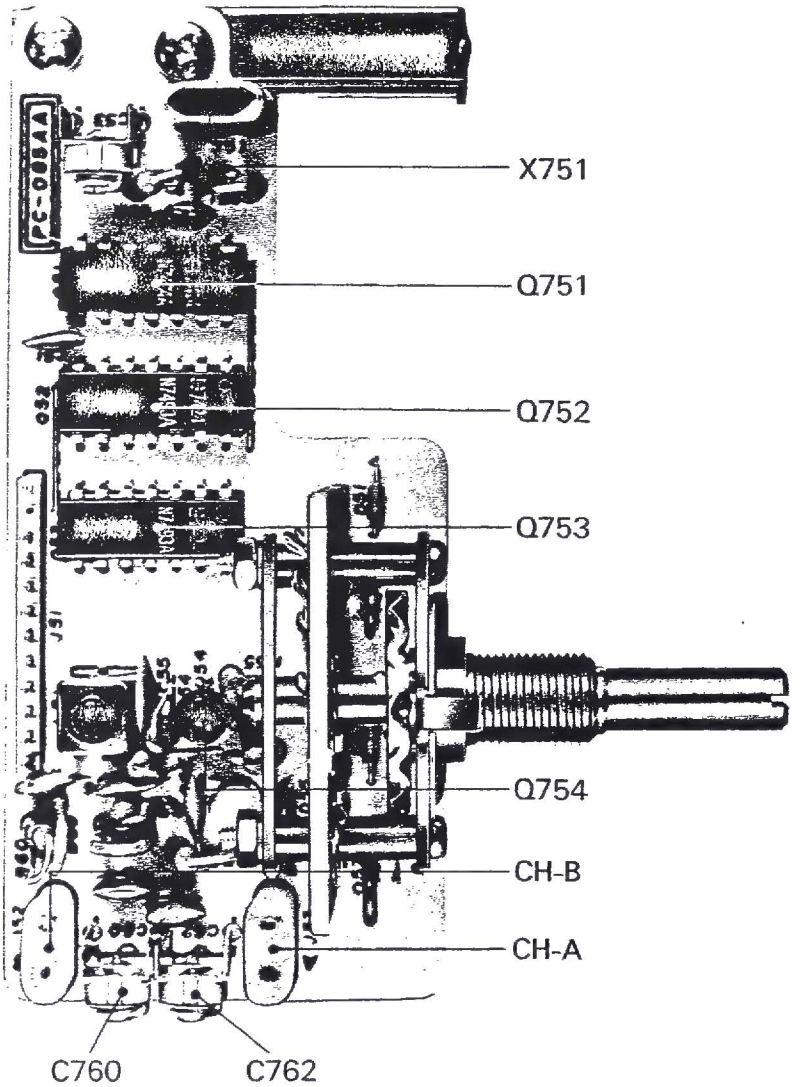
BAND	f_{TR}	f_L	f_1	f_p	f_2
3.5	3.5— 3.6	9.687— 9.787	25.525	15.838—15.738	6.700
	3.6— 3.7	9.787— 9.887		15.738—15.638	6.600
	3.7— 3.8	9.887— 9.987		15.638—15.538	6.500
	3.8— 3.9	9.987—10.087		15.538—15.438	6.400
	3.9— 4.0	10.087—10.187		15.438—15.338	6.300
7.0	7.0— 7.1	13.187—13.287	29.025	15.838—15.738	6.700
	7.1— 7.2	13.287—13.387		15.738—15.638	6.600
	7.2— 7.3	13.387—13.487		15.638—15.538	6.500
	7.3— 7.4	13.487—13.587		15.538—15.438	6.400
	7.4— 7.5	13.587—13.687		15.438—15.338	6.300
14.0	14.0—14.1	20.187—20.287	36.025	15.838—15.738	6.700
	14.1—14.2	20.287—20.387		15.738—15.638	6.600
	14.2—14.3	20.387—20.487		15.638—15.538	6.500
	14.3—14.4	20.487—20.587		15.538—15.438	6.400
	14.4—14.5	20.587—20.687		15.438—15.338	6.300
21.0	21.0—21.1	27.187—27.287	43.025	15.838—15.738	6.700
	21.1—21.2	27.287—27.387		15.738—15.638	6.600
	21.2—21.3	27.387—27.487		15.638—15.538	6.500
	21.3—21.4	27.487—27.587		15.538—15.438	6.400
	21.4—21.5	27.587—27.687		15.438—15.338	6.300
28.0	28.0—28.1	34.187—34.287	50.025	15.838—15.738	6.700
	28.1—28.2	34.287—34.387		15.738—15.638	6.600
	28.2—28.3	34.387—34.487		15.638—15.538	6.500
	28.3—28.4	34.487—34.587		15.538—15.438	6.400
	28.4—28.5	34.587—34.687		15.438—15.338	6.300
28.5	28.5—28.6	34.687—34.787	50.525	15.838—15.738	6.700
	28.6—28.7	34.787—34.887		15.738—15.638	6.600
	28.7—28.8	34.887—34.987		15.638—15.538	6.500
	28.8—28.9	34.987—35.087		15.538—15.438	6.400
	28.9—29.0	35.087—35.187		15.438—15.338	6.300
29.0	29.0—29.1	35.187—35.287	51.025	15.838—15.738	6.700
	29.1—29.2	35.287—35.387		15.738—15.638	6.600
	29.2—29.3	35.387—35.487		15.638—15.538	6.500
	29.3—29.4	35.487—35.587		15.538—15.438	6.400
	29.4—29.5	35.587—35.687		15.438—15.338	6.300
29.5	29.5—29.6	35.687—35.787	51.525	15.838—15.738	6.700
	29.6—29.7	35.787—35.887		15.738—15.638	6.600

5.12 OPERATION UNIT (PC-085)

This circuit board holds the calibrator circuit which generates a marker signal at 25 KHz intervals. Q751 (SN 7404) is the oscillator and Q752 and Q753 (SN 7493 x 2) are the dividers. X751, the calibrator crystal, oscillates at 6.4 MHz.

The board also holds the fixed frequency oscillator circuit and the function switch. Q754 (2SC380) is the oscillator which can be selected between two positions (A or B). C760 and C762 are crystal trimmers for the fixed frequency crystals.

FIGURE 46. Operation Unit (PC-085) Board.



5.13 DISPLAY UNIT (PC-088 and PC-089)

PC-088 holds the MHz and 100 KHz LED frequency displays. D901 is the VFO LED which is lighted whenever the 2020's VFO is operating.

PC-089 holds the decoder circuit for the display. Q901, Q902, and Q903 are BDC to 7 segment decoder (SN 7309 x 3).

FIGURE 47. Display Unit (PC-088) Board.

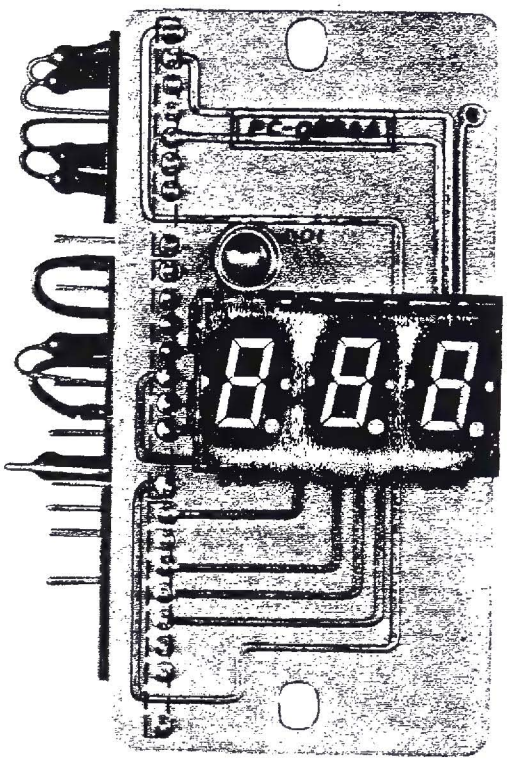
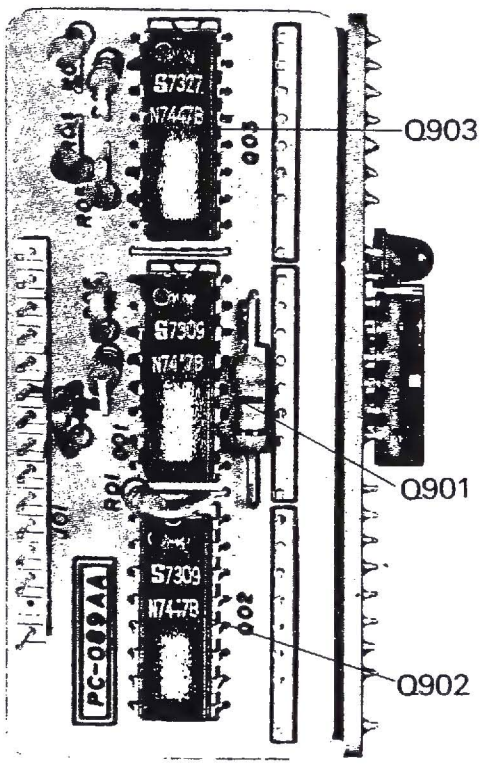


FIGURE 48. Display Unit (PC-089) Board.



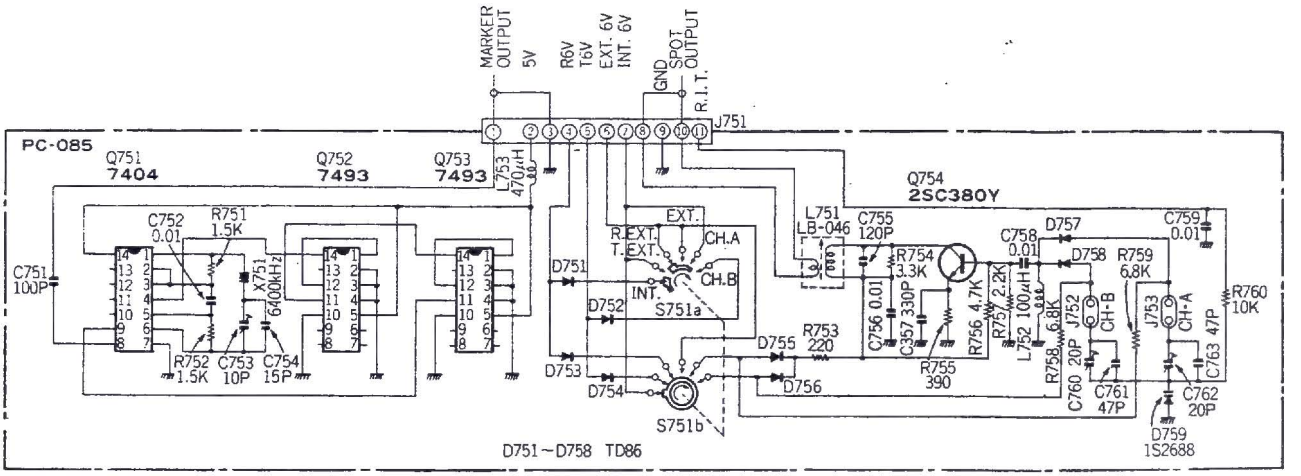
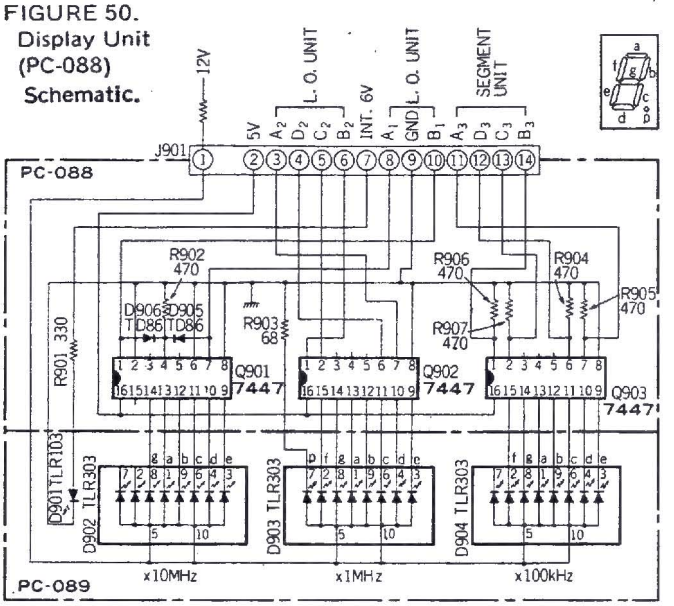


FIGURE 49. Operation Unit (PC-085) Schematic.

FIGURE 50. Display Unit (PC-088) Schematic.



5.14 AVR UNIT (PC-082)

This circuit board holds the AVR circuit (automatic voltage regulator). The voltage outputs from the circuit are 5 VDC for the IC circuits, 8 VDC for the solid state section of the transceiver, and 6 VDC for the VFO circuit. The voltage control for the RIT circuit is also included in the circuit.

FIGURE 51. AVR Unit (PC-082) Board.

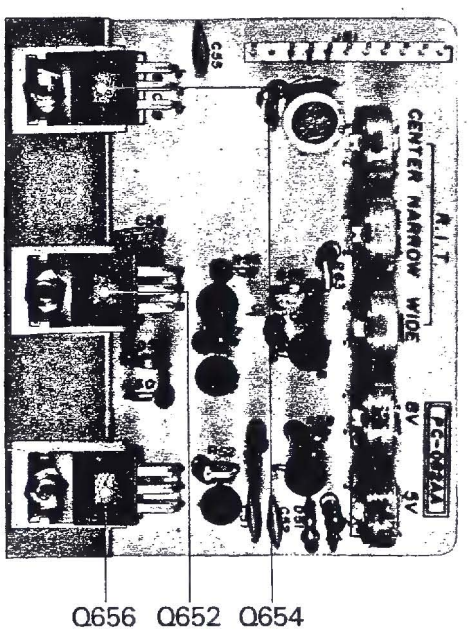
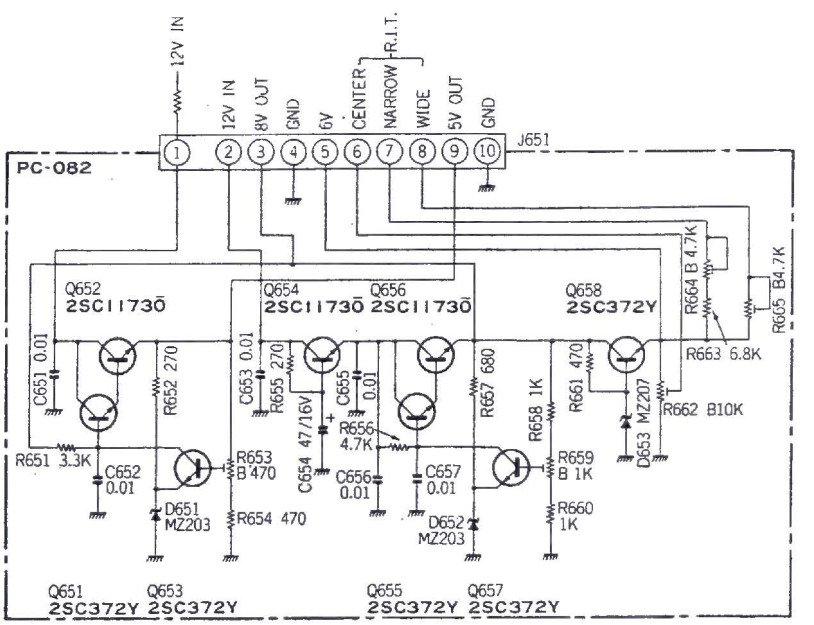


FIGURE 52. AVR Unit (PC-082) Schematic.



SECTION 6. MAINTENANCE AND SERVICE

6.1 GENERAL INFORMATION

The 2020 has been factory aligned and tested to specifications before delivery to the customer. Under normal circumstances the transceiver will be properly adjusted to operate in accordance with the operating instructions given in this manual. In fact the equipment's owner can void the transceiver's warranty by attempting service or alignment without permission from the factory. Damage caused in shipment can also void the warranty, so it is extremely important to be aware of any shipping damage before attempting to operate the equipment.

When operated properly, the transceiver can give years of service without requiring realignment. Any service work should be performed only by an experienced electronic technician who has access to the proper test equipment. The 2020 is a sophisticated, complicated electronic circuit which can easily be damaged by improper service.

6.2 POWER TRANSFORMER REWIRING

The 2020 is supplied for distribution in the United States for operation from a 117 VAC power source. It is possible however to rewire the power transformer primary windings so that the 2020 can operate from 110/110/200/220 VAC.

The power transformer has two primary windings. For 200/220/234 VAC operation the windings are wired in series, and for 100/110/117 VAC operation the windings are wired in parallel.

Figure 55 below diagrams the wiring of the power transformer for each possible AC line voltage.

6.3 REPLACING THE FUSE

When the fuse blows, there is some cause. Be sure to find the cause before attempting operation. Use a 5 amp fuse for 117 VAC operation, and a 3 amp fuse for 234 VAC operation. Under **NO** circumstances use a higher amperage fuse than those specified. Extensive damage can be caused by an improper fuse. Also, the warranty can be voided if the wrong fuse is used.

6.4 CLEANING AND MAINTENANCE

The knobs, front panel, and cabinet of the 2020 are likely to become soilded after extended use. The knobs should be removed from the transceiver and cleaned with a neutral soap and warm water. Use a netral soap and a damp cloth to clean the cabinet and front panel (do not use harsh chemicals).

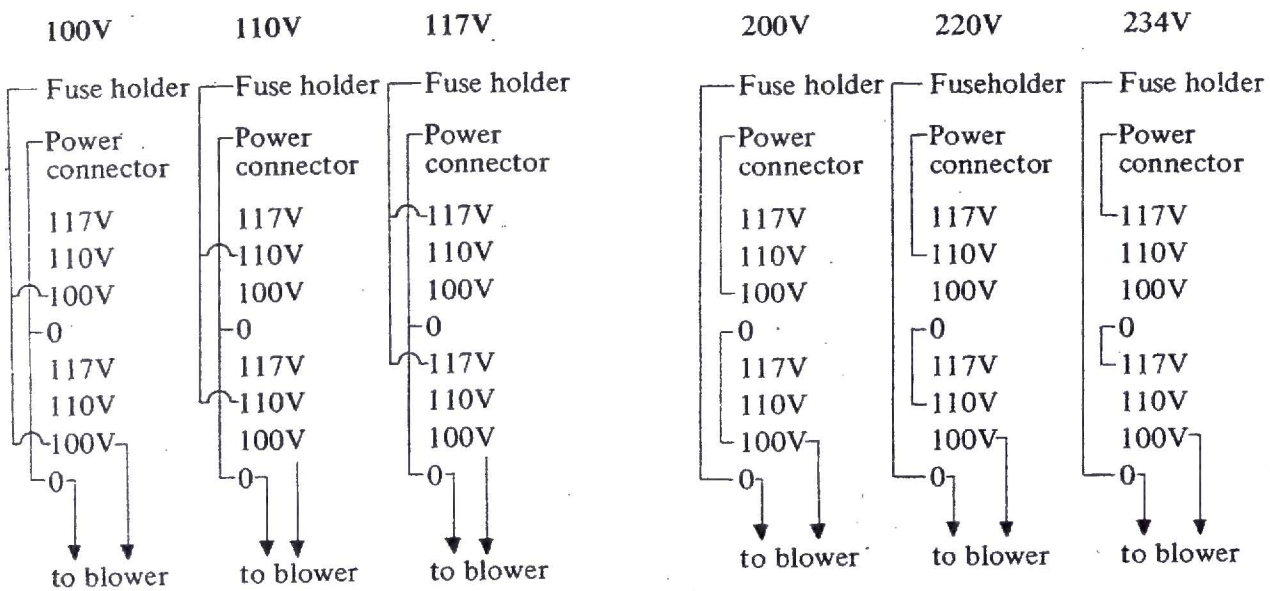
Use an air blower or a soft brush to keep the interior clean and dust free. Make certain that the air passages of the transceiver are kept free.

6.5 SERVICE AND REPLACEMENT PARTS

6.5.1 TUBES AND TRANSISTORS

Operation of the 2020 without proper tuning or without a proper antenna will significantly reduce the life of the final amplifier tubes. A bad tube or tubes should be replaced with 6146B tubes. Matched tubes are not required however neutralization is required with new tubes. The driver tube is a 12BY7A.

FIGURE 55. Power Transformer Rewiring.



5.15 RECTIFIER UNIT (PC-081)

This board holds all of the diode rectifiers for the power supply section of the transceiver. The board supplies the high voltage to the plates of the 6146B's and the 12BY7A tubes, the screen grid voltages and and bias voltages.

FIGURE 53. Rectifier Unit (PC-081) Board.

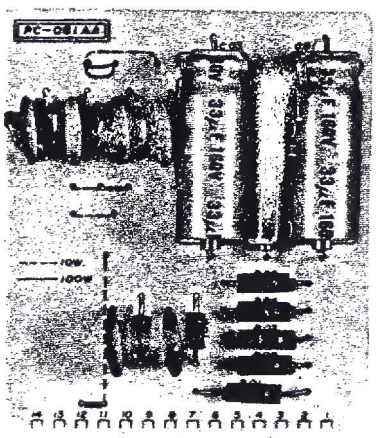
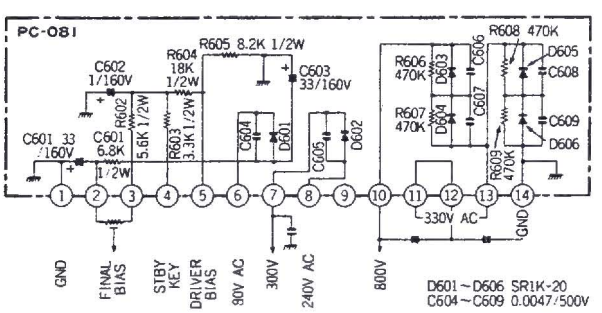


FIGURE 54. Rectifier Unit (PC-081) Schematic.



The transistors in the 2020 can easily be damaged by being shorted by metalic tools. Be very careful during service operations and when possible, use insulated tools.

CAUTION: DANGEROUS HIGH VOLTAGES ARE PRESENT INSIDE THE CASE OF THE 2020 WHEN THE TRANSCEIVER IS TURNED ON. EXERCISE EXTREME CAUTION TO AVOID ELECTRIC SHOCK.

6.5.2 SERVICE PARTS

Be certain to use replacement parts of equal or better ratings when servicing the 2020.

When ordering replacement or spare parts for your equipment, be sure to specify the following information:

> The model number and serial number of the equipment — The schematic number of the part — The board number on which the part is located — and a description of the part.

This information will aid in fast and correct handing of all parts orders.

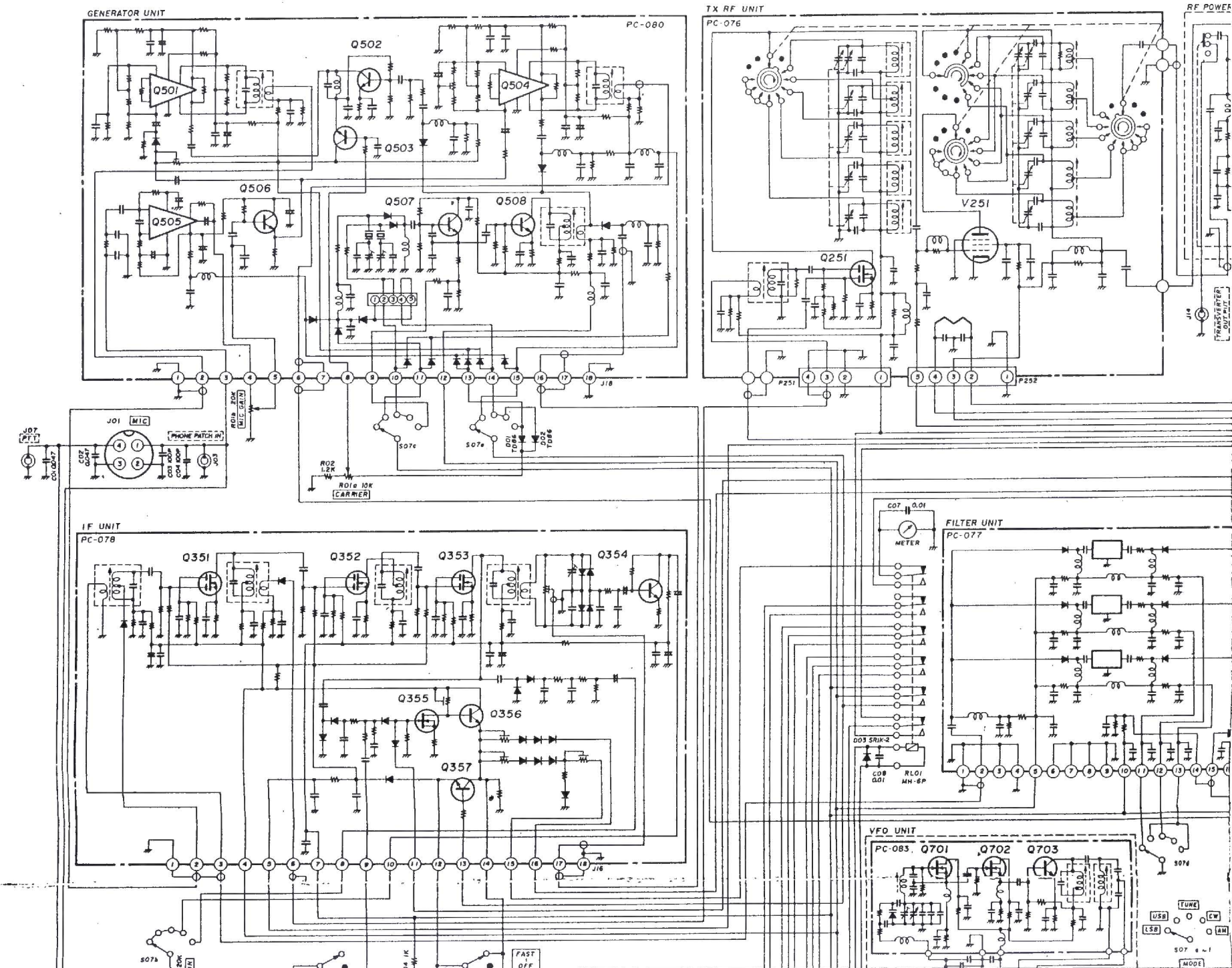
6.5.3 SHIPPING THE 2020 FOR REPAIR

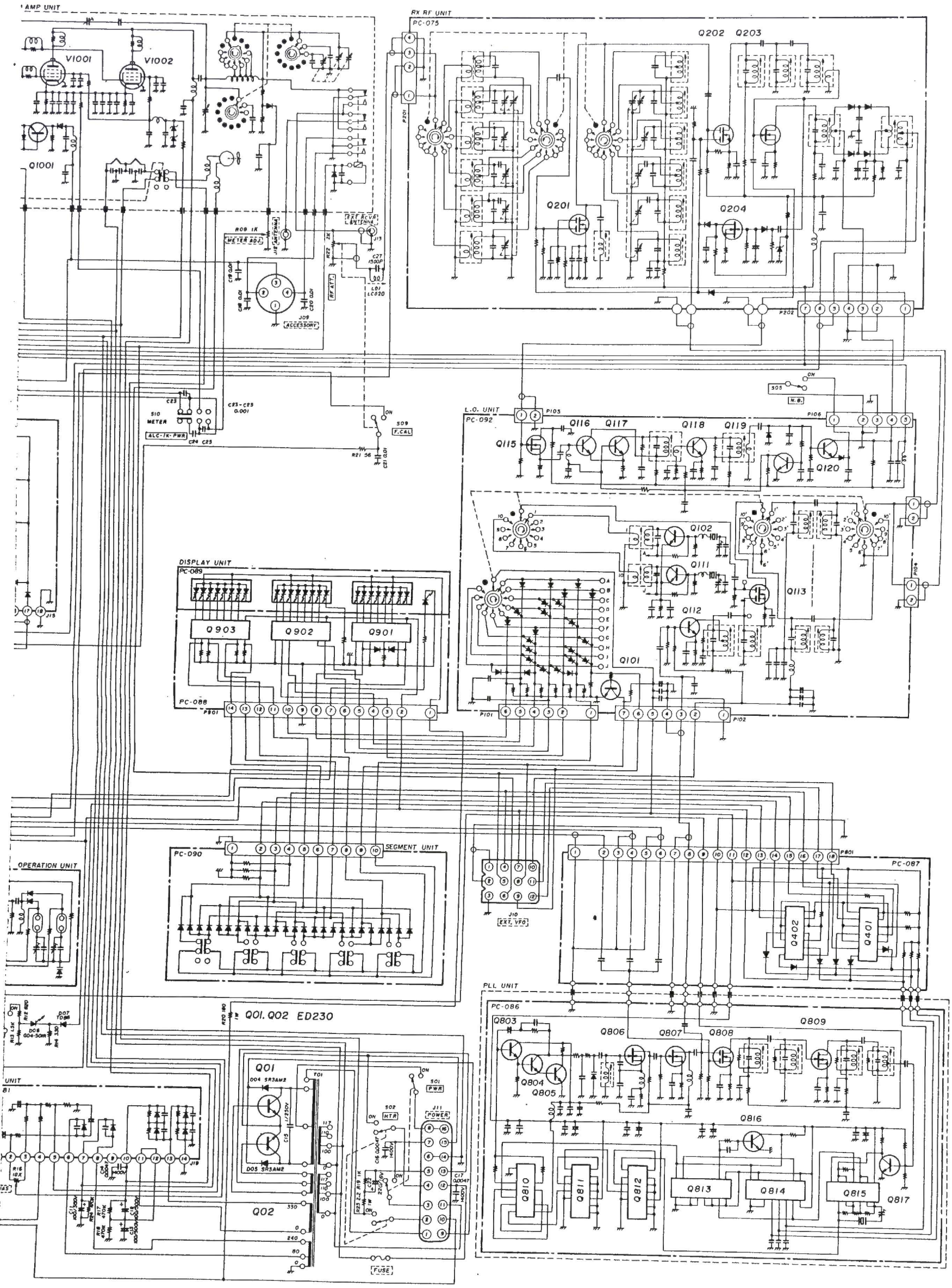
Whenever it becomes necessary to ship the 2020 to a service center for repair, repack the transceiver in its original carton (or an equivalent box with adequate packing) to prevent shipping damage.

CAUTION: A large percentage of equipment received in our service centers is not packed properly. Please note that any shipping damage caused by poor packaging will not be covered by insurance.

After the 2020 has been properly packed, return the transceiver to the service center prepaid. Be certain to insure the package for its full value. Also include a short note describing the problems involved.

Any transceiver returned for warranty repair must include some proof of the purchase date.


GENERATOR UNIT
PC-080
Q501
Q502
Q503
Q504
Q505
Q506
Q507
Q508
J18
TX RF UNIT
PC-076
V251
Q251
P251
P252
RF POWER
TRANSVERTER OUTPUT
J01 MIC
PHONE PATCH IN
J07 PTT
J03
R01a 20K MIC GAIN
R02 1.2K
R01a 10K CARRIER
S07c
S07e
D01 1S84
D02 1S86
IF UNIT
PC-078
Q351
Q352
Q353
Q354
Q355
Q356
Q357
J16
FILTER UNIT
PC-077
METER
C07 0.01
D03 SR1K-2
C08 0.01
RL01 MH-6P
VFO UNIT
PC-083
Q701
Q702
Q703
S07a
S07b
FAST
TUNE
USB
CW
LSB
AM
MODE



MODEL 2020 SCHEMATIC DIAGRAM

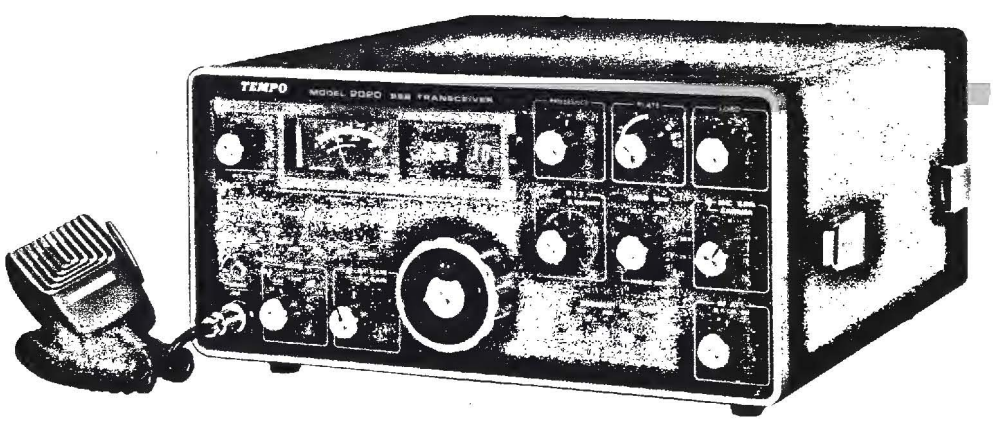
Features and specification subject to change without notice.

TEMPO 2020

INSTRUCTION MANUAL

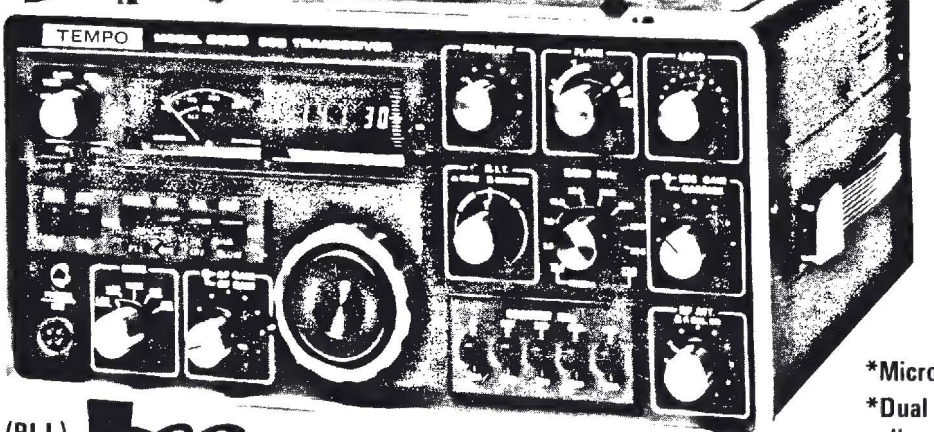
● Tempo

MODEL 2020



Henry Radio

INTRODUCING



The TEMPO 2020

A BRILLIANT NEW SSB TRANSCEIVER PROVIDING AN UNBEATABLE COMBINATION OF ADVANCED ENGINEERING AND UNIQUE OPERATING FEATURES.

YOU MAY NEVER HAVE OWNED A TRANSCEIVER THAT OFFERS SO MUCH.

Send for descriptive information on this fine new transceiver, or on the time proven Tempo ONE transceiver which continues to offer reliable, low cost performance.

- *Phase lock-loop (PLL) oscillator circuit minimizes unwanted spurious responses.
- *Hybrid Digital Frequency Presentation.
- *Advanced Solid-state design...only 3 tubes.
- *Built-in AC and 12 VDC power supplies.
- *CW filter standard equipment...not an accessory.
- *Rugged 6146-B final amplifier tubes.
- *Cooling fan standard equipment...not an accessory.
- *High performance noise-blanker is standard equipment ...not an accessory.
- *Built-in VOX and semi-break in CW keying.
- *Crystal Calibrator and WWV receiving capability.
- *Microphone provided.
- *Dual RIT control allows both broad and narrow tuning.
- *All band 80 through 10 meter coverage.
- *Multi-mode USB, LSB, CW and AM operation.
- *Extraordinary receiver sensitivy (.3u S/N 10 db) and oscillator stability (100 Hz 30 min. after warm-up)
- *Fixed channel crystal control on two available positions.
- *RF Attenuator.
- *Adjustable ALC action.
- *Phone patch in and out jacks.
- *Separate PTT jack for foot switch.
- *Built-in speaker.
- *The TEMPO 2020 ...$759.00.

Model 8120 external speaker...$29.95.

Model 8010 remote VFO...$139.00.

Henry Radio

11240 W. Olympic Blvd., Los Angeles, Calif. 90064 213/477-6701
931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

MODEL 2020 OPERATING MANUAL

TABLE OF CONTENTS

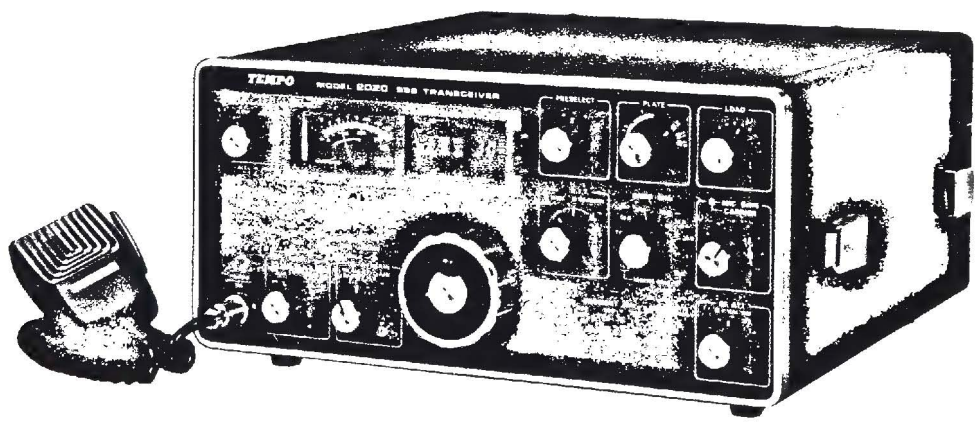
TEMPO 2020 AMATEUR RADIO TRANSCEIVER

DISTRIBUTED BY: HENRY RADIO
11240 West Olympic Boulevard
Los Angeles, California 90064

SPECIFICATIONS

FREQUENCY RANGE:	80 meter band —	3.5 to 4.0 MHz
	40 meter band —	7.0 to 7.5 MHz
	20 meter band —	14.0 to 14.5 MHz
	15 meter band —	21.0 to 21.5 MHz
	10 meter band —	28.0 to 28.5 MHz (A)
		28.5 to 29.0 MHz (B)
		29.0 to 29.5 MHz (C)
		29.5 to 30.0 MHz (D)
	WWV —	15.0 to 15.5 MHz (receive only)
	11 meter	eceive only)
MODE:	USB, LSB, CW or AM.	
POWER REQUIREMENTS:	100/110/117/200/220/234 VAC, 50/60 Hz or 13.8 VDC ±10%.	
	Receive:	100 watts (heaters on) 28 watts (heaters off)
	Transmit:	305 watts (maximum)
PLATE POWER INPUT:	More than 180 watts PEP for SSB operation. More than 180 watts DC for CW operation. More than 90 watts DC for AM operation.	
POWER OUTPUT:	120 watts nominal PEP into 50 ohms for SSB operation. 100 watts nominal DC into 50 ohms for CW operation. 25 watts nominal DC into 50 ohms for AM operation.	
AUDIO INPUT IMPEDANCE:	50 K ohms (high impedance).	
AUDIO OUTPUT IMPEDANCE:	4 ohms (speaker or headphones).	
AUDIO OUTPUT:	More than 2.5 watts (with less than 10% distortion) into a 4 ohm load.	
RF OUTPUT IMPEDANCE:	50 ohms with SWR less than 3:1.	
FREQUENCY STABILITY:	Within 100 Hz during any 30 minute period after warmup. Within 300 Hz during the first hour after 1 minute of warmup.	
CALIBRATION ACCURACY:	Within 1 KHz across the VFO frequency range after calibration at zero.	
KEYING:	Break-in CW with sidetone provided.	
AUDIO FREQUENCY RESPONSE:	300 to 2700 Hz, within —6 db.	
CARRIER SUPPRESSION:	Carrier better than 50 db down from the output signal.	
SIDEBAND SUPPRESSION:	Unwanted sideband is better than 50 db down from the output signal at 1000 Hz.	
IMAGE RATIO:	Image frequency is better than 50 db down from the output signal.	
HARMONIC RADIATION:	Better than 40 db down from the output signal.	
IF REJECTION:	First IF frequency is 50 db or more down from the output signal.	
RECEIVER SENSITIVITY:	Better than 0.3 microvolts for a 10 db (signal + noise)/noise ratio at 14 MHz for SSB and CW operation. Better than 1.0 microvolt for a 10 db (signal + noise)/noise ratio at 14 MHz for AM operation.	
RECEIVER SELECTIVITY:	SSB —	2.4 KHz bandwidth (— 6 db down) 4.0 KHz bandwidth (—60 db down)
	CW —	0.6 KHz bandwidth (— 6 db down) 1.5 KHz bandwidth (—60 db down)

CALIBRATOR:	Built-in 25 KHz crystal oscillator.
TYPE OF MODULATION:	SSB — Balanced modulation. AM — Low power modulation.
RIT:	The receiver incremental tuning control can vary the receive frequency (without changing the transmit frequency) ±5 KHz or more in the RIT's wide position, and ±1 KHz in the RIT's narrow position.
NOISE BLANKER:	The built-in noise blanker is desinged to reduce impulse type (ignition) noises.
METERING:	ALC (Automatic Level Control) — Recommended range (transmit) or IK (Plate Current) — 0 to 350 ma (transmit) or PWR (Relative Power Output) — No scale. S-meter during receive.
VOX:	The 2020 has a built-in VOX circuit with adjustable VOX gain and delay.
MODULAR CONSTRUCTION:	All major electronic circuits are built onto separate plug-in printed circuit boards.
TUBE COOLING:	The 2020 has a built-in cooling fan to cool the final RF section.
TUBE AND SEMICONDUCTOR COMPLEMENT:	3 Tubes — 6146B (x2) and 12BY7A. 18 IC's 52 Transistors 154 Diodes.
DIMENSIONS:	350 mm (14.75") wide x 165 mm (6.5") high x 333 mm (13.25") deep.
WEIGHT:	Unpacked — Approximately 18 Kg (39.6 lbs.) Shipping — Approximately 21 Kg (46.5 lbs.).
MICROPHONE:	A hand-held, high impedance microphone with coil cord is included.
SPEAKER:	A built-in 2.5 watt 4 ohm speaker is provided.



SECTION 1. INTRODUCTION

1.1 TEMPO 2020

The 2020 is a sophisticated solid state amateur radio transceiver employing only three vacuum tubes. Operating on all amateur bands between 3.5 and 30.0 MHz, this unit offers many advanced, modern features. Its entire construction is modular, with all major electronic circuits built on plug-in circuit boards. The 2020 includes many built-in features found as extras on other transceivers. Included in the equipment are a VOX circuit, a 25 KHz crystal calibrator, an RIT circuit with narrow and wide ranges, and a very effective noise blanker. The 2020 also includes automatic gain control (AGC), automatic level control (ALC), provisions for break-in CW with sidetone, PLL oscillator circuit design and built-in power supplies.

Other special features offered by the 2020 include a hybrid digital readout, rugged 6146B final output tubes, and complete separation of the transmit and receive circuits. The 2020 is totally self-contained including AC and DC power supplies, a microphone, a cooling fan, and a speaker. It is ready to use with the addition of a proper antenna.

Designed for operation on SSB, CW, or AM the 2020 delivers more than 120 watts PEP output for CW and SSB, and more than 25 watts output for AM. The low power consumption of the 2020, resulting from its solid state design, makes the transceiver ideal for portable and mobile operation. Any complicated electronic equipment will be damaged if it is operated incorrectly, and this transceiver is no exception. Please read all of the operating instructions before putting the 2020 on the air.

1.2 REQUIREMENTS FOR OPERATION

1.2.1 AC OPERATION

The 2020 requires no external power supply for operation. For fixed station operation, the 2020 operates from any 100/110/117/200/220/234 VAC, 50/60 Hz power source capable of supplying 305 watts or more. The transceiver has a built-in 4 ohm speaker.

1.2.2 DC OPERATION

The 2020 has a built-in DC-DC converter for operation from a 13.8 VDC negative ground power souce capable of supply at least 22 amps of current.

1.2.3 ANTENNA

FIXED STATION ANTENNAS — Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the 2020, provided the input impedance of the transmission line is not outside the capability of the pi-output matching network. The transmission line should be of the coaxial cable type. An antenna system which shows a standing wave ratio of less than 2:1 when using 50 or 75 ohm coaxial transmission line, or a system that results in a transmission line input impedance that is essentially resistive, and between 15 and 200 ohms will take power from the transceiver with little difficulty. If open wire or balanced type transmission line is used with the antenna, a suitable antenna tuner is recommended between the transceiver and the feed line. Methods of construction and operation of such tuners are described in detail in the ARRL Antenna Handbook, and similar publications. For operation on the 75 and 40 meter bands, a simple dipole antenna, cut to resonance in the most used portion of the bands, will perform satisfactorily. For operation of the transceiver on the 10, 15, and 20 meter bands, the efficiency of the station will be greatly increased if a good directional rotary antenna is used. Remember that even the most powerful transceiver is useless without a proper antenna.

MOBILE ANTENNAS — Mobile antenna installations are critical, since any mobile antenna for use on the high frequency bands represents a number of compromises. Many amateurs lose the efficiency of their antenna through improper tuning. Remember the following points when using the 2020 with a mobile antenna.

The "Q" of the antenna loading coil should be as high as possible. There are several commercial models available which use high "Q" coils.

The loading coil must be capable of handling the power of the transceiver without over heating. In the CW mode the power output of the transceiver will exceed 100 watts.

The SWR bridge is a useful instrument, but unfortunately it is quite often misunderstood, and overrated in importance. Basically, the SWR bridge will indicate how closely the antenna load impedance matches the transmission line. With long transmission lines, such as will be used in many fixed station installations, it is desireable to keep the impedance match fairly close in order to limit power loss. This is particularly true at the higher frequencies. The longer the line, and the higher the frequency, the more important SWR becomes. However, in moblie installations the transmission line seldom esceeds 20 feet in length, and an SWR of even 4:1 adds very little to the power loss. The only time SWR will idicate a low figure is when the antenna presents a load close to 50 ohms, but many moblie antennas will have a base impedance as low as 15 or 20 ohms at their resonant frequency. In such a case, SWR will indicate 3 or 4 to 1, and yet the system will be radiating efficiently.

The really important factor in your mobile antenna is that it should be carefully tuned to resonance at the desired frequency. The fallacy in using an SWR bridge lies in the fact that it is sometimes possible to reduce the SWR reading by detuning the antenna. Field strength may actually be reduced in an effort to bring SWR down. Since field strength is the primary goal, we recommend a field strength meter for antenna tuning.

For antenna adjustments, the transceiver may be loaded lightly, using the TUNE position instead of operating at full power output. This will limit tube dissipation during adjustments, and will also help to reduce interference on the frequency. In any case, do not leave the transmitter on for very long at one time. Turn it on just long enough to tune, load, and get a field strength reading. Start out with the antenna whip at about the center of its adjustment range. Set the VFO to the desired operating frequency and then adjust the PLATE control for a dip, and then the LOAD control. Then observe the field strength reading. The field strength meter may be set on top of the dash, on the hood, or at an elevated location some distance from the car.

Change the whip length a half inch, or so at a time, retune the finals each time, and again check the field strength at the antenna. Continue this procedure until the point of maximum field strength is found. This adjustment will be most critical on 75 meters, somewhat less critical on 40, until on 10 meters the adjustment will be quite broad. After tuning the antenna to resonance, the finals can be loaded to full power.

MARINE ANTENNAS — For most applications requiring the use of a 2020 on a boat, it has been found that a long wire with an antenna tuner offer the most efficient antenna system. The length of the wire should be at least ¼ of the wavelength of the lowest frequency to be used.

Tuned vertical antennas can also be used on boats, but are more expensive to purchase, less likely to withstand the harsh marine environment, and require good grounding.

1.2.4 MICROPHONE

The microphone input is designed for high impedance (50 K ohms) microphones. A hand held, high impecance microphone is included with the 2020. The choice of microphone is important for good speech quality, and should be given serious consideration. The circuits in the transceiver provide all of the limiting and amplification necessary on audio response, and further restriction (or amplification) is not required. It is more important to have a microphone with a smooth, flat response throughout the speech range.

If a different microphone is used, the microphone manufacturer's instructions should be followed in connecting the microphone cable to the plug. With many microphones the push-to-talk button must be pressed to make the microphone operative. For VOX operation, this feature may be disabled, if desired, by opening the microphone case and permanently connecting the contacts which control the microphone.

1.2.5 EXTERNAL SPEAKER OR HEADPHONES

Receiver audio output from the 2020 is 2.5 watts at 4 ohms. The 2020 has a built-in speaker. However, if an external speaker is desired for fixed station or mobile operation, simply connect it to the EXT. SP. jack on the rear panel. The speaker may be any good 4 ohm permanent magnet type in the 4 inch or larger size. TheTempo 8120 is a matching external speaker for the 2020.

Headphones should also be 4 ohms impedance. When the headphones are connected to the front panel PHONES jack the speaker is disabled.

8010 REMOTE VFO

The 8010 is a remote external VFO designed to be used with the 2020. The 9138 to 9038 KHz output allows split frequency operation with the 2020, and the 10 fixed crystal positions allow 10 additional fixed frequency channels. The 8010, like the 2020 has a hybrid digital readout and a dual range RIT circuit.

Dimensions: 205 mm (8.125") wide x 165 mm (6.5") high x 333 mm (13.25") deep.

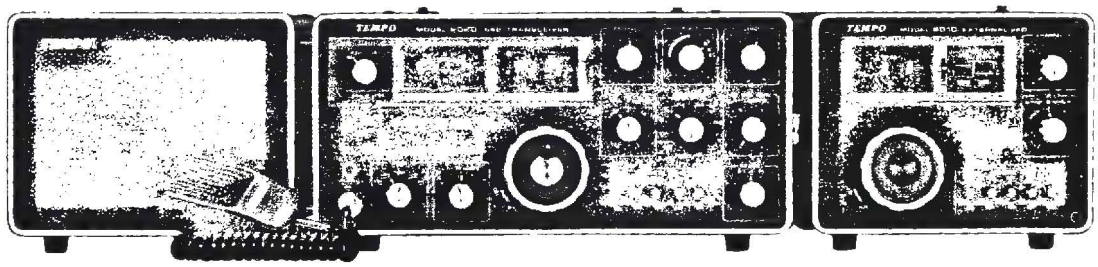
Weight: 3 kg (6.6 pounds).

8120 EXTERNAL SPEAKER

The 8120 is a 15 x 10 cm oval speaker mounted in a cabinet which matches the 2020. The impedance is 4 ohms.

Dimensions: 205 mm (8.125") wide x 165 mm (6.5") high x 333 mm (13.25" deep.

Weight: 1.5 kg (3.3 pounds).



External Speaker model 8120 SSB Transceiver model 2020 Remote VFO model 8010

SECTION 2. INSTALLATION

2.1 UNPACKING

Remove the 2020 carefully from its shipping box and packing material and examine it for visible damage. Check all of the controls for normal operation, and check for internal damage, or loose parts. If the equipment has been damaged in shipment, do not put it into operation, but save the boxes and packing material and notify the transportation company immediately. It is a good idea to save the boxes and packing in any case because they are very useful for shipping or moving the equipment.

CAUTION: Be certain to check the cooling fan very carefully to make certain that is operating properly. Damage to the fan's cover can keep it from rotating, causing the final section to overheat, resulting in extensive damage.

The following accessories should be included with the transceiver:

1 Operating Manual and warranty card.
1 Microphone with coil cord and connector.
1 Extra microphone connector.
2 RF type RCA phono plugs for external receiver and transverter jacks.
6 RCA phono plugs.
2 Alignment tools.
2 Plastic extension feet to change the viewing angle of the transceiver (with screws).
1 4-pin accessory plug.
1 6 foot AC power cord and connector.
1 10 foot DC power cord with connector and fuse.
1 Headphones plug.
1 Coax connector, type PL-259.
2 3 AG, 5 amp fuses.
2 30 amp DC fuses.

2.2 OPERATING LOCATION

As with any solid state electronic equipment, the 2020 should be kept from extremes of heat and humidity. Choose an operating location that is dry and cool, and avoid operating the transceiver when it is setting in direct sunlight. Also, allow at least 3 inches clearance between the back of the equipment and any object. This space allows an adequate air flow from the ventilating fan to keep the transceiver cool.

2.3 CABLING

The following wiring must be done before the 2020 can be operated. The connectors and controls are described in greater depth in Section 3.

2.3.1 FRONT PANEL CONNECTIONS

HEADPHONES — If desired, connect the headphone plug to a set of 4 to 16 ohm headphones and plug them into the PHONES jack. CAUTION: Insert the headphone plug completely into the jack. Otherwise the audio attenuator which provides proper headphone output may not work causing an unattenuated (too loud) output.

MICROPHONE — Use the supplied hand held microphone, or attach the extra microphone connector to another suitable microphone as shown in Figure 1. Be certain that the PTT switch of the microphone is separate from the microphone circuit if VOX operation is desired.

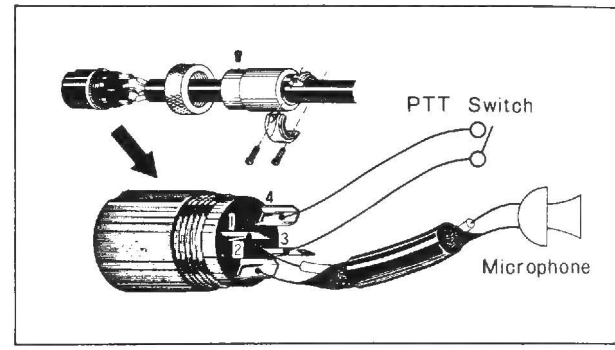


Fig. 1 Microphone plug connections

2.3.2 REAR PANEL CONNECTIONS

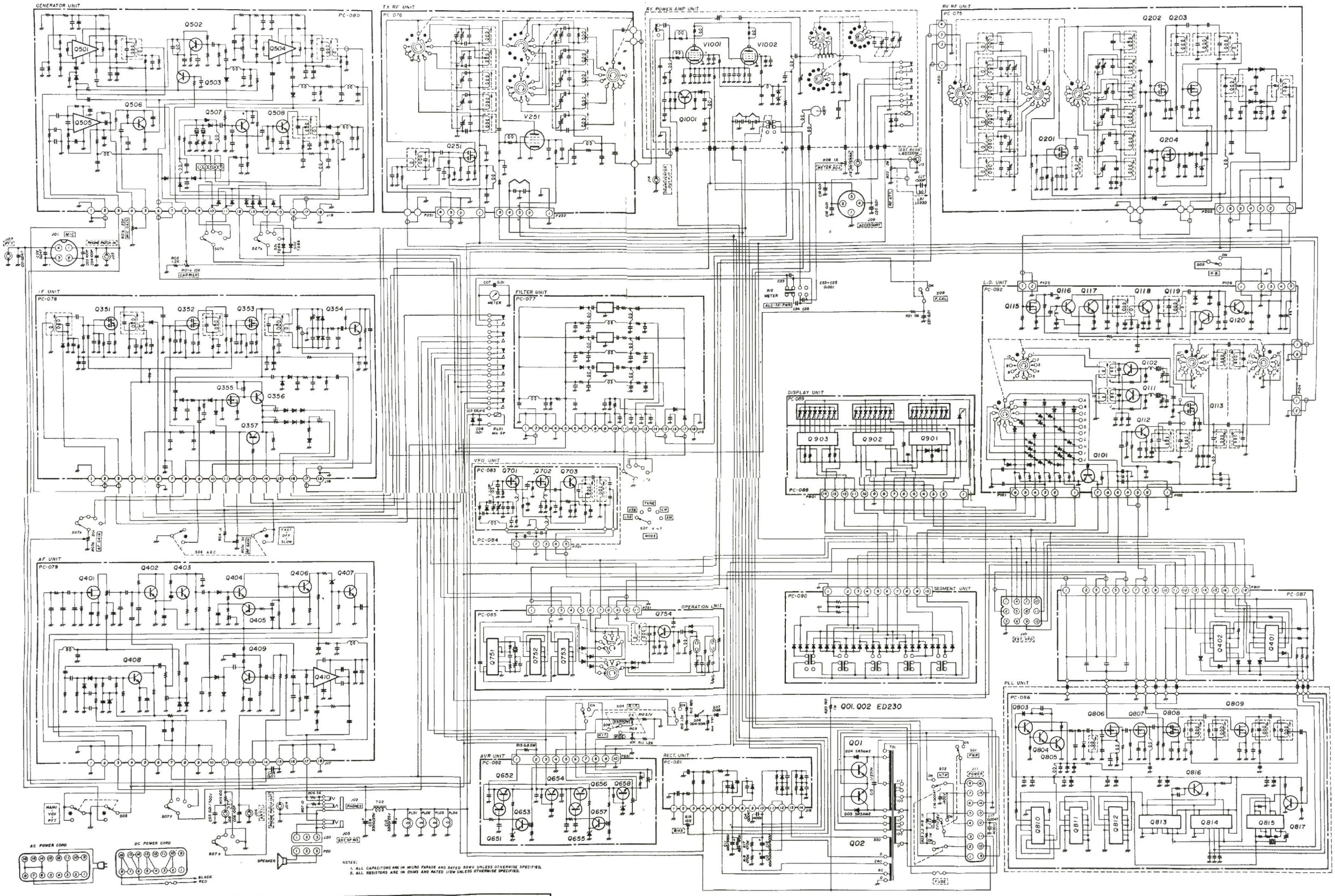
POWER CONNECTIONS — Make sure the PWR switch is turned off and the MANU./REC/VOX switch is in the REC position. Connect the AC or DC power cord to an appropriate external power source. For distribution in the United States the transceiver is normally supplied with the power transformer wired for operation from a 117 VAC power source. Instruction for rewiring the transformer are given in Section 5.

ANTENNA — Connect a 50 ohm antenna feedline from an appropriate high frequency antenna to the coaxial ANTENNA connector on the rear panel.

GROUND — Connect a wire from a good earth ground to the GROUND stud on the back of the transceiver. If a good earth ground is not available and the 2020 is operated from an approved three-wire electrical system in the United States, the third or neutral wire will normally supply an adequate ground. The transceiver should be grounded to prevent accidental operator shock as well as to prevent TVI type interference.

KEY — If CW operation is desired, connect a key to the KEY jack. The keying is done by shorting the —50 volt blocking bias, so choose an appropriate type of key or electronic keyer. CAUTION: Please be careful! There is —50 volts output at this terminal.

These are all of the connections necessary for operation. Figures 2 and 3 show cabling connections for other accessories. These connections will be described in more detail in Section 3.



Wiring harness and schematic for the TEMPO 2020 AMATEUR RADIO TRANSCEIVER
(See the individual board schematics for detailed parts and circuit descriptions.)

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Los Angeles, California 90064

MODEL 2020 SCHEMATIC DIAGRAM

Features and specification subject to change without notice.

FIGURE 2. Connections of the 2020 to its accessories.

NOTE 1: An external stand-by switch or foot switch will only work when the MANU./REC/VOX switch on the front panel is in the REC position.

NOTE 2: The audio output impedance is 4 ohms. When the external speaker is connected, the built-in speaker is automatically disconnected.

NOTE 3: The anti-trip input for the VOX is obtained from the speaker voice coil of the separate receiver.

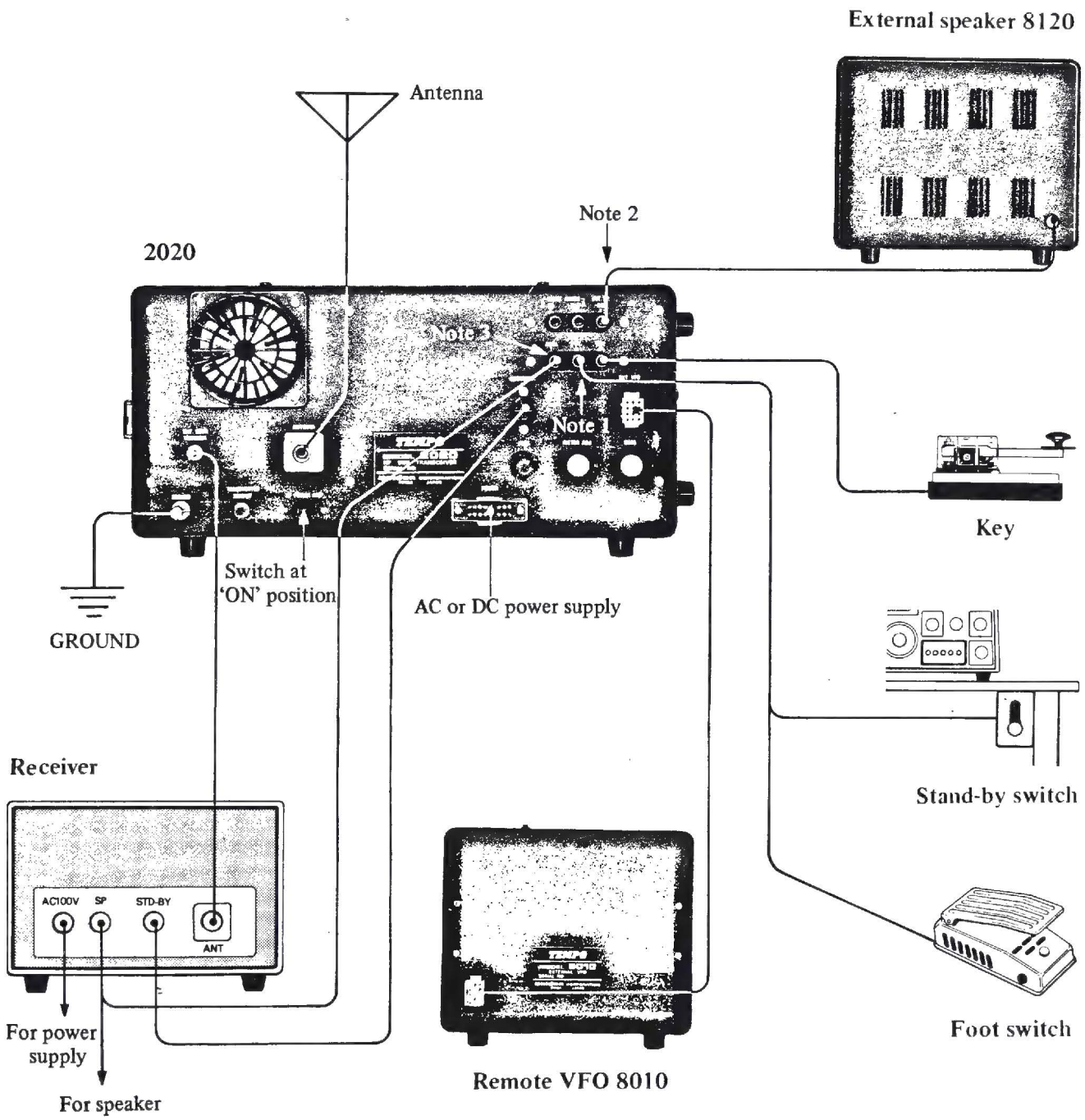
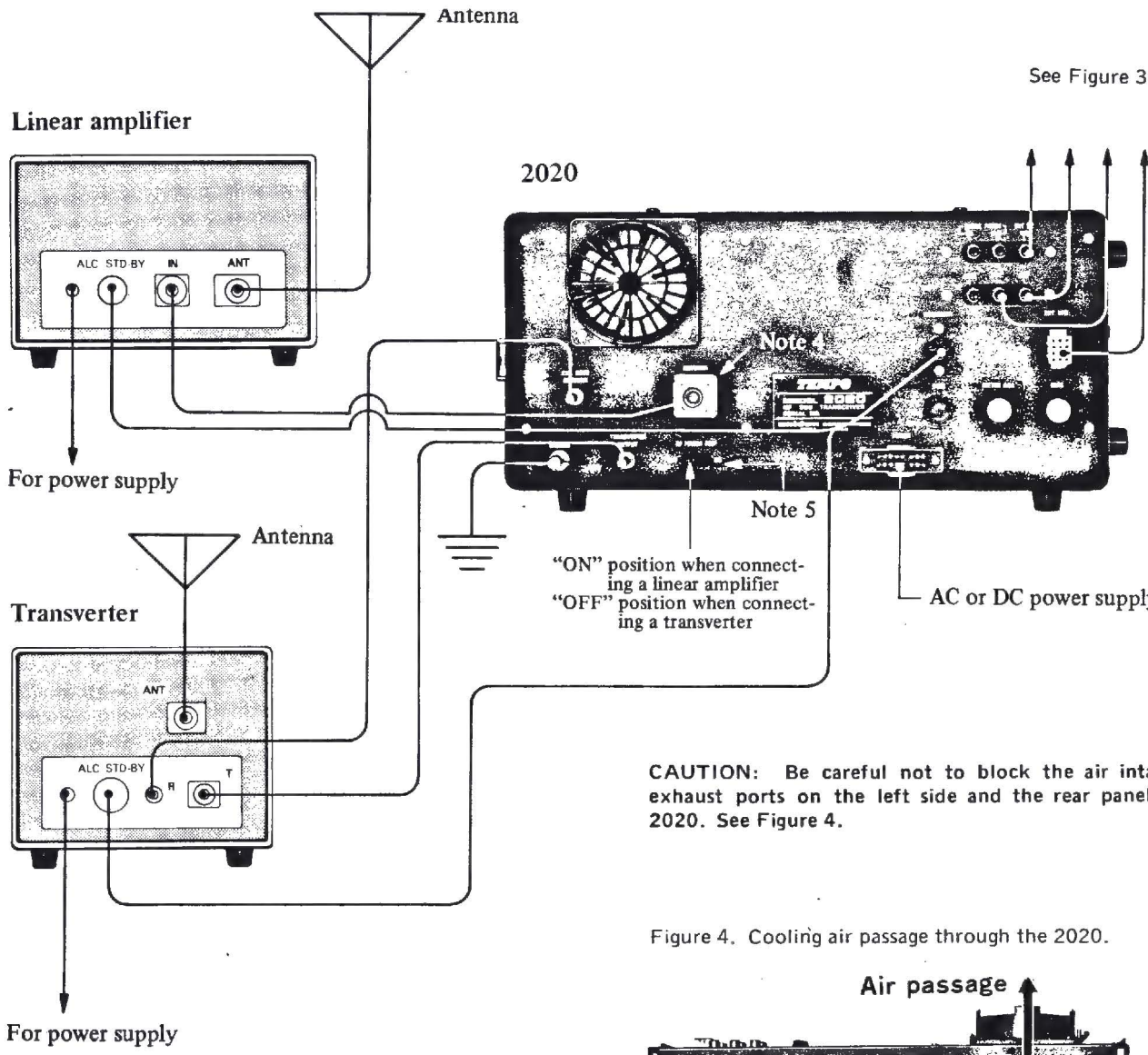


FIGURE 3. Connections of the 2020 to its accessories (2).

NOTE 4: For transverter operation, the high frequency antenna should be disconnected.

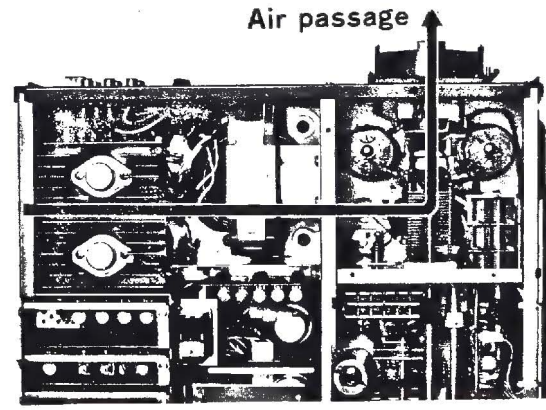
NOTE 5: The RF POWER AMP switch on the back of the 2020 should be in the OFF position when using a transverter and should be in the on position during normal operation. With the switch in the OFF POSITION the RF output is switched to the TRANSVERTER OUTPUT jack and the final amplifier tubes and blower are disconnected.

CAUTION: The 2020 can only be operated from a negative ground DC system. Be certain of the polarity of the connections. Reversed polarity may cause serious damage to the transceiver.



CAUTION: Be careful not to block the air intake and exhaust ports on the left side and the rear panel of the 2020. See Figure 4.

Figure 4. Cooling air passage through the 2020.

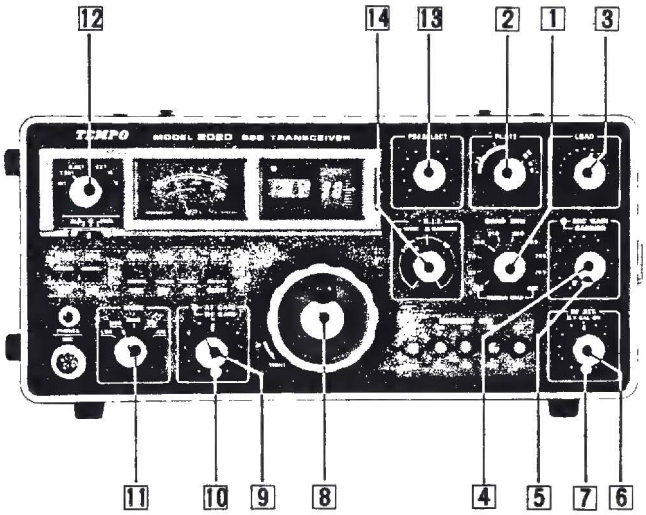


SECTION 3. OPERATING CONTROLS

You should read this section very carefully and try to completely understand the function of each of the controls before beginning to operate the transceiver.

3.1 FRONT PANEL CONTROLS (See Figure 5)

FIGURE 5. Front Panel Controls (Part 1).



3.1.1 BAND MHZ SWITCH

This 10 position rotary switch selects all of the necessary circuits to tune the transceiver to the desired 500 KHz band. The band numbers printed in red (3.5, 28.5 and 29.5) correspond to the red numbers below the 100 KHz segment buttons (500, 600, 700, 800, and 900).

3.1.2 PLATE CONTROL

This control adjusts the plate tuning circuit of the final amplifier tubes.

3.1.3 LOAD CONTROL

This control tunes the output circuit of the final section's pi-network to match the circuit to the antenna's impedance.

3.1.4 MIC GAIN CONTROL

This control adjusts the gain of the microphone amplifier to control the audio level from the microphone during SSB operation.

3.1.5 CARRIER CONTROL

This potentiometer adjusts the output carrier level when the transceiver is operating in the CW, AM, or TUNE mode.

3.1.6 RF ATTENUATOR CONTROL

The RF attenuator can be used to adjust the level of a received signal to minimize interference from strong local signals.

3.1.7 F. CAL ON SWITCH

When the RF ATTENUATOR knob is pulled out, the transceiver's calibrator circuit generates a marker signal at every 25 KHz for normal calibration of the built-in VFO.

3.1.8 MAIN TUNING KNOB

This control tunes the VFO through its 100 KHz range to determine the exact frequency of operation. The operating frequency is determined by the setting of the BAND MHZ switch, the selection of the SEGMENT KHZ buttons, and the setting of the VFO. The control covers the 100 KHz at a 4:1 ratio (the knob turns four times to cover 0 to 100 KHz).

3.1.9 AF GAIN CONTROL

This control adjusts the gain of the receiver's audio amplifier. The audio volume of the received signal increases as the control is turned clockwise. The control adjusts the audio output of the internal speaker, as well as at the external speaker jack and at the headphones jack.

3.1.10 RF GAIN CONTROL

The RF gain control is the outside portion of the AF GAIN/RF GAIN control. The lever adjusts the gain of the receiver section's RF and IF amplifiers. Turn the knob fully clockwise for maximum gain and for a correct S-meter reading. Turn the control counter-clockwise to reduce the gain.

3.1.11 MODE SWITCH

This 5-position rotary switch selects all of the necessary circuits for the desired mode of operation -- LSB, USB, TUNE, CW or AM. NOTE: International amateur practice dictates using the following modes on each band.

3.5 to 4.0 MHz	LSB
7.0 to 7.5 MHz	LSB
14.0 to 14.5 MHz	USB
21.0 to 21.5 MHz	USB
28.0 to 30.0 MHz	USB
WWV Band	AM

3.1.12 FUNCTION SWITCH

This 6-position rotary switch selects one of the following transceive functions.

INT.— In this position, the 2020's internal VFO controls the transmit and receive frequencies.

T.EXT. — In this position, the 2020's internal VFO controls only the receive frequency and the transmit frequency is controlled by the 8010 remote VFO.

R. EXT. — In this position, the 2020's internal VFO controls only the transmit frequency and the receive frequency is controlled by the 8010 remote VFO.

EXT. — In this position the receive and transmit frequency are both determined by the 8010 remote VFO.

A or B — In this position the receive and transmit frequencies of the transceiver are determined by a crystal which has been installed inside the 2020 for fixed frequency operation.

3.1.13 PRESELECT CONTROL

The PRESELECT tuning control tunes the plate tank circuit of the 12BY7A driver as well as the receiver's antenna and mixer coils. In receive the PRESELECT control is tuned for maximum sensitivity (maximum S-meter deflection). In transmit the PRESELECT control is tuned for a maximum scale reading on the ALC meter. When the control is correctly tuned for transmission it will be correctly tuned for reception.

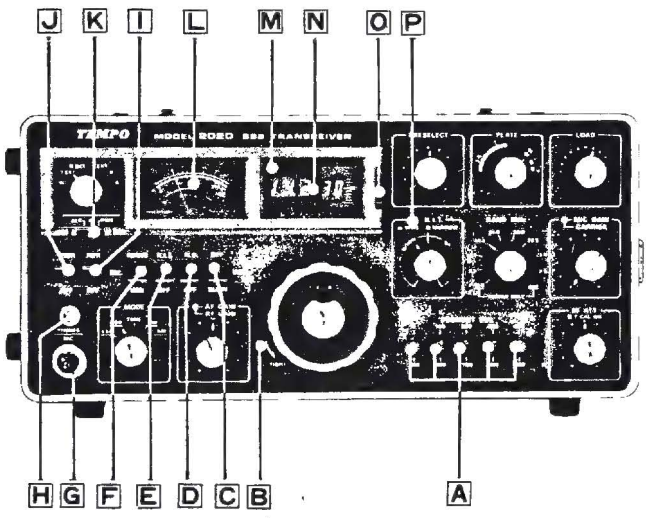
3.1.14 RIT (RECEIVER INCREMENTAL TUNING)

The RIT control tunes the 2020's receive frequency, without changing the transmit frequency. With the knob pushed in the RIT control is in its WIDE position and will tune the receiver ±5 KHz from the transmit frequency. With the knob pulled out the RIT control is in its NARROW position and will tune the receiver ±1 KHz from the transmit frequency. The RIT switch turns the circuit on and off and the RIT LED indicates when the RIT circuit is turned on. CAUTION: Be certain that you are transmitting on the desired frequency when the RIT circuit is turned on.

3.2 FRONT PANEL CONTROLS (Continued)

(See Figure 6)

FIGURE 6. Front Panel Controls (Part 2).



3.2.A SEGMENT KHZ BUTTONS

These push buttons are used to select the 100 KHz portion of the band in which you wish to operate. These buttons, along with the BAND MHZ switch and the VFO determine the operating frequency of the transceiver. The numbers in white refer to the bands printed in white on the BAND MHZ switch, and the numbers printed in red refer to the bands printed in red on the BAND MHZ switch. The number printed on the panel indicates the bottom frequency of the segment (for example the number 0 indicates a frequency range of 0 to 100 KHz and the number 500 indicates a frequency range of 500 to 600 KHz).

3.2.B TIGHT LEVER CONTROL

This lever adjusts the tension on the main tuning knob. A tighter tension is generally more desireable for mobile operations so that the main tuning dial is not bounced off frequency. The smoother tension is more desireable for base operation.

3.2.C OFF/FAST/SLOW AGC SWITCH

This lever switch controls the AGC (Automatic Gain Control) circuit giving the operator three choices:

OFF — It may be desireable to turn the AGC off when attempting to receive a very weak signal.

FAST — The fast action of the AGC is designed for use in receiving CW and AM signals.

SLOW — The slow action of the AGC is designed for use in receiving SSB signals.

3.2.D N.B./OFF SWITCH

This lever switch turns the built-in noise blanker circuit on and off. The noise-blanker is designed to reduce pulsating ignition type noises. When the lever switch is flipped up, the circuit is turned on.

3.2.E R.I.T./OFF SWITCH

This lever switch turns the RIT circuit on and off. When the RIT is turned on (the switch is in the up position) the RIT LED will light to indicate that the circuit is working. The RIT circuit will only work when the 2020's internal VFO or fixed frequency crystal is controlling the receive frequency. Therefore the RIT circuit will only work when the function switch is in the INT., T.EXT, A, or B position.

3.2.F MANU./REC/VOX SWITCH

This three position lever switch selects the way that the 2020 is keyed into transmit. There are three choices.

MANU. (Manual) — With the switch in this position the 2020 is keyed into transmit and remains keyed until the switch is moved out of this position.

REC — With the switch in this position, the transceiver is switched into transmit or receive by the PTT switch on the microphone, or by an external PTT switch which is connected to the rear panel PTT jack.

VOX (Voice Operated Transmit) — With the switch in this position, the VOX circuit is turned on for voice operated transmitter keying on SSB or AM and for semi-automatic break-in operation on CW.

3.2.G MIC JACK

This 4-pin microphone connector is used for audio input from a microphone and for PTT relay keying of the 2020. Figure 1 shows the pin connections for the connector.

3.2.H PHONES JACK

This is a ¼" phone type jack for connecting a 4 to 16 ohm pair of headphones to the transceiver. When the plug is inserted in the jack the internal speaker is disconnected.

3.2.I HTR/OFF SWITCH

This lever switch turns the filaments of the three tubes on and off. The filaments (or heaters) are on when the switch is in the up position. The tubes require about 30 seconds of warm-up before transmitting. The heaters should be turned on only when you are going to transmit, especially when operating from a DC source. The 2020 consumes approximately 70 watts of power less during receive with the heaters off.

3.2.J PWR/OFF SWITCH

This lever switch turns the transceiver on and off for AC and DC operation. The 2020 is on when the switch is in the up position.

3.2.K ALC/IK/PWR SWITCH

The meter slide switch selects the mode of the meter during transmit. Each mode is described in detail under the description of the meter (Section 3.2.L).

3.2.L METER

The function of the meter during transmit is determined by the ALC/IK/PWR slide switch. During receive the meter acts as an S-meter. The S-meter is adjusted to read S-9 with an input signal of 34 dBu. The meter scale is calibrated at ever 10 dB above S-9, and is calibrated at every 4 dB below S-9.

ALC — With the meter switch in the ALC position the meter indicates the ALC action of the 2020 during voice transmission. The scale on the meter shows the acceptable ALC range.

IK (Plate Current) — With the meter switch in the IK position, the meter indicates the plate current of the final amplifier tubes on a scale from 0 to 350 ma. There is a green ▵ on the dial scale to show the recommended idle current of the 6146B final amplifier tubes. The bias is adjusted by a rear panel control and usually needs adjustment only once at a new power source.

3.2.M VFO LED

This light emitting diode is lighted whenever the 2020's internal VFO is controlling the operating frequency. If the frequency is being controlled by the external VFO then the LED will not be lighted.

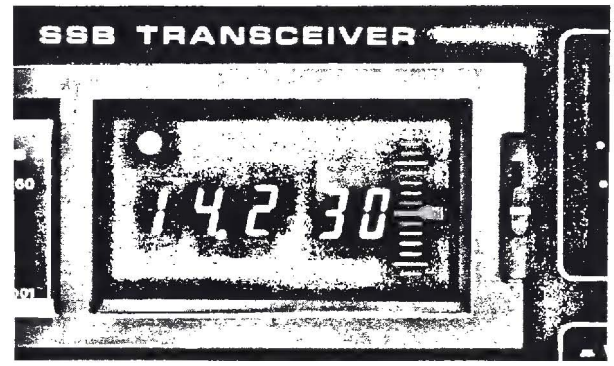
3.2.N DIAL SCALE

The 2020 uses a hybrid digital/analog dial scale. The digital portion shows the MHz and 100 KHz reading and the analog portion of the dial shows the frequency between 0 and 100 KHz. The MHz portion of the dial is switched by the BAND MHZ switch and the 100 KHz portion of the dial is switched by the SEGMENT KHZ buttons. The 100 KHz drum is turned with the main tuning dial as the VFO is tuned. See Figure 7.

3.2.O DIAL SET LEVER

The dial set lever moves the frequency pointer to calibrate the 2020. The crystal calibrator gives a marker signal every 25 KHz to calibrate the dial scale with this lever. The calibration is described in Section 4.

FIGURE 7. The Dial Scale.



3.2.P RIT LED

This LED indicates when the RIT circuit is turned on. If the LED is lighted you should be very careful that you are transmitting and receiving on the desired frequency because your transmit and receive frequencies may be different.

3.3 REAR PANEL CONTROLS (See Figure 9)

3.3.1 POWER CONNECTOR

This connector receives power from the AC or DC power source for operation of the 2020. Plug wiring for AC and for DC wiring is given in Figure 8 below. The transceiver is wired for operation from 117 VAC and from 13.8 VDC (Negative Ground!). Be certain to observe proper polarity for DC operation.

FIGURE 8. Power Plug Wiring.

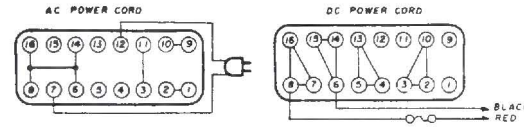
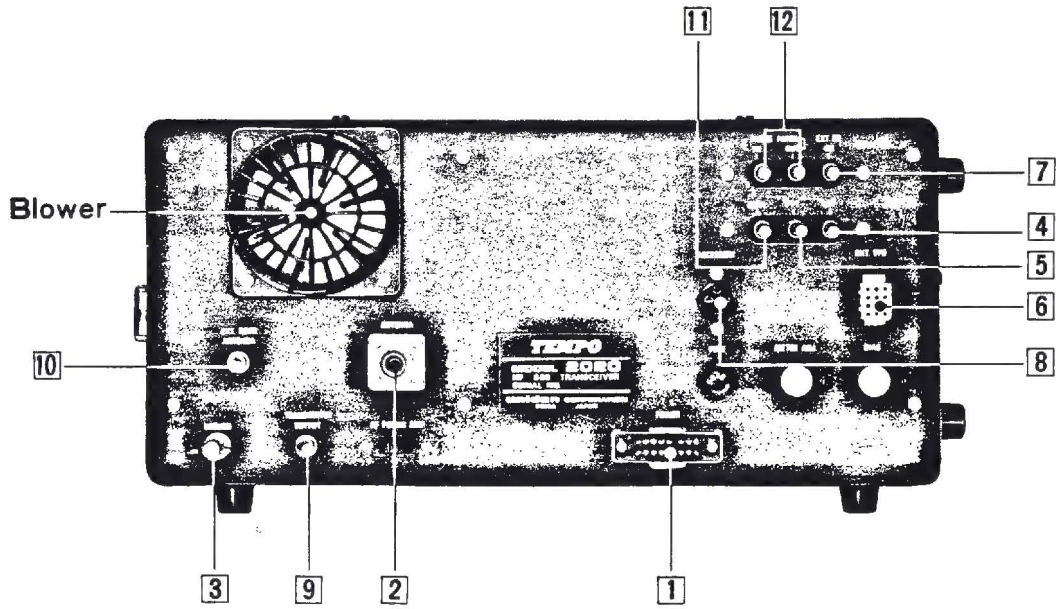


FIGURE 9. Rear Panel Controls (Part 1).



3.3.2 ANTENNA CONNECTOR

This SO-239, UHF type, coax connector should be attached to a suitable antenna for transmitting and receiving. See Section 1.2.3 for a discussion of an appropriate antenna.

3.3.3 GROUND LUG

To prevent accidental shocks from the chassis, as well as to reduce RF interference, connect a good earth ground to this lug.

3.3.4 KEY JACK

Connect a key to this ¼ inch phone type jack for CW operation. The keying is done by shorting the —50 volt blocking bias so be certain to choose an appropriate key or keyer. CAUTION: There is a —50 volt potential across this jack, so be careful not to expose yourself to it.

3.3.5 PTT JACK

An external stand-by or foot switch can be placed across this jack to control PTT transmitter keying. The external switch will only operate when the front panel MANU./REC/VOX switch is in the REC position. This jack is an RCA type phono jack.

3.3.6 EXT. VFO CONNECTOR

This 12-pin connector provides means for interconnecting the 2020 and the 8010 external VFO. The interconnecting cable is provided with the 8010. The function of each pin is listed below.

Pin 1 — VFO signal coax shield.
Pin 2 — VFO signal.
Pin 3 — Ground.
Pin 4 — 6V.
Pin 5 — 13 V during transmit.
Pin 6 — 12 V during transmit.
Pin 7 — 5V.
Pin 8 — 100 KHz segment and local osc. signal.
Pin 9 — 100 KHz segment and local osc. signal.
Pin 10 — PLL control signal.
Pin 11 — PLL control signal.
Pin 12 — PLL control signal.

3.3.7 EXT. SP. JACK

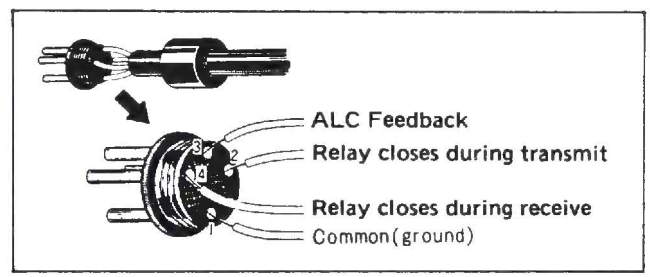
The receiver audio output can be connected through this RCA type phono jack to the 8120 or another external 4 ohm speaker. The internal speaker is disconnected when an external speaker is connected. CAUTION: A short circuit of this jack could cause failure of the 2020's audio IC.

3.3.8 ACCESSORY CONNECTOR

The ACCESSORY connector is a 4-pin socket for use in interconnecting the 2020 with a linear amplifier, transverter, receiver, or other accessory. Figure 10 shows a diagram of the plug. The function of each pin is as listed.

Pin 1 — Ground.
Pin 2 — Relay control open during receive.
Pin 3 — ALC feedback.
Pin 4 — Relay control open during transmit.

FIGURE 10. Accessory plug connections.



3.3.9 TRANSVERTER OUTPUT JACK

This RF type RCA phono jack provides a low power output (approximately 2 watts) when the RF POWER AMP slide switch is in the OFF position. This low power output is generally used to drive an accessory transverter.

3.3.10 EXT. RCVR ANTENNA JACK

This RF type RCA phono jack is used for a separate receive antenna when an external receiver is being used with the 2020.

3.3.11 ANTI JACK

This RCA phono jack accepts audio feedback from an external accessory receiver to prevent the VOX from being activated by the audio from the speaker of the receiver. It serves the same function as the ANTI-VOX adjustment of the 2020.

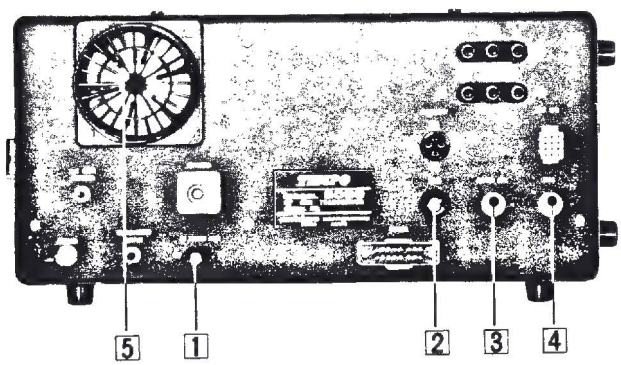
3.3.12 PHONE PATCH JACKS

PHONE PATCH IN — This RCA phono jack is for the connection of a 50 K ohm input from an accessory phone patch.

PHONE PATCH OUT — This RCA phono jack is for the audio output (at 4 ohms) from the 2020 to an accessory phone patch.

3.4 REAR PANEL CONTROLS (Continued) (See Figure 11)

FIGURE 11. Rear Panel Controls (Part 2).



3.4.1 RF POWER AMP. ON/OFF SWITCH

This slide switch switches a low power output from the driver stage to the TRANSVERTER OUTPUT jack at the same time it turns off the heaters to the two final tubes. The switch also turns off power to the blower.

3.4.2 FUSE

This fuse is a 3 AG, 5 amp (3 amp for 234 VAC operation) which protects the power supply of the transceiver against short circuits. Never use a higher amperage fuse than the one specified. An improper fuse can cause extensive damage to the 2020. When the fuse blows out, try to determine the cause before replacing it.

3.4.3 METER ADJ. CONTROL

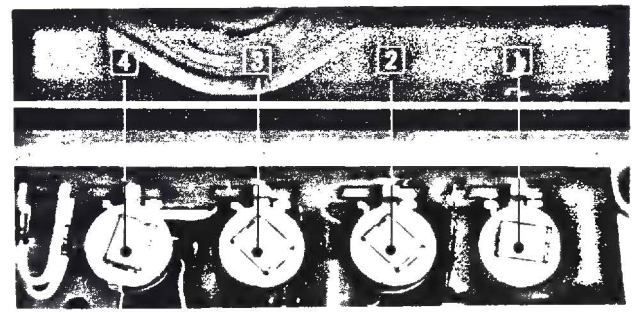
Use this control to adjust the sensitivity of the PWR (relative power output) function of the meter. Adjust the control so that full output from the transceiver reads approximately 2/3 scale on the meter (with the meter switch in the PWR position) during CW transmission.

3.4.4 BIAS CONTROL

The BIAS control adjusts the bias current of the two 6146B final amplifier tubes so that they operate linearly and have proper plate dissipation. Turning the control clockwise increases the idling plate current of the tubes. The control is adjusted so that the meter (with the meter switch in the IK position) indicates a plate current where the needle is on the green triangle on the meter scale (approximatly 60 ma). Adjustment of the bias is described in Section 4. The bias will normally only need adjustment when the 2020 is being set up in a new operating location, or when the final tubes have been replaced.

3.5 INTERNAL CONTROLS (See Figure 12)

FIGURE 12. Internal Operating Controls.



3.5.1 VOX CONTROL

This small potentiometer adjusts the sensitivity of the VOX circuit by adjusting the gain of the VOX amplifier. With the MANU./REC/VOX switch in the VOX position, adjust this control until your normal speaking voice keys the 2020 into transmit. This control may also have to be adjusted when operating semi-automatic break-in CW.

3.5.2 DELAY CONTROL

The DELAY control adjusts the holding time of the VOX circuit for VOX or beak-in CW operation. The control will have to be adjusted to the preference of the operator so that the circuit does not drop out between words.

3.5.3 ANTI CONTROL

This control adjusts the level of the anti VOX signal fed from the 2020's audio circuits to the VOX circuit. Set the AF gain of the transciever to its normal listening level and adjust the ANTI control to the minimum point that will prevent the audio from the speaker from tripping the VOX circuit.

3.5.4 TONE CONTROL

The level of the CW sidetone is adjusted by this control.

SECTION 4. OPERATING INSTRUCTIONS

4.1 INITIAL CONTROL SETTINGS

Before beginning operation of the 2020 be sure to complete all of the required cabling, as described in Section 2. The 2020 must be operated into a 50 ohm antenna or dummy load with an SWR less than 3:1. Random length antennas or light-bulb dummy loads cannot be used. Conventional half-wave dipoles and beam antennas should only be used at or near their resonant frequency. Operating the 2020 into an SWR greater than recommended can damage the components in the output stage of the transceiver. Make a small investment in a good SWR meter and be certain of a good antenna before damaging the 2020.

With a suitable antenna and a microphone (or key) connected to the transceiver, set the 2020 controls to the positions described below.

4.1.1 FRONT PANEL CONTROLS

BAND MHZ Switch . . . . . Desired band
PLATE CONTROL . .Middle of the range
. . . . . for the selected band.
LOAD CONTROL. . . . . Centered.
MIC GAIN CONTROL.Counterclockwise.
CARRIER CONTROL.Counterclockwise.
RF ATTENUATOR CONTROL. . . . . .
. . . . . Clockwise.
F. CAL ON SWITCH . . . . . .Off.
MAIN TUNING KNOB. . . . . .
. . . . . .Desired Frequency.
AF GAIN CONTROL. . . . . .
. . . . . Counterclockwise.
RF GAIN CONTROL. . . . . Clockwise.
MODE SWITCH . . . . . .Desired mode.
FUNCTION SWITCH. . . . . INT.
PRESELECT CONTROL . . . . Centered.
RIT CONTROL . . . . . Centered.
SEGMENT KHZ BUTTONS . . . . . .
. . . . . .Desired KHz range.
TIGHT CONTROL . . . .Desired tension.
OFF/FAST/SLOW SWITCH . . . . . .
.FAST or SLOW per mode selected.
N.B./OFF SWITCH . . . . . .Off.
R.I.T./OFF SWITCH . . . . . .Off.
MANU./REC/VOX SWITCH . . . . . PTT.
HTR/OFF SWITCH. . . . . .Off.
PWR/OFF SWITCH. . . . . .Off.
ALC/IK/PWR SWITCH. . . . . ALC.
DIAL SET LEVER . . . . . Centered.

4.1.2 REAR PANEL CONTROLS

RF POWER AMP SWITCH . . . . . On.

4.2 RECEIVER TUNING

After the controls have been set as described in Section 4.1, turn the 2020 on using the PWR/OFF switch. Check that the dial scale and meter are lighted and that the blower is operating properly. Check all of the BAND MHZ positions and each of the SEGMENT KHZ buttons to make certain that the dial is reading properly. Turn the RIT/OFF switch on and check that the RIT LED is operating. And check that the VFO LED lights properly when the function switch is in the INT. and T.EXT. positions.

With the transceiver turned on you are ready to receive. The receiver section is fully solid state and requires no warm-up and will operate with the HTR./OFF switch off.

As an example, select a frequency of 14.150 MHz for reception. All of the controls are still as they were initially set-up and the BAND MHZ switch is turned to 14, the SEGMENT KHZ button labeled 100 is selected and the main tuning knob is turned so that 50 shows on the dial.

Advance the AF GAIN control clockwise until some receiver noise is heard in the speaker. Adjust the main tuning knob until a signal is heard. Tune the signal for the clearest possible reception, and then adjust the PRESELECTOR control for maximum deflection of the S-meter.

The RF GAIN control varies the AGC feedback voltage which effects the S-meter reading. With the RF GAIN control fully clockwise, the S-meter gives a proper signal strength reading. Turning the control counter-clockwise reduces the RF gain, reducing signal strength and band noise.

4.3 READING THE OPERATING FREQUENCY

The 2020's unique hybrid frequency display offers the advantages of a digital readout and a dial readout. There is never any question of the exact operating frequency because the digital portion of the dial reads the exact MHz and 100 KHz frequency while the analog portion (dial drum) reads out the frequency down to a 1 KHz calibration.

4.4 CALIBRATION

4.4.1 NORMAL TRANSCEIVER CALIBRATION

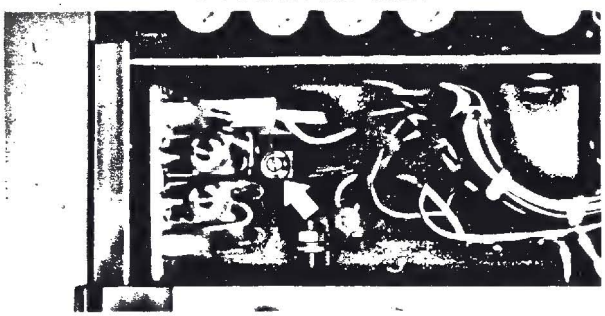
Pull the F. CAL knob out to turn on the built-in 25 KHz calibrator circuit. Be sure that the R.I.T./OFF switch is in the OFF position. Turn the main tuning knob to receive one of the marker signals which is generated at 00, 25, 50, 75, and 100 on the analog portion of the dial scale. For greatest accuracy, choose the calibration frequency closest to your operating frequency.

Zero beat one of the calibrator signals in any mode and adjust the dial set lever so that the dial pointer is pointing to the exact frequency marking (00, 25, 50, 75, or 100). The 2020 is unique in its circuit design in that the carrier frequency is always 6187 KHz regardless of the selected mode. By using separate USB, LSB, and CW filters, and by using the USB and LSB filters together for AM operation, the 2020 need not be recalibrated for different modes.

4.4.2 CALIBRATOR OSCILLATOR ADJUSTMENT

To check that the marker signals from the calibrator circuit are exactly on frequency beat the calibrator signal against WWV at 15.0 MHz. Receive WWV at 15 MHz as described in Section 4.5. Turn the calibrator on. The calibrator signal and WWV signal should overlap and zero beat at the zero marking on the dial scale. If they do not, remove the top cover of the 2020 and locate the calibrator adjustment trimmer just below the fixed frequency crystals (See Figure 13). Turn the MODE switch to AM and use a plastic screw driver to precisely adjust the marker signal to zero-beat the WWV signal at zero on the dial scale.

FIGURE 13. Trimmer Capacitor for Adjusting the Marker Oscillator.



4.5 WWV RECEPTION

The 2020 receives the WWV time signal at 15 MHz when the bands switch is turned to WWV, the SEGMENT KHZ button labeled 0 is selected, and the VFO is tuned to 00. Receive the WWV signal in the AM mode as you would receive any other signal, except the receiver RF circuits are pretuned and the PRESELECTOR control has no effect.

4.6 NOISE BLANKER

The 2020 has an effective built-in noise blanker designed to reduce ingition type impulse noises. The noise blanker is particulary important for mobile operation. When necessary, activate the noise blanker circuit by setting the N.B./OFF switch in the up position.

4.7 AGC (Automatic Gain Control)

Set the OFF/FAST/SLOW AGC switch to the position appropriate for the received signal. Generally for SSB reception set the AGC switch to SLOW, for AM and CW reception set the AGC switch to FAST, and for reception of a very weak signal the switch may be set to off.

4.8 RIT (Receiver Incremental Tuning)

With the R.I.T./OFF switch turned off the 2020 receives and transmits at the same frequency. At times the received signal may drift off frequency and become less intelligible. When this happens, flip the R.I.T./OFF switch up to activate the RIT circuit and return the received signal to an intelligible state using the RIT control. A unique feature of the 2020 is its dual position RIT control. When the knob is pushed in the RIT control can change the receive frequency more than ±5 KHz. When the knob is pulled out the RIT control can change the receive frequency more than ±1 KHz for fine tuning. When the RIT circuit is turned on the RIT LED is lighted. The RIT circuit has no effect on the transmit frequency. Be careful to turn the RIT circuit off when returning to normal transceive operation to prevent unintentionally transmitting and receiving on different frequencies.

4.9 TRANSMITTER TUNING

Connect the 2020 to a 50 ohm dummy load or a 50 ohm antenna with an SWR of less than 2:1 before making any transmitter adjustments. The life of the final tubes is directly related to the SWR of the antenna and to the length of tuning periods.

Section 4.1 lists the initial set-up procedure for the 2020. Begin with the controls in the described positions. Turn the tube filaments on by setting the HTR/OFF switch in the up position and allow approximately 30 seconds of warm-up for the tubes. For an example we will choose an operating frequency of 14.250 MHz. The BAND MHZ switch will be at 14, the SEGMENT KHZ button labeled 200 will be selected and the MODE switch will be in the USB postion.

4.9.1 PLATE IDLING CURRENT ADJUSTMENT

The BIAS adjustment usually need be made only when the 2020 is being set up in a new station, or after the final tubes have been replaced. But it should be checked periodically.

CAUTION: If the plate current is very much higher than the recommended level, do not leave the 2020 in transmit for more than a few seconds. Excessive plate current shortens the life of the final tubes.

At 14.250 MHz, in USB,set the MANU./REC/VOX switch to the MANU. postion and check the plate current (the meter switch must be put in the IK position). The needle should be positioned over the green triangle on the IK scale. If the BIAS current is incorrect, adjust the rear panel BIAS control until the reading is on the triangle (about 60 ma). Return the MANU./REC/VOX switch to REC.

4.9.2 TUNE-UP PROCEDURE

Switch the meter switch back to ALC and switch the MODE switch to the TUNE postion. Key the 2020 by setting the MANU./REC/VOX switch to MANU. position and adjust the CARRIER control until the ALC meter reading just reaches the top of the marked ALC scale. Adjust the PRESELECT control to peak the ALC reading (maximum meter deflection) and then readjust the CARRIER control until the ALC reading is just at the top of the ALC scale.

Set the meter switch to PWR and alternately adjust the PLATE and LOAD control for the maximum relative power output.

CAUTION; You should complete this procedure in less than 30 seconds.

TABLE 1. Summary of Transmitter Tuning Procedures.

MODE Switch	Meter Switch	MANU./VOX/PTT Switch	Procedure
USB or LSB	IK	MANU.	Adjust the BIAS control for proper idling current.
TUNE	ALC	MANU.	Adjust CARRIER control for a reading at top of ALC scale.
TUNE	ALC	MANU.	Peak the ALC reading with the PRESELECTOR control.
TUNE	ALC	MANU.	Readjust CARRIER control for reading at top of ALC scale.
TUNE	PWR	MANU.	Peak RF output by alternately adjusting the PLATE and LOAD controls.
TUNE	IK	MANU.	Check for 240-250 ma of plate current then reduce CARRIER control to minimum.

Set the meter switch to the IK position and check for a plate current reading of approximately 240 to 250 ma. Return the CARRIER control to its minimum (counter-clockwise) position.

When selecting a different SEGMENT KHZ button the tuning procedure must be repeated.

CAUTION: The SEGMENT KHZ switches must be pushed one at a time, otherwise the frequency reading on the dial scale will be meaningless.

4.10 SSB OPERATION

4.10.1 PTT OPERATION

Tune the 2020 as described in Sections 4.1 through 4.9. Select your desired operating frequency and set the mode switch to USB or LSB. Connect the microphone to the front panel MIC connector.

NOTE: International amateur practice dictates using USB on amateur bands above 10 MHz and LSB on amateur bands below 10 MHz.

With the MANU./REC/VOX switch in the REC position, key the 2020 by pushing the PTT switch on the microphone and speak into the microphone with the tone of voice normally used in operation. Adjust the MIC GAIN control clockwise until your voice peaks are just within the top limit of the ALC range printed on the meter scale. (The meter switch is in the ALC position.) If the transmitter section is driven beyone this range, the transmitted signal will be distorted.

An external foot switch or PTT switch can be attached to the rear panel PTT jack if desired.

4.10.2 VOX OPERATION

Adjust the transceiver as described in the previous paragraph. Set the MANU./REC/VOX switch to VOX and close talk into the microphone, increasing the internal VOX gain control until the VOX just operates. For VOX operation it is desireable to close talk the microphone to prevent background noises from tripping the 2020 into transmission.

Check that the ALC reading for voice peaks is still within the ALC range on the meter. If necessary, readjust the MIC GAIN control for a proper ALC reading.

If the VOX circuit is activated by speaker noise, adjust the internal ANTI control as necessary to prevent the feedback.

Do not use more VOX gain or more ANTI VOX gain than necessary to control VOX operation. If the VOX circuit drops out between words, or holds too long, adjust the release time constant by turning the internal DELAY control for the desired performance.

4.11 CW OPERATION

4.11.1 MANUAL OPERATION

Tune and load the 2020 as described in Section 4.1 through Section 4.9, except do not reduce the CARRIER control after finishing the tuning. There are several alternatives for keying the 2020 in CW operation. You can leave the MANU./REC/VOX switch in the REC position and key the transceiver by pushing the PTT button on the microphone or by pushing a foot switch or external PTT switch. You can also key the 2020 by putting the MANU./REC/VOX switch into the MANU. position when you wish to transmit. The plate current reading in CW operation should be between 200 and 250 ma.

The 2020 offers a side-tone feature for monitoring your CW operation. The level of the side-tone is adjusted by the internal TONE control.

4.11.2 SEMI-AUTOMATIC BREAK-IN CW

You can also key the 2020 into transmit during CW operation by placing the MANU./REC/VOX switch into the VOX position. The side-tone will then automatically key the VOX circuit. The VOX control can be adjusted by holding the key down and adjusting the control until the side-tone just breaks the VOX circuit. As with SSB VOX operation the DELAY control can be adjusted so that the VOX circuit will not drop out between letters and words.

4.12 AM OPERATION

Tune and load the 2020 as described in Sections 4.1 through 4.9 except instead of reducing the CARRIER control to its minimum position, reduce it until the IK meter reading is between 110 and 120 ma. Adjust the MIC GAIN control so that the plate current increases slightly as you speak into the microphone.

The PTT and VOX functions are the same as described in Section 4.10.

4.13 RECOMMENDED METER POSITIONS

The position of the meter switch during transmitting depends on the mode used. For SSB operation, the recommended meter function is the ALC reading. For proper operation the voice peaks should just be within the top of the marked ALC scale. For CW operation, the recommended meter function is the IK reading. For proper operation the plate current should be between 200 and 250 ma. For AM operation, the recommended meter function is the IK reading. For proper operation the plate current should peak just over 120 ma while the operator is speaking.

4.14 OPERATION WITH A LINEAR AMPLIFIER

Tune and load the 2020 as described in Sections 4.1 through 4.9 and adjust the transceiver for the selected mode.

The 4-pin ACCESSORY connector on the back panel is provided for interconnections with an amplifier. Figure 3 shows a diagram of the necessary interconnections. See the instruction manual of the amplifier to determine whether the linear requires a normally open (during receive) or a normally closed (during receive) relay contact for keying control. Connect either pin 2 (normally open to ground during receive) or pin 4 (normally closed to ground during receive) of the ACCESSORY connector to the relay control jack of the amplifier. Connect the ALC feedback from the amplifier to pin 3. The output of the 2020 is quite adequate to drive most amplifiers to full rated output.

4.15 OPERATION WITH A RECEIVER

To operate the 2020 with an external receiver, connect the mute connection of the receiver (see the receiver's instruction manual) to the appropriate relay contact (normally open or normally closed during receive) at the ACCESSORY connector of the transceiver.

If the 2020 is used with both an external receiver and a linear amplifier which require the same type of relay contact, an external relay may be required. In this case choose a relay that can be controlled by the opposite relay connection of the transceiver. Figure 2 shows the necessary interconnections. The 2020 also has provisions for ANTI VOX feedback from the receiver's speaker jack.

4.16 CHANGING THE BAND COVERAGE

The 2020 is supplied for amateur band use. However, in cases where the owner is willing to sacrifice one or more of the standard frequency ranges, he can substitute an adjacent special range by changing the appropriate high frequency crystal.

The transition is easiest for frequencies very close to the amateur band, such as MARS frequencies. You can achieve coverage of these frequencies by replacing the appropriate HF crystal (not to be confused with fixed frequency operation). The crystals are located on Local Oscillator Unit (PC-092). You must remember that the dial scale will still read the old fequency range. The transceiver will have to be realigned when these crystals are installed, and the procedure should only be done by a competent technician.

The band crystals provided with the 2020 are as follows:

WWV	— 15.0 MHz is 37.025 MHz
80 meter band	— 3.5 MHz is 25.525 MHz
40 meter band	— 7.0 MHz is 29.025 MHz
20 meter band	— 14.0 MHz is 36.025 MHz
15 meter band	— 21.0 MHz is 43.025 MHz
10 meter band	— 28.0 MHz is 50.025 MHz
	— 28.5 MHz is 50.525 MHz
	— 29.0 MHz is 51.025 MHz
	— 29.5 MHz is 51.525 MHz

Crystal Frequency =
22.025 MHz + Lowest Freq. desired
Crystal type: HC-25/U

The band coverage will change exactly the same amount as the band crystal is changed. For example if you replace the 3.5 MHz crystal (25.525 MHz) with a 26.025 MHz crystal, the transceiver would cover 4.0 to 4.5 MHz.

4.17 FIXED FREQUENCY OPERATION

The 2020 has a built-in 2-position crystal controlled oscillator for fixed frequency operation. This feature is most useful for commonly used frequencies, nets or any situation where crystal controlled operation is required. To use the fixed frequency oscillator, turn the function switch to the A or B position. If an accessory fixed frequency crystal has been installed the 2020 would be tuned and operated the same as if it were operated normally (as described in Sections 4.1 through 4.9). Because the fixed frequency crystal replaces the VFO, it will operate at each BAND MHZ and SEGMENT KHZ postion. Therefore each fixed frequency crystal operates at 50 different frequencies in the 2020 (10 BAND MHZ positions and 5 SEGMENT KHZ positions).

4.17.1 CRYSTAL FREQUENCIES

The 2020's VFO operates in the 9138 to 9038 KHz range so the fixed frequency crystal will also be in that range.

The crystal frequency f(x) is determined by the following formula:

$$f(x) = 9138\ KHz - (f(F) - f(Fr))$$

where f(F) = the desired operating frequency
where f(Fr) = the nearest whole 100 KHz below the desired operating frequency.

Example: Desired Frequency = 21,335 KHz

Crystal Frequency =
9,138 KHz — (21,335 — 21,300) KHz

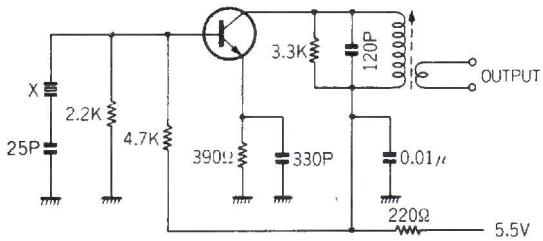
Crystal Frequency = 9138 KHz — 35 KHz
Crystal Frequency = 9103 KHz

NOTE: These fixed frequency crystals are for frequencies within the normal operating bands of the 2020. The crystals can not give frequencies outside the normal operting range of the transceiver.

Figure 14 shows the type of oscillator circuit for ordering the crystals and the crystal type is HC-25/U.

FIGURE 14. Fixed Frequency Crystals Oscillator Circuit.

2SC380Y

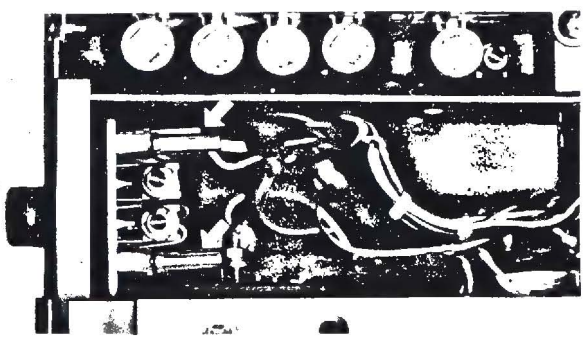


4.17.2 FIXED FREQUENCY CRYSTAL INSTALLATION AND OPERATION

Once you have received the correct crystal, you must plug it into either the A or B position as shown in Figure 15. Each crystal socket has a trimmer to net the crystal onto frequency. The crystal board is located at the top left, front corner of the transceiver. With the crystal installed, select the band desired, and the 100 KHz segment desired, and put the function switch into the A or B position. Then operate the 2020 as described earlier.

NOTE: The 9103 KHz crystal described above will not only work at 21,335 KHz but also 3.535, 3.635, 3,735, 3.835, 3.935, 7.035 MHz, etc., etc.

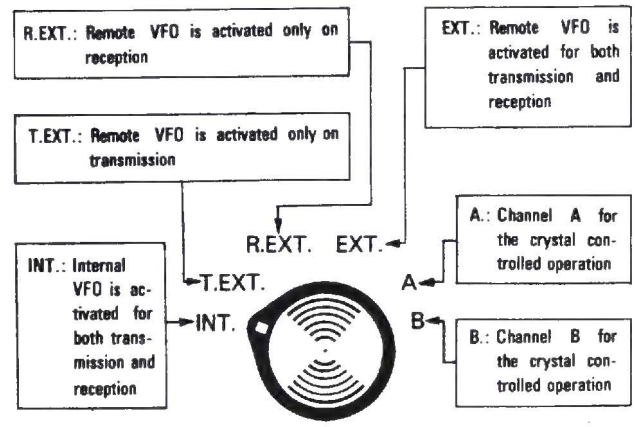
FIGURE 15. Fixed Frequency Crystal Installation.



4.18 OPERATION WITH A REMOTE VFO

When the 2020 is operated with the 8010 remote VFO the function switch on the transceiver determines which VFO is controlling what function. Figure 16 shows the function switch. The VFO LED above the dial scale helps by showing when each VFO is functional. The 8010 also has such a VFO LED. When the LED is lighted, the VFO is operating

FIGURE 16. Function Switch.



4.19 MOBILE OPERATION

The compact size and solid state design of the 2020 make it very useful for mobile or portable operation. Be certain that the mobile antenna meets the requirements described in Section 1.

The normal operating procedures, described previously, also apply to mobile operation. The noise blanker should be used to reduce ignition and impulse noises for clear reception. Remember that during transmission the transceiver draws more than 20 amps so be careful not to drain the car's battery.

4.20 OPERATION WITH A PHONE PATCH

The 2020 has rear panel jacks to accept the leads to and from a phone patch. The PHONE PATCH IN jack accepts an audio input impedance of 50 K ohms, and the PHONE PATCH OUT jack delivers an audio output at 4 ohms.

4.21 SSTV OPERATION

The 2020 will adapt well to slow scan television operation. The easiest way is to use the PHONE PATCH IN and PHONE PATCH OUT jacks as described in Section 4.20. Be careful to keep the input power of the 2020 down to a safe level with the MIC GAIN control. If you exceed the plate power dissipation capability of the tubes, they will be damaged.

4.22 NOVICE OPERATION

The plate power input to the 2020 can be reduced for novice CW operation by adjusting the CARRIER control for about 90 ma of plate current.

SECTION 5. CIRCUIT DESCRIPTION

INTRODUCTION

The 2020 is constructed with fifteen separate sections, called units. Most of them are built onto plug-in type modules or circuit boards. The transceiver has been engineered for easy acess and fast servicing. The front panel pivots easily away from the frame, as shown in Figure 17. Refer to Figure 20, the Block Diagram for a circuit description. The large, main schematic is really a wiring diagram between sections, with component listings for the parts which are not included in one of the 15 main sections. For details on any one of the 15 main sections, refer to the appropriate paragraph in Section 5.

The Local Oscillator Unit employs a unique circuit design employing a PLL (Phase Lock Loop) programmed oscillator. The block diagram of the Local Oscillator Unit is included with Section 5.10.

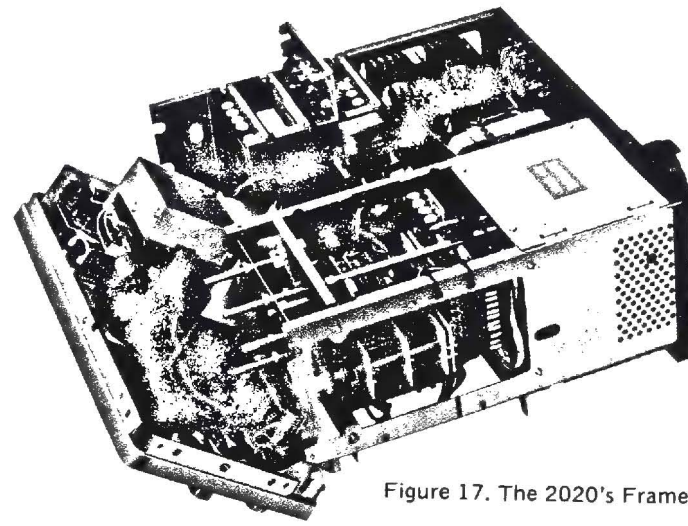
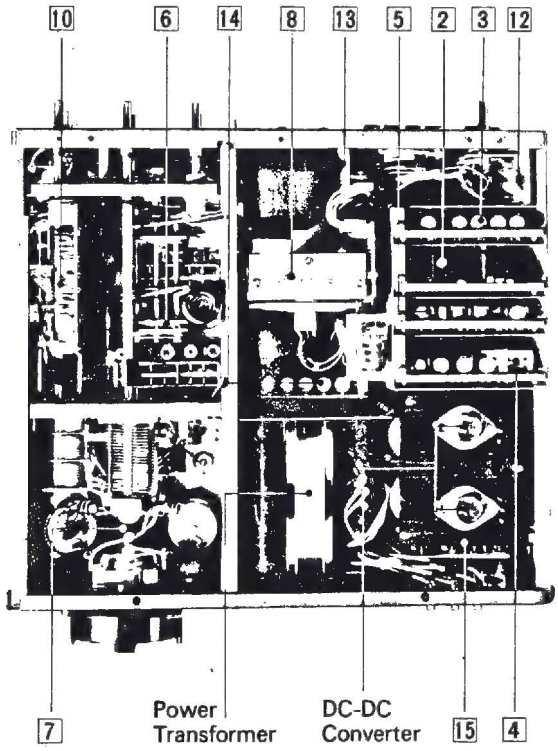


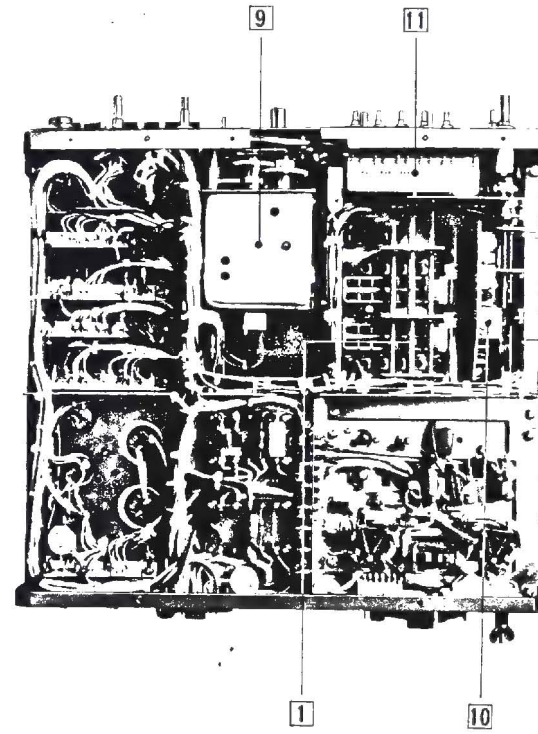
Figure 17. The 2020's Frame.

FIGURE 18. 2020 Module Locations, Top View.



2. Filter Unit (PC-077)
3. IF Unit (PC-078)
4. AF Unit (PC-079)
5. Generator Unit (PC-080)
6. Transmitter RF Unit (PC-076)
7. Transmitter Power Amplifier Unit
8. PLL Unit (PC-086 and PC-087)
12. Operation Unit (PC-085)
13. Display Unit (PC-088 and PC-089)
14. AVR Unit (PC-082)
15. Rectifier Unit (PC-081)

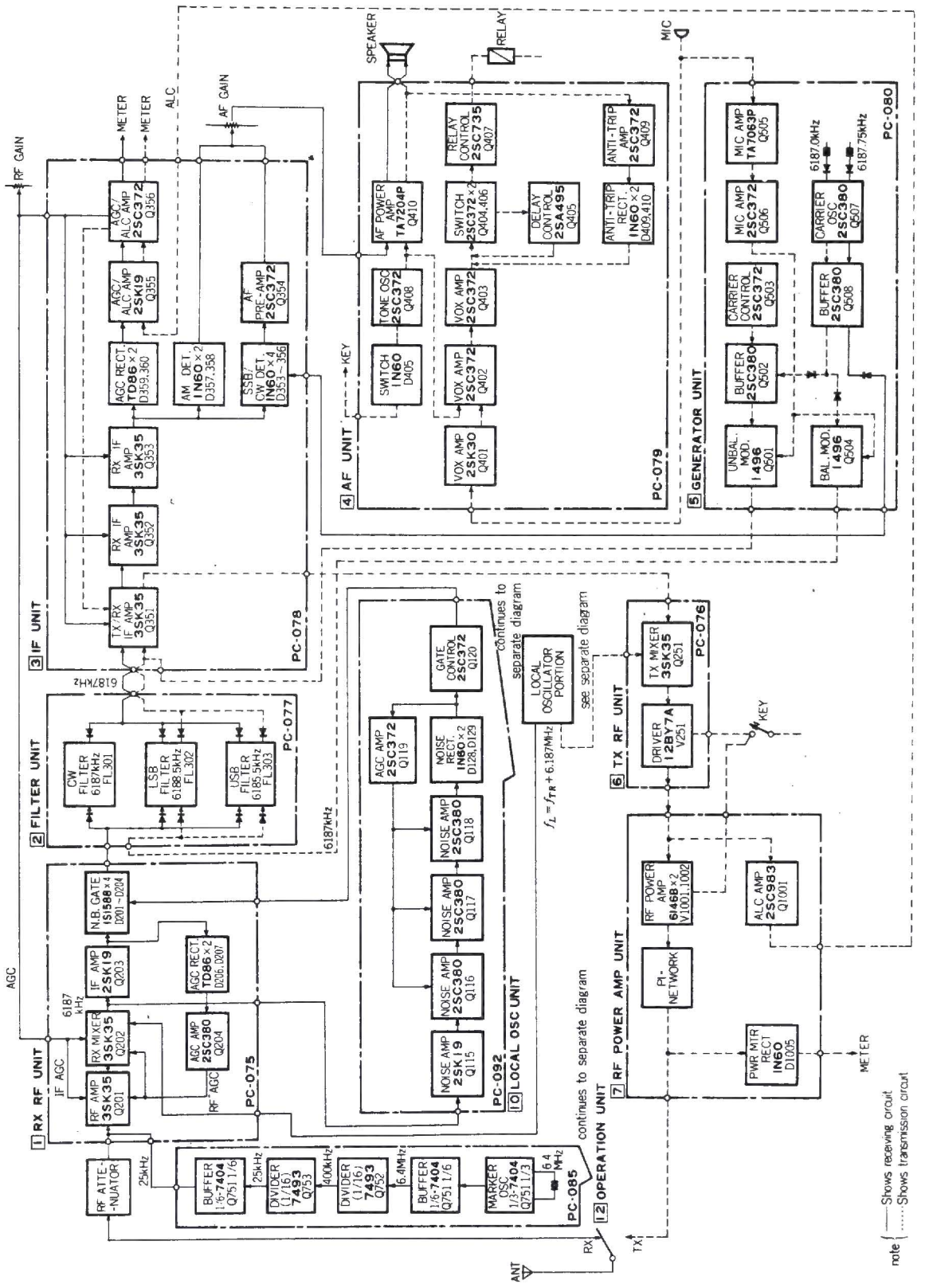
FIGURE 19. 2020 Module Locations, Bottom View.



1. Receiver RF Unit (PC-075)
9. VFO Unit (PC-083 and PC-084)
10. Local Oscillator Unit IPC-092)
11. Segment Unit (PC-090

FIGURE 20. BLOCK DIAGRAM OF THE 2020.

(The block diagram of the local oscillator section is in Section 5.10)



* Features and specifications subject to change without notice.

5.1 RECEIVER RF UNIT (PC-075)

This circuit board holds all band receiver RF amplifier Q201 (3SK35), all band mixer Q202 (3SK35), and the noise blanker gate (D201 through D204).

Q204 (2SC380) is the AGC amplifier and D206 and D207 (TD86x2) are the AGC rectifiers. Tuning capacitors C209 and C224) are controlled by the front panel PRE-SELECT control. The WWV circuits are pre-tuned and the PRESELECT control has no effect.

The receiver amplifier is electrically independent from the transmitting section, providing simple, stable tuning. The receiver circuit uses a single conversion design with a fixed IF output at 6,187 KHz.

FIGURE 21. Receiver RF Unit (PC-075) Schematic.

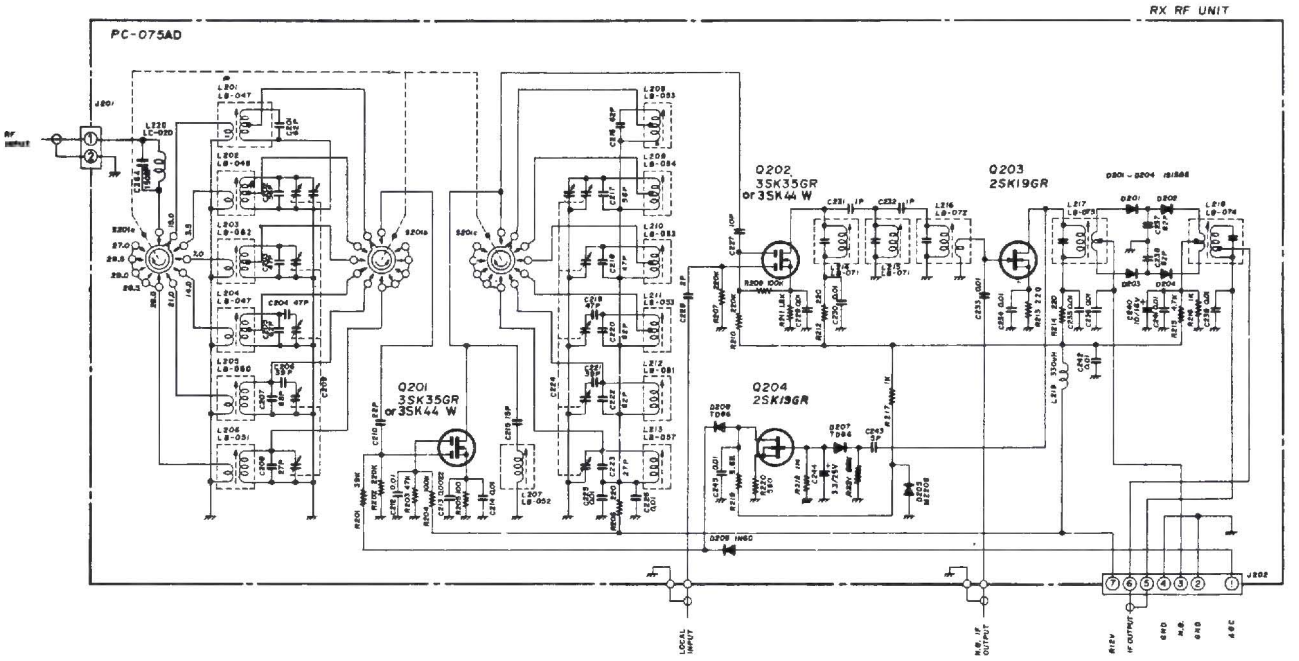
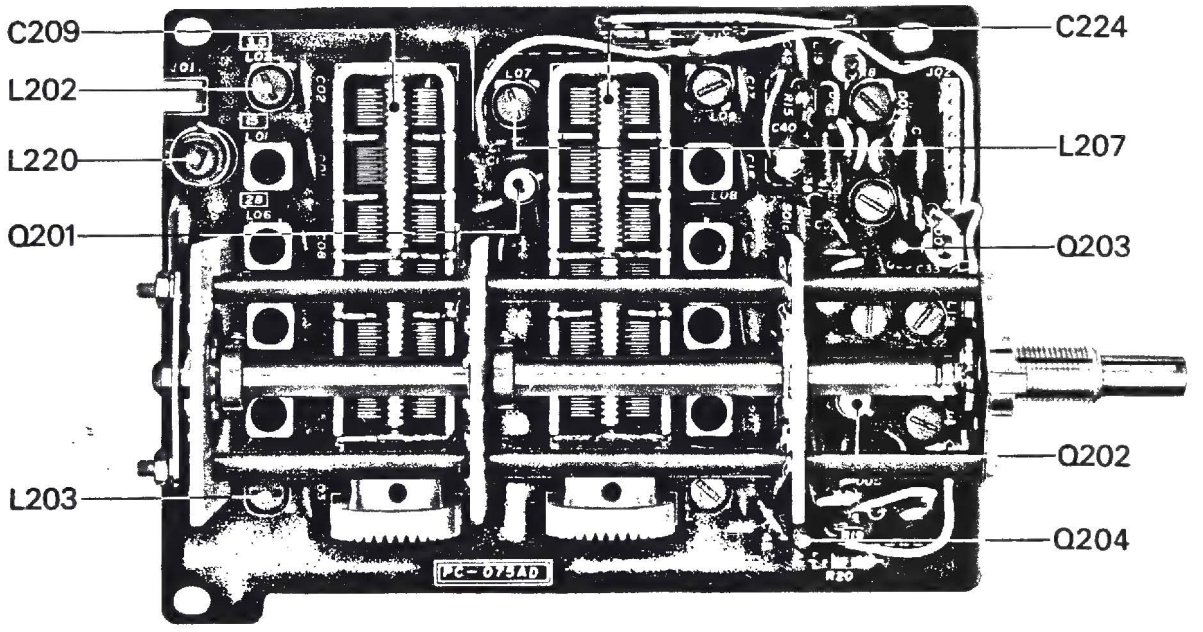


FIGURE 22. Receiver RF Unit (PC-075) Circuit Board.



NOTE: The component labels printed on the circuit board delete the 100 digit. L202 is labeled L02.

5.2 FILTER UNIT (PC-077)

This plug-in circuit board holds the three crystal filters used in the 2020. By using a separate filter for USB, LSB, and CW, the 2020 avoids the problem of a carrier shift for different modes. The carrier frequency is 6,187 KHz. FL301 is the CW filter (6,187 KHz) with a bandwidth of 600 Hz. FL302 is the LSB filter (6,188.5 KHz) and FL303 is the USB filter (6,185.5 KHz) and each have a bandwidth of 2.1 KHz.

The filters are selected with diodes connected to the front panel MODE switch. The USB filter is used for AM operation. Figure 24 shows the filter characteristics of the SSB filters.

FIGURE 23. Filter Unit (PC-077) Schematic.

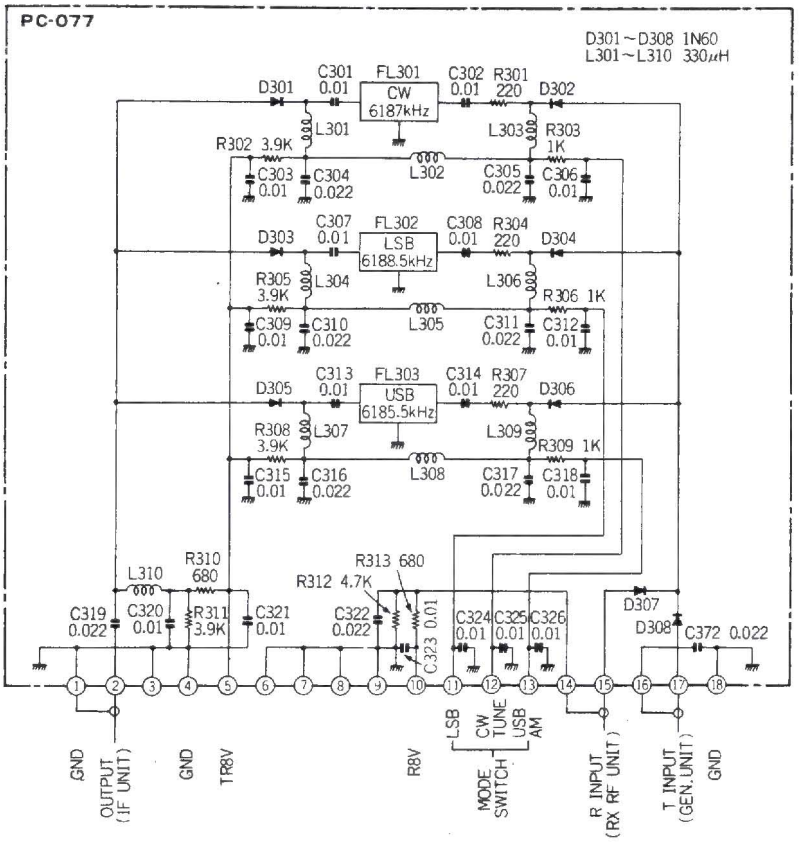


FIGURE 24. SSB Filter Characteristics.

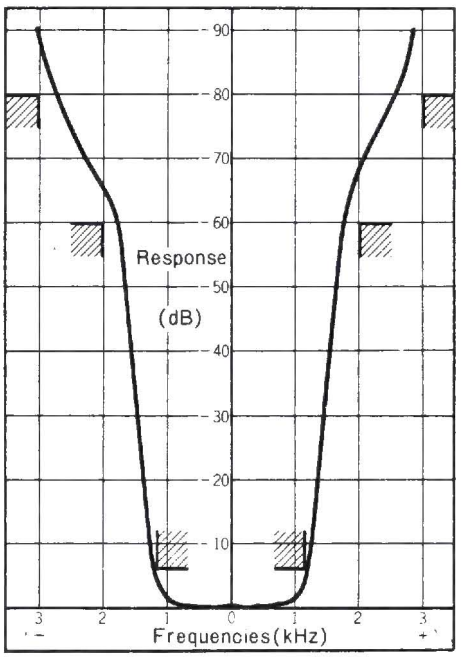
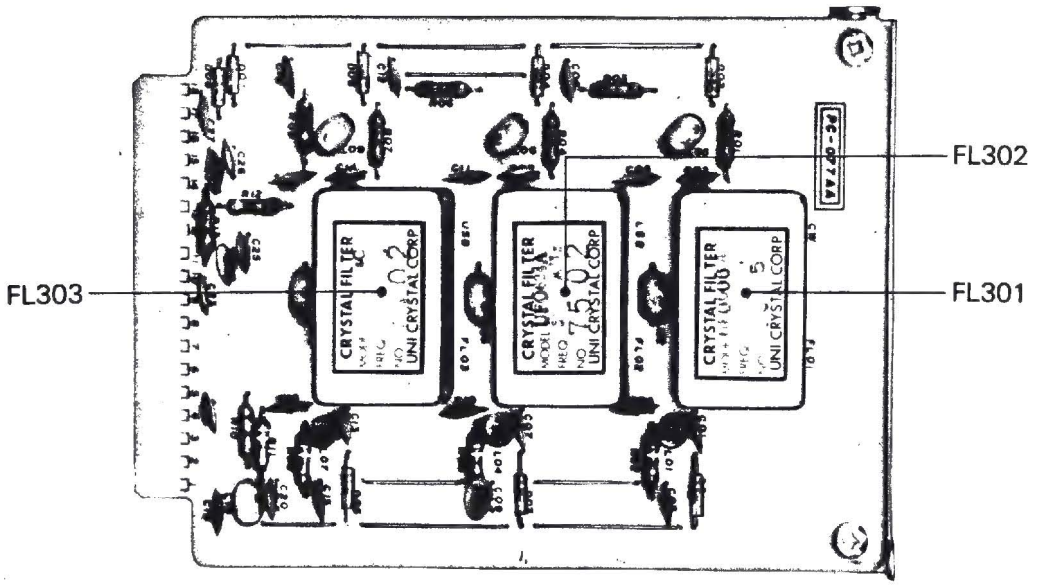


FIGURE 25. Filter Unit (PC-077) Board.



5.3 IF UNIT (PC-078)

The IF circuit board includes Q351 (3SK35) an IF amplifier for receive and transmit, and two independent receiver IF amplifiers Q352 (3SK35) and Q353 (3SK35). D357 and D358 (1N60) are the AM detector, and D353 through D356 are the SSB/CW detector. D359 and D360 (TD86 x 2) are AGC rectifiers feeding into AGC/ALC amplifiers Q355 (2SK19) and Q356 (2SC372). Q354 is an AF preamplifier. All of the IF amplifiers are FET's to insure linear amplification and good AGC/ALC action.

FIGURE 26. IF Unit (PC-078) Schematic.

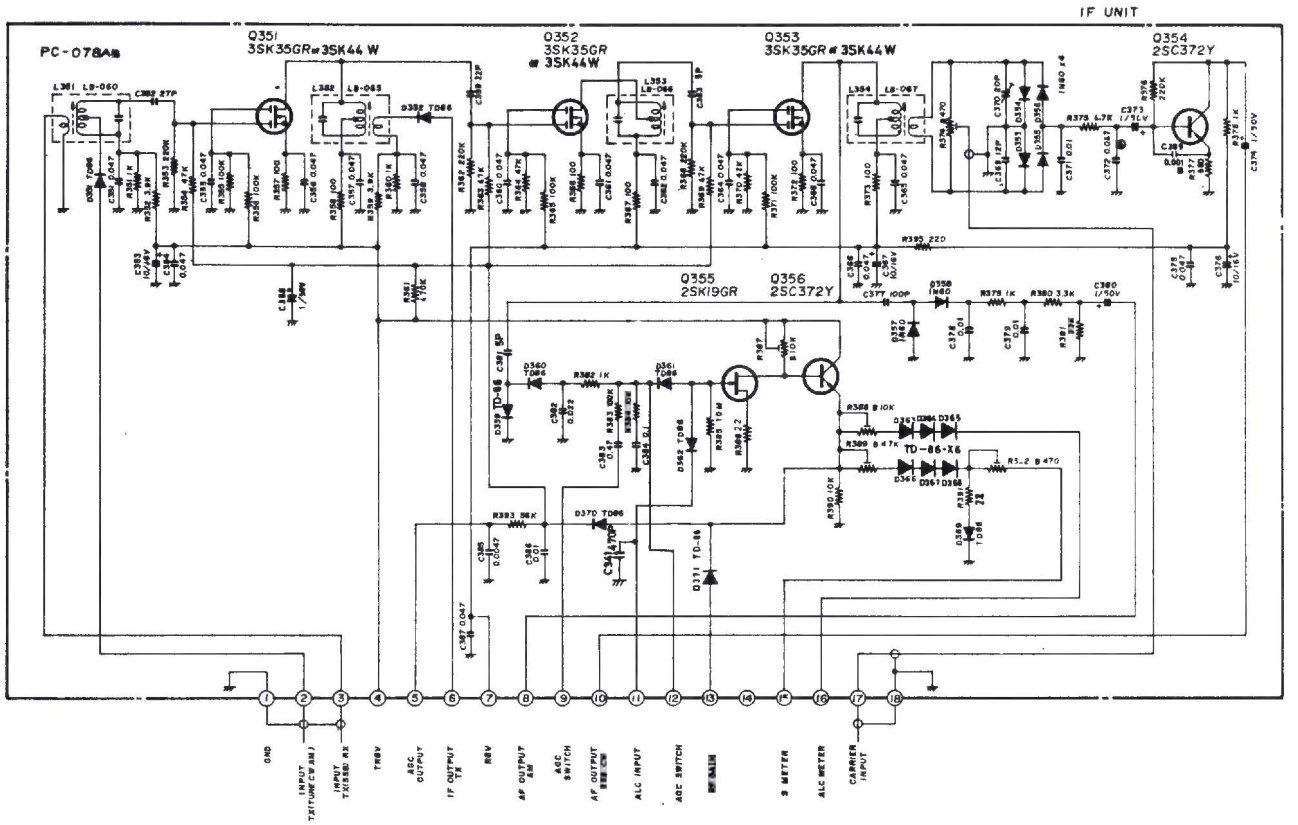
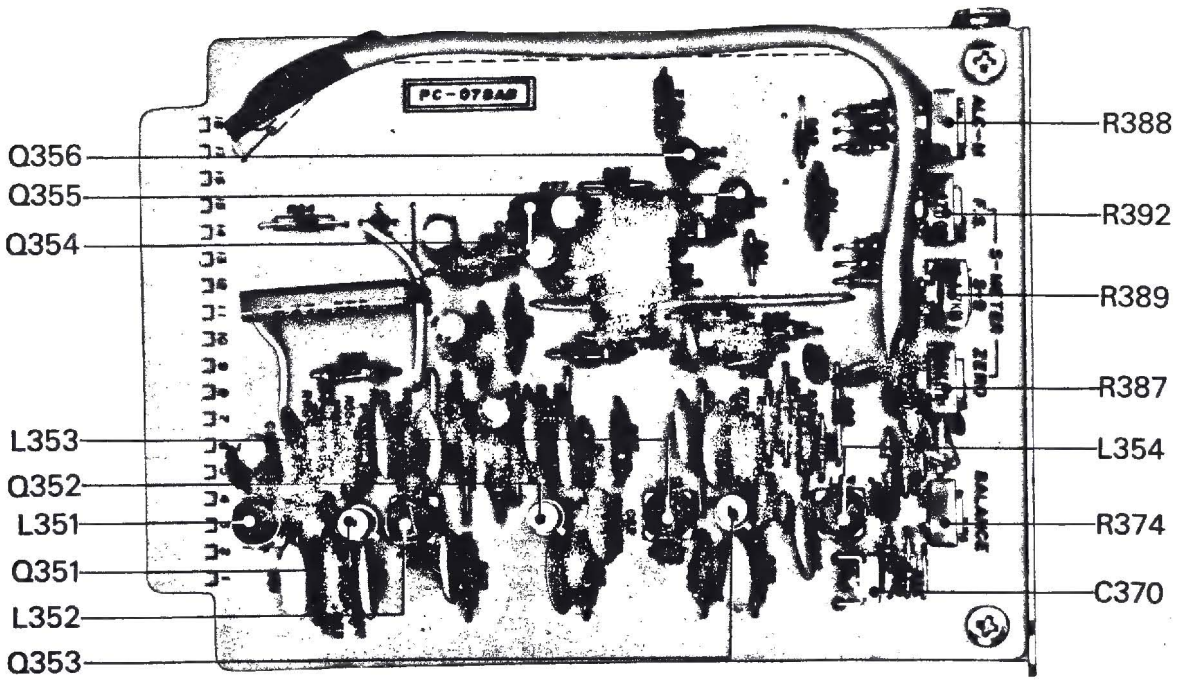


FIGURE 27 IF Unit (PC-078) Board.



5.4 AF UNIT (PC-156)

This plug-in circuit board includes audio amplifier Q410 (TA7204P), a tone oscillator for the CW sidetone Q408 (2SC372), and all of the VOX circuits. Q401 (2SK30), Q402 (2SC372) and Q403 (2SC372) are VOX amplifiers. Q404 and Q406 (2SC372 x 2) form the VOX switch, and Q405 (2SA495) is the delay control. Q409 (2SC372) is the ANTI VOX amplifier, and D409 and D410 (1N60) are the ANTI VOX rectifiers.

The audio amplifier circuit design is a SEPP-OTL to insure good tone and adequate audio output.

FIGURE 28. AF Unit (PC-156) Schematic.

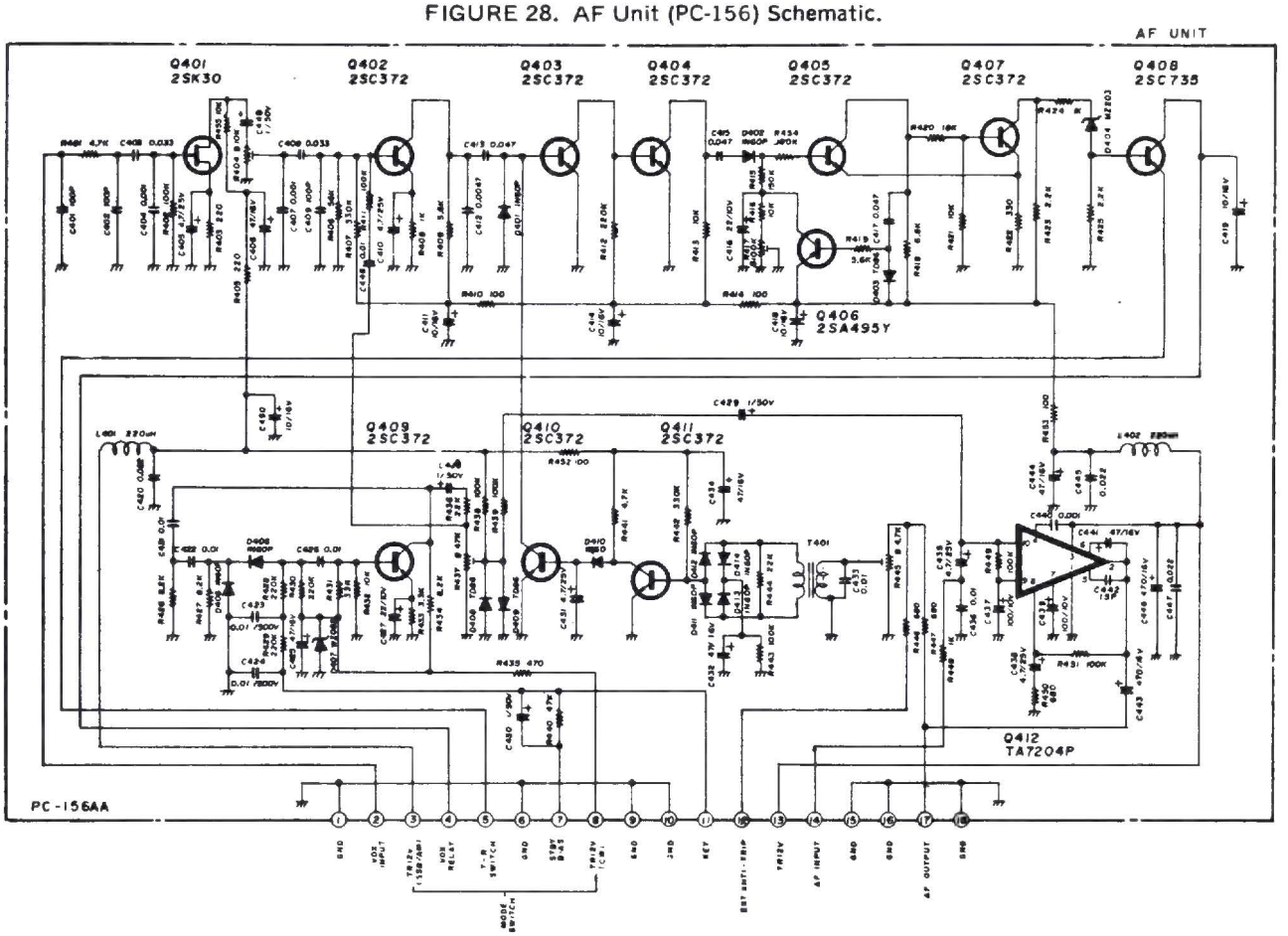
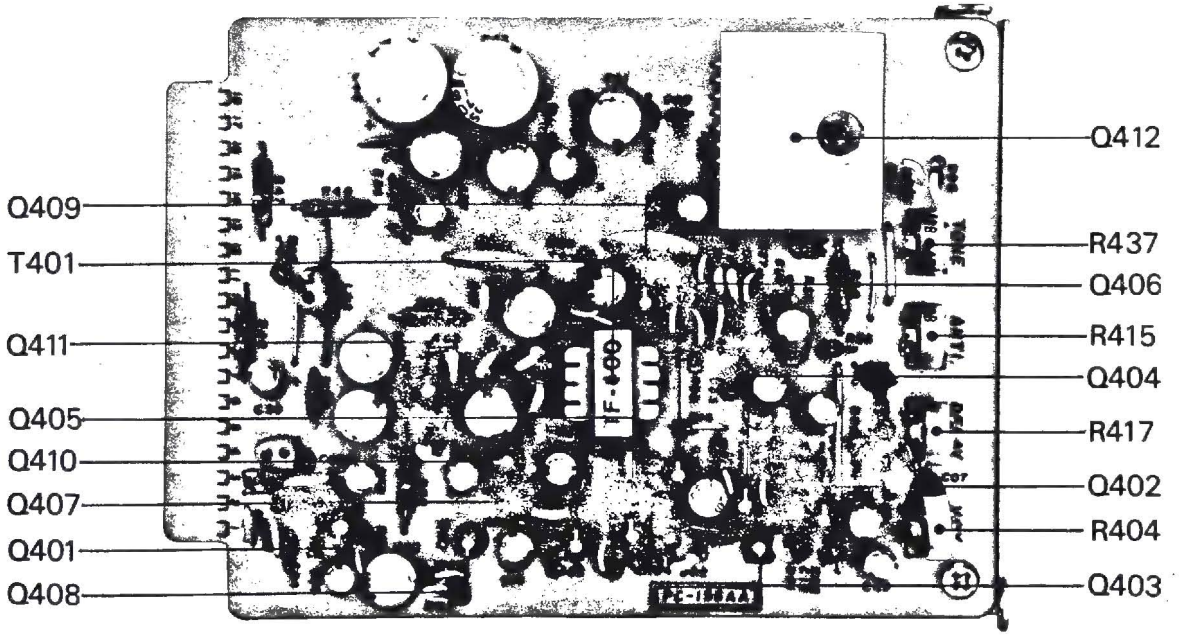


FIGURE 29. AF Unit (PC-156) Board.



5.5 GENERATOR UNIT (PC-080)

The SSB, CW, and AM carriers (6187 KHz) are generated on this plug-in circuit board. Q507 (2SC380) is the carrier oscillator, and IC Q504 (I496) is a dual balanced modulator circuit to provide maximum carrier supression. Q501 (IC I496) is an unbalanced modulator for AM operation. Q505 (IC TA7063P) and Q506 (2SC372) are microphone amplifiers. X501 (6187.0 KHz) is the carrier crystal for transmit on all modes, and X502 (6187.75 KHz) is the carrier crystal for CW reception.

5.6 TRANSMITTER RF UNIT (PC-076)

This circuit board holds the heterodyne mixers for transmit on all bands. Q251 (3SK35) is the transmitter mixer. V251 (12BY7A) is the 2020's driver tube. The transmitter RF circuits are tuned independently from the receiver's RF circuits for maximum stability.

FIGURE 30. Generator Unit (PC-080) Board.

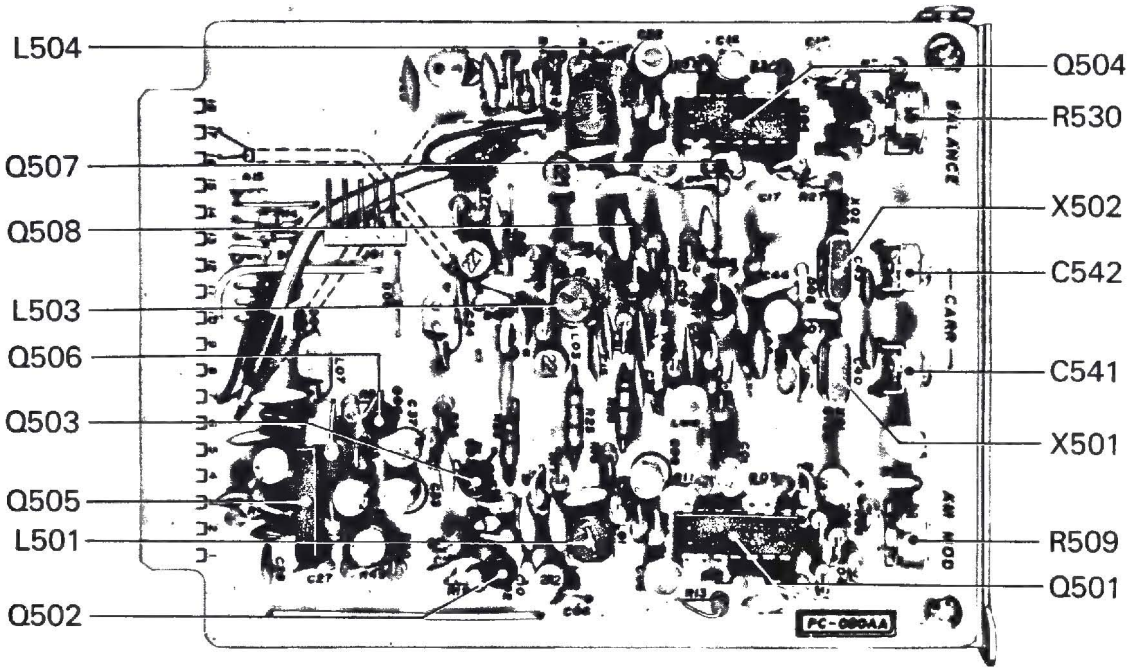


FIGURE 31. Transmitter RF Unit (PC-076) Board.

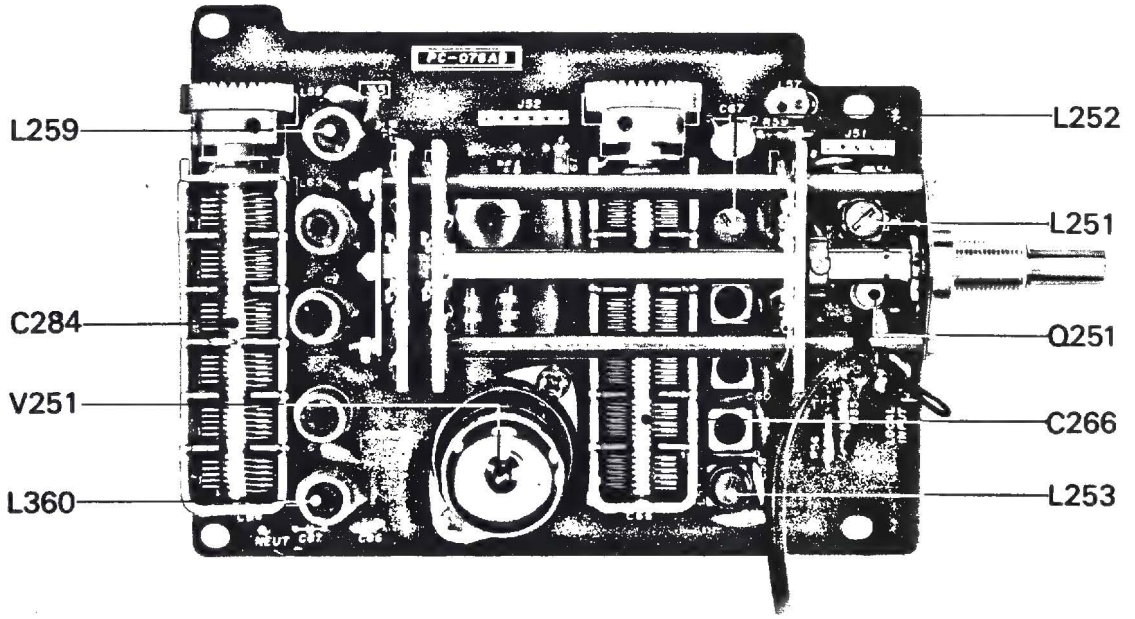


FIGURE 32. Generator Unit (PC-080) Schematic.

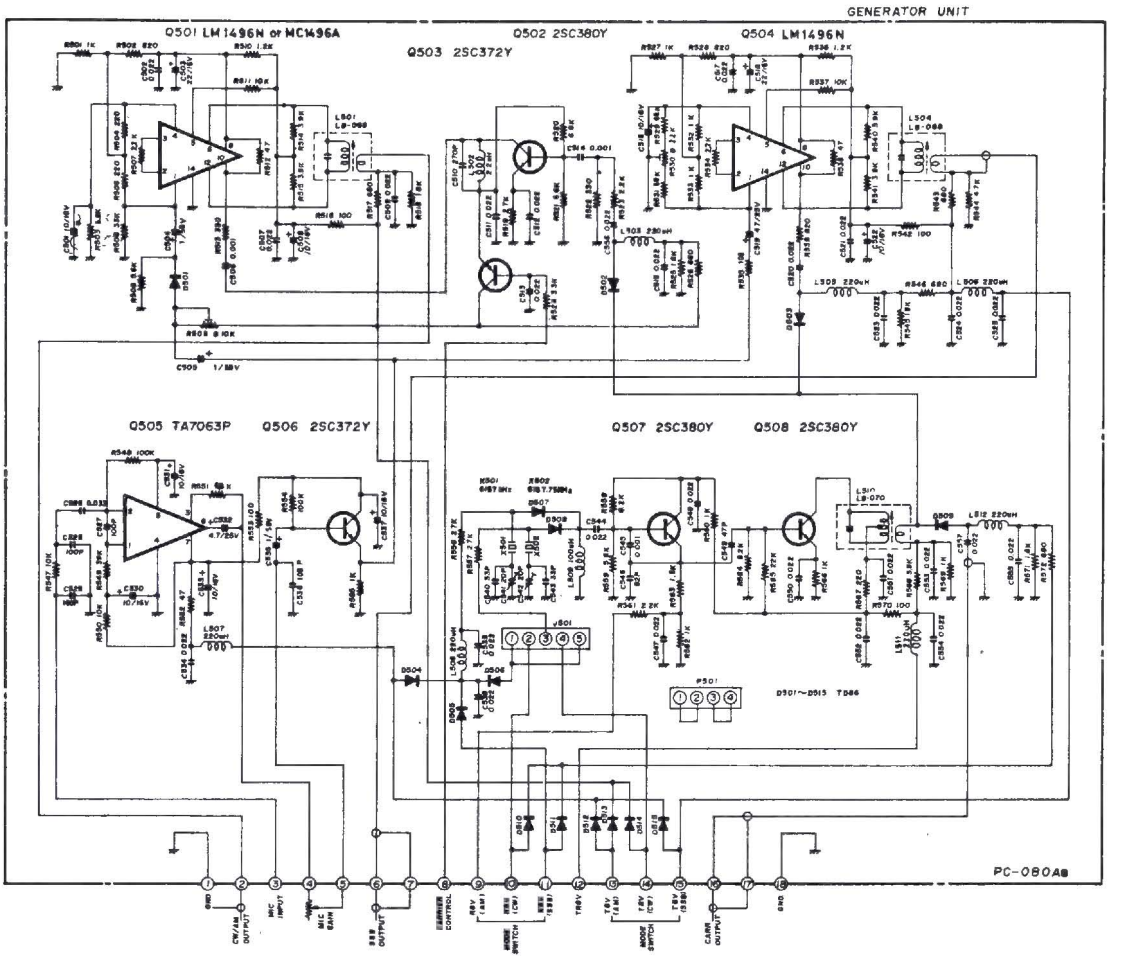
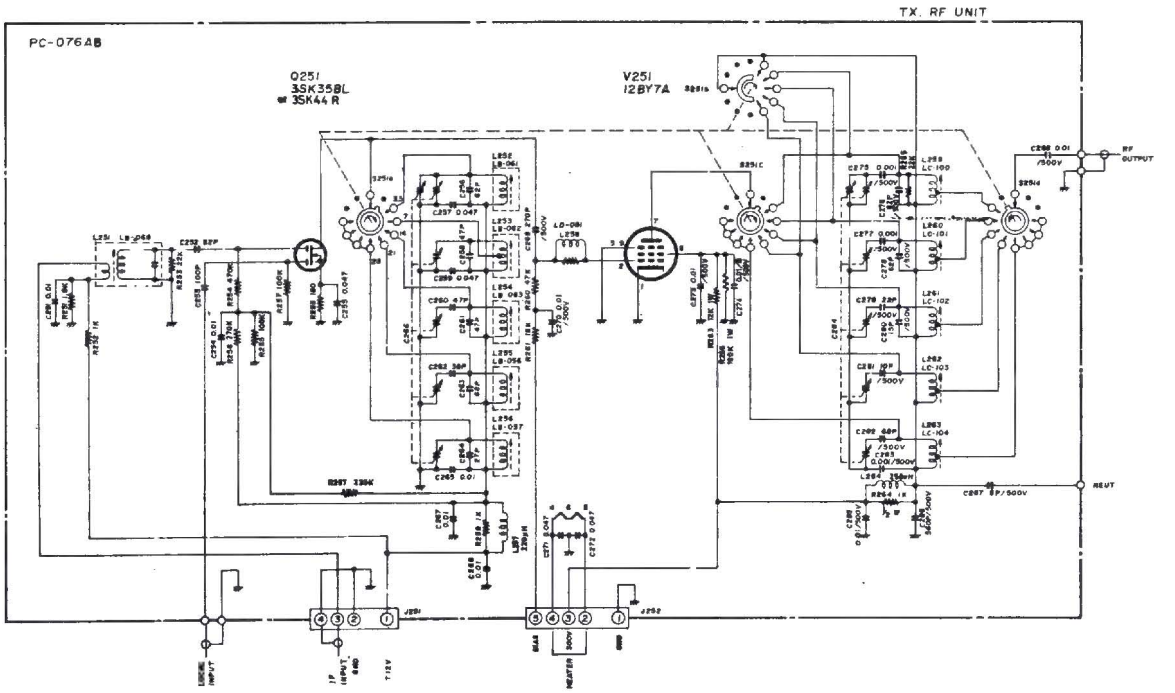


FIGURE 33. Transmitter RF Unit (PC-076) Schematic.



5.7 TRANSMITTER POWER AMPLIFIER UNIT

The final amplifier section is built onto the 2020's chassis. V1001 and V1002 (6146B x 2) are the final tubes and Q1001 (2SC9830) is the ALC amplifier. Zener diodes D1003 and D1004 (TD86 x 2) stabilize the screen grid voltage to the 6146B's to insure maximum linearity.

FIGURE 34. TRANSMITTER Power Amplifier Unit.

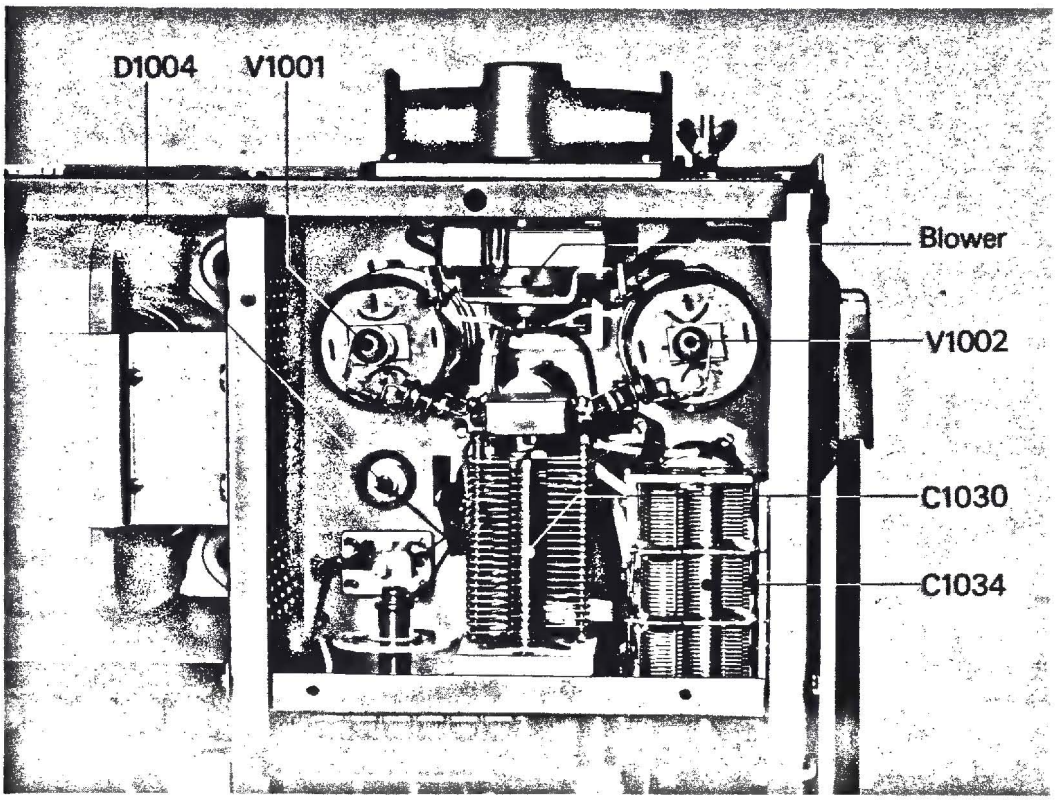
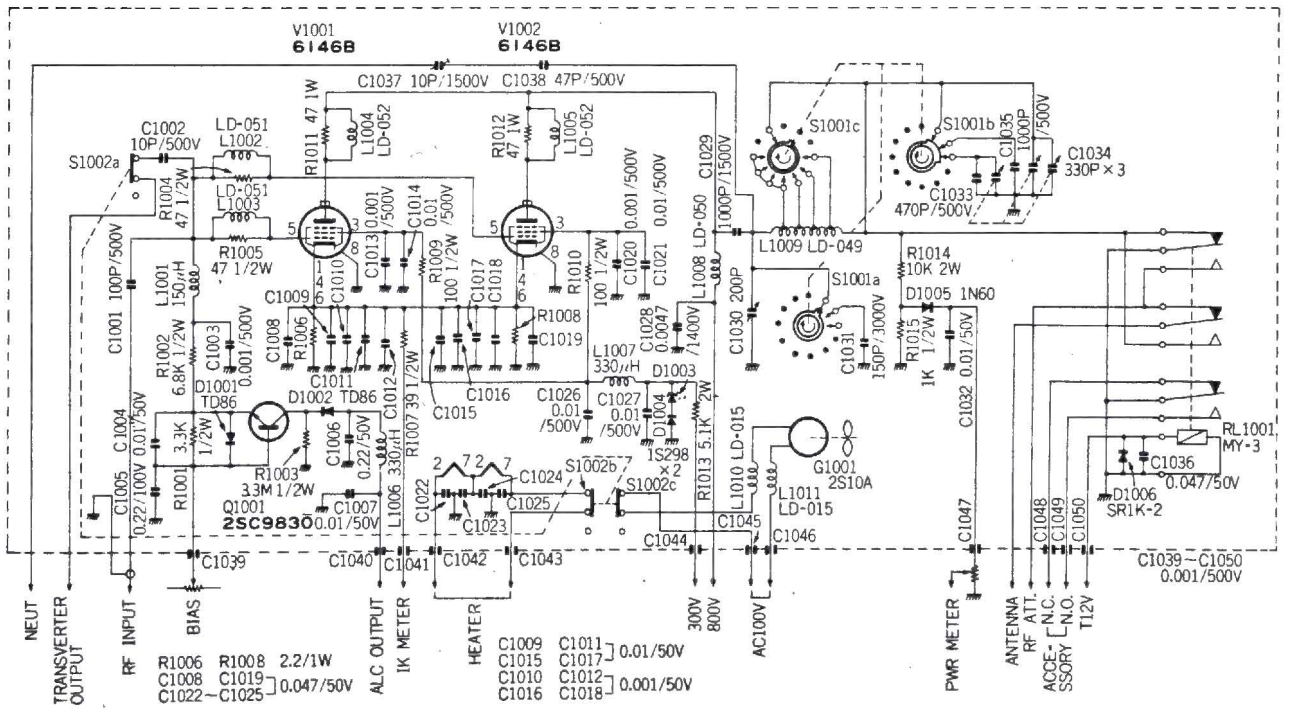


FIGURE 35. TRANSMITTER Power Amplifier Schematic.



5.8 PLL UNIT (PC-086 and PC-087)

See Figure 41 for a circuit description of the PLL section. The PLL circuit generates IF frequencies at 6.3 MHz, 6.4 MHz, 6.5 MHz, 6.6 MHz, or 6.7 MHz (as selected by the SEGMENT KHz buttons). See Table 2 for information on frequency determination in the 2020.

PLL-1 (PC-086) holds the main PLL circuits and PLL-2 (PC-087) holds the program selector circuits. When the VFO frequency is heterodyned with the IF frequencies in this circuit the output from the section is between 15.838 MHz and 15.338 MHz.

FIGURE 36.
PLL Unit (PC-086) Board.

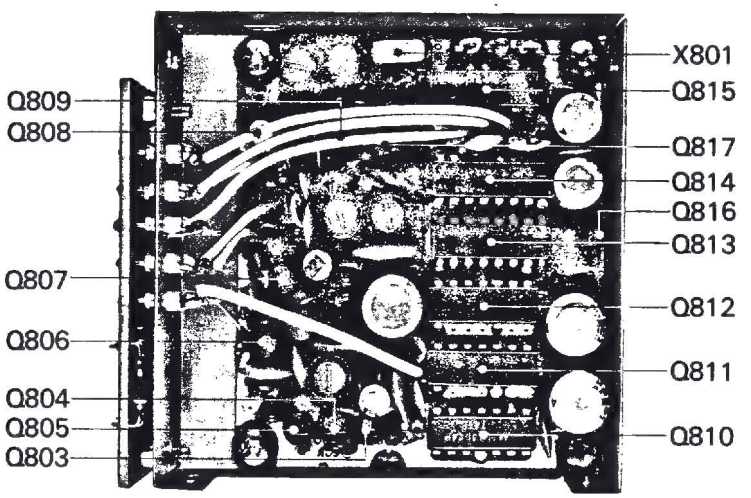


FIGURE 37. PLL Unit (PC-087) Board.

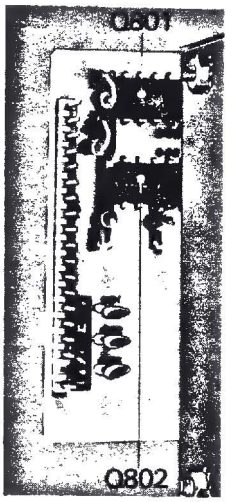
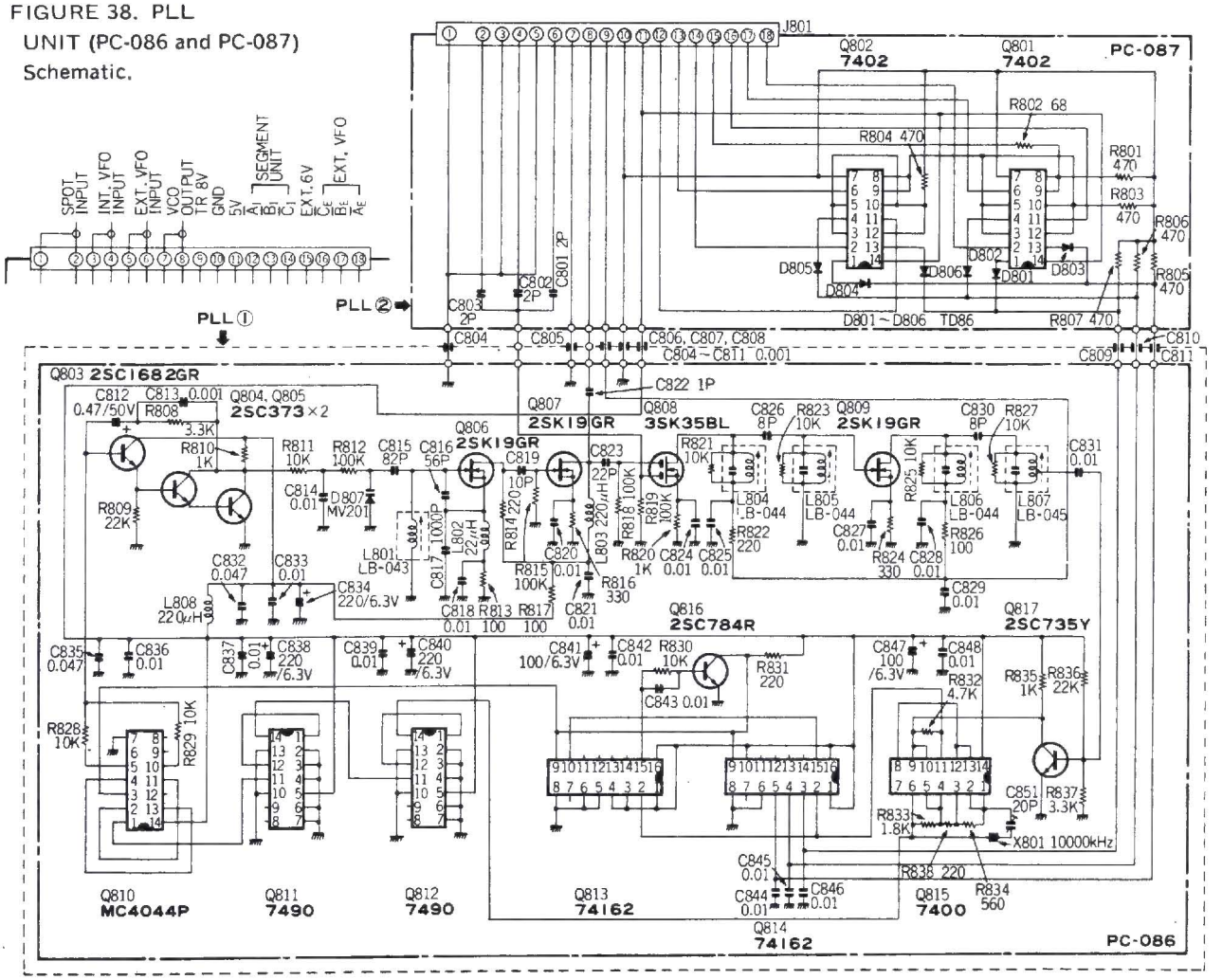


FIGURE 38. PLL
UNIT (PC-086 and PC-087)
Schematic.



5.9 VFO UNIT (PC-083 and PC-084)

The inherent frequency stability and readout accuracy of the 2020 results from the care and quality of the design and components of the VFO (Variable Frequency Oscillator). The 2020 uses a unique 100 KHz VFO for nearly drift-free, stable operation. The oscillator frequency ranges from 9138 to 9038 KHz. One revolution of the main tuning knob tunes through 25 KHz of the band. Buffers Q702 (2SK19) and Q703 (2SC380) help avoid load fluctuations.

FIGURE 40. VFO Unit (PC-083 and PC-084) Board.

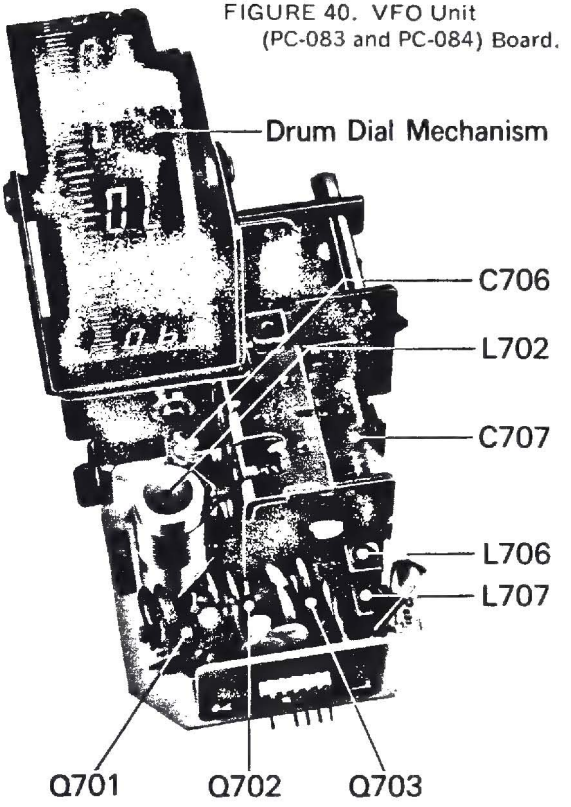


FIGURE 39. VFO Unit (PC-083 and PC-084) Schematic.

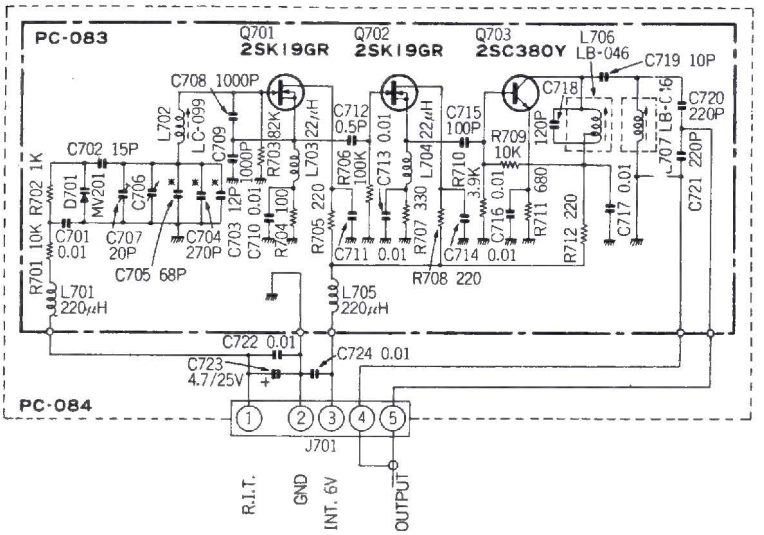
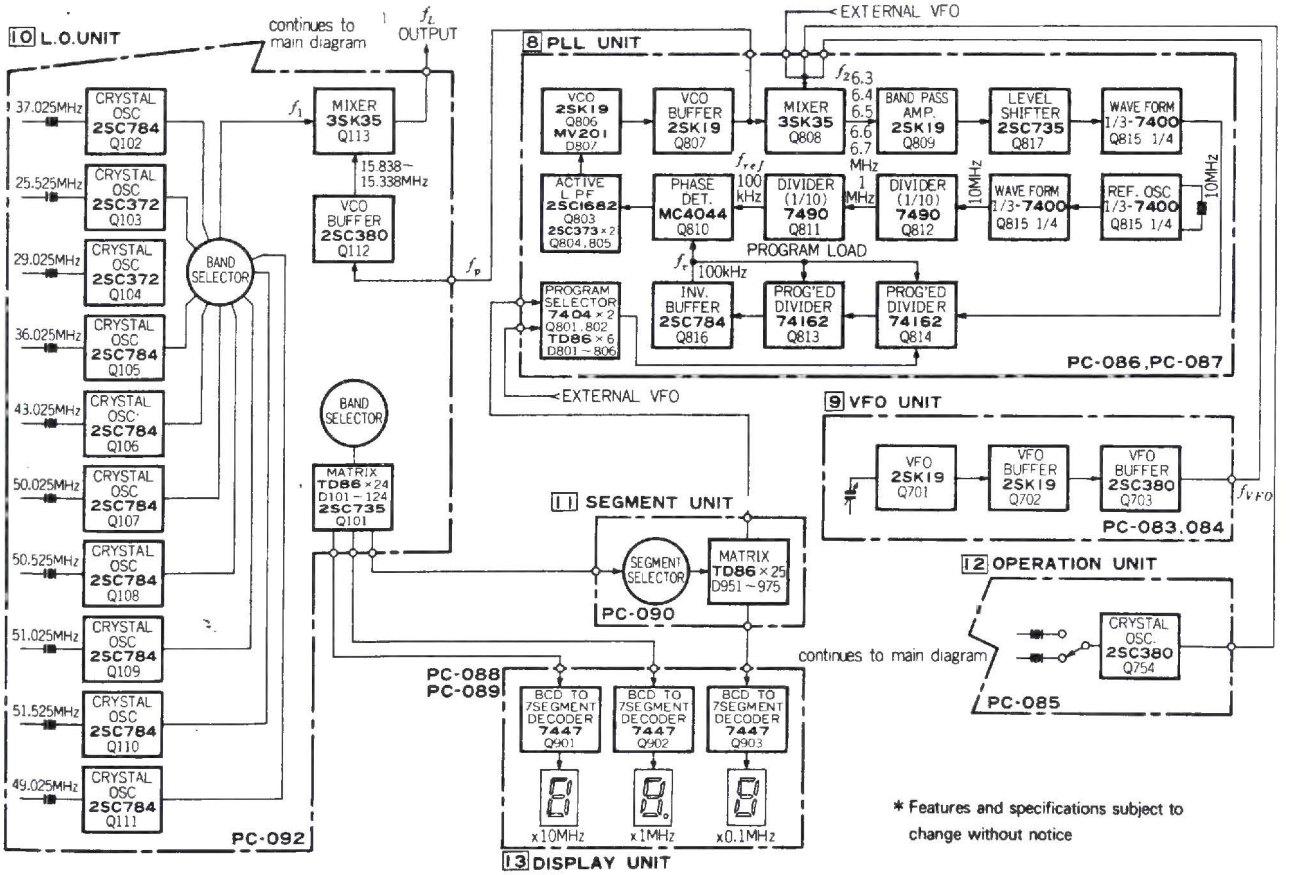


FIGURE 41. Local Oscillator Block Diagram.

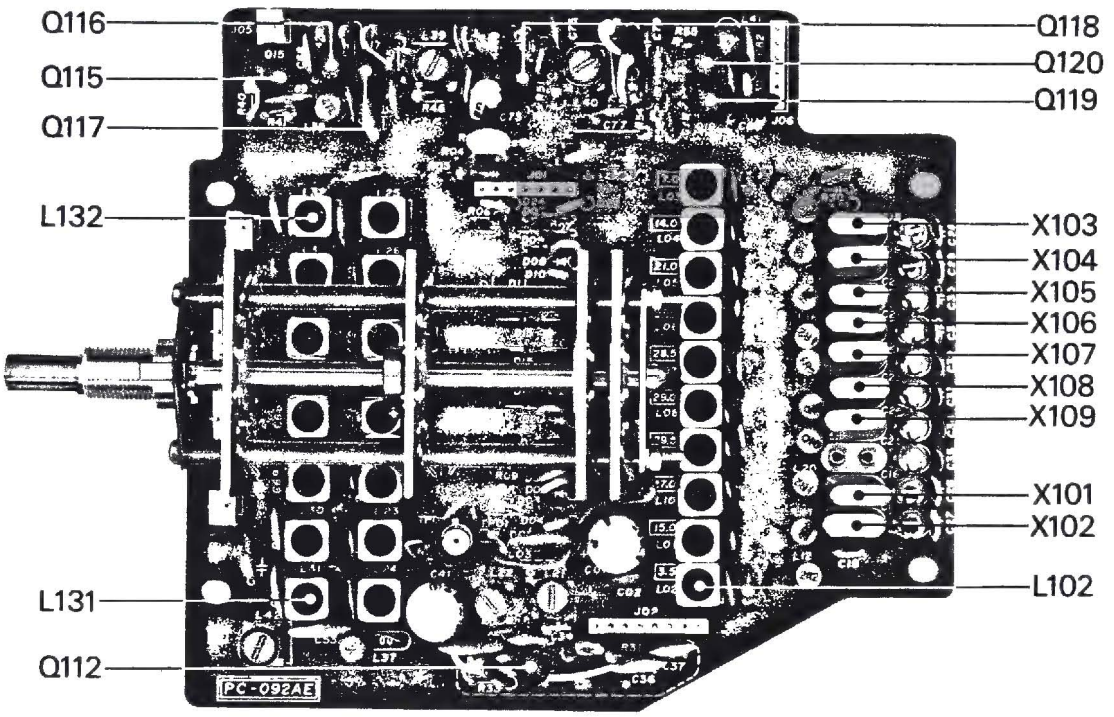


5.10 LOCAL OSCILLATOR UNIT (PC-092)

This circuit board holds the BAND MHZ switch and the 10 separate local heterodyne oscillators which determine the operating frequency of the 2020. Q113 (3SK35) is an all-band mixer to premix the local oscillator frequency with the 15.338 MHz to 15.838 MHz signal from the PLL unit. Each local oscillator employs separate transistors (Q102 to Q111) for equally stable output on each band. A dual tuned circuit for the pre-mix output reduces spurious radiation. The diode matrix circuits for the MHz dial display are also on this board.

The Local Oscillator board also holds the noise blanker circuit. Q115 (2SK19) and Q116 to Q118 (2SC380 x 3) are noise amplifiers and Q120 (2SC372) is the gate control.

FIGURE 42. Local Oscillator Unit (PC-092) Board.



5.11 SEGMENT UNIT (PC-090)

This small circuit board holds the SEGMENT KHZ buttons and the diode matrix circuit which determines the correct 100 KHz display.

FIGURE 43. Segment Unit (PC-090) Schematic.

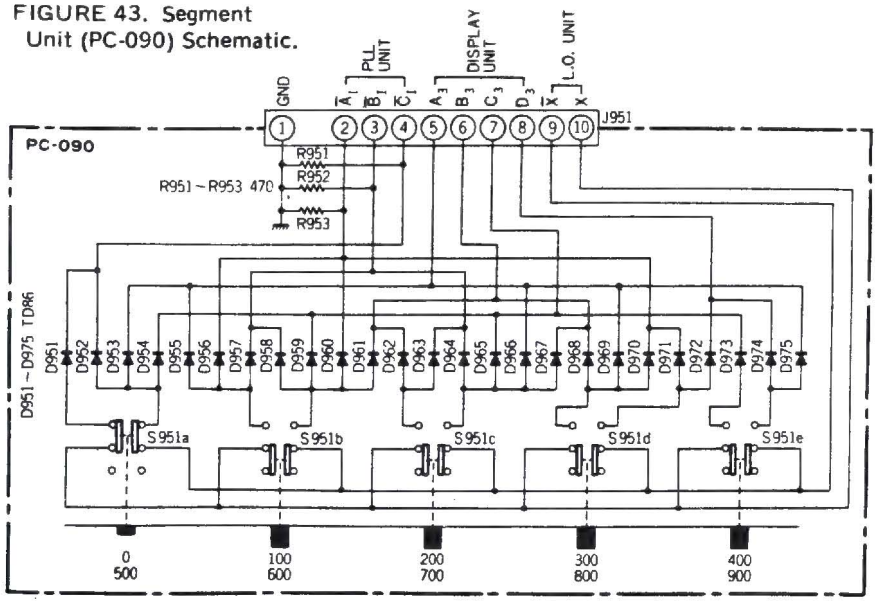


FIGURE 44. Segment Unit Board.

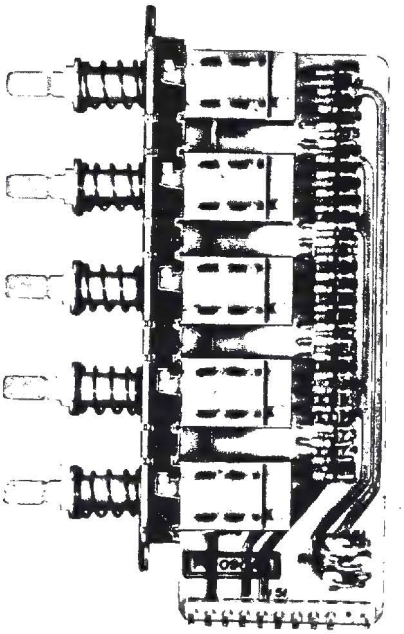
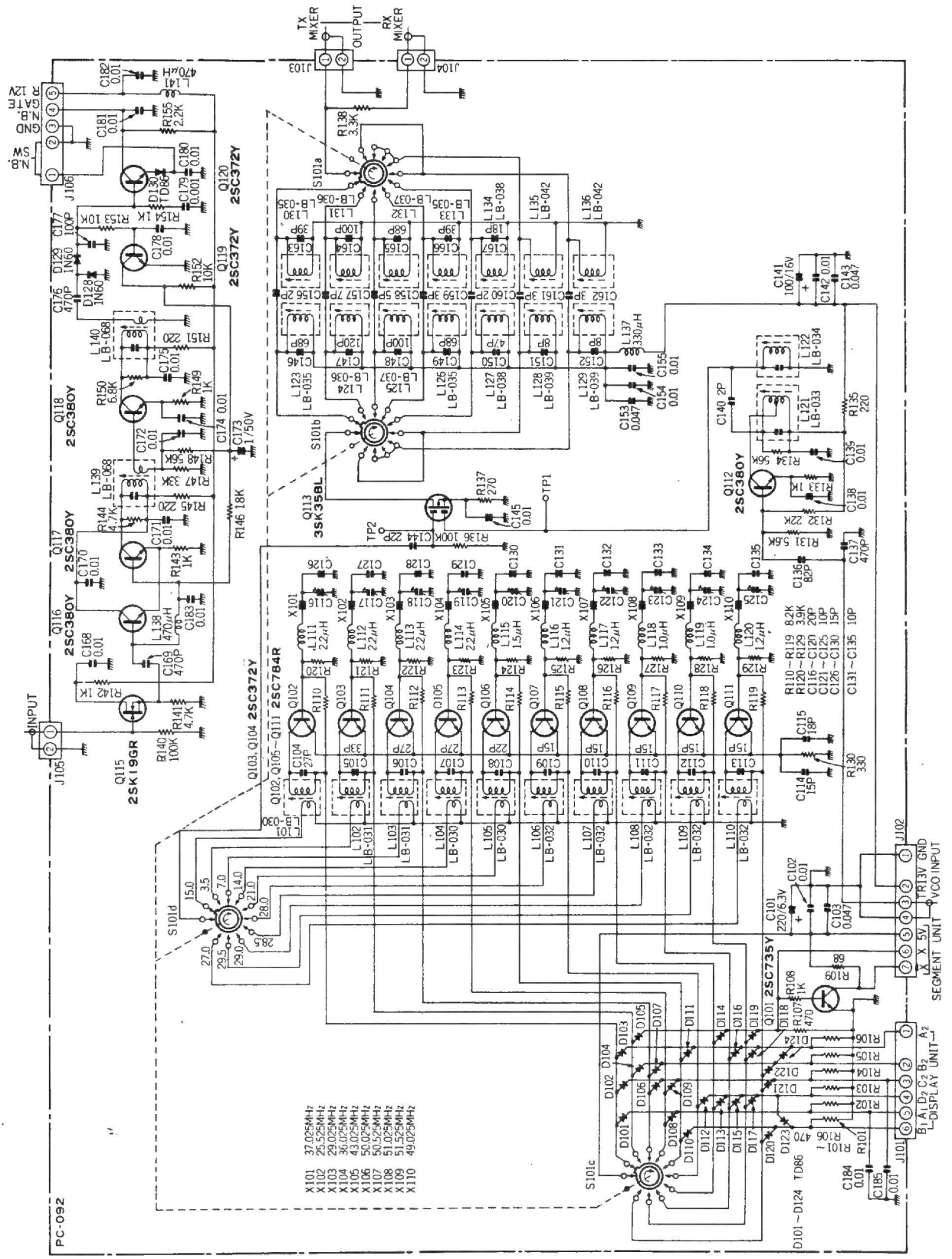


FIGURE 45. Local Oscillator Unit (PC-092) Schematic.



* Features and specifications subject to change without notice.

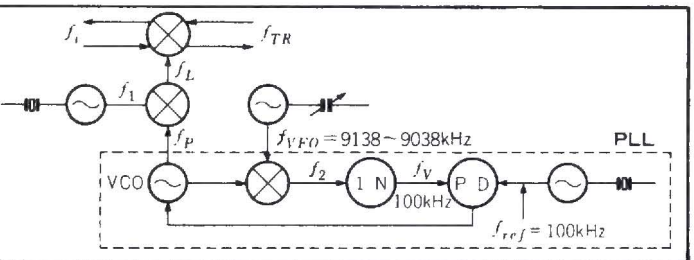
TABLE 2. FREQUENCY DETERMINATION IN THE 2020.

The operating frequency of the 2020 is determined by 4 different sources.

Operating frequency = Local Oscillator frequency — (PLL heterodyne frequency + VFO frequency) — Carrier frequency

For example: 3.5 MHz = 25.525 MHz — (6.700 MHz + 9.138 MHz) — 6.187 MHz

fTR – Transmitting & receiving frequency
fi – Intermediate frequency
fL – Local oscillator frequency
fl – Crystal oscillator frequency
fp – PLL output frequency
f2 – PLL heterodyne output frequency



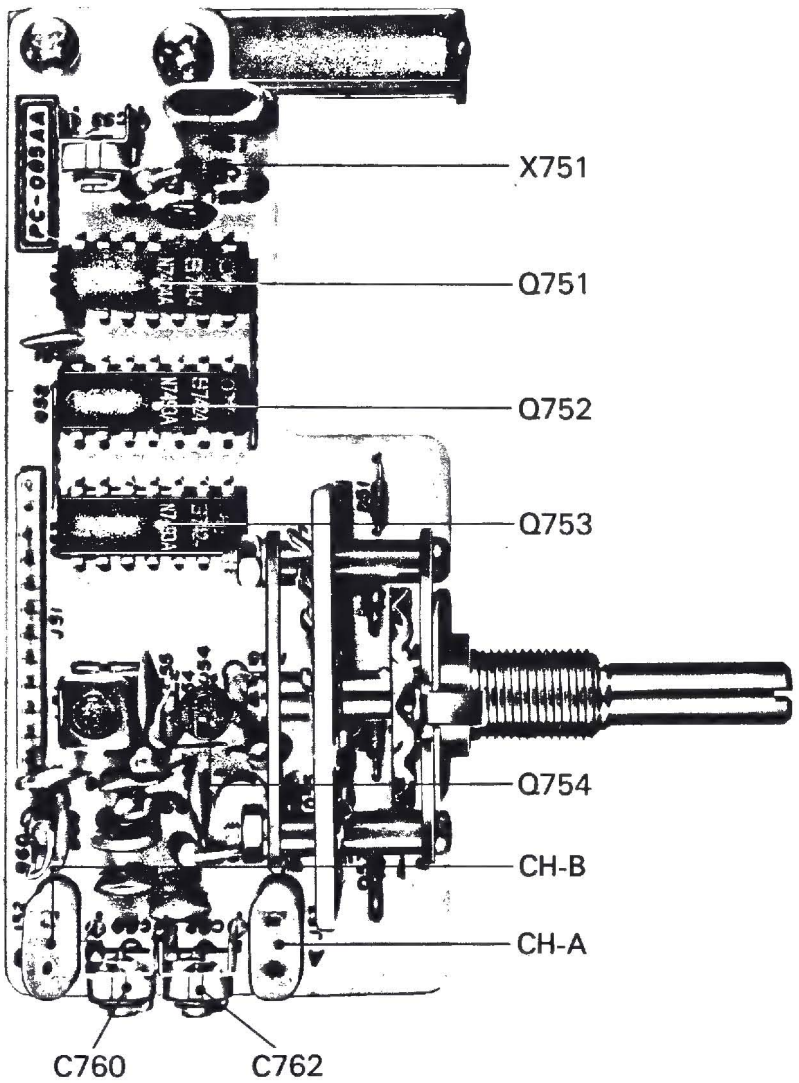
BAND	f_{TR}	f_L	f_1	f_p	f_2
3.5	3.5– 3.6	9.687– 9.787	25.525	15.838–15.738	6.700
	3.6– 3.7	9.787– 9.887		15.738–15.638	6.600
	3.7– 3.8	9.887– 9.987		15.638–15.538	6.500
	3.8– 3.9	9.987–10.087		15.538–15.438	6.400
	3.9– 4.0	10.087–10.187		15.438–15.338	6.300
7.0	7.0– 7.1	13.187–13.287	29.025	15.838–15.738	6.700
	7.1– 7.2	13.287–13.387		15.738–15.638	6.600
	7.2– 7.3	13.387–13.487		15.638–15.538	6.500
	7.3– 7.4	13.487–13.587		15.538–15.438	6.400
	7.4– 7.5	13.587–13.687		15.438–15.338	6.300
14.0	14.0–14.1	20.187–20.287	36.025	15.838–15.738	6.700
	14.1–14.2	20.287–20.387		15.738–15.638	6.600
	14.2–14.3	20.387–20.487		15.638–15.538	6.500
	14.3–14.4	20.487–20.587		15.538–15.438	6.400
	14.4–14.5	20.587–20.687		15.438–15.338	6.300
21.0	21.0–21.1	27.187–27.287	43.025	15.838–15.738	6.700
	21.1–21.2	27.287–27.387		15.738–15.638	6.600
	21.2–21.3	27.387–27.487		15.638–15.538	6.500
	21.3–21.4	27.487–27.587		15.538–15.438	6.400
	21.4–21.5	27.587–27.687		15.438–15.338	6.300
28.0	28.0–28.1	34.187–34.287	50.025	15.838–15.738	6.700
	28.1–28.2	34.287–34.387		15.738–15.638	6.600
	28.2–28.3	34.387–34.487		15.638–15.538	6.500
	28.3–28.4	34.487–34.587		15.538–15.438	6.400
	28.4–28.5	34.587–34.687		15.438–15.338	6.300
28.5	28.5–28.6	34.687–34.787	50.525	15.838–15.738	6.700
	28.6–28.7	34.787–34.887		15.738–15.638	6.600
	28.7–28.8	34.887–34.987		15.638–15.538	6.500
	28.8–28.9	34.987–35.087		15.538–15.438	6.400
	28.9–29.0	35.087–35.187		15.438–15.338	6.300
29.0	29.0–29.1	35.187–35.287	51.025	15.838–15.738	6.700
	29.1–29.2	35.287–35.387		15.738–15.638	6.600
	29.2–29.3	35.387–35.487		15.638–15.538	6.500
	29.3–29.4	35.487–35.587		15.538–15.438	6.400
	29.4–29.5	35.587–35.687		15.438–15.338	6.300
29.5	29.5–29.6	35.687–35.787	51.525	15.838–15.738	6.700
	29.6–29.7	35.787–35.887		15.738–15.638	6.600

5.12 OPERATION UNIT (PC-085)

This circuit board holds the calibrator circuit which generates a marker signal at 25 KHz intervals. Q751 (SN 7404) is the oscillator and Q752 and Q753 (SN 7493 x 2) are the dividers. X751, the calibrator crystal, oscillates at 6.4 MHz.

The board also holds the fixed frequency oscillator circuit and the function switch. Q754 (2SC380) is the oscillator which can be selected between two positions (A or B). C760 and C762 are crystal trimmers for the fixed frequency crystals.

FIGURE 46. Operation Unit (PC-085) Board.



5.13 DISPLAY UNIT (PC-088 and PC-089)

PC-088 holds the MHz and 100 KHz LED frequency displays. D901 is the VFO LED which is lighted whenever the 2020's VFO is operating.

PC-089 holds the decoder circuit for the display. Q901, Q902, and Q903 are BDC to 7 segment decoder (SN 7309 x 3).

FIGURE 47. Display Unit (PC-088) Board.

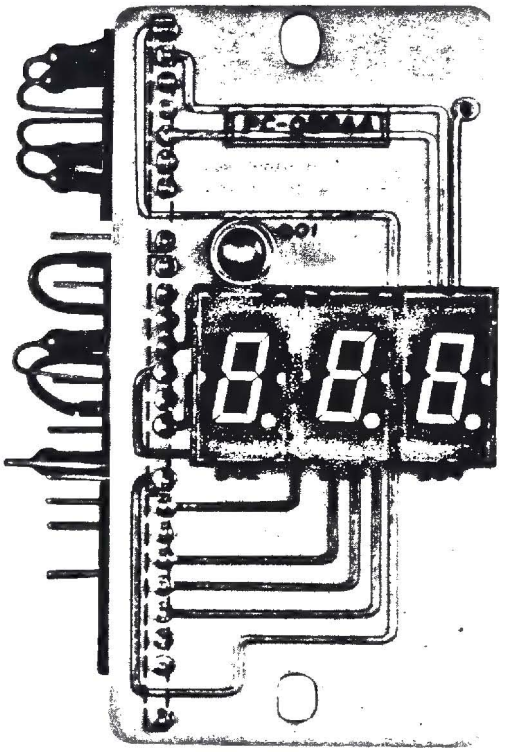
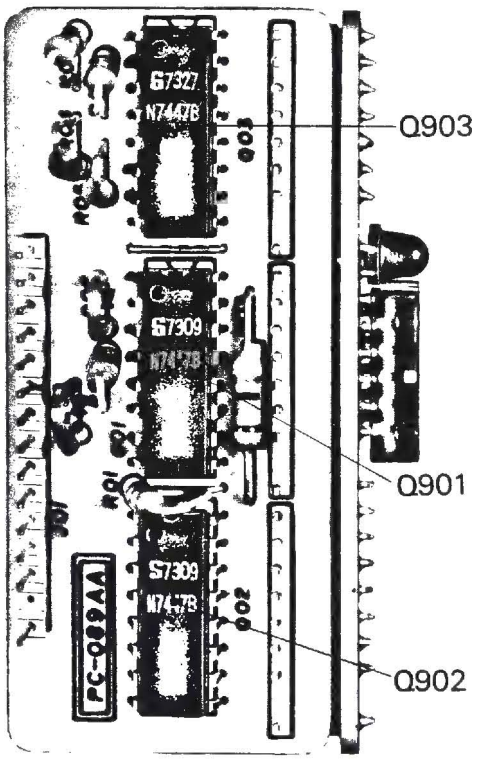


FIGURE 48. Display Unit (PC-089) Board.



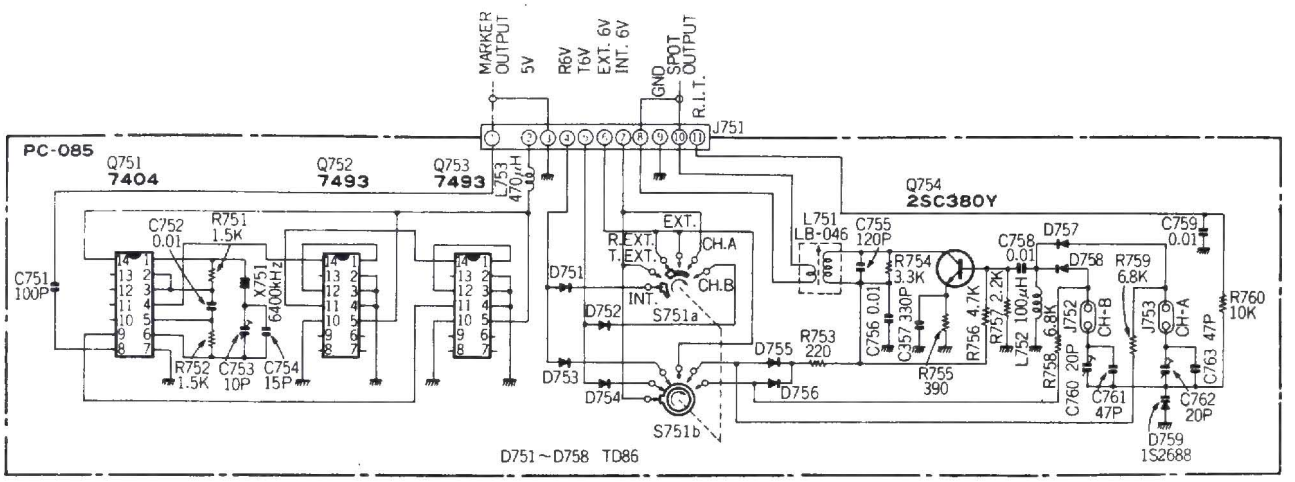
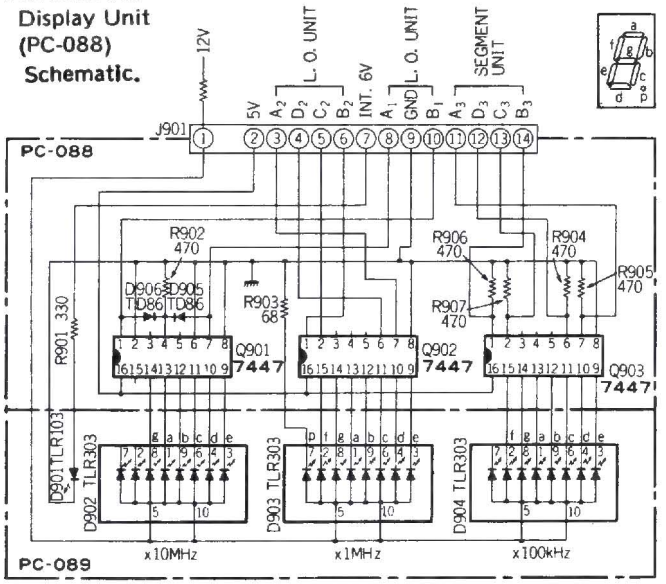


FIGURE 49. Operation Unit (PC-085) Schematic.

FIGURE 50. Display Unit (PC-088) Schematic.



5.14 AVR UNIT (PC-082)

This circuit board holds the AVR circuit (automatic voltage regulator). The voltage outputs from the circuit are 5 VDC for the IC circuits, 8 VDC for the solid state section of the transceiver, and 6 VDC for the VFO circuit. The voltage control for the RIT circuit is also included in the circuit.

FIGURE 51. AVR Unit (PC-082) Board.

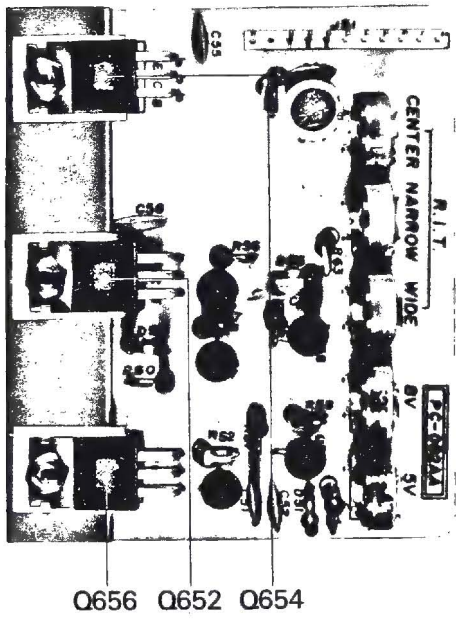
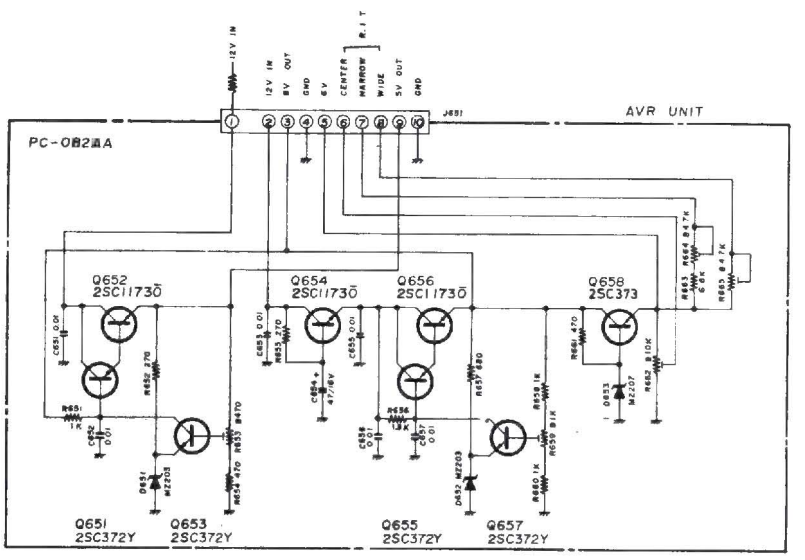


FIGURE 52. AVR Unit (PC-082) Schematic.



SECTION 6. MAINTENANCE AND SERVICE

6.1 GENERAL INFORMATION

The 2020 has been factory aligned and tested to specifications before delivery to the customer. Under normal circumstances the transceiver will be properly adjusted to operate in accordance with the operating instructions given in this manual. In fact the equipment's owner can void the transceiver's warranty by attempting service or alignment without permission from the factory. Damage caused in shipment can also void the warranty, so it is extremely important to be aware of any shipping damage before attempting to operate the equipment.

When operated properly, the transceiver can give years of service without requiring realignment. Any service work should be performed only by an experienced electronic technician who has access to the proper test equipment. The 2020 is a sophisticated, complicated electronic circuit which can easily be damaged by improper service.

6.2 POWER TRANSFORMER REWIRING

The 2020 is supplied for distribution in the United States for operation from a 117 VAC power source. It is possible however to rewire the power transformer primary windings so that the 2020 can operate from 110/110/200/220 VAC.

The power transformer has two primary windings. For 200/220/234 VAC operation the windings are wired in series, and for 100/110/117 VAC operation the windings are wired in parallel.

Figure 55 below diagrams the wiring of the power transformer for each possible AC line voltage.

6.3 REPLACING THE FUSE

When the fuse blows, there is some cause. Be sure to find the cause before attempting operation. Use a 5 amp fuse for 117 VAC operation, and a 3 amp fuse for 234 VAC operation. Under **NO** circumstances use a higher amperage fuse than those specified. Extensive damage can be caused by an improper fuse. Also, the warranty can be voided if the wrong fuse is used.

6.4 CLEANING AND MAINTENANCE

The knobs, front panel, and cabinet of the 2020 are likely to become soilded after extended use. The knobs should be removed from the transceiver and cleaned with a neutral soap and warm water. Use a netral soap and a damp cloth to clean the cabinet and front panel (do not use harsh chemicals).

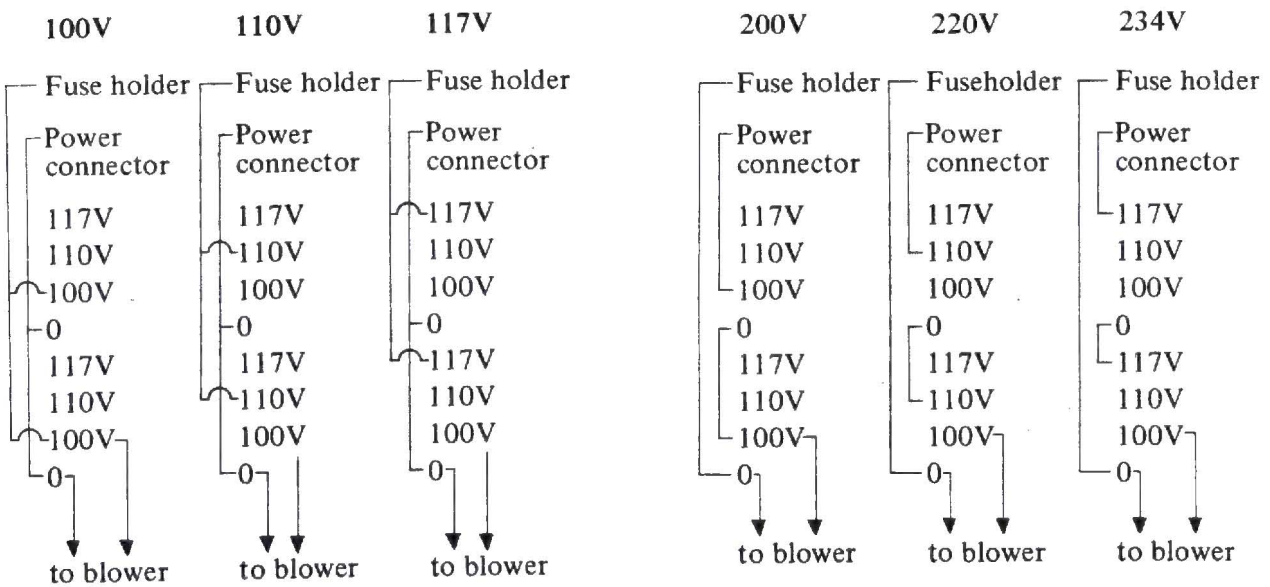
Use an air blower or a soft brush to keep the interior clean and dust free. Make certain that the air passages of the transceiver are kept free.

6.5 SERVICE AND REPLACEMENT PARTS

6.5.1 TUBES AND TRANSISTORS

Operation of the 2020 without proper tuning or without a proper antenna will significantly reduce the life of the final amplifier tubes. A bad tube or tubes should be replaced with 6146B tubes. Matched tubes are not required however neutralization is required with new tubes. The driver tube is a 12BY7A.

FIGURE 55. Power Transformer Rewiring.



5.15 RECTIFIER UNIT (PC-081)

This board holds all of the diode rectifiers for the power supply section of the transceiver. The board supplies the high voltage to the plates of the 6146B's and the 12BY7A tubes, the screen grid voltages and and bias voltages.

FIGURE 53. Rectifier Unit (PC-081) Board.

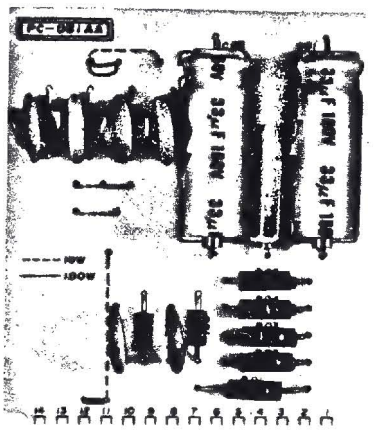
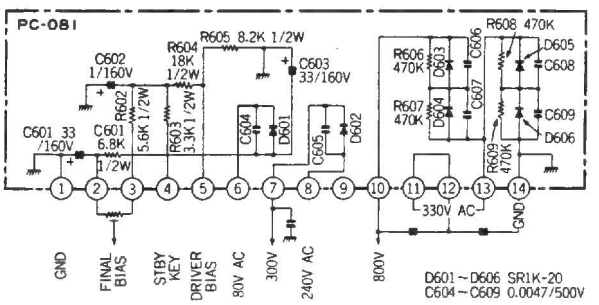


FIGURE 54. Rectifier Unit (PC-081) Schematic.



The transistors in the 2020 can easily be damaged by being shorted by metalic tools. Be very careful during service operations and when possible, use insulated tools.

CAUTION: DANGEROUS HIGH VOLTAGES ARE PRESENT INSIDE THE CASE OF THE 2020 WHEN THE TRANSCEIVER IS TURNED ON. EXERCISE EXTREME CAUTION TO AVOID ELECTRIC SHOCK.

6.5.2 SERVICE PARTS

Be certain to use replacement parts of equal or better ratings when servicing the 2020.

When ordering replacement or spare parts for your equipment, be sure to specify the following information:

> The model number and serial number of the equipment — The schematic number of the part — The board number on which the part is located — and a description of the part.

This information will aid in fast and correct handing of all parts orders.

6.5.3 SHIPPING THE 2020 FOR REPAIR

Whenever it becomes necessary to ship the 2020 to a service center for repair, repack the transceiver in its original carton (or an equivalent box with adequate packing) to prevent shipping damage.

CAUTION: A large percentage of equipment received in our service centers is not packed properly. Please note that any shipping damage caused by poor packaging will not be covered by insurance.

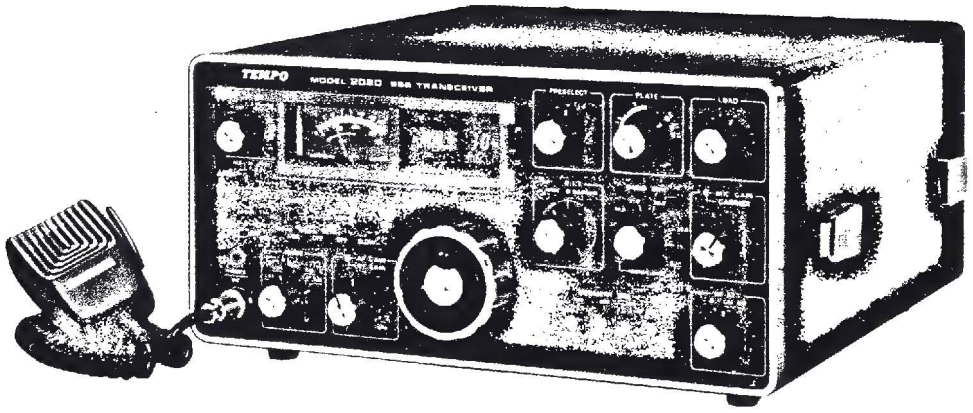
After the 2020 has been properly packed, return the transceiver to the service center prepaid. Be certain to insure the package for its full value. Also include a short note describing the problems involved.

Any transceiver returned for warranty repair must include some proof of the purchase date.

INSTRUCTION MANUAL

● Tempo

MODEL 2020



Henry Radio

TEMPO 2020 PARTS LIST

PART CODE	DESCRIPTION	PART NUMBER	PRICE
PRINTED CIRCUIT BOARD			
PPCY075013	RX RF Unit Board	PC-075	
PPCY076011	TX RF Unit Board	PC-076	
PPCY077011	Filter Unit Board	PC-077	
PPCY078012	IF Unit Board	PC-078	
PPCY156011	AF Unit Board	PC-156	
PPCY080012	Generator Unit Board	PC-080	
PPCY081011	Rectifier Unit Board	PC-081	
PPCY082011	AVR Unit Board	PC-082	
PPCY083012	VFO Unit Board (A)	PC-083	
PPCY084011	VFO Unit Board (B)	PC-084	
PPCY085011	Operation Unit Board	PC-085	
PPCY086011	PLL Unit Board (A)	PC-086	
PPCY087011	PLL Unit Board (B)	PC-087	
PPCY088011	Display Unit Board (A)	PC-088	
PPCY089011	Display Unit Board (B)	PC-089	
PPCY090011	Segment Unit Board	PC-090	
PPCY091011	R.I.T. Indicator Board	PC-091	
PPCY092013	N.O. Unit Board	PC-092	
DIODE			
DDAY001004	Germanium Diode 1N60	D-128,129,209,301-308, 353-358,401,405, 409, 410, 411,412,413,414, 1005	
DDAY002002	Silicon Rectifier SR1K-2	D-03,1006	
DDAY002003	Silicon Rectifier SR1K-20	D-601-606	
DDAY006001	Varactor 1S2688E	D-759,760	
DDAY017002	Silicon Rectifier SR3AM-2	D-04,05	
DDAY027001	Zener MZ203	D-403,651,652,363, 366	
DDAY027002	Zener MZ207	D-653	
DDAY027003	Zener MZ209	D-406	
DDAY027004	Zener MZ208	D-205	
DDAY028001	Varactor MV-201	D-701,807	
DDAY029001	Silicon Diode TD860100	D-01,02,07,101-124,130, 207,208,351,352,370, 371, 402,404,407,408, 501-515,751-758,801-806,905,906,951-975, 1001,1002,1006	
DDAY031001	LED GD4-501R	D-06	
DDAY037001	Numeric Display LED TLR303	D-902-904	
DDAY038001	Zener DZ750522A	D-1003,1004	
DDAY047001	Silicon Diode 1S1588	D-201-204	
DDAY053001	LED TLR103	D-901	
TRANSISTOR & FET			
DDBY001001	Transistor 2SA495Y	Q-405	
DDBY201002	Transistor 2SC372Y	Q-103,104,119,120,354, 356,402-404,406,408, 409,503,506,651,653, 655,657,658	
DDBY202001	Transistor 2SC373	Q-804,805	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
TRANSISTOR & FET (Continued)			
DDBY214002	Transistor 2SC735Y	Q-101,407,817	
DDBY219001	Transistor 2SC784R	Q-102,105-111,816	
DDBY228001	Transistor 2SC1173O	Q-652,654,655	
DDBY247001	Transistor 2SC380Y	Q-112,116-118,502,507 508,703,754	
DDBY252001	Transistor 2SC1682GR	Q-803	
DDBY253001	Transistor 2SC983O	Q-1001	
DDBY503001	Transistor ED230	Q-01,02	
DDCY001001	FET 2SK19GR	Q-115,203,204,355,701, 702,806,807,809	
DDCY003001	FET 2SK30AY	Q-401	
DDCY102001	FET 3SK44W	Q-201,202,351-353	
DDCY102002	FET 3SK44R	Q-113,251,808	
INTEGRATED CIRCUIT			
DDEY008001	AF AMP. TA7063P	Q-505	
DDEY010001	AF Power AMP. TA7204P	Q-410	
DDEY013001	Quad NAND Gate 7400	Q-815	
DDEY014001	Binary Counter 7493	Q-752,753	
DDEY015001	Presettable Decimal Counter 74162	Q-813,814	
DDEY019001	Phase Detector MC4044P	Q-810	
DDEY020001	Balanced Modulator MC1496P	Q-501,504	
DDEY021001	Quad NOR Gate 7402	Q-801,802	
DDEY022001	HEX Inverter 7404	Q-751	
DDEY023001	BCD To 7-Segment Decorder 7447	Q-901-903	
DDEY024001	Decimal Counter 7490	Q-811,812	
COIL & INDUCTOR			
LLBY030001	LB-030	L-101,104,105	
LLBY031001	LB-031	L-102,103	
LLBY032001	LB-032	L-106-110	
LLBY033001	LB-033	L-121	
LLBY034001	LB-034	L-122	
LLBY035001	LB-035	L-123,126,130,133	
LLBY036001	LB-036	L-124,131	
LLBY037001	LB-037	L-125,132	
LLBY038001	LB-038	L-127,134	
LLBY039001	LB-039	L-128,129	
LLBY042001	LB-042	L-135,136	
LLBY043001	LB-043	L-801	
LLBY044001	LB-044	L-804-806	
LLBY045001	LB-045	L-807	
LLBY046001	LB-046	L-706,707,751	
LLBY047001	LB-047	L-201,204	
LLBY048001	LB-048	L-202	
LLBY049001	LB-049	L-203	
LLBY050001	LB-050	L-205	
LLBY051001	LB-051	L-206	
LLBY052001	LB-052	L-207	
LLBY053001	LB-053	L-208,211	
LLBY054001	LB-054	L-209	
LLBY055001	LB-055	L-210	
LLBY056001	LB-056	L-212,255	
LLBY057001	LB-057	L-213,256	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
COIL & INDUCTOR (Continued)			
LLBY060001	LB-060	L-351	
LLBY061001	LB-061	L-252	
LLBY062001	LB-062	L-253	
LLBY063001	LB-063	L-254	
LLBY065001	LB-065	L-352	
LLBY066001	LB-066	L-353	
LLBY067001	LB-067	L-354	
LLBY068001	LB-068	L-139,140,251,501,504	
LLBY070001	LB-070	L-510	
LLBY071001	LB-071	L-214,215	
LLBY072001	LB-072	L-216	
LLBY073001	LB-073	L-217	
LLBY074001	LB-074	L-218	
LLCY020001	LC-020	L-01	
LLCY099001	LC-099	L-702	
LLCY100001	LC-100	L-259	
LLCY101001	LC-101	L-260	
LLCY102001	LC-102	L-261	
LLCY103001	LC-103	L-262	
LLCY104001	LC-104	L-263	
LLDY015001	Choke Coil LD-015	L-1010,1011	
LLDY049001	Tank Coil LD-049	L-1009	
LLDY050001	Plate Choke Coil LD-050	L-1008	
LLDY051001	Parastic Suppressor LD-051	L-258,1002,1003	
LLDY052001	Parastic Suppressor LD-052	L-1004,1005	
LLZY001005	Choke Coil LF1 22μH ± 10%	L-703,704,802	
LLZY001013	Choke Coil LF1 100μH ± 10%	L-509,752	
LLZY001015	Choke Coil LF1 150μH ± 10%	L-1001	
LLZY001017	Choke Coil LF1 220μH ± 10%	L-503,505,512,701,705, 803,808	
LLZY001019	Choke Coil LF1 330μH ± 10%	L-219,301,304,307	
LLZY001021	Choke Coil LF1 470μH ± 10%	L-138,141,753	
LLZY002001	Choke Coil LF4 1.0μH ± 10%	L-118,119	
LLZY002002	Choke Coil LF4 1.2μH ± 10%	L-116,117,120	
LLZY002003	Choke Coil LF4 1.5μH ± 10%	L-115	
LLZY002005	Choke Coil LF4 2.2μH ± 10%	L-111-114,502	
LLZY004001	Choke Coil EL0710 220μH ± 10%	L-257,264,401,402, 506-508,511	
LLZY004002	Choke Coil EL0710 330μH ± 10%	L-137,302,303,305, 306,308-310, 1006,1007	
FIXED RESISTOR			
CARBON COMPOSITION RESISTOR			
RCEL121005	¼W 10 Ω ± 10%	R-07	
RCEL123905	¼W 39 Ω ± 10%	R-1007	
RCEL125605	¼W 56 Ω ± 10%	R-06,21	
RCEL121015	¼W 100 Ω ± 10%	R-05,1009,1010	
RCEL123315	¼W 330 Ω ± 10%	R-14	
RCEL128215	¼W 820 Ω ± 10%	R-12	
RCEL121025	¼W 1 KΩ ± 10%	R-04,19,264,1015,1002	
RCEL121225	¼W 1.2 KΩ ± 10%	R-02,11	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
CARBON COMPOSITION RESISTOR (Continued)			
RCEL121525	¼W 1.5 KΩ ± 10%	R13	
RCEL122725	¼W 2.7 KΩ ± 10%	R-10	
RCEL123325	¼W 3.3 KΩ ± 10%	R-603	
RCEL125625	¼W 5.6 KΩ ± 10%	R-602	
RCEL126825	¼W 6.8 KΩ ± 10%	R-601	
RCEL128225	¼W 8.2 KΩ ± 10%	R-605	
RCEL121034	¼W 10 KΩ ± 10%	R-1001	
RCEL121535	¼W 15 KΩ ± 10%	R-263	
RCEL121835	¼W 18 KΩ ± 10%	R-604	
RCEL122235	¼W 22 KΩ ± 10%	R-265	
RCEL124745	¼W 470 KΩ ± 10%	R-17,18,24	
RCEL123354	¼W 3.3 MΩ ± 10%	R-1003	
RCEL102295	1W 2.2 Ω ± 10%	R-23,1006,1008	
RCEL101815	1W 180 Ω ± 10%	R-20	
RCEL201035	2W 10 KΩ ± 10%	R-1014	
CARBON FILM RESISTOR			
RPBZ142204	¼W 22 Ω ±5%	R-336	
RPBZ141004	¼W 10 Ω ± 5%	R-391	
RPBZ144704	¼W 47 Ω ± 5%	R-552	
RPBZ146804	¼W 68 Ω ± 5%	R-109,903	
RPBZ141014	¼W 100 Ω ± 5%	R-357,358,366,367,362, 362,373,553	
RPBZ141814	¼W 180 Ω ± 5%	R-258	
RPBZ142214	¼W 220 Ω ± 5%	R-135,206,301,304,307, 395	
RPBZ144714	¼W 470 Ω ± 5%	R-101-105,452,805-807	
RPBZ146814	¼W 680 Ω ± 5%	R-310,313,526,377	
RPBZ141024	¼W 1 KΩ ± 5%	R-259,303,306,309,351, 360,378,379,382, 447	
RPBZ141824	¼W 1.8 KΩ ± 5%	R-525,656	
RPBZ142224	¼W 2.2 KΩ ± 5%	R-523	
RPBZ143324	¼W 3.3 KΩ ± 5%	R-380	
RPBZ143924	¼W 3.9 KΩ ± 5%	R-302,305,308,311,352, 359	
RPBZ144724	¼W 4.7 KΩ ± 5%	R-312,375	
RPBZ141034	¼W 10 KΩ ± 5%	R-384,390	
RPBZ141534	¼W 15 KΩ ± 5%	R-261,446	
RPBZ142234	¼W 22 KΩ ± 5%	R-381	
RPBZ144734	¼W 47 KΩ ± 5%	R-208,260,354,363, 364, 369,370,453	
RPBZ145634	¼W 56 KΩ ± 5%	R-393	
RPBZ141044	¼W 100 KΩ ± 5%	R-255,257,355,356,365, 371,383,436	
RPBZ142244	¼W 220 KΩ ± 5%	R-353,362,368,376, 267	
RPBZ142744	¼W 270 KΩ ± 5%	R-256	
RPBZ144744	¼W 470 KΩ ± 5%	R-254	
RPBZ141054	¼W 1MΩ ± 5%	R-218,1016	
RPBZ121065	¼W 10MΩ ± 5%	R-385	
RUBZ144704	¼W 47 Ω ± 5%	R-512,538	
RUBZ146804	¼W 68 Ω ± 5%	R-802	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
	CARBON FILM RESISTOR (Continued)		
RUBZ141014	¼W 100 Ω ± 5%	R-410,441,451,516,535,542, 570,704,813,817,826	
RUBZ142214	¼W 220 Ω ± 5%	R-145,151,212,214,405, 413,439,504,505,567, 705,708,712, 753,814,822,831,838	
RUBZ142714	¼W 270 Ω ± R 137,652,655	R-137,652,655	
RUBZ143314	¼W 330 Ω ± 5%	R-130,421,513,522, 707,816,824,901	
RUBZ143914	¼W 390 Ω ± 5%	R-440,755	
RUBZ144714	¼ 470 Ω ± 5%	R-106,107,403,654,661, 801,803,804,902, 904-907,951-953	
RUBZ145614	¼W 560 Ω ± R-555,834	R-834	
RUBZ146814	¼W 680 Ω ± 5%	R-449,517,543,546,572, 675,711	
RUBZ148214	¼W 820 Ω ± 5%	R-502,528,539	
RUBZ141024	¼W 1KΩ ± 5%	R-108,133,142,143,149, 154,216,217,252,423,440 501,507,527,532,533,534, 555,560,562,566,569,658 660,702,810,820,835	
RUBZ141224	¼W 1.2 Ω ± 5%	R-510,536	
RUBZ141524	¼W 1.5 Ω ± 5%	R-213,563,751,752	
RUBZ141824	¼W 1.8 Ω ± 5%	R-211,251,518,545,571,656, 833	
RUBZ142224	¼W 2.2 KΩ ± 5%	R-155,422,424,561,757	
RUBZ142724	¼W 2.7 KΩ ± 5%	R-519,556,557	
RUBZ143324	¼W 3.3 KΩ ± 5%	R-432,524, 754,808,837	
RUBZ143924	¼W 3.9 KΩ ± 5%	R-120-129,514,515,540. 541,568,710	
RUBZ144724	¼W 4.7 KΩ ± 5%	R-141,144,215,401,408, 544,756,832	
RUBZ145624	¼W 5.6 KΩ ± 5%	R-131,411,417,443,508, 521,559	
RUBZ146824	¼W 6.8 KΩ ± 5%	R-150,418,503,520,663, 758,759	
RUBZ148224	¼W 8.2 KΩ ± 5%	R-110-119,425,426, 433,558,564	
RUBZ141034	¼W 10 KΩ ± 5%	R-152,153,219,420,431, 511, 537,547,550,551,701,709, 760, 811,821,823,825,827 -830	
RUBZ141534	¼W 15 KΩ ± 5%	R-442,445	
RUBZ141834	¼W 18 KΩ ± 5%	R-146,419	
RUBZ142234	¼W 22 KΩ ± 5% %	R-132,253,434,529,531, 565,809,836	
RUBZ143334	¼W 33 KΩ ± 5%	R-147,415,430,506	
RUBZ143934	¼W 39 KΩ ± 5%	R-201,549	
RUBZ144734	¼W 47 KΩ ± 5%	R-203	
RUBZ145634	¼W 56 KΩ ± 5%	R-134,148,221	
RUBZ148234	¼W 82 KΩ ± 5%	R-703	
RUBZ141044	¼W 100 KΩ ± 5%	R-136,140,204,209,402,406, 412,437,448,450,548,554, 706,812,815, 818,819	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
	CARBON FILM RESISTOR (Continued)		
RUBZ141544	¼W 150 KΩ ± 5%	R-414	
RUBZ142244	¼W 220 KΩ ± 5%	R-202,207,210,427-429	
RUBZ143944	¼W 390 KΩ ± 5%	R-406	
RUBZ144744	¼W 470 KΩ ± 5%	R-606-609	
RUBZ148244	¼W 820 KΩ ± 5%	R-407	
RUBZ141054	¼W 1 MΩ ± 5%	R-438	
	CERAMIC COATED RESISTOR		
RXJZ205124	2W 5.1KΩ ± 5%	R-1013	
RXJZ506894	5W 6.8 Ω ± 5%	R-15	
	VARIABLE RESISTOR		
RRVY132002	Trimmer SR29R 470 Ω	R-374,392,653	
RRVY132004	Trimmer SR29R 1 KΩ	R-659	
RRVY132008	Trimmer SR29R 4.7 KΩ	R-389,444,664,665	
RRVY132010	Trimmer SR29R 10 KΩ	R-387,388,404,509,662	
RRVY132014	Trimmer SR29R 47 KΩ	R-435	
RRVY132016	Trimmer SR29R 100 KΩ	R-416,530	
RRVY118001	(AF-RF Gain) B10K/A20K RV118	R-01	
RRVY121001	(Bias Meter ADJ.) B1K RV121	R-08,16	
RRVY124001	(RF ATT.) B2K RV124	R-22	
RRVY125001	(R.I.T.) C2K/C10K RV125	R-09a,09b	
RRVY131001	(MIC Gain-Carrier) B5K/A20K RV131	R-03a,03b	
	FIXED CAPACITOR		
	CERAMIC DISC CAPACITOR		
CCCE815081	NPO 50WV 0.5PF ± 0.25PF	C-712	
CCCB811092	NPO 50WV 1PF ± 0.5PF	C-231,232	
CCCB812092	NPO 50WV 2PF ± 0.5PF	C-140,156,160,228, 801-803	
CCCB813092	NPO 50WV 3PF ± 0.5PF	C-159,161,162	
CCCB815092	NPO 50WV 5PF ± 0.5PF	C-158	
CCCB817092	NPO 50WV 7pF ± 0.5pF	C-157	
CCCB811003	NPO 50WV 10pF ± 1pF	C-131-135,719	
CCCB811505	NPO 50WV 15pF ± 10%	C-114,126-130,702	
CCCB811805	NPO 50WV 18pF± 10%	C-115	
CCCB812205	NPO 50WV 22pF ± 10%	C-144	
CCCB818205	NPO 50WV 82pF ± 10%	C-136,815	
CCCB811015	NPO 50WV 100pF ± 10%	C-715	
CCRB818092	N220 50WV 8pF ± 1pF	C-151,152	
CCRB811504	N220 50WV 15pF ± 5%	C-109-113,215	
CCRB811804	N220 50WV 18pF ± 5%	C-167	
CCRB812204	N220 50WV 22pF ± 5%	C-180	
CCRB812704	N220 50WV 27pF ± 5%	C-104,106,107,208,223, 264	
CCRB813304	N220 50WV 33pF ± 5%	C-105	
CCRB813904	N220 50WV 39pF ± 5%	C-163,166,206,221,262	
CCRB814704	N220 50WV 47pF ± 5%	C-150,203,204,218,219, 258,260,261	
CCRB815604	N220 50WV 56pF ± 5%	C-202,217,816	
CCRB816204	N220 50WV 62pF ± 5%	C-201,205,216,220,222, 256	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
	CERAMIC DISC CAPACITOR (Continued)		
CCRB816804	N220 50WV 68pF ± 5%	C-146,149,165,207,263	
CCRB811014	N220 50WV 100pF ± 5%	C-148,164,529	
CCRB811214	N220 50WV 120pF ± 5%	C-147,718,755	
CCRB812214	N220 50WV 220pF ± 5%	C-720,721	
CCUD811204	N750 50WV 12pF ± 5%	C-703	
CCUD816804	N750 50WV 68pF ± 5%	C-705	
CCGB815093	SL 50WV 5pF ± 1pF	C-243	
CCGB811005	SL 50WV 10pF ± 10%	C-751	
CCGB811505	SL 50WV 15pF ± 10%	C-440	
CCGB811015	SL 50WV 100pF ± 10%	C-03,04,06,177,401,402, 410,527,528,536	
CCGB814715	SL 50WV 470pF ± 10%	C-169,176,341	
CKAE811035	YA 50WV 0.01μF ± 10%	C-371,378,379,701,710, 711,713,714,716,717, 722,724,1004,1007, 1009,1011,1015,1017,1032	
CKBB812715	B 50WV 270pF ± 10%	C-510	
CKBB813315	B 50WV 330pF ± 10%	C-757	
CKBB814715	B 50WV 470pF ± 10%	C-137	
CKBB811026	B 50WV 0.001μF ± 20%	C-389,506,514, 545,1010,1012,1016,1018	
CKBA822715	B 500WV 270pF ± 10%	C-269	
CKBA825615	B 500WV 560pF ± 10%	C-286	
CKBA821026	B 500WV 0.001μF ± 20%	C-1003,1013,1020	
CKFB811020	F 50WV 0.001μF ± 20%	C-23-25	
CKFB812220	F 50WV 0.0022μF ± 20%	C-213	
CKFB811030	F 50WV 0.01μF ± 20%	C-07,08,18-21,26,28, 102,138,139,142,145, 154,155,172,174,181-183 212,214,225,226,229, 230,233-235,241,242, 245,251,254,265,267, 268,301-303,306-309, 312-315,318,320,321, 323-326,651-653, 655-657,756,758,759, 824,825,828,829,831, 833,836,837,839,842, 844-846,848	
CKFB812230	F 50WV 0.022μF ± 20%	C-304,305,310,311,316,317, 319,322,327,418,443,445 502,507,509,511-513, 515,517,520,521,523-525 534,538,539,544,547, 548,550-557	
CKFB814730	F 50WV 0.047μF ± 20%	C-01,02,103,143,153,255, 257,259,271,272,351, 354-358,360-362, 364-366,368,375,387, 832,835,1008,1019, 1022-1025,1036	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
	CERAMIC DISC CAPACITOR (Continued)		
CKEA821020	E 500WV 0.001μF + 100% − 0%	C-274,283	
CKEA824720	E 500WV 0.0047μF + 100% − 0%	C-604-609	
CKEA821030	E 500WV 0.01μF + 100% − 0%	C-05,270,273,285,288, 421,422,1014,1021, 1026,1027	
CKEA334720	E 1400V 0.0047μF + 100% − 0%	C-14,16,17,1028	
CCZY022001	RDA30 3KV-AC 150pF ± 10%	C-1031	
	CERAMIC FEED-THRU BY-PASS CAPACITOR		
CCZY018001	CZ-018 50WV 0.001μF + 100% − 20%	C-804-811	
CCZY019001	CZ-019 500WV 0.001μF + 100% − 0%	C-1039-1050	
	DIPPED MICA CAPACITOR		
CCDG811091	50WV 1pF ± 0.25pF	C-822	
CDCG815092	50WV 5pF ± 0.5pF	C-363,381	
CDCG818092	50WV 8pF ± 0.5pF	C-826,830	
CDCG811003	50WV 10pF ± 1pF	C-227,819	
CDCG811205	50WV 12pF ± 10%	C-369	
CDCG811505	50WV 15pF ± 10%	C-754	
CDCG812205	50WV 22pF ± 10%	C-210,823,359	
CDCG812705	50WV 27pF ± 10%	C-352	
CDCG823305	50WV 33pF ± 10%	C-540,543	
CDCG814705	50WV 47pF ± 10%	C-549,761,763	
CDCG818204	50WV 82pF ±5%	C-237,238,252,546	
CDCG811014	50WV 100pF ± 5%	C-253,377	
CDCG812719	50WV 270pF ±2%	C-704	
CDCG814714	50WV 470pF ± 5%	C-1033	
CDCG811024	50WV 1000pF ± 11%	C-708,709,817,1035	
CDCG811525	50WV 1500pF ± 10%	C-27	
CDCG825092	500WV 5pF ± 0.5pF	C-287	
CDCG821505	500WV 15pF ± 10%	C-280	
CDCG826204	500WV 62pF ± 5%	C-276,278	
	MOULDED MICA CAPACITOR		
CMAS821005	500WV 10pF ± 10%	C-1002	
CMAS821005	500WV 47pF ± 10%	C-1038	
CMAS 821015	500WV 100pF ± 10%	C-1001	
CMAS331025	1500WV 1000pF ± 10%	C-1029	
	PLASTIC FILM CAPACITOR		
CQME811026	50WV 0.001μF ± 20%	C-179,404,407,413,428, 436,813	
CQME814726	50WV 0.0047μF ± 20%	C-385	
CQME811036	50WV 0.01μF ± 20%	C-178,180,236,239,386, 409,419,420,423,434, 752,814,843,818,820 821	
CQME812236	50WV 0.022μF ± 20%	C-382	
CQME813336	50WV 0.033μF ± 20%	C-403,408,526	
CQME814736	50WV 0.047μF ± 20%	C-414,430,372	
CQME811046	50WV 0.1μF ± 20%	C-384,416	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
	PLASTIC FILM CAPACITOR (Continued)		
CQME812246	50WV 0.22μF ± 20%	C-1006	
CQME122246	100WV 0.22μF ± 20%	C-1005	
	METALIZED PLASTIC FILM CAPACITOR		
CNAG524746	250WV 0.47μF ± 20%	C-383	
CNAG521056	250WV 1μF ± 20%	C-15	
	ELECTROLYTIC CAPACITOR		
CEWF901010	6.3WV 100μF	C-841,847	
CEWF902210	6.3WV 220μF	C-101,834,838,840	
CEWF112200	10WV 22μF	C-415,425,503,518	
CEWF111010	10WV 100μF	C-435,438	
CEWF112210	10WV 220μF	C-441	
CEWF311000	16WV 10μF	C-240,353,367,376,405 417,501,508,816,522 530,531,533,537	
CEWF313300	16WV 33μF	C-429	
CEWF314700	16WV 47μF	C-406,412,424,439,444,654	
CEWF311010	16WV 100μF	C-141	
CEWF314710	16WV 470μF	C-442	
CEWF514790	25WV 4.7μF	C-431,433,437,519,532,723	
CEWF814780	50WV 0.47μF	C-411,432,812	
CEWF811090	50WV 1μF	C-173,373,374,380,426, 427,446,535,504 505	
CEMF511000	25WV 10μF	C-1053	
CELF513396	25WV 3.3μF ± 20%	C-244	
CEXF312210	16WV 220μF	C-22	
CEXA321090	160WV 1μF	C-602	
CEAX323300	160WV 33μF	C-601,603	
CCZY013001	25WV 3300μF	C-09,10	
CCZY016001	350WV 100μF	C-11	
CCZY017001	500WV 100μF HR	C-12,13	
	VARIABLE CAPACITOR		
	CERAMIC TRIMMER		
CCVY022002	ECV1ZW 10P40 10pF	C-753	
CCVY022003	ECV1ZW 20p40 20pF	C-370,541,542,760,762	
CCVY028002	CV52 10pF	C-121-125	
CCVY028004	CV52 20pF	C-116-120,851	
	AIR TRIMMER		
CCVY031001	TM1117-521 21pF	C-706	
CCVY033001	KD-2 1500V 10pF	C-1037	
	AIR VARIABLE		
CCVY026001	C521C125 (VFO)	C-707	
CCVY027001	C134E119 (LOAD)	C-1034	
CCVY032001	T35 200pF (PLATE)	C-1030	
CCVY034001	C365A118 (PRESELECT)	C-209,224,266,284	
	SWITCH		

PART CODE	DESCRIPTION	PART NUMBER	PRICE
	ROTARY SWITCH		
SSRY088001	SR-088	S-07	
SSRY094001	SR-094	S-101	
SSRY095001	SR-095	S-201	
SSRY096001	SR-096	S-251	
SSRY097001	SR-097	S-751	
SSRY098001	SR-098	S-1001	
	PUSH BUTTON SWITCH		
SSWY044001	SW-044 MO-5	S-451	
	PADDLE LOCKER SWITCH		
SSWY050001	SW-050 PW2022	S-01,02,04,05	
SSWY051001	SW-051 PW2023	S-03,06	
	SLIDE SWITCH		
SSWY059001	SW-059	S-10	
SSWY061001	SW-061	S-1002	
	QUARTZ CRYSTAL OSCILLATOR		
QQXY053001	HC-25/u 25.525 MHz	X-101	
QQXY053002	HC-25/u 29.025 MHz	X-102	
QQXY052003	HC-25/u 36.025 MHz	X-103	
QQXY053004	HC-25/u 37.025 MHz	X-104	
QQXY053005	HC-25/u 43.025 MHz.	X-105	
QQXY053006	HC-25/u 49.025 MHz	X-106	
QQXY053007	HC-25/u 50.025 MHz	X-107	
QQXY053008	HC-25/u 50.525 MHz	X-108	
QQXY053009	HC-25/u 51.025 MHz	X-109	
QQXY053010	HC-25/u 51.525 MHz	X-110	
QQXY048001	HC-18/u 6400 KHz	X-751	
QQXY066001	HC-18/u 6187 kHz	X-501	
QQXY067001	HC-18/u 6187.75 kHz	X-502	
QQXY052001	HC-18/u 10000 kHz	X-801	
	CRYSTAL FILTER		
FFLY012001	(LBS) 6185,5 KHz	FL-303	
FFLY013001	(USB) 6188,5 KHz	FL-302	
FFLY025001	(CW) 6187,0 KHz	FL-301	
	TRANSFORMER & AF CHOKE COIL		
TTFY081001	Power Transformer TF-081	T-01	
TTFY089001	Ripple Filter Coil TF-089	T-02	
TTFY100001	AF Input Transformer	TF-100	
	CONNECTOR, SOCKET & TERMINAL		
JJKY032002	Konectcon Wafer Ass'y 5048-4A	J-201,251	
JJKY032003	Konectcon Wafer Ass'y 5048-5A	J-106,252,701	
JJKY032004	Konectcon Wafer Ass'y 5048-6A	J-101	

PART CODE	DESCRIPTION	PART NUMBER	PRICE
CONNECTOR, SOCKET & TERMINAL (Continued)			
JJKY032005	Konectcon Wafer Ass'y 5048-7A	J-102,202	
JJKY032008	Konectcon Wafer Ass'y 5048-10A	J-651,951	
JJKY932009	Konectcon Wafer Ass'y 5048-11A	J-751	
JJKY032012	Konectcon Wafer Ass'y 5048-14A	J-901	
JJKY032016	Konectcon Wafer Ass'y 5048-18A	J-801	
JJKY033002	Konectcon Wafer Ass'y 5045-2A	J-103,104 105	
JJKY046004	Konectcon Wafer Ass'y 3094-5A	J-501	
JJKY031006	Konectcon Wafer Ass'y 5049-8A	J-902-904	
JJKY004001	MIC Jack NS-144	J-01	
JJKY017001	ANT. JACK (Coax) M-R	J-12	
JJKY029001	Phone Jack SG-7814	J-02	
JJKY030001	(Accessory) SI-6303-1	J-09	
JJKY034001	(Power) P-1316-SB	J-11	
JJKY038002	(EXT. VFO) 1625-12R	J-10	
JJKY041001	Edge Card Connector 14p	J-19	
JJKY042001	Edge Card Connector 18p	J-15-18	
JJKY044001	(Ext. RCVR ANT) (Transverter)CN-7017	J-13 14	
JJKY045001	3p Pin Jack	J-03 - 08	
JSKY008001	Crystal Socket S2-1010-01		
JSKY011001	Vacuum Tube Socket Noval S9-241Y	VS-251	
JSKY012001	Vacuum Tube Socket Octal -02	VS-1001,1002	
JSKY013001	Relay Socket (VOX)		
JSKY014001	Relay Socket (ANTENNA)		
JSKY015001	Lamp Socket (SWAN BASE)		
JTPY009001	Hermetic Terminal A-102 (PLL UNIT)		
JTPY011001	Pin Terminal (TX RF UNIT)		
JTPY014001	Terminal 1-0-1		
JTPY017001	Terminal Board ML-5p		
JTPY018001	Transistor Socket Pin (RX RF UNIT)		
JPGY023001	Short Plug	P-501	
VACUUM TUBE			
VVTY002001	12BY7A	V-251	
VVTY001001	6146B	V-1001,1002	
RELAY			
ZRLY015001	(ANTENNA) MY-3 12V DC	K-1001	
ZRLY-014001	(VOX) MH-6P 12V DC	K-01	
METER			
ZMTY069001	MT-069	M-01	
COOLING FAN MOTOR			
ZYYY017001	2S10A with Fan	G-1001	
LAMP			
VPZY002001	Swan Base 16V 0.15A RED (DIAL)		
VPLY030011	With Lead Wire 14V 50mA GREEN (DIAL POINTER)		
VPLY031011	With Lead Wire 12V 60mA (METER)		

PART CODE	DESCRIPTION	PART NUMBER	PRICE
SPEAKER			
ASPY026001	SA-70 2"-3/4 DIA. 3W 4Ω	SP-01	
ACCESSORY			
WWZY012001	AC Power Cord with Connector		
WZDZ070028	DC Power Cord with Connector & Fuse		
JPGY011001	Coax PL-259 (ANTENNA)		
JPGY014001	4P S-I5908-01 (ACCESSORY)		
JPGY019001	4P PG-019 (MIC)		
JPGY020001	Pin Plug (TRANSVERTER) (EXT. RX ANTENNA)		
JPGY021001	Phone Plug (PHONES)		
JPGY022001	Pin Plug (PHONE PATCH, KEY) (EXT. SPKR, PTT, ANTI.)		
ZFSY001007	Fuse 5AMP. (AC)		
ZFSY001009	Fuse 30AMP. (DC)		
AMKY030001	Microphone DF-43B		

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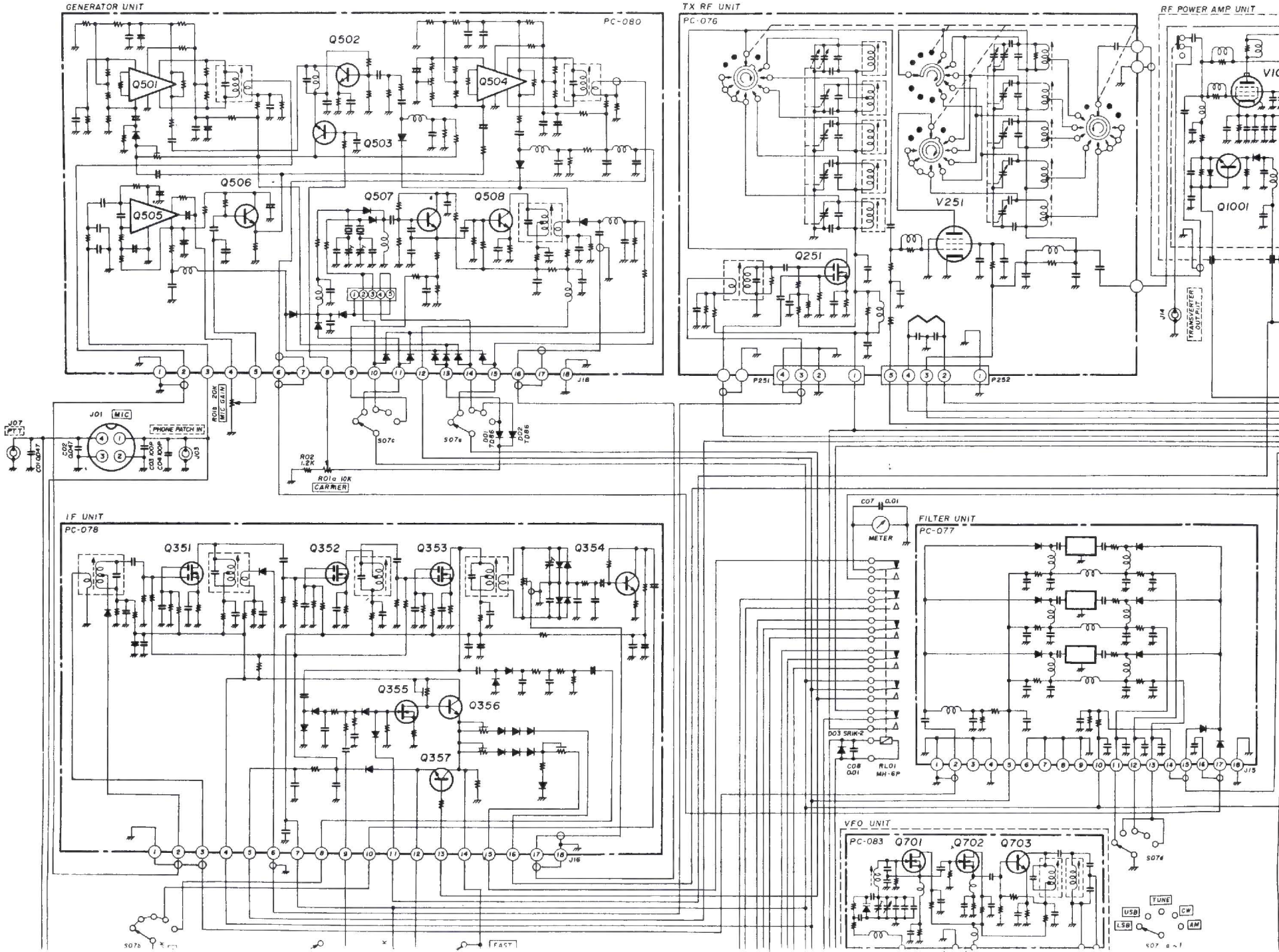
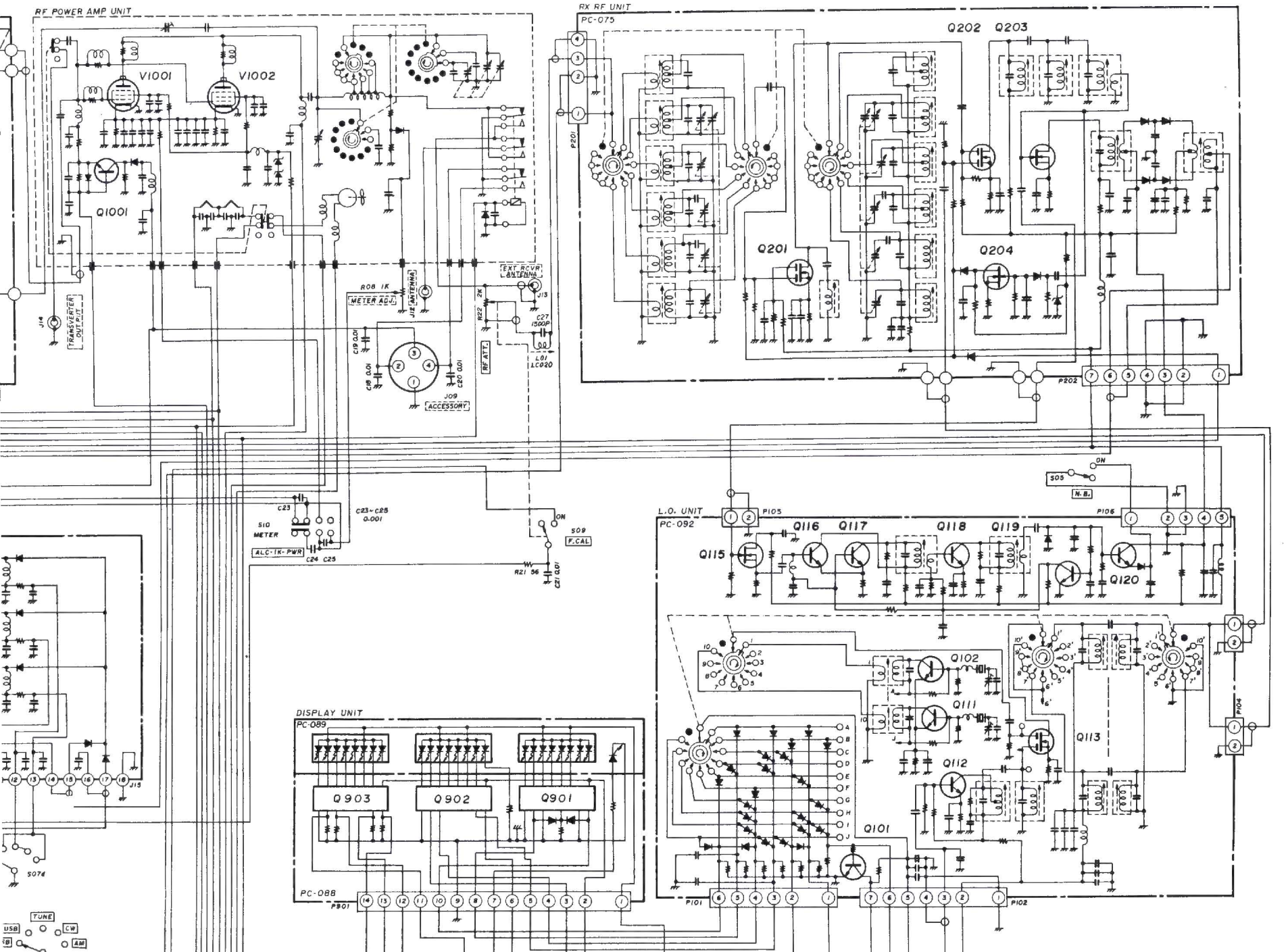
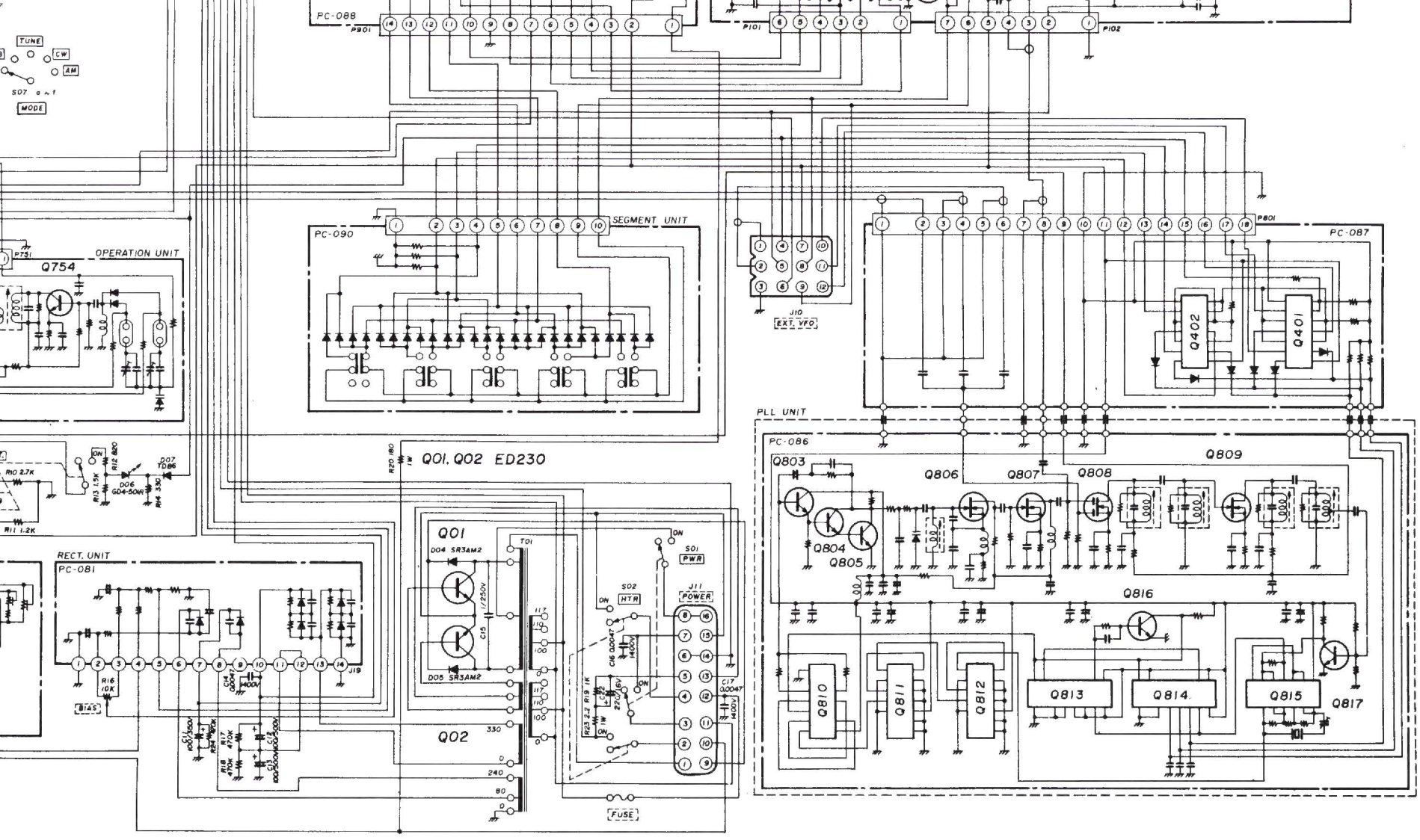
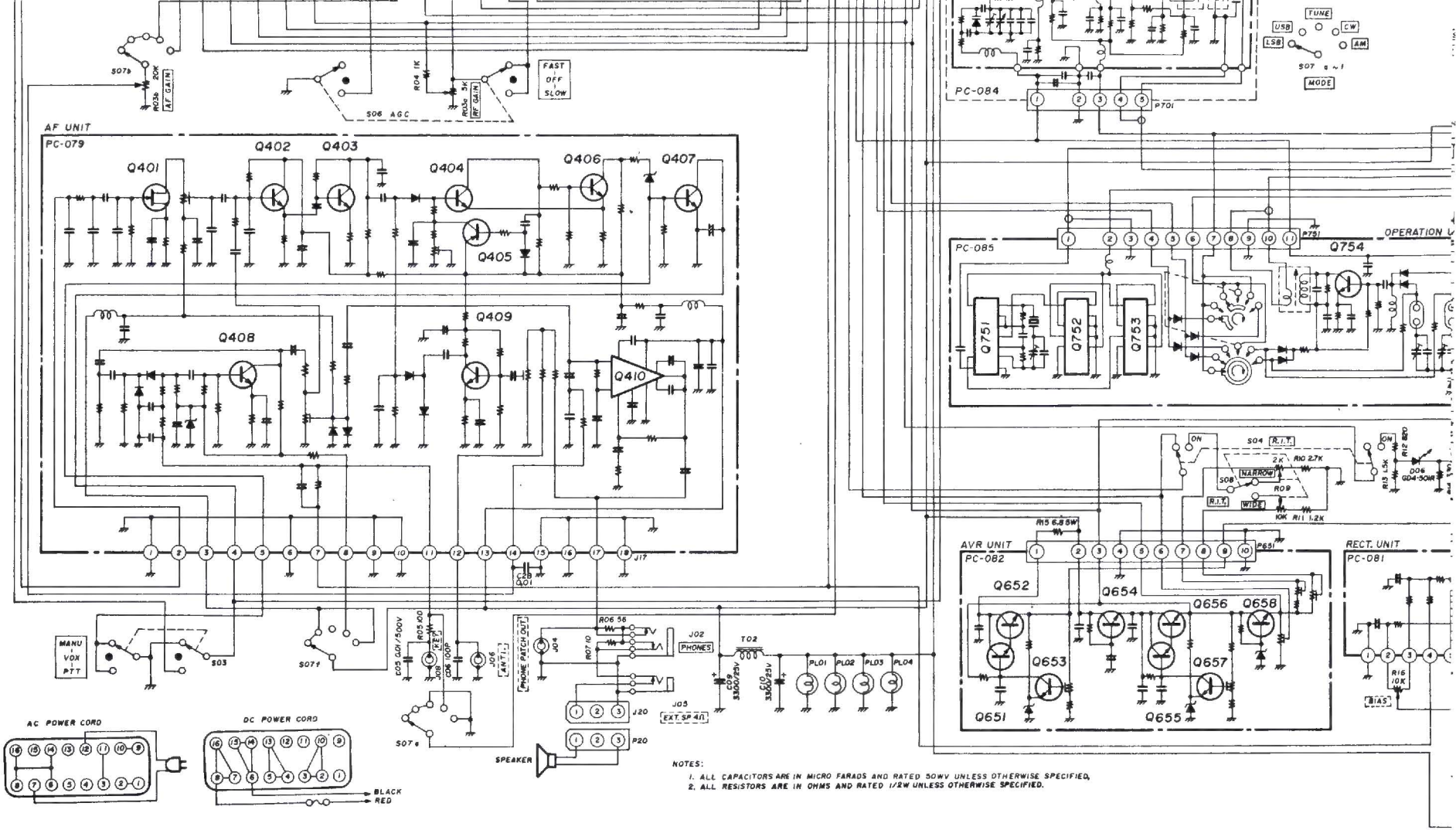

GENERATOR UNIT
PC-080
Q501
Q502
Q503
Q504
Q505
Q506
Q507
Q508
J18
J01 MIC
PHONE PATCH IN
J07 PTT
J05
R01a 10K CARRIER
R01b 20K MIC GAIN
R02 1.2K
S07c
S07a
D01 1086
D02 1086
TX RF UNIT
PC-076
V251
Q251
P251
P252
RF POWER AMP UNIT
Q1001
J14 TRANSVERTER OUTPUT
IF UNIT
PC-078
Q351
Q352
Q353
Q354
Q355
Q356
Q357
J16
S07b
FAST
C07 0.01
METER
FILTER UNIT
PC-077
D03 SR1K-2
C08 0.01
RL01 MH-6P
J15
VFO UNIT
PC-083
Q701
Q702
Q703
S07d
TUNE
USB
CW
LSB
AM
S07 a~f


RF POWER AMP UNIT
V1001
V1002
Q1001
J14
TRANSVERTER OUTPUT
R08 1K
METER ADJ.
J12 ANTENNA
EXT RCVR ANTENNA
J13
R22 2K
C27 1500P
L01 LC020
RF ATT.
C19 0.01
C18 0.01
C20 0.01
J09 ACCESSORY
C23
S10 METER
ALC·TK·PWR
C24 C25
C23~C25 0.001
S09 F.CAL
ON
R21 56
C21 0.01
RX RF UNIT
PC-075
P201
Q202 Q203
Q201
Q204
P202
S05 N.B.
L.O. UNIT
PC-092
P105
P106
Q115
Q116 Q117 Q118 Q119
Q120
Q102
Q111
Q113
Q112
Q101
P101
P102
P104
DISPLAY UNIT
PC-089
Q903 Q902 Q901
PC-088
P501
J15
S07
TUNE
USB
CW
AM



MODEL 2020 SCHEMATIC DIAGRAM

Features and specification subject to change without notice.



Wiring harness and schematic for the TEMPO 2020 AMATEUR RADIO TRANSCEIVER
(See the individual board schematics for detailed parts and circuit descriptions.)

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