

# IC-551D

50MHz ALL MODE TRANSCEIVER

## INSTRUCTION MANUAL



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## SECTION I SPECIFICATIONS

### GENERAL

Number of Semi-conductors	:	Transistors	74
		FET	17
		IC (includes CPU)	44
		Diodes	162
Frequency Coverage	:	50 ~ 54MHz	
Operationable Temperature	:	-10°C ~ +60°C (14°F ~ 140°F)	
Frequency Stability	:	Less than $\pm 500$ Hz after switch on 1 min to 60 min, less than 100Hz per 1 hour after 60 min, and less than $\pm 1$ KHz in the range of -10°C to +60°C	
Antenna Impedance	:	50 ohms unbalanced	
Power Supply Requirements	:	13.8V DC $\pm 15\%$ , negative ground Current drain 18A max. (at 200W input) AC power supply speaker console is available for AC operation.	
Power Consumption (at 13.8V DC)	:	Receive at min. audio level	0.5A
		at max. audio level	0.7A
		Transmit in SSB/CW modes	15A
		in AM mode	8A
		in FM mode*	15A
Dimensions	:	111mm (H) x 241mm (W) x 311mm (D)	
Weight	:	6.6 kg	

### TRANSMITTER

Emission Modes	:	A3J	SSB (USB/LSB)
		A1	CW
		A3H	AM
		F3*	FM
RF Output Power	:	SSB	80W PEP (1 ~ 80W adjustable)
		CW	80W (1 ~ 80W adjustable)
		AM	40W (0 ~ 40W adjustable)
		FM*	80W (1 ~ 80W adjustable)
Modulation System	:	SSB/AM	Balanced modulation
		FM*	Variable reactance frequency modulation
Max. Frequency Deviation*	:	$\pm 5$ KHz	
Spurious Emission	:	More than 60dB below peak power output	
SSB Carrier Suppression	:	More than 40dB below peak power output	
SSB/AM Unwanted Sideband	:	More than 40dB down at 1000Hz AF input	
Microphone	:	600 ohm dynamic or electret condenser microphone	

## RECEIVER

Receiving Mode	:	A1 (CW), A3J (USB, LSB), A3H (AM), F3 (FM)*
Receiving System	:	SSB/CW/AM Triple Conversion Superheterodyne FM* Dual Conversion Superheterodyne
Intermediate Frequency	:	SSB/CW/AM 1st IF: 9.0115MHz, 2nd IF: 10.75MHz 3rd IF: 9.0115MHz FM* 1st IF: 9.0115MHz, 2nd IF: 455KHz
Sensitivity	:	SSB/CW/AM Less than 0.5 $\mu$ V for 10dB S+N/N FM* More than 30dB S+N+D/N+D at 1 $\mu$ V
Spurious Response Rejection Ratio	:	More than 60dB
Selectivity	:	SSB/CW/AM More than $\pm$ 1.1KHz at -6dB Less than $\pm$ 2.2KHz at -60dB Adjustable to 1KHz at -6dB FM* More than $\pm$ 7.5KHz at -6dB Less than $\pm$ 15KHz at -60dB
Squelch Sensitivity	:	SSB/CW/AM 1 $\mu$ V FM* 0.4 $\mu$ V
Audio Output Power	:	More than 2 watts
Audio Output Impedance	:	8 ohms

\*Only when FM Unit is installed.



## **SECTION II DESCRIPTION**

### **50MHz ALL-MODE TRANSCEIVER INCORPORATING A MICROCOMPUTER**

CPU control with ICOM's original programs provides various operating capabilities. No-backlash dial controlled by ICOM's unique photo-chopper circuit. Band-edge detector and Endless System provides out-of-band protection. No variable capacitors or dial gear, giving problem-free use. All mode capability: SSB, CW, AM and FM. Operating mode is indicated on the display unit.

### **MULTI-PURPOSE SCANNING**

Memory Scan allows you to monitor three different memory channels. Program Scan provides scanning between two programmed frequencies. Adjustable scanning speed. Auto-stop stops scanning when a signal is received, in all modes. Auto-start restarts scanning after a pre-set interval.

### **TWO VFO'S BUILT IN**

No extra equipment needed for split-frequency operation. Easy writing and reading of the three memory channels. Smooth and easy tuning with a 5KHz-per-turn dial marked in 100Hz increments. Complete 4MHz coverage without a band select switch.

### **EASIER OPERATION AND LIGHTER WEIGHT**

The most compact, lightest weight all-mode 80 watts 50MHz transceiver. 50mm-diameter large tuning control knob for smooth and easy tuning. Trouble-free controlling knobs for both receiving and transmitting. LED indicator for transmit and receive modes.

### **MOST SUITABLE FOR BOTH FIXED AND PORTABLE STATIONS**

Optional lighter weight 117V/240V AC pulsed power supply and built-in DC power supply. Convenient Dial Lock switch for mobile operation. Easy-carry handle. Effective Noise Blanker to reduce outcoming pulse noise. IC-SM2 high quality stand microphone is suitable for fixed station operation. Powerful audio output, 2 watts at 8 ohm, for easy listening even in noisy surroundings.

### **EXCELLENT SPURIOUS AND INTERMODULATION CHARACTERISTICS**

ICOM's specially designed helical cavities at both the input and output of the RF amplifier provide excellent intermodulation characteristics. Newly developed high quality FET's for improved S/N ratio. Dual-gate MOS FET's for IF amplifiers. Newly developed compact high quality crystal filter for better selectivity. Variable RF output power.

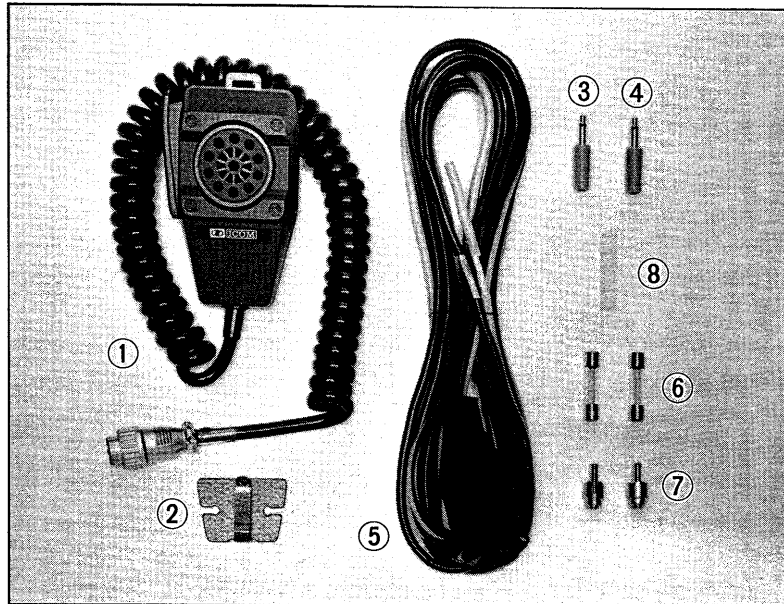
### **ADDITIONAL CIRCUITS**

ICOM's original effective Noise Blanker to reduce pulse noise. AGC selection to reduce QSB effect. RIT circuit to shift the receiving frequency without effecting the transmitting frequency. Voice control unit for smooth VOX operation. Pass Band Tuning unit to improve selectivity in the receive mode and for RF speech processing in the transmit mode. Optional FM unit for ICOM's traditional high quality FM operation.

## SECTION III INSTALLATION

### UNPACKING

Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any be apparent, notify the delivering carrier or dealer immediately, stating the full extent of the damage. It is recommended you keep the shipping cartons. In the event storage, moving, or reshipment becomes necessary, they come in handy. Accessory hardware, cables, etc., are packed with the transceiver. Make sure you have not overlooked anything.



1. Microphone (dynamic type) . . . . .	1	5. DC Power Cord . . . . .	1
2. Microphone hook . . . . .	1	6. Spare Fuse (20A) . . . . .	2
3. External Speaker Plug . . . . .	1	7. Pin Plug . . . . .	2
4. Key Plug . . . . .	1	8. Trimmer Driver . . . . .	1

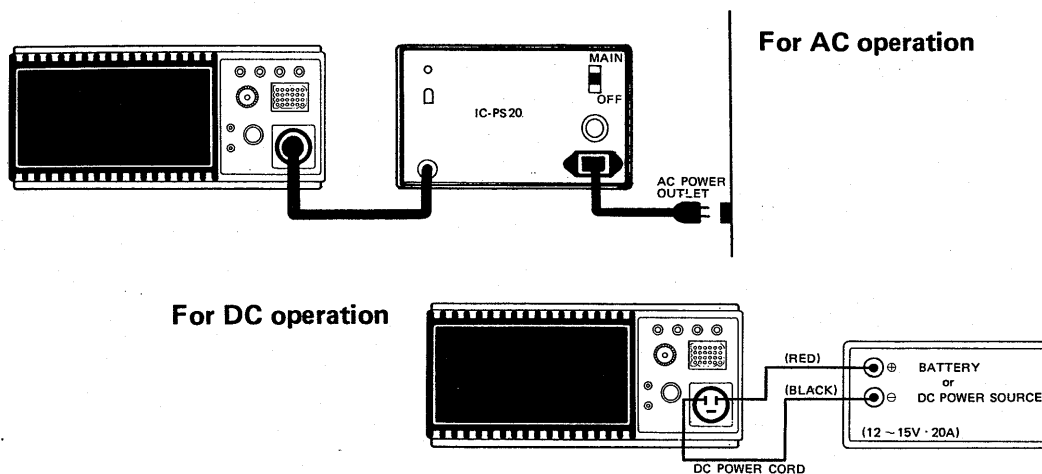
### RECOMMENDATIONS FOR INSTALLATION

1. Avoid placing the IC-551D in direct sunlight, high temperature, dusty or humid places.
2. Both sides of the unit, function also as heatsinks. The temperature there will usually become relatively warm. Any equipment should be at least 1 inch (3cm) away from the unit so as to provide good ventilation. Also avoid places near outlets of heaters, air conditioners etc.
3. Place the unit so that the controls and switches can easily be handled and the frequency indication and meter can easily be read.  
For mobile installation, an optional mounting bracket is available. Select the best location that can stand the weight of the unit and that does not interfere with your driving in any way.
4. Use the Ground Lug!

### POWER SUPPLY

For AC operation, use the special power supply IC-PS20. If you would like to use your car battery or any other DC power supply, be sure that its output voltage is 12-15 Volts and the current capacity is at least 20 Amps. The maximum power consumption of the set during transmission runs from 16-20 Amps, so keep that in mind if the unit is installed in your automobile, and turn it on after you have started the engine. Attention should also be paid to the condition of the battery and electrical system.

The connection of the DC power cord supplied with the IC551D is done in the following way: First make sure that the power switch of the unit is in the OFF position and the T/R switch is in the receive position. Connect the cord to the DC power supply with the RED lead to the positive terminal and the BLACK lead to the negative terminal. (Reverse connection will cause the protection circuit to operate and blow the fuse.) Connect the DC plug to the socket on the rear panel of the IC-551D. Refer to the drawing below.



## ANTENNA

The most important single item that will influence the performance of any communication system is the antenna. For that reason, a good, high-quality, gain antenna of 50 ohms impedance is recommended, fixed or mobile. In VHF as well as the low bands, every watt of ERP makes some difference. Therefore, 80 watts average output plus 3dB of gain antenna equals 160 watts ERP, presuming low VSWR of course. The few more dollars invested in a gain type antenna is well worth it. When adjusting your antenna, whether mobile or fixed, by all means follow the manufacturer's instructions. There are some pitfalls to be aware of. For example, do not attempt to adjust an antenna for lowest VSWR when using a diode VSWR meter not engineered for VHF applications. Such readings will invariably have an error of 40% or more. Instead, use an in-line watt meter similar to the Drake WV-4, Bird Model 43 or Sierra Model 164B with VHF cartridge. Further, when adjusting a mobile antenna, do so with the motor running preferably above normal idling speed. This will insure proper voltage level to the transceiver.

The RF coaxial connector on the rear chassis mates with a standard PL-259 connector. Some models may have metric threads. In any event, the RF connector will mate with almost any PL-259 connector if care is taken to seat them properly.

## EXTERNAL SPEAKER

The IC-551D contains an internal speaker, and is also designed so that it can drive an external speaker from the external (EXT) speaker jack on the rear panel. Be sure the impedance of the external speaker is 8 ohms, and remember that with the external speaker connected, the internal speaker is disabled.

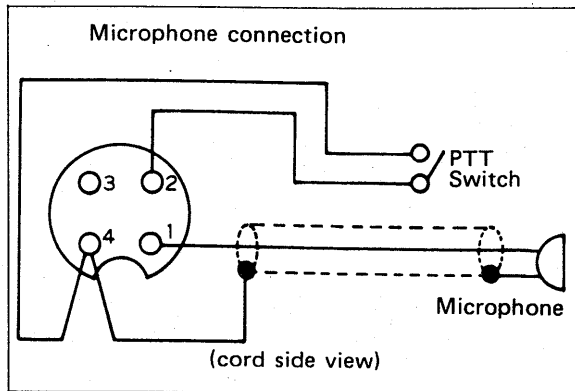
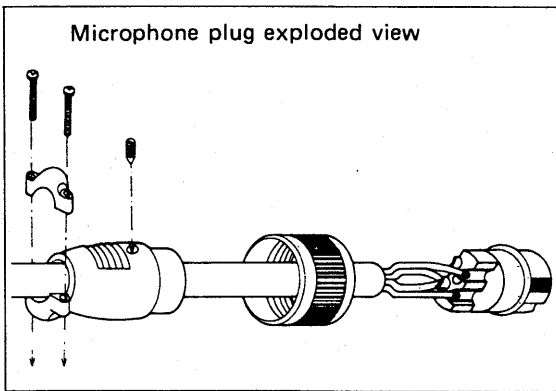
## HEADPHONES

Any good headphone set, including stereo type, that has 4~16 ohms impedance can be used. With the plug inserted halfway into the PHONES jack, both the headphones and speaker will operate. This is convenient when others wish to listen in on the station, or you wish to record

contacts using a tape recorder connected to the headphones jack. With a stereo headphone set inserted this way, however, the headphones will lose the sound on one side. With the plug inserted completely, only the headphones work.

### MICROPHONE

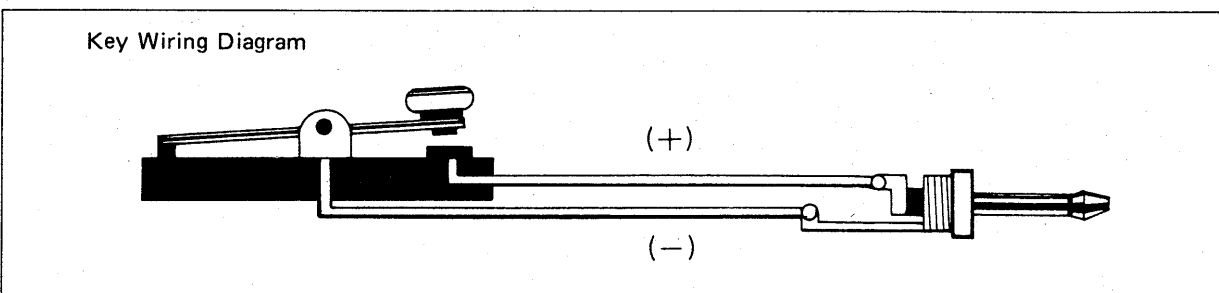
A high quality dynamic microphone is supplied with your transceiver. Merely plug it into the proper receptacle on the front panel. Should you wish to use a different microphone, make certain it is approximately 600 ohms. Particular care should be exercised in wiring also, as the internal electronic switching system is dependent upon it. See the schematic for the proper hook up.



### CW KEY

When operating CW, connect the Key to the Key Jack with the plug supplied. The connection of the plug is shown below.

If the terminals have polarity, be sure to make the correct connection. Note that the keyed voltage when switching with semiconductors or relays with resistors in the circuit, should be adjusted to be below 0.4 Volts!



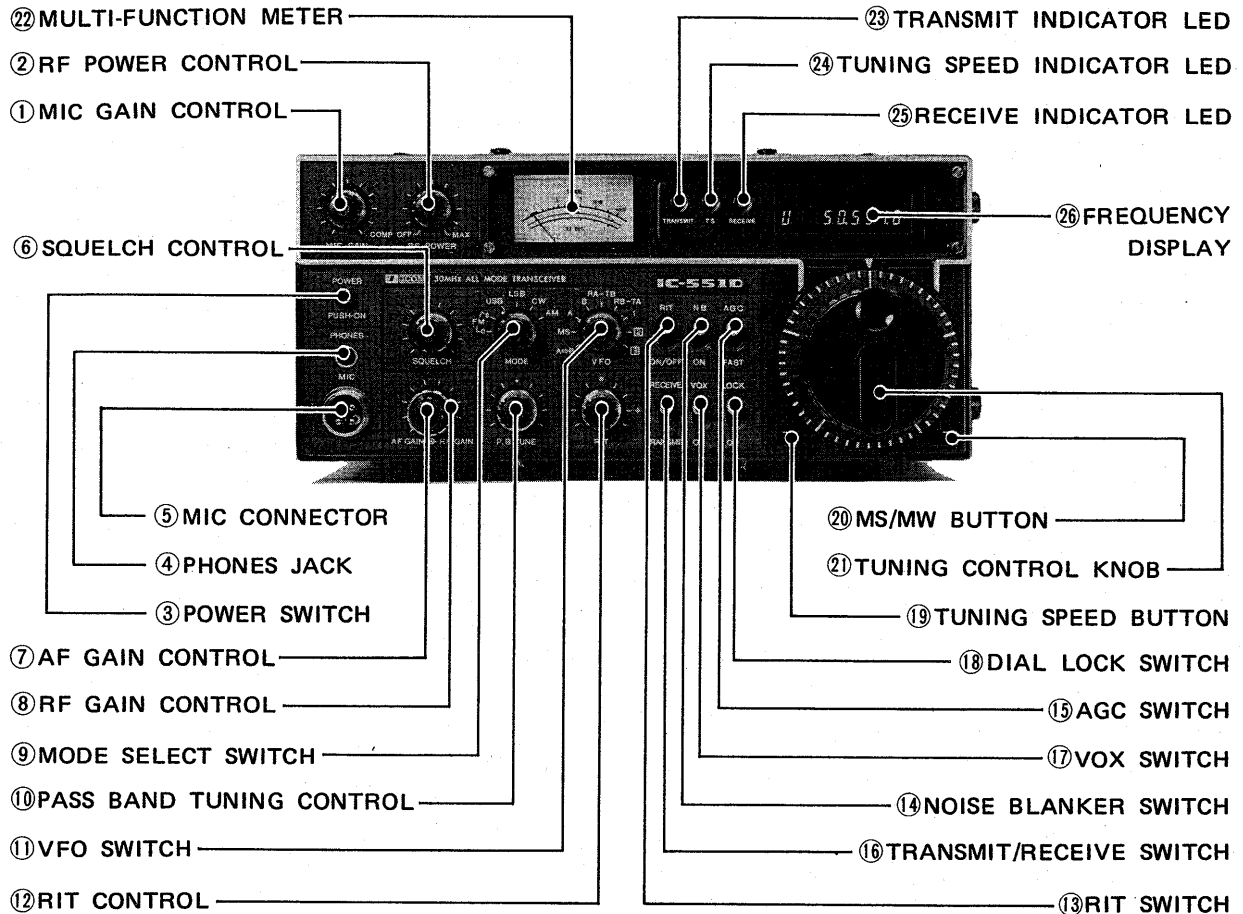
### GROUND

In order to prevent electrical shocks, TVI, BCI and other problems, be sure to connect a heavy wire ground, as short as possible, from a good earth point to the ground terminal on the rear panel.



## SECTION IV CONTROL FUNCTIONS

### FRONT PANEL



#### 1. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. Clockwise rotation increases microphone gain. When the speech processor is turned ON, the MIC Gain Control adjusts the clipping level.

#### 2. RF POWER CONTROL

Adjusts the RF output power to between 1 and 80 watts in FM, SSB and CW modes, and from 0 to 40 watts in the AM mode. In the OFF position, it sets the RF output power to the maximum for each mode. The speech processor is turned ON by turning the RF POWER Control clockwise from the OFF position (a click will be heard).

### 3. POWER SWITCH

The POWER Switch is a push-lock type switch which controls the input of either AC or DC power supplies, whichever is used. When the switch is pushed IN and locked, power is supplied to the set. When the switch is pushed again and released, power is cut to all circuits except the CPU, if the MEMORY power supply is connected to the MEMORY POWER terminal on the rear panel.

### 4. PHONES JACK

Accepts a standard 1/4-inch headphone plug for a 4 ~ 16 ohm headphone set. Stereo headphones can be used without modification.

### 5. MIC CONNECTOR

Connect the supplied microphone or optional microphone to this jack. The IC-SM2 stand-type Electret microphone or the IC-HM5 noise cancelling microphone can also be used. If you wish to use a microphone other than one of these, refer to the drawing on page 6. Microphone impedance must be 500 ~ 600 ohms.

### 6. SQUELCH CONTROL

Sets the squelch threshold level. To turn OFF the squelch function, rotate this control completely counterclockwise. To set the threshold level higher, rotate the control clockwise.

### 7. AF GAIN CONTROL

Controls the audio output level in the receive mode. Clockwise rotation increases audio output.

### 8. RF GAIN CONTROL

Controls the gain of the RF section in the receive mode. Clockwise rotation gives the maximum gain.

### 9. MODE SELECT SWITCH

This switch selects the mode of operation for both transmit and receive. The initial letter of each mode is displayed on the frequency display unit according to the switch setting.

- FM-c Frequency modulation, and the Multi-function Meter functions as a discriminator meter in the receive mode.
- FM-s Frequency modulation, and the Multi-function Meter functions as a signal strength meter in the receive mode.
- USB Upper Sideband
- LSB Lower Sideband
- CW Continuous Wave, for CW operation
- AM Amplitude Modulation, the BFO also functions in this mode.

### 10. PASS BAND TUNING (P.B. TUNE) CONTROL

This control allows continuous setting of the pass band selectivity, moving the edge of the filter up to approximately 1KHz/-6dB from either the upper or lower side in all modes except the FM mode. This not only improves selectivity, but also can improve the audio quality. The normal position is in the center (12 o'clock) position and is 2.4KHz wide.

## 11. VFO SWITCH

Selects an operating VFO from "A" VFO and "B" VFO, and selects the other various operations.

- A → B Instantly sets the frequency of "B" VFO to the same as that of "A" VFO.
- MS Sets the MEMORY SCAN function. Push the MS/MW Button to start scanning the three programmed frequencies in Memory Channels 1, 2 and 3.
- A Selects "A" VFO for both transmit and receive. "A" Scan is started by pushing the MS/MW Button while at this setting.
- B Selects "B" VFO for both transmit and receive. "B" Scan is started by pushing the MS/MW Button while at this setting.
- RA-TB Selects "A" VFO for receive and "B" VFO for transmit.
- RB-TA Selects "B" VFO for receive and "A" VFO for transmit.
- 1, 2, 3 Selects the three Memory Channels. 2 and 3 are also used for Programmed Scan operation. For details of this operation, refer to MEMORY CHANNEL OPERATION on page 19.

In addition, when the VFO is switched from "A" VFO to "B" VFO, the frequency indicated on the frequency display just prior to switching goes into a memory inside the CPU chip. Thus, even if "B" VFO is being used, switching to "A" again will enable you to operate at the initial frequency. Switching from "A" to "B" results in the same operation.

## 12. RIT CONTROL

Shifts the receiver frequency  $\pm 800\text{Hz}$  either side of the transmit frequency. When the RIT is ON, the RIT LED is illuminated. The LED also represents the "0" position. Rotating the control to the (+) side raises the receiver frequency, and rotating to the (-) side lowers the receiver frequency. With the RIT ON, if the Tuning Control Knob ① is moved one increment, the RIT circuit is automatically pulsed OFF. Therefore it is not necessary to manually turn OFF the RIT when changing operating frequency. The frequency shift by tuning the RIT Control is not indicated on the frequency display.

## 13. RIT SWITCH

This is a spring-loaded switch for the RIT Control. To turn ON the RIT, push down once. If the OFF position is desired, push down again. When the RIT is ON, the LED above the RIT control knob is lit. This LED also indicates the center position of the RIT control. When the RIT circuit is OFF, the LED is also OFF. Also, if the RIT is ON, rotating the Tuning Knob by one increment will pulse the RIT OFF. The remains ON even after the power is turned OFF.

## 14. NOISE BLANKER SWITCH

When pulse-type noise such as automobile ignition noise is present, set this switch to the ON (down) position. The noise will be reduced to provide comfortable reception.

## 15. AGC (AUTOMATIC GAIN CONTROL) SWITCH

With this switch you can select the time constant of the AGC circuit. With the switch in the AGC (up) position, the AGC voltage is released slowly, and thus is suitable for SSB reception. With the switch in the FAST (down) position, the AGC voltage is released faster, and the AGC is suitable for stations suffering from fast fading or when operating in the CW mode.

## 16. TRANSMIT/RECEIVE (T/R) SWITCH

This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (up) and the IC-551D is in the receive mode. Set the switch to TRANSMIT (down) and it switches to transmit. When switching with the PTT switch on the microphone or with the VOX switch set to ON, the T/R switch must be in the RECEIVE position.

## 17. VOX SWITCH

This switches the VOX circuit ON and OFF. When the switch is in the ON (down) position in SSB, T/R switching is accomplished by means of a voice signal. In CW operation, semi-break-in switching by means of keying is possible.

## 18. DIAL LOCK SWITCH

After the IC-551D is set to a certain frequency for rag chewing, mobile operation, etc., by switching the DIAL LOCK Switch to the ON position (down), the VFO is electronically locked at the displayed frequency, and this inactivates the operation of the Tuning Knob. To change frequency, the Dial Lock must first be disengaged by setting the DIAL LOCK Switch to OFF (up) position.

## 19. TUNING SPEED (TS) BUTTON

Pushing the TUNING SPEED Button will illuminate the TS indicator LED, and the small vernier marks on the Tuning Knob are changed to correspond to 1KHz increments in any mode. At the same time, the 100Hz digit is cleared on the display to show "0" in the last digit. When the Tuning Speed Button is depressed again, the TS indicator LED goes OFF and the small vernier marks will again correspond to 10KHz steps in the FM mode and 100Hz steps in all other modes. This button will allow you to quickly QSY over a great frequency range in SSB, CW and AM, and to tune in FM signals which are off from 10KHz-step frequencies.

## 20. MEMORY SCAN START/STOP & MEMORY WRITE (MS/MW) BUTTON

The following three functions are provided by pushing the MS/MW Button.

MEMORY WRITE	Writing a frequency into Memory Channel 1, ②, or ③.
SCAN START	Starting the "A" and "B" scans and Memory Scan.
SCAN STOP	Stopping any of the scan functions.

## 21. TUNING CONTROL KNOB

Rotating the Tuning Control Knob clockwise increases the frequency, while rotating it counterclockwise decreases it. The frequency is changed in 100Hz steps (all modes except FM) and 10KHz steps (FM mode) which correspond to the smaller vernier marks on the knob. When the TUNING SPEED Button is pushed and the TS indicator LED is illuminated, the frequency is changed in 1KHz steps, which correspond to the smaller vernier marks on the knob, in all modes including FM.

By rotating the Tuning Control knob clockwise beyond the highest edge of the band the operating frequency is automatically reverted to the lowest edge of the band, and vice versa. This system prevents you from operating out of the amateur radio band.

When QSYing over a large frequency range is required in the SSB, CW or AM mode, use the TUNING SPEED Button.

When the operating frequency needs to be locked, use the DIAL LOCK Switch.

## 22. MULTI-FUNCTION METER

This meter functions as a relative RF output meter in transmit mode, and as an S-meter (signal strength meter) in receive mode, unless the MODE Select Switch is set at the FM-c position, in which case the meter functions as a discriminator meter in the receive mode.

## 23. TRANSMIT INDICATOR LED

When your set is in the transmit mode, this LED is lit.

## 24. TUNING SPEED (TS) INDICATOR LED

Illuminates when the TUNING SPEED Button is pressed to set the dial to 1KHz-step tuning.

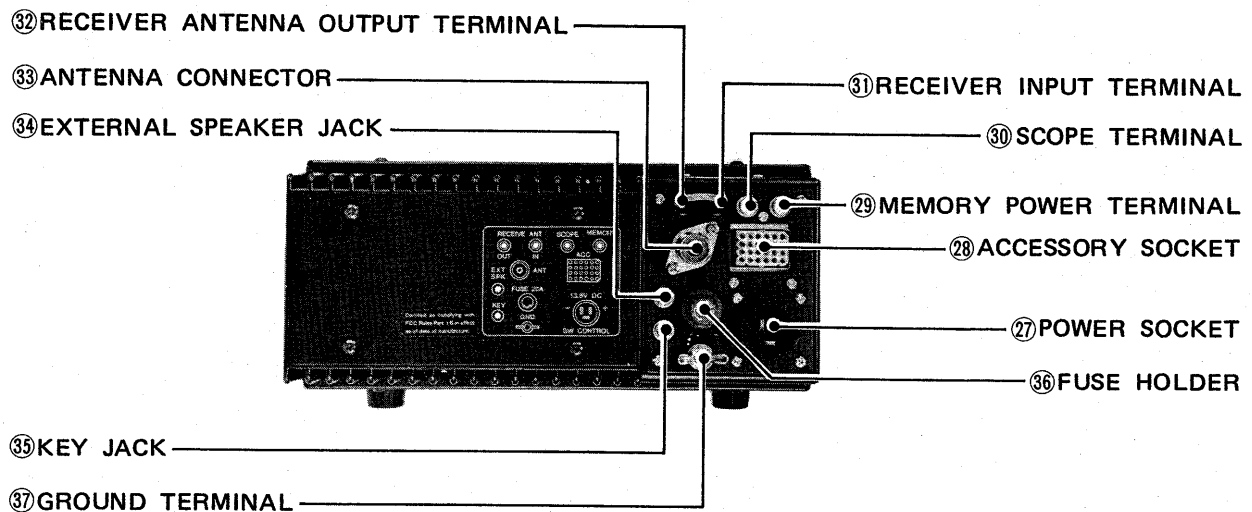
## 25. RECEIVE INDICATOR LED

Illuminates when the squelch is opened in the receive mode.

## 26. FREQUENCY DISPLAY

The frequency of the IC-551D is displayed on a luminescent display tube. Since the 1MHz and 1KHz decimal points are displayed, the frequency can be easily read. The frequency indicated is the carrier frequency of each mode. The frequency which is changed by use of the RIT is not changed on the frequency display. The letter shown to the left of the frequency indication is the initial letter of the operating mode set by the MODE Select Switch.

## REAR PANEL



## 27. POWER SOCKET

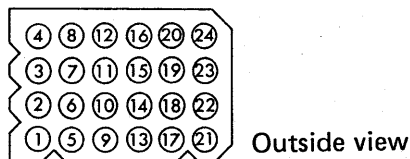
Connect the DC power cord or cable from the IC-PS20 or suitable DC source to this connector.

**28. ACCESSORY (ACC) SOCKET**

The table below shown terminal connections of this connector.

**NOTE:** IC-RM2/3 does not function with the IC-551D.

**ACC SOCKET CONNECTIONS**



PIN No.	FUNCTION
1.	Output from squelch control stage. (+7V when squelch is ON)
2.	13.8 Volts DC in conjunction with the power switch operation. (Max. 0.3A)
3.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
4.	Output from the receiver detector stage. Fixed output regardless of AF output of AF gain.
5.	Output from Transmitter MIC amplifier stage.
6.	8 Volts DC available when transmitting. (relay can not be directly actuated. Max. 5mA)
7.	Input for external ALC voltage.
8.	Ground.
9. ~ 24.	NC (no connection).

**29. MEMORY POWER TERMINAL**

When a memory power source is connected to this terminal, the power to the CPU of the IC-551D is supplied continuously, even when the POWER Switch on the front panel is turned OFF, to retain all the programmed frequencies in the Memory Channels, the operating frequencies of the two VFO's, etc. When the memory power source is not connected, all the power, including that to the CPU, is turned OFF by turning OFF the POWER Switch, so that all the programmed frequencies in the Memory Channels, the operating frequencies of the two VFO's, etc., are erased.

**30. SCOPE TERMINAL**

This terminal brings out the 9.0115MHz IF signal from the mixer in the receiver. Observation of not only the received signal, but also of signals of the selected band width are possible by using a panadaptor or panascope.

**31. RECEIVER INPUT TERMINAL**

This is an input terminal which is connected directly to the receiver.

**32. RECEIVER ANTENNA OUTPUT TERMINAL**

This is a terminal to which received signals from the antenna connector are fed through after the signal passes through the transmit/receive antenna switching circuit. Usually the receiver IN and OUT terminals are jumpered. The receiver antenna output terminal is usually used when another receiver is used or a preamplifier is connected to the IC-551D.

**33. ANT (ANTENNA) CONNECTOR**

This is used to connect the antenna to the set. Its impedance is 50 ohms and connects with a PL-259 connector.

**34. EXTERNAL SPEAKER JACK**

When an external speaker is used, connect it to this jack. Use a speaker with an impedance of 8 ohms. When the external speaker is connected, the built-in speaker does not function.

**35. KEY JACK**

For CW operation, connect the key here using the included key plug.

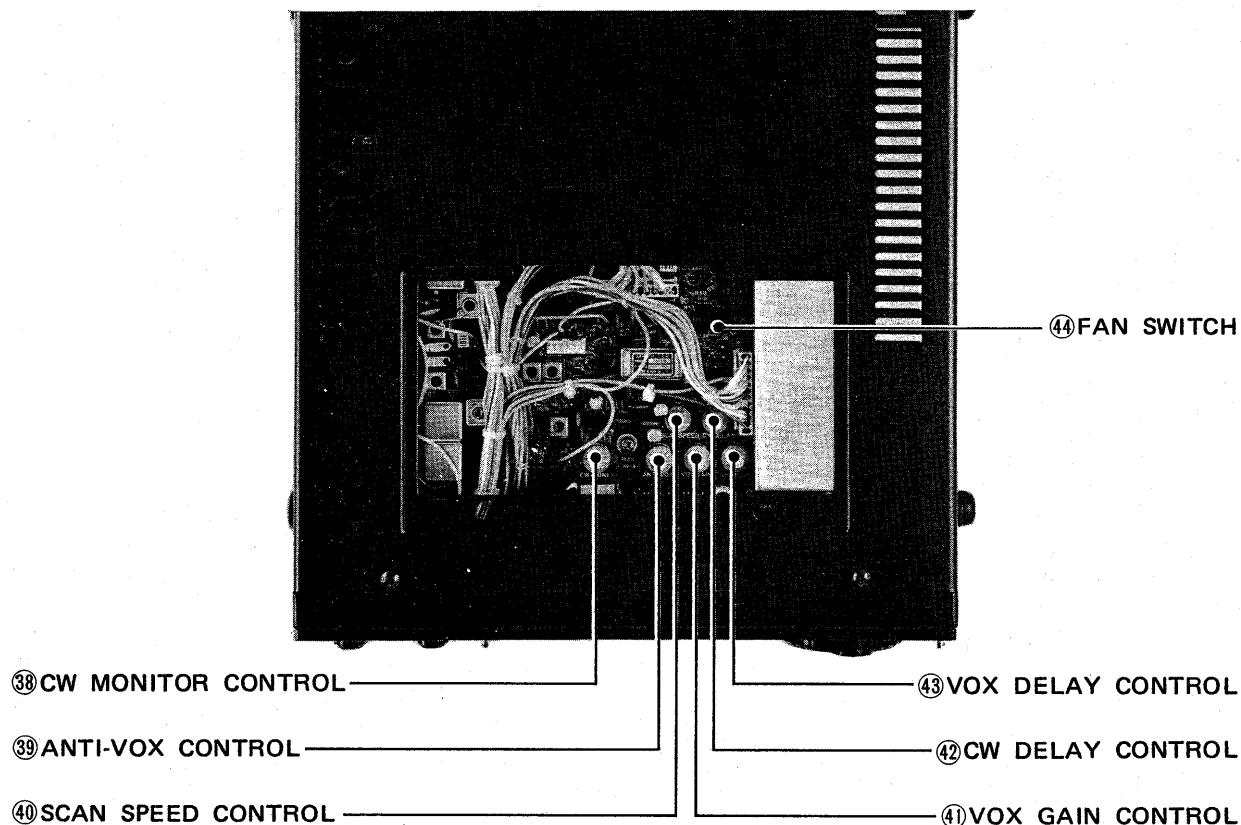
**36. FUSE HOLDER**

This holds the fuse for the DC power circuit. If the fuse is blown, replace it with a new fuse (20 Amp) after checking the cause. Open the fuse holder with a Phillips head driver.

**37. GROUND TERMINAL**

To prevent electrical shock, TVI, BCI and other problems, be sure to ground the equipment through the GROUND TERMINAL. For best results use as heavy a gauge wire or strap as possible and make the connection as short as possible, even in mobile installations.

**CONTROLS UNDER ACCESS COVER**



**38. CW MONI (MONITOR) CONTROL**

This control adjusts the audio volume of the side tone (monitor) audio during CW transmit operation. Adjust it to your desired level for easy listening.

**39. ANTI-VOX CONTROL**

In VOX operation, the VOX circuit may be operated by sound from the speaker, causing a switch to the transmit mode. This can be prevented by adjusting the input level of the ANTI-VOX circuit with this control along with the VOX gain control so that the VOX circuit operates only from the operator's voice, not by sound from the speaker.

**40. SCAN SPEED CONTROL**

This controls the scanning speed in Programmed Scan "A" and "B". Adjust the control to desired scanning speed.

**41. VOX GAIN CONTROL**

This control adjusts the input signal level via the microphone to the VOX circuit. For VOX operation, adjust the control so that the VOX circuit will operate with normal speech.

**42. CW DELAY (CW TIME DELAY CONSTANT) CONTROL**

In semi-break-in CW operation, this controls the transmit/receive switch-over time delay. Adjust it to suit your keying speed.

**43. VOX DELAY (VOX TIME CONSTANT) CONTROL**

This controls the transmit-to-receive switching time. Adjust it so switching will not occur during short pauses in normal speech.

**44. FAN SWITCH**

This switches the function of cooling fan in the PA unit. In the "FAN" position, the fan turns in the transmit mode only. In the "R-ON" position, the fan turns in either the transmit mode or the receive mode.



## SECTION V OPERATION

### HOW TO TUNE

The following instructions are for tuning in any mode. Please read carefully and understand fully before turning ON your unit. Proper tuning is necessary for optimum operation.

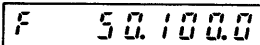
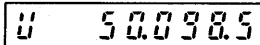
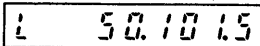
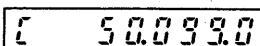
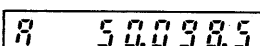
### PRESET FREQUENCIES

When the POWER switch is turned ON, the frequency display will be shown 50.100.0.

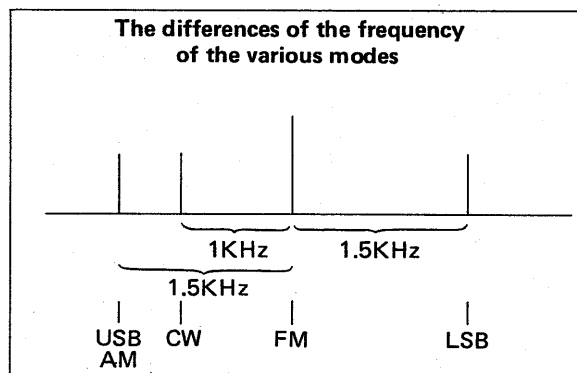
Turn the VFO Switch to "B", "RA-TB", and "RB-TA" positions to see if the same frequency can be read on the display. Continue turning the VFO Switch to "1", "2", and "3" positions to see if 51.000.0MHz shown on the display. The frequencies of the VFO's and the Memory Channels are preset so that they start from the frequencies shown above whenever the IC-551D is turned ON or whenever the power to the CPU is cut for even a short time. Turn the VFO Switch to the "A" position again.

### FREQUENCY DISPLAY ON EACH MODE

Turn the MODE Select Switch to "USB", to "LSB", to "CW" and to "AM". The displayed frequency and the initial letter will be changed as follows.

At the "FM" position	
At the "USB" position	
At the "LSB" position	
At the "CW" position	
At the "AM" position	

To avoid the trouble of recalibrating the dial when you change the operating mode, the displayed frequency is set to shift to the carrier frequency of each mode automatically. For the differences of the frequency shifts of the various modes, refer to the following figure.



**NOTE:** At some operating frequencies, when changing the operating mode, the frequency display may indicate a frequency which is out of the operating range of the IC-551D. If this happens, rotate the Tuning Control either clockwise or counterclockwise by at least one small vernier mark on the Knob. Do not set the IC-551D in the transmit mode, before following this procedure.

## TUNING CONTROL

Rotating the Tuning Knob clockwise increases the frequency; turning it counterclockwise decreases the frequency in 100Hz steps in the USB, LSB, CW and AM modes and in 10KHz steps in the FM mode. The smaller vernier marks on the knob represent 100Hz (10KHz in the FM mode).

When you reach 53.999.9 in the SSB, CW or AM modes, or 53.990.0 in the FM mode, turning the Tuning Control Knob clockwise will bring the operating frequency to 50.000.0, the lowest edge, and you can continue increasing the frequency from there by continuing to rotate the Knob clockwise. The VFO endless system functions in the same way when decreasing the frequency from 50.000.0, and will prevent you from inadvertently operating out of the amateur radio band. When the MODE Select Switch is set to the "FM" position from any other mode, the last two digits of the display frequency are designed to show "0.0", and the frequency is shifted in 10KHz steps by rotating the Tuning Control. If 10KHz-step frequency shift with the last two digits other than "0.0" is desired, set the dial using the following procedure.

The TS Switch must be OFF.

Set the VFO Switch to "A", and the MODE Select Switch to "USB".

By rotating the Tuning Control, set the last two digits on the display at the frequency you desire.

Set the VFO Switch to "B" and then the MODE Select Switch to "FM".

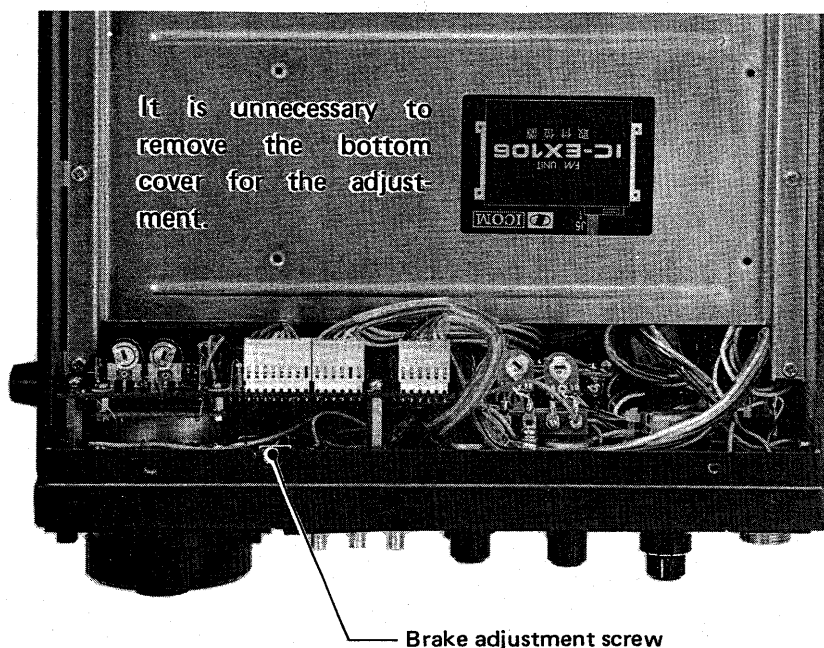
Set the VFO Switch to "A".

This completes the setting so that the frequency is shifted in 10KHz steps with the desired figures in the last two digits of the operating frequency. To reset the last two digits to "0.0", push the TS Button twice.

If the knob is too loose or too stiff for comfortable use, you can adjust the torque by tightening or loosening the brake adjustment screw accessible from underneath the set.

### Brake Adjustment

The following instructions should be used to adjust the tension of the Tuning Knob.



1. The Tuning knob tension will become tighter by turning the brake adjustment screw clockwise, and will become looser by turning the screw counterclockwise.
2. While performing this adjustment, the Tuning knob must be turned continuously as the screw is adjusted in order to set the tension for a comfortable touch.

### **DIAL LOCK SWITCH**

After the IC-551D is set at a certain frequency for rag chewing, mobile operation, etc., turning the Dial Lock switch to the ON (down) position, the VFO is locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change the frequency, the Dial Lock must first be disengaged by turning the dial lock switch again to OFF (up) position, the frequency will change with the direction of the tuning knob rotation.

### **TS (TUNING SPEED) BUTTON**

Pushing the TS Button, the TS indicator LED will be illuminated. While this indicator is ON, the frequency is increased or decreased in 1KHz steps in all modes, and the smaller vernier marks on the Knob correspond to 1KHz steps.

### **VFO SELECT SWITCH**

The CPU in the IC-551D contains two "VFO's" for both receiving and transmitting. The VFO's are labeled "A" VFO and "B" VFO and are selectable with the VFO Select Switch. This dual VFO system gives the IC-551D many very convenient features. Please read this section very carefully and perform the operation several times until you are comfortable with the system. Try the example!

1. "A" VFO is for both transmitting and receiving and is selected by placing the VFO Select Switch in the "A" position. The transmit and receive frequency will be controlled by "A" VFO, displayed on the frequency display and stored in "A" memory.
2. "B" VFO is for both transmitting and receiving and is selected by placing the VFO Select Switch in the "B" position. The transmit and receive frequency will be controlled by "B" VFO, displayed on the frequency display, and stored in "B" memory.
3. RA-TB: The receive frequency is controlled by "A" VFO and the transmit frequency is controlled by "B" VFO. Both frequencies are stored in their respective memories, and displayed during their respective operation times ("A" frequency during receive, and "B" frequency during transmit).
4. RB-TA: The receive frequency is controlled by "B" VFO and the transmit frequency is controlled by "A" VFO, the reverse of the above. Again, both frequencies are stored in their respective memories, and displayed during their respective operation times (this time "B" frequency during receive and "A" frequency during transmit).
5. A → B: Instantly sets the frequency of "B" VFO to the same as that of "A" VFO. This is very convenient when the RIT control can not cover the transmitting and receiving frequencies differ by more than 1KHz or when you want to QSO with several KHz split transmitting and receiving frequencies.

**NOTE:** The MS, 1, 2, and 3 positions are described in the "MEMORY CHANNEL OPERATION" on page 19.

- When the IC-551D is first turned ON, the frequency displayed on the readout is the frequency 50.100.0MHz.

**FOR EXAMPLE:**

When the set is turned ON, 50.100.0 will be displayed on the readout. This will occur whether the VFO Switch is in either the "A" or "B" or combination VFO position. Rotating the tuning knob clockwise will increase the frequency, and rotating the tuning knob counterclockwise will decrease the frequency in 100Hz steps. (10KHz steps in the FM mode)

- Switching from one VFO to the other VFO does not clear the first VFO. The frequency is retained in the VFO's memory.

**FOR EXAMPLE:**

If 50.125.0MHz is set with "A" VFO, and the VFO switch is set to "B" VFO, the frequency readout will show "B" VFO's frequency, but 50.125.0MHz is still stored in "A" VFO's memory. Returning the VFO Switch to "A" VFO position, and 50.125.0 will be displayed on the readout. Accordingly, if the switch is placed in the "B" VFO position, the frequency that was set with the "B" VFO will appear. This allows you to set a certain frequency with one VFO, work up and down the band with the other VFO, and periodically check the set frequency simply by switching between "A" and "B" VFO. It also allows you to search for a clear frequency with one VFO, while keeping your operating frequency on the other VFO. When you have found a clear frequency, switch back to your operating frequency, inform the station you are in contact with of the new frequency, and switch back. It's that simple!

**RA-TB/RB-TA**

These positions will allow you to operate a repeater or split transmit/receive frequencies.

**FOR EXAMPLE:**

Set "A" VFO to 53.250.0MHz and "B" VFO to 52.250.0MHz. Then set the VFO select to the RA-TB position. 53.250.0MHz will be shown on the readout during receive ("A" VFO) and 52.250.0MHz during transmit ("B" VFO). You are now receiving on 53.250.0MHz and transmitting on 52.250.0MHz, so you can access 52.25/53.25 repeater.

If you change the receiving ("A" VFO) frequency, the transmitting ("B" VFO) frequency does not follow the receiving frequency. So, set "A" VFO and "B" VFO at the frequencies for repeater input/output whenever you change frequency.

**FOR EXAMPLE:**

If you change the receiving frequency from 53.250MHz to 53.170MHz, the transmitting frequency will remain at 52.250MHz. So please set "B" VFO to 52.170MHz. Now you can access a 52.17/53.17 repeater.

Setting the VFO select switch to RB-TA reverses the above.

**RIT (RECEIVER INCREMENTAL TUNING)**

By using the RIT circuit, you can shift the receive frequency  $\pm 800$ Hz either side of the transmit frequency without moving the transmit frequency itself. Therefore, when you get a call slightly off frequency, or when the other station's frequency has shifted, you can tune in the receiving

frequency without disturbing the transmitting frequency. By pushing the RIT switch down once (it's a spring loaded switch) the RIT circuit is turned ON and the RIT LED is lit. The receive frequency is shifted with the RIT knob.

When the RIT knob is in the "0" position, the transmitting and receiving frequencies are the same. Rotating the control to the (+) side raises the receiving frequency, and rotating to the (–) side lowers the frequency. To turn OFF the RIT control, again push the RIT switch once and the RIT LED will go OFF. When the RIT circuit is OFF, the transmit and receive frequencies are the same regardless of the setting of the RIT control knob.

When the RIT circuit is ON, if the tuning knob is moved by one increment, the RIT circuit is automatically pulsed OFF. However, this function can be eliminated by continuously depressing the RIT switch with your finger, while turning the tuning knob, the RIT circuit will remain operational while tuning.

Other things to remember are: The RIT circuit is operational when the frequency is locked with the dial lock switch. The frequency shifted by turning the RIT control is not indicated on the frequency display. When the transmitting and receiving frequencies differ by more than 1KHz, use "A" and "B" VFOs as outlined previously.

## MEMORY CHANNEL OPERATION

### MEMORY-WRITE (PROGRAMMING THE MEMORY CHANNELS)

Only "A" VFO can be used for memory-writing.

1. Set the Tuning Control to the desired frequency, using "A" VFO. For example, set it for  on the display.
2. Set the VFO Switch to the channel to be programmed (1, , or ). For example, set it at Memory Channel 1. If no frequency has been programmed since turning the power of the unit ON,  will be shown on the display and the unit will receive on this frequency.
3. One push of the MS/MW Button erases the previous programmed frequency (51.000.0) and programs the new frequency (50.500.0) into Memory Channel 1.
4. Program any desired frequencies in Memory Channels  and  in the same manner. Memory Channels  and  are used also for Programmed Scan "A" and "B". For Programmed Scan operation, refer to SCANNING OPERATION.

### MEMORY READING

Set the VFO Switch to the desired Memory Channel 1, , or . At whichever frequency the "A" or "B" VFO was set, that previously programmed frequency is recalled. When the VFO Switch is set back to "A" or "B" VFO, the previous operating frequency of that VFO will again be shown on the display.

The programmed frequencies in the three Memory Channels are maintained as long as the power, including MEMORY power, of the IC-551D is not turned OFF or new frequencies reprogrammed. When an external memory power supply is connected to the MEMORY POWER TERMINAL on the rear panel, all the programmed frequencies on the Memory Channels and the operating frequencies of both "A" and "B" VFO's are retained even when the POWER Switch is turned OFF.

## SCANNING OPERATION

The IC-551D provides various scanning operations. Read the following instructions carefully to fully enjoy the IC-551D's many capabilities.

### MEMORY SCAN

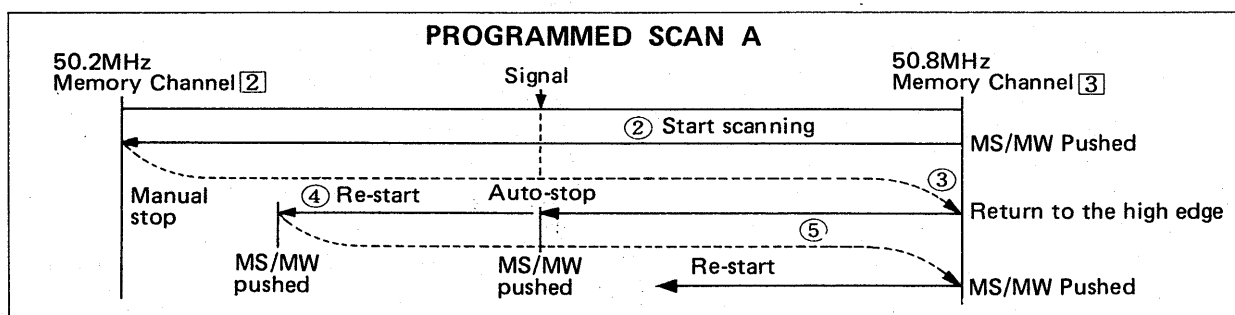
This is to scan the three Memory Channels continuously.

1. Program three desired frequencies in Memory Channels 1, 2, and 3.
2. Set the VFO Switch to the "MS" position. At this time, the operating or displayed frequency is not changed.
3. Depress the MS/MW Switch, and the display frequency starts scanning the programmed frequencies in the Memory Channels 1, 2, 3, 1, 2, 3, . . .
4. If the SQUELCH is engaged, the scan stops when the squelch is opened and receives a signal. To stop scanning without opening the squelch, depress the MS/MW Button. Depress it again to restart the scanning.

### PROGRAMMED SCAN "A"

This is to scan between two desired frequencies, which are programmed in Memory Channels 2 and 3.

1. Program the frequencies of the high and low edge of the desired scanning range in Memory Channels 2 and 3. Regardless of which channel the higher frequency is programmed in, the scan starts from the high edge of the range.  
For example, program 50.2MHz in Memory Channel 2 and 50.8MHz in Memory Channel 3.
2. Set the VFO Switch to "A". Depressing the MS/MW Button starts the scan from the high edge (50.8MHz) to the low edge. The scanning frequency increments depend on the MODE Switch setting and the TS Button setting.
3. When the scanning frequency reaches the low edge (50.2MHz), it automatically returns to the high edge (50.8MHz) and continues scanning down to provide endless scanning operation.
4. While the SQUELCH is engaged, the squelch opening when a signal is received will stop the scanning automatically to lock onto the frequency. Depressing the MS/MW Button will restart the scan from the frequency at which it stopped. If the RECEIVE indicator LED is lit because the SQUELCH is not engaged, the scan does not stop at any signals.
5. To stop the scan operation, depress the MS/MW Button. Depressing the MS/MW Button again restarts the scan from the high edge (50.8MHz) of the programmed range.



### PROGRAMMED SCAN "B"

As with PROGRAMMED Scan "A", this is a scanning operation between two programmed frequencies in Memory Channels 2 and 3, the basic difference being shown in 3 below.

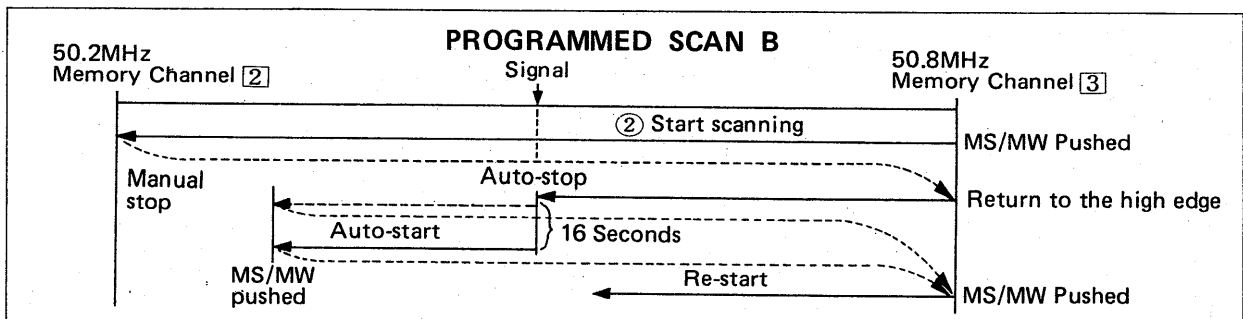
1. Program the frequencies of the high and low edge of the desired scanning range in Memory Channels ② and ③. It does not matter in which Memory Channel the higher frequency is programmed. For instance, program 50.2MHz in Memory Channel ② and 50.8MHz in Memory Channel ③.
2. Set the VFO Switch to "B" and the SQUELCH Control above the threshold. By depressing the MS/MW Button, the scan is started from the high edge of the programmed range (50.8MHz) to the lower frequency. Programmed Scan "B" is also an endless scanning operation, and when the scan reaches the low edge of the programmed range (50.2MHz), it reverts to the high edge and again starts down.
3. The scanning operation automatically stops when the SQUELCH is opened by any signals, and the signals can be monitored. After approximately 16 seconds, the scan automatically starts again from the frequency the scan stopped at, continuing to the lower frequencies.
4. Depressing the MS/MW Button while the scan is operating or during the 16 seconds of monitoring, clears the scanning operation and the VFO goes back to normal operation.
5. Depressing the MS/MW Switch again starts the scanning from the high edge of the programmed range.

The scanning speed can be adjusted by the SCAN SPEED Control located under the access cover. Rotating the control clockwise makes the scanning speed faster.

The Tuning Control does not function while the scan is operating. In Programmed Scan "B" mode, during the 16-second stop of the scanning when the squelch is opened, the VFO can be used freely, and after the 16 seconds, the scan starts from the frequency set by the VFO as long as the frequency is within the programmed scanning range.

When faster scanning is required in SSB, CW or AM mode, push the TS Button to set the scanning step at 1KHz. Normally the 1KHz-step scanning is good enough to search SSB, CW and AM signals and provides much faster scanning in the range.

**NOTE:** The auto-stop circuit functions with SSB, CW or AM signals, but the scan does not always stop at the exact carrier frequencies. When the scan stop operating on one of these signals, tune in to the signals for suitable reception by rotating the Tuning Control and by setting the MODE Select Switch to the proper mode.



## SSB OPERATION

### 1. RECEIVING

After connecting an antenna, microphone, etc., set knobs and switches as follows.

POWER SWITCH	OFF (button out position)
T/R SWITCH	RECEIVE (UP)
VOX SWITCH	OFF (UP)
AGC SWITCH	SLOW (UP)
NB (NOISE BLANKER) SWITCH	OFF (UP)
MODE SELECT SWITCH	USB or LSB
VFO SWITCH	"A" or "B"
AF GAIN CONTROL	Fully Counterclockwise
RF GAIN CONTROL	Fully Clockwise
SQL CONTROL	Fully Counterclockwise
DIAL LOCK SWITCH	OFF (UP)
RIT CONTROL	Center (12 o'clock) position

The other knobs are unrelated to receiving and need not be set at this time.

In SSB operation there is both a USB (upper side band) and an LSB (lower side band). USB is usually used on the 50MHz band.

Now turn ON the power switch. The meter lamp will be illuminated and "50.100.0" will be shown on the frequency display. Slowly turn the AF gain control clockwise to a comfortable level. Rotate the Tuning Knob until a signal is received. The multi-function meter needle will move according to the signal strength, so tune for the highest possible meter reading and the clearest audio. If you cannot get a clear signal, you may be receiving in the opposite sideband. If so, change the mode switch to the proper sideband.

The VFOs in the IC-551D change in 100Hz steps. Therefore the maximum possible difference in your receiving frequency and the received signal frequency is 50Hz. However, for normal voice signal reception, a difference of 50Hz is negligible and indeed may be hard to distinguish. Since the frequency is changed in 100Hz steps with the IC-551D, as opposed to continuous variable frequency systems, tuning is simplified and more accurate.

If squelch operation is required to cut out noise when no signal is received, turn the SQUELCH Control clockwise until the noise from the speaker stops and leave it just below this threshold.

### 2. NB (NOISE BLANKER)

Turn the NB switch ON (down) when there is pulse type noise, such as ignition noise from automobile motors. Noise will be suppressed and even weak signals will be received comfortably. The noise blanker may not work as effectively when there is a strong signal on a nearby frequency or when there is continuous (not pulse type) noise.

### 3. AGC (AUTOMATIC GAIN CONTROL)

The IC-551D has a fast attack/slow release AGC system which holds the peak voltage of rectified IF signals from the IF amp circuit for a certain period. Therefore, during the pauses in normal speech of the received signal, uncomfortable noise will not be heard. The multi-function meter indicates the peak value for a certain period, facilitating reading of the meter "S" function.



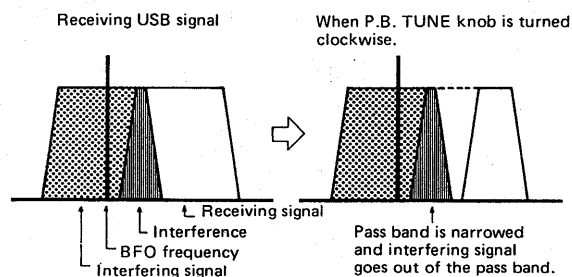
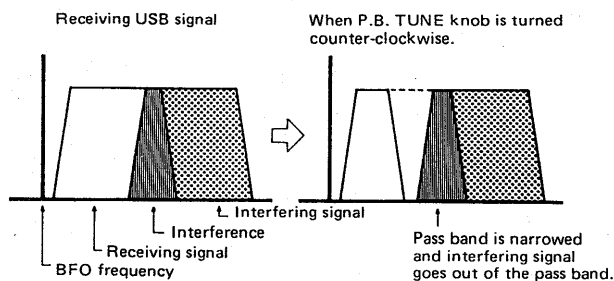
For normal SSB reception, set the AGC switch in the UP (slow) position. Set the AGC switch in the FAST (down) position, when tuning or receiving signals with short interval fading. When in the FAST position, the time constant is shortened.

#### 4. P.B. (PASS BAND) TUNING

The Pass Band Tuning unit is a system in the receive mode to narrow the band width (selectivity) of the frequencies that will pass through the crystal filter electrically from either the upper or lower side continuously by up to 1KHz. This is very effective in reducing interference from nearby signals.

For example, while receiving in the USB mode, if you get interference from a higher frequency (interfering signals are high pitched tones), narrow the band width by turning the P.B. tuning control counterclockwise. When the interfering signals are low pitched tones, they are from a lower frequency, and you should narrow the band width by turning the P.B. tuning control clockwise.

When receiving in the LSB mode, the band width is narrowed in the opposite manner. Interference from a lower frequency will be high pitched tones, and the P.B. tuning control should be turned clockwise. Interference from a higher frequency will be low pitched tones and the P.B. tuning control is turned counterclockwise.



This control can also be used for audio tone adjustment, so it may be set for the most comfortable reception. The Pass Band Tune functions in the SSB, AM and CW modes, but not in the FM mode.

#### 5. TRANSMITTING

Before transmitting, listen in the receive mode to make sure your transmission will not interfere with other communications. If possible, use a dummy load for adjustment instead of an antenna. Set the MIC GAIN CONTROL to the CENTER (12 o'clock) position, and the RF POWER CONTROL to the fully counterclockwise position beyond the "click" (COMP OFF position).

Other knobs and switches are left in the same positions as for receiving. When the T/R switch is moved to transmit, or when the PTT (push to talk) switch on the microphone is depressed, the transmit LED is illuminated. By speaking into the microphone, the meter needle will move according to the strength of your voice and SSB signals will be transmitted.

Hold the microphone about three inches from your mouth and speak in a normal voice. The microphone is of the dynamic type and provides good pickup for all levels of voice. Turning the MIC GAIN Control too high or speaking too loudly into the microphone does not increase the RF output power, but causes some distortion in the SSB signals or spurious radiation. If you wish to decrease the peak power, turn the RF POWER Control clockwise beyond the "click" and adjust to obtain the desired RF output power of between 1 watt and 80 watts.

To receive again, turn the T/R switch to RECEIVE or release the PTT button. This will also switch OFF the transmit indicator.

## 6. HOW TO USE THE SPEECH PROCESSOR

The Pass Band Tuning unit acts as a low distortion RF Speech Processor. This enables greater talk power and better results in DX operation.

Follow the steps below for use of the RF Speech Processor:

MIC GAIN CONTROL	Set to the CENTER (12 o'clock) position.
RF POWER CONTROL	Turn from the "COMP" OFF position until it "CLICK" ON.

Switch to transmit and turn the RF POWER CONTROL clockwise while speaking into the microphone until you obtain the desired RF "PEAK" output power of between 1 watt and 80 watts.

Adjust the MIC GAIN CONTROL to a point where the RF "AVERAGE" output power just saturates.

The Speech Processor should be turned OFF or MIC GAIN CONTROL carefully set for minimum compression for all communication other than DX operation for a very natural voice quality.

## 7. HOW TO USE THE VOX CIRCUIT

The VOX (voice operated relay) unit allows automatic T/R switching by voice signals into the microphone. For VOX use, set the knobs inside the top access cover as follows:

VOX GAIN CONTROL	FULLY COUNTERCLOCKWISE
VOX DELAY CONTROL	FULLY CLOCKWISE
ANTI VOX CONTROL	FULLY COUNTERCLOCKWISE

Turn the VOX switch on the front panel to the ON (down) position. Leaving the T/R switch in the receive position and without pushing the PTT switch, turn the VOX GAIN control clockwise while speaking into the microphone. At a certain point, the T/R switching circuit will be activated by your voice. This is the proper position for VOX GAIN control. Set the VOX GAIN control at a level which provides for T/R switching at your normal voice level. Transmit-release time (the time delay before the set automatically returns to receive when you

stop talking) is controlled by the VOX DELAY control. Turning the control counterclockwise makes the time shorter. Set it at a position which is comfortable and which allows for short pauses in normal speech.

Adjust the ANTI VOX control so that the VOX circuit is not activated by sounds from the speaker by turning the control clockwise while receiving a signal.

## **CW OPERATION**

### **1. RECEIVING**

For CW reception, set the MODE Select Switch to the CW position. Other switches and knobs are set the same as for SSB reception.

Rotate the tuning knob until an 800Hz (approx.) beat tone is heard from the speaker or head phones. Set the noise blanker switch and/or the AGC switch for clear reception, the same as for SSB reception.

The receiving pass band will be adjustable continuously to 500Hz/−6dB by turning the P.B. TUNE CONTROL. This is very effective in reducing interference the same as for SSB reception.

### **2. TRANSMITTING**

Insert the keyer plug into the KEY Jack on the rear panel of the unit, and set knobs and switches the same as for CW reception.

By setting the T/R switch to Transmit, the transmit LED is lit and shows that you are ready for CW transmission. When you key the keyer, the meter needle moves and your CW signal is transmitted.

To decrease the transmitting power, turn the RF POWER Control clockwise beyond the "click" to ON and rotate to adjust while watching the meter needle on the Multi-function Meter for the desired output power.

### **3. CW MONITOR**

When keying, the side tone oscillator circuit is activated and an 800Hz tone is heard from the speaker. The loudness of this tone is adjusted by rotating the CW MONI Control, located under the access cover. Rotating the CW MONI Control clockwise makes the tone louder. (In the receive mode, this side tone is audible and can therefore be used for Morse Code Practice, adjustment of the keyer, etc.) To receive again, place the T/R switch in the receive position.

### **4. SEMI BREAK-IN OPERATION**

The IC-551D has Semi-Break-In CW capability. When keying, the unit is automatically set in the transmit mode. After keying, it is returned to the receive mode, also automatically, after a given transmit-release delay time constant. Leave the T/R switch in the Receive position, and set the VOX switch in the ON (down) position.

The transmit release delay time constant is set by adjusting the VOX DELAY Control located under the access cover. Turning the VOX DELAY Control clockwise will make the transmit release time longer. Set for your keying speed.

## AM OPERATION

### 1. RECEIVING

Set the MODE Select Switch to "AM". Turn the Tuning Knob so that the beat caused with the AM signal carrier becomes a "zero beat".

A incoming AM signal's carrier and lower side band signal are removed with the crystal filter, and the resulting upper side band signal is fed to the detector, the same for SSB detection. Therefore, the other procedures are the same as for SSB reception.

### 2. TRANSMITTING

Set the MIC GAIN CONTROL to the CENTER (12 o'clock) position, and the RF POWER CONTROL to the fully counterclockwise position beyond the "click" (COMP OFF position).

Other knobs and switches are left in the same positions as for receiving. When the T/R switch is moved to transmit, or when the PTT (push to talk) switch on the microphone is depressed, the transmit LED is illuminated and the meter indicates the relative carrier power output. (The maximum carrier output power is set at 40 watts.) By speaking into the microphone, AM (A3H, single side band with full carrier) signals will be transmitted. If you wish to decrease the output power, turn the RF POWER CONTROL clockwise beyond the "click" and adjust to obtain the desire output power of between 0 and 40 watts.

### 3. P.B.T. UNIT AND VOX UNIT

You can use these units the same as in SSB operation. The operating procedures are described in the SSB OPERATION section between page 22 and page 24.

## FM OPERATION (When the optional FM unit is installed.)

### 1. RECEIVING

Set knobs and switches as follows.

MODE SELECT SWITCH	FMs or FMc
VFO SWITCH	A or B
SQUELCH CONTROL	Completely Counterclockwise

Other knobs and switches are set the same as for SSB reception.

Adjust the AF GAIN control to a comfortable listening level of noise, if no signal is present.

Carefully adjust the squelch control clockwise until the noise just disappears, and the RECEIVE indicator goes out. This is the proper squelch threshold setting and must be done when no signal is present. Your transceiver will now remain silent until an incoming signal is received which opens the squelch and lights the RECEIVE indicator. If the squelch is unstable due to the reception of weak or mobile stations, adjust the squelch control further until the proper threshold is obtained.

When the MODE SELECT switch is in the "FMs" position, the multi-function meter indicates the signal strength of the incoming signals and is calibrated in S units and dB over S9. When the MODE SELECT switch is in the "FMc" position, the meter indicates the off set of the incoming signals.

The NOISE BLANKER and the AGC circuits do not actuate in this mode.

## 2. TRANSMITTING

Set knobs and switches as follows.

MIC GAIN CONTROL	Center (12 o'clock) position
RF POWER CONTROL	Completely Counterclockwise (COMP OFF position)

Other knobs and switches are left in the same positions as for receiving.

Turn the T/R switch to TRANSMIT or push the PTT (push to talk) button on the microphone and the transceiver will transmit. At the same time the TRANSMIT indicator will be illuminated red and the multi-function meter will provide an indication of relative power output of the transmitter.

Rotate the RF POWER control while watching the meter needle of the multi-function meter for the desired output power. The output power is adjustable between 1 watt to 80 watts in this mode.

Now, speak into the microphone the same as for SSB transmitting. The VOX circuit also actuates in this mode.

## 3. REPEATER OPERATION

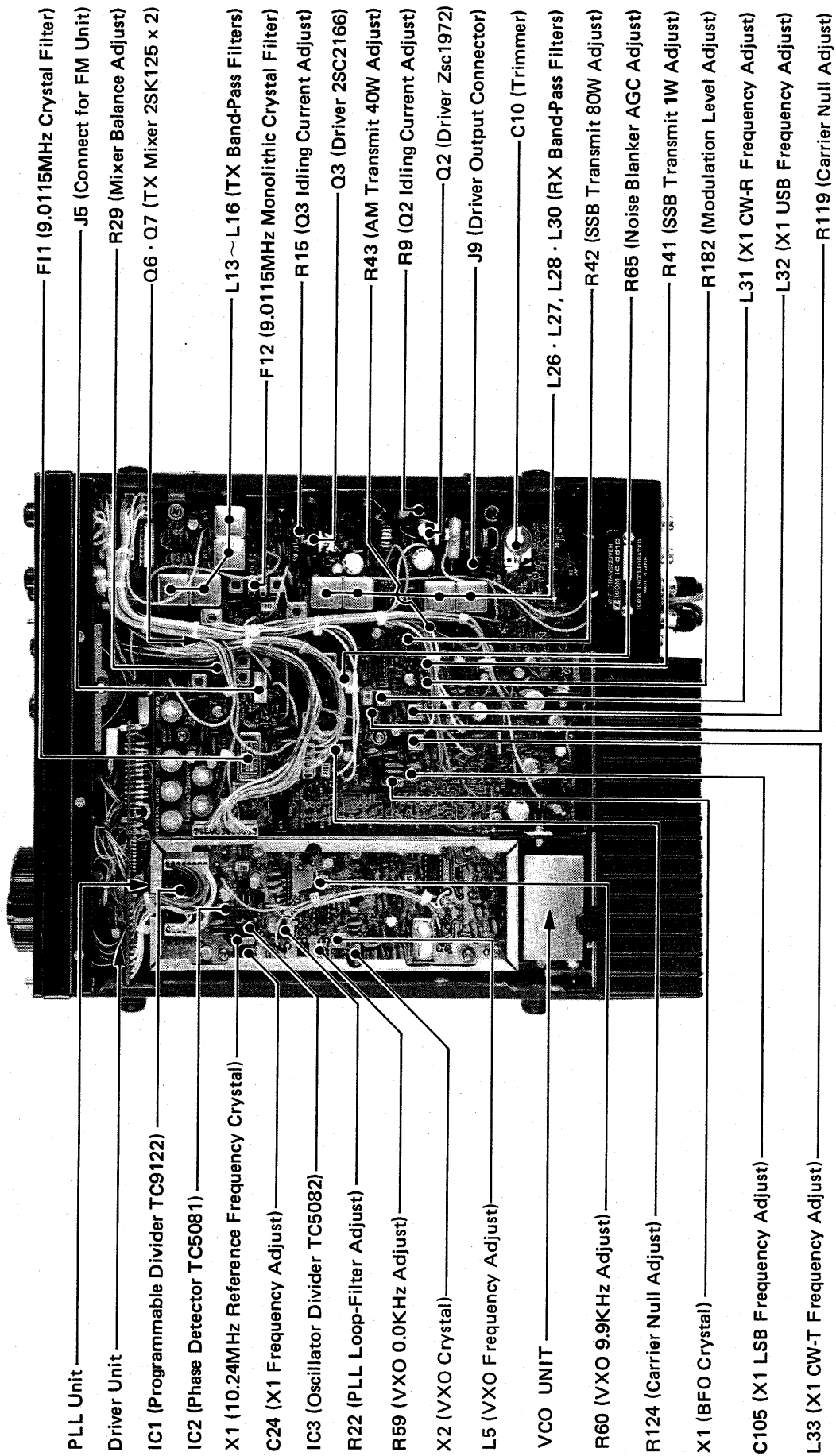
If you desire to access a repeater, first, set the "A" VFO frequency for the desired repeater output frequency and "B" VFO frequency for the input frequency. Then turn the VFO SWITCH to RA-TB position.

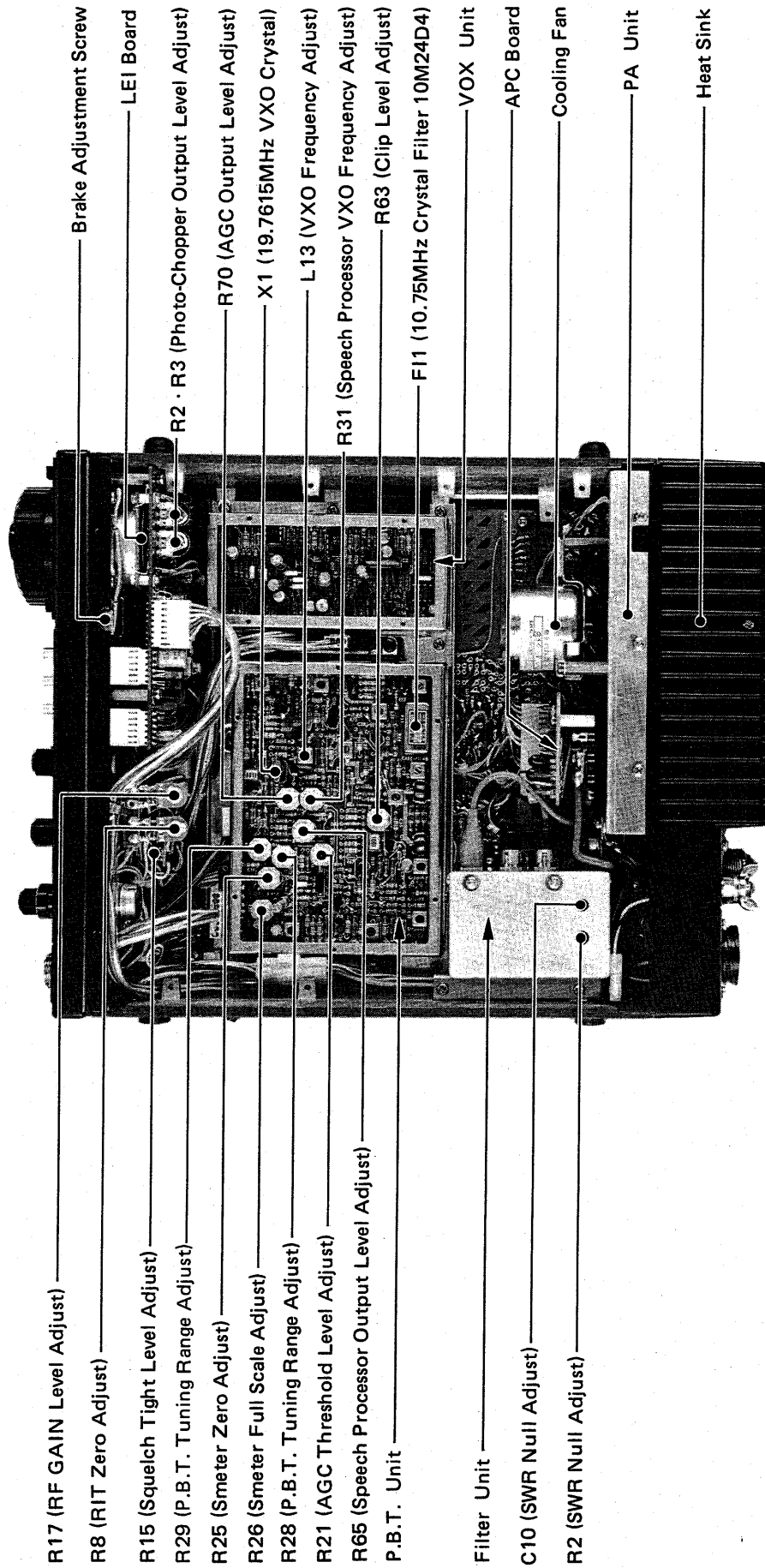
During receive, the set is controlled by "A" VFO and receives on "A" VFO frequency (repeater output frequency).

During transmit, the set is controlled by "B" VFO and transmits on "B" VFO frequency (repeater input frequency). So now you can access the repeater.

If a repeater has reversed input/output frequencies or you desire to listen the repeater input frequency, turn the VFO SWITCH to RB-TA position. Now you will receive on "B" VFO frequency and transmit on "A" VFO frequency.

# SECTION VI INSIDE VIEW





## SECTION VII THEORY OF OPERATION

### OUTLINE

The IC-551D employs a digital phase locked loop (PLL) circuit as the local oscillator for both transmit and receive. The output of the PLL circuit is approximately 9MHz below the receive frequency, thereby spurious is kept to a minimum.

The operating frequency is controlled by pulse signals, generated by the optical chopper circuit located at the tuning knob, being added to or subtracted from the preset frequencies in the micro-computer.

The microcomputer controls the PLL circuit which determines the output frequency of the VCO (Voltage Controlled Oscillator).

In the receiver section, signals from the antenna are mixed with the local oscillator output from the PLL circuit. The circuits function as a triple-conversion type with a 9MHz IF in the SSB, CW, and AM modes with the Pass Band Tuning unit, and as a dual-conversion type with an additional 455KHz IF in the FM mode.

The IF signals are amplified, then detected to become audio signals, amplified again and sent to the speaker.

In the USB and LSB modes, the transmitter uses a carrier of 9.010MHz for USB and 9.013MHz for LSB. The carrier and the voice signal are sent to a balanced modulator where the DSB suppressed carrier signal is generated. The unwanted sideband is removed by a crystal filter, and an SSB signal of 9.0115MHz is obtained.

The Pass Band Tuning unit acts as a low distortion RF speech processor. This enables greater talk power and better results in DX operation.

In the CW mode, the set uses the carrier for USB which is shifted about +500Hz. This carrier is fed to the transmit mixer directly.

In the AM mode, the set uses the carrier for USB. The same 9.0115MHz SSB signal as for USB and a part of the carrier signal is fed to the transmit mixer, and an AM (A3H, single side band with full carrier) signal is obtained.

In the FM mode, the set uses another crystal oscillator to produce the 9.0115MHz signals which are direct-frequency modulated. (Only when the optional FM unit is installed.)

The SSB, CW, AM or FM signal is mixed with the local oscillator output from the PLL circuit, which is the same as that of the receiver section, and then amplified, filtered, and sent to the antenna.

### RECEIVER CIRCUITS

#### ANTENNA SWITCHING CIRCUIT

Signals from the antenna connector are fed to the two-stage helical cavity filter L29 and L30, through T/R relay RL1 which are turned ON in the transmit mode, and through J3 the receiver antenna output terminal and J4 the receiver input terminal.



## RF CIRCUIT

Filtered signals from the double-helical cavity filter, which reduces interference and intermodulation from other radio signals or nearby signals, are fed to the bridge attenuator consisting of L28, D23, C95 and C96. RF gain control and AGC voltage is added to diode D23, which changes the balance of the bridge to control the input signal level. Signals then are amplified by the low-noise, wide dynamic range FET Q19 and then sent to the gate of the first mixer Q18 through the two-stage band pass filter L26 and L27. To the source of the high quality FET mixer Q18, a 40MHz signal is supplied from the PLL unit through D22. The 9.0115MHz signals are taken from Q18 and tuned by L25 and C89.

## IF CIRCUIT

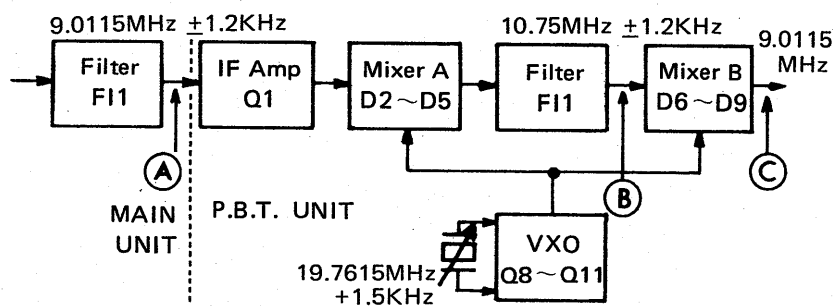
9.0115MHz 1st IF signals from the drain of Q18 are fed to the 1st gate of the dual gate MOS FET Q16, through monolithic crystal filter F12 and the impedance-matching coil L22. AGC voltage is supplied to the 2nd gate of Q16 to improve the receiving characteristics.

The output signals from Q16 are also fed to the external scope terminal through the source follower Q17. Signals amplified by Q16 are fed through L21, L20 and D21 to the FM Unit through D14 in the FM mode, and to the high-selectivity 4-stage monolithic crystal filter F11 through D13 in the SSB, CW and AM modes. In the SSB, CW and AM modes, D10 and D11 are turned ON and the signals are fed to the source follower Q11. These output signals are fed to the Pass Band Tuning circuit through J3 and P1 of the unit.

## PASS BAND TUNING CIRCUIT

A VXO circuit composed of Q8~Q11, X1 and D16 in the P.B.T. unit. The bias voltage of D16 is changed by turning the Pass Band Tuning control, located on the front panel, which varies the VXO frequency (19.7615MHz) by  $\pm 1.5$ KHz. The signals from P1 are fed to Q1 through D18, D1 and L1. The amplified signals are fed to the balanced mixer, D2~D5, where the 9.0115MHz signal is mixed with the 19.7615MHz VXO signal. From the balanced mixer, the resultant 10.750 MHz signal is fed through F11, a high-selectivity 4-stage monolithic crystal filter having a center frequency of 10.750MHz and a band width of  $\pm 1.2$ KHz. This 10.750MHz signal is then again mixed with the VXO frequency, to result in the original 9.0115MHz signal to be fed to the IF amplifier circuit.

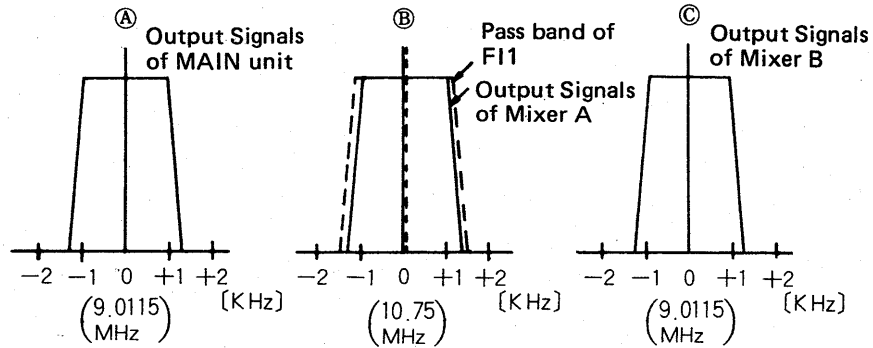
The diagrams will explain the operation of the Pass Band Tuning in more detail.



In the diagrams, "A" represents the 10.750MHz signals that are the result of mixing of the 9.0115 MHz input signals with the 19.7615MHz VXO signal in the Mixer A. These 10.750MHz signals are represented by the solid line. The dotted line represents the pass band of the crystal filter, F11 in the P.B.T. unit. With the Pass Band Tuning control in the center position, signals between 9.0127 MHz and 9.0103MHz ( $9.0115 \pm 1.2$ KHz), when mixed with the VXO center frequency (19.7615

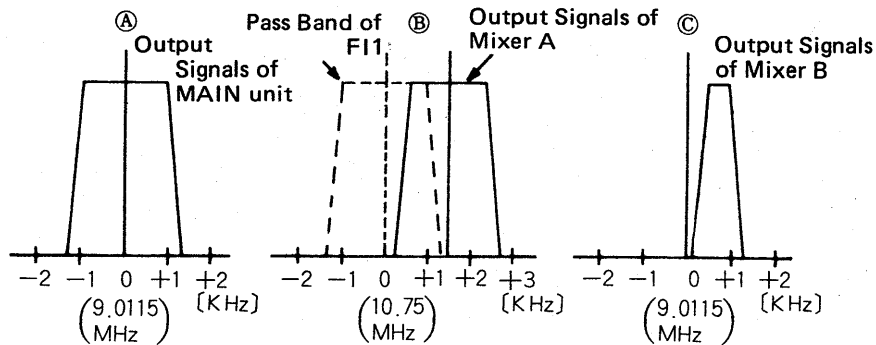
MHz) result in signals of 10.7512MHz to 10.7488MHz ( $10.750\text{MHz} \pm 1.2\text{KHz}$ ), all signals will pass through the filter.

**A : P.B. TUNE centered**



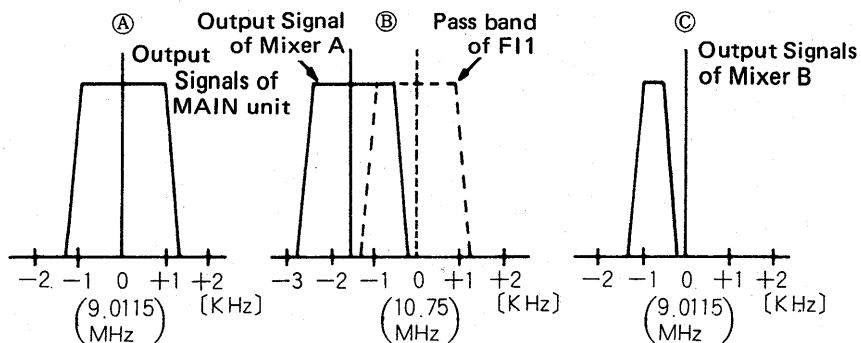
Turning the Pass Band Tuning control fully clockwise, the VXO frequency will become 19.7630 MHz ( $19.7615 + 1.5\text{KHz}$ ). When mixed with the incoming 9.0115MHz signals, the resultant frequencies become 10.7503MHz to 10.7527MHz. Since the upper frequency pass band limit of the filter is 10.7512MHz, not all the signals will be passed by the filter. Only the signals between 10.7503MHz and 10.7512MHz, the upper limit, will be passed. As you can see, the pass band has been narrowed to 900Hz to one side of the center frequency of the filter. Therefore, all signals outside the 10.7503MHz to 10.7512MHz range will not pass through the filter.

**B : P.B. TUNE fully clockwise**



By turning the Pass Band Tuning control in the fully counterclockwise position, the VXO frequency becomes 19.760MHz. The 10.750MHz signals from the mixer A will be from 10.7497MHz to 10.7473MHz. Again with the 10.7512MHz to 10.7448MHz pass band width of the filter, not all signals will be passed. Only those between 10.749MHz to 10.7488MHz will be passed. Again, the pass band has been narrowed to 900Hz and offset to the opposite side of the center frequency of the crystal filter.

**C : P.B. TUNE fully counterclockwise**



The signal which has passed through the pass band tuning circuits is amplified by a three-stage amplifier consisting of dual-gate MOS FET's Q2, Q3 and Q4. These amplifiers provide high gain and high stability, and the IF coils L9, L10 and L11 reject interference from outside the IF pass band and other wide-range noise. AGC voltage is supplied to the 2nd gate of the amplifiers for a wide AGC range.

IF signals amplified by Q2, Q3 and Q4 are rectified by the double voltage rectifier D10 and D11 and filtered by C18. This DC voltage is fed to the differential amplifier Q5 and then amplified by Q6 before being supplied as the AGC voltage. This AGC voltage is also fed to Q16 and the attenuator D23 on the main unit.

The amplified IF signal is then sent to the detector circuit.

### **SSB, CW, AM DETECTOR CIRCUIT**

Signal from the IF amplifiers is fed to Pin 5 of the balanced modulator, IC3, through P1 of P.B.T. unit, J3 and C185. BFO signal is supplied to Pin 7 and the audio output signal appears at Pin 3.

### **BFO CIRCUIT**

The BFO circuit consists of an oscillator Q20, a buffer Q21 and crystal X1. To shift the oscillating frequency according to the operating mode, the total inductance of L31, L32 and L33 is changed by supplying a voltage to an anode of the switching diodes D24, D25 and D26, depending on the operating mode.

### **AF CIRCUIT**

Demodulated signals from IC3 are fed from Pin 3 of IC3 to Pin 2 of the AF amplifier IC1 through C152, R164 and R115. The level of the output signals from IC1 is controlled by the AF GAIN control variable resistor on the front panel and then fed to Pin 1 of the AF amplifier IC4 to obtain enough power to drive the speaker.

In the transmit mode, Pin 1 of IC4 is shunted through R156 by turning ON Q33. In the SSB and AM modes, while transmitting, +9V is supplied to Pin 2 of IC4 to control the amplification by changing the bias voltage.

### **NOISE BLANKER CIRCUIT**

Signals amplified by the IF amplifier Q16 are coupled by C92. Noise signals are amplified by IC2 and rectified by D19. A part of the rectified signals is integrated by C67 and R63, then amplified by Q14 and Q15, and supplied to IC2 as its AGC voltage. The other part of the rectified signals is fed to Q13, which is a Darlington transistor with a large DC gain. The emitter of Q13 is at the ground level when the noise blanker is turned ON.

When a pulse noise is received the positive part of the pulse turns ON Q13 and Pin 1 of IC8 is grounded through Q13. This acts as a trigger for the monostable multivibrator, IC8. IC8 generates a negative pulse which depends on the time constant of C63 and R71. D20 and D21 are biased by the negative pulse so that the pulse signal (noise) cannot go through L20. C78 and the capacitance caused by turning OFF D21 functions as an attenuator to improve the isolation when noise is received.

## **TRANSMITTER CIRCUITS**

### **MICROPHONE AMPLIFIER AND LIMITER CIRCUIT**

Audio signals from the microphone are fed to Pin 6 of the audio amplifier IC5/2. Amplified signals appear at Pin 7 and are sent through C172 and J4 to the MIC GAIN control variable resistor on the front panel. Adjusted signals are fed to Pin 2 of IC5/1 through C171, D45 and C170 in the FM mode, as D45 is turned ON by the voltage supplied through R188; and through C171, D44, C169 and R184 in the SSB and AM modes, as D44 is turned ON by the voltage supplied through R187. IC5/1 functions as a limiter amplifier in the FM mode. In the SSB and AM modes, since the input level is approximately 10dB lower than in the FM mode, because of R184, IC5/1 functions as a normal amplifier.

### **BALANCED MODULATOR CIRCUIT**

In the SSB and AM modes, the amplified audio signals from Pin 1 of the audio amplifier IC5/1 are fed to Pin 5 of the balanced modulator IC3 (same as the receiver detector), through C164 and R182 level adjust trimmer. The BFO signal is fed to Pin 7, resulting in a 9.0115MHz suppressed carrier double side band signal brought out from Pin 3.

In the CW mode, a voltage is applied to D17 and D16 through D51, then D17 and D16 are turned ON, therefore the BFO signal from Pin 7 of the IC3 is fed to the transmit mixer circuit.

The keying control is done by stopping the oscillation of the BFO. During key up, a voltage is applied to the source of Q20, BFO oscillator, through R128, R127 and D30. Thus the BFO oscillation is stopped, and therefore no RF output. During key down, the applied voltage is shunted to ground through D29, thus the source voltage of Q20 becomes normal and the BFO starts oscillating.

### **TRANSMIT IF AMPLIFIER CIRCUIT**

When the RF POWER CONTROL is in COMP OFF position, DSB signals which appear at Pin 3 of IC3, are fed to the gate of Q12 through D17, D27, D19 and D20 on the Pass Band Tuning unit. The DSB signals are amplified by Q12, and then fed to F11 through the switching diodes D9 and D11. DSB signals are converted to SSB signals by the filter and sent to the transmit mixer circuit through D13, R61 and D8. In the AM mode, BFO signals from Pin 7 of the balanced modulator IC3 are fed through C69, R66, D16, D17 and D8 to the output of F11 and mixed with SSB signals to generate AM (A3H) signals.

When the RF POWER CONTROL is turned clockwise to turn ON the speech processor circuit, the DSB signals are fed to the 1st gate of Q1 on the Pass Band Tuning unit through D17, D27 and D1. This DSB signals are amplified by Q1 and fed to the balanced mixer consisting of D2 ~ D5, where it is mixed with the VXO output frequency of 19.7615MHz. It passes through the crystal filter F11 and becomes an SSB signal of 10.750MHz. This signal is mixed with the VXO output at another mixer consisting of D6 ~ D9 again to become an SSB signal of 9.0115MHz, amplified by Q2, Q3 and Q15, and passed to D25 and D26. D25 and D26 are the limiting circuit, and it clips signals above a fixed level.

Q14 is the clip level control circuit. The clipping current of D25 is applied to Q14's base, and amplified the voltage of Q2's 2nd gate is controlled by Q14's output, and controls Q2's gain and fixes the clip level. The clip level is adjustable with R63 and the output level is adjustable with R65. Some splatter is included in the output signal which has passed through the limiter circuit,

but this is completely removed by the crystal filter F11 on the MAIN unit, and the final signal is a clean and powerful SSB signal.

### **TRANSMIT MIXER CIRCUIT**

High quality FET's Q6 and Q7, and coils L17 and L18 work as a double-balanced mixer to provide low spurious generation and excellent mixer characteristics. The local oscillator signals are supplied to L18 through D7 from the PLL circuit and mixed with the AM, SSB or CW signals fed through D8 from F11. Both added and subtracted frequencies are generated by this mixer, but only the signals of the added frequency are filtered through the transmit band-pass filter L15 and L16.

### **BUFFER AMPLIFIER CIRCUIT**

The filtered 50MHz signals, supplied to the first gate of the dual-gate FET Q5, are amplified to approximately 10mW PEP. The second gate is controlled by the ALC in the SSB mode and by the APC in the FM mode. The output of this buffer amplifier is sent through the transmit band-pass filter L13 and L14 to the other buffer amplifier Q4, whose output level is approximately 200mW PEP. L11 and C35 work as a trap for the local oscillator signals.

### **DRIVER CIRCUIT**

The output signals of Q4 are amplified by Q3 up to approximately 1.5W PEP. D5, which is connected to the base circuit of Q3, is for temperature compensation to stabilize the bias voltage. The idling current is controlled by R15 to eliminate cross-over distortion.

The signals from Q3 are amplified by Q2 to obtain 10W PEP. The heat from Q2 is transmitted to the diecast chassis which radiates the heat very efficiently. D4 is for the bias voltage stabilization, and the idling current is controlled by R9. The output signals of Q2 are tuned by C10 and fed to the PA unit through J9 and P1 of the PA unit.

### **POWER AMPLIFIER CIRCUIT**

The 10 Watt signal from the exciter stage is amplified class B push-pull in the final amplifier stage transistors, Q1 and Q2 of the PA unit to a level of about 80 Watts. Bias voltage is treated by D1, D2 and Q3. The junction voltage of D1 and D3 is amplified by Q3 and applied to the bases of Q1 and Q2, from the emitter of Q3, for the bias voltage.

The thermo-switch is set at near the PA transistors, and the thermo-switch is turned ON when the temperature of the PA transistors is over 80°C and the buzzer beeps for warning to stop transmitting.

The PA unit has the cooling fan to increase the efficiency of the heatsink. The cooling fan is selectable to turn in the transmit mode only or to turn in either the transmit mode or the receive mode.

The 80 Watt signal is fed to the filter circuit.

### **LOW-PASS FILTER CIRCUIT**

The PA output is fed to two section low-pass filters which serve to attenuate harmonics by more than 60dB in order to get a pure transmit output. This signal is fed to the ANTENNA connector through contacts of the T/R relay which is made in the transmit mode and SWR pick up coil L3, J3 and P6.

## APC/ALC CIRCUIT

This circuit stabilizes the output power, even when the power voltage or the antenna load is fluctuating, and sets the output power between 1 and 80 watts. The variation in the collector current of Q2 is detected at R6 and amplified by differential amplifier IC1/1. The output voltage from Pin 7 of IC1/1 is fed to the second gate of Q5 to stabilize the RF output power. In the SSB mode, when output signals are higher than the saturation level, Q8 and Q9 are turned ON, C54 is charged up, and R33 and R36 are set in parallel to control the ALC voltage level. In the AM mode, Q10 is turned ON and the RF output is set at 40 watts by R43. The ALC time constant is set by C41 and R22, and D6 shortens the attack time. The APC/ALC signals are applied to the accessory socket on the rear panel through D46, D48 and C17.

L3 of the Low-Pass Filter circuit is an SWR pick up coil, and D1 and D2 are the detection diodes. The voltage of a traveling wave is detected by D1 as a positive DC voltage, and a reflected wave is detected as a positive DC voltage by D2. They are fed to IC2 and compared there voltage ratio. When VSWR is over 3:1, the ALC voltage is put out at Pin 1 of IC2. The ALC voltage is fed to the 2nd gate of Q5 through D46 and D48, and the driving power to the final PA stage becomes low and protects the PA transistors.

## VOX CIRCUIT

A new time delay device is used in the VOX circuit. It is a low-noise, no-loss BBD (Bucket Brigade Device) and its maximum time delay is about 50 milliseconds.

The BBD has 1024 stages and each stage, consisting of a MOS FET and a capacitor, transfers electric charges corresponding to the input level from one stage to the next by the clock pulse. This delayed audio signal is fed to the transmitter and the direct signal from the microphone amplifier is fed to VOX circuit.

Thus receive to transmit change over time is negligible and it provides smooth VOX operation. In the SSB, AM and FM modes, the audio signal from the microphone amplifier through J4 of the main unit and P1, is fed to the input terminal Pin 3 of IC4 and time-delayed during the time which the signal is transferred between 1024 bucket stages. IC5 is the clock pulse generator for the BBD and oscillates about 10KHz. The output signal is fed to the low-pass filter to remove the clock pulse signals and amplified by 1/2IC3. The amplified signal is fed to the MIC GAIN control through P1 and J4, and applied to the transmitter section. A part of the output signals of the microphone amplifier is fed to the amplifier IC1 through R152 VOX GAIN control and J4 in the main unit and P1.

The amplified signal is fed to the base of VOX detector transistor Q1. The output of the emitter is supplied through R15 to one of the bases of a dual transistor Q3, the collector of which is connected to the DC switching circuit Q4 and Q5.

When you speak to the microphone, Q5 turns ON and the set is turned in the transmit mode. C6 and R12, and R140 VOX DELAY control on the MAIN unit compose a circuit to determine the time constant to the VOX circuit.

The VOX circuit provides the ANTI-VOX circuit to prevent the set turns in the transmit mode with sounds from the speaker.

A part of the output signals of the AF power amplifier is fed to the amplifier 1/2IC3 through R138 ANTI-VOX GAIN control and J4 in the main unit and P1. The amplified signal is fed to the

base of ANTI-VOX detector Q2 and its output of the emitter is supplied to the other base of Q3. The emitter voltage of Q3 is changed to ground level by turning ON Q3 to cancel the VOX signals.

In the CW mode, the keying signal is fed to the base of Q10 through R33 and keys the input terminal of the BBD, IC4.

The time-delayed keying signal, the output signal of IC4 is fed to the base of Q7 and switches Q6 corresponding to keying. The collector of Q6 is connected to the transmitter's keying circuit through P1 and J4 in the MAIN unit. A part of the keying signals is fed to the base of Q9.

When key down, Q9 is turned ON and charges up C13 rapidly and also Q8 is turned ON. The collector of Q8 is connected to the base of Q4 and Q5 is turned ON the same as SSB VOX operation. Thus the set is turned in the transmit mode with the keying, C13 and R30, and R137 CW DELAY control in the MAIN unit compose a circuit to determine the time constant to the CW break-in circuit.

In the CW mode, +9V is applied to the base of Q11 and Q11 is turned ON and shunts the voice signals fed to the input terminal of the BBD, IC4.

#### **CW MONITOR CIRCUIT**

Phase oscillator Q34 oscillates at approximately 800Hz. The positive line of the key jack is connected to the base of Q35 through R178. When the key is up, Q35 is ON and Q34 is OFF, when the positive line is grounded by keying, the base of Q35 is grounded and turned OFF, and Q34 is turned ON to oscillate. The oscillator signals are fed to Pin 1 of AF amplifier IC4 through the level adjust resistor R172, C157 and R163.

#### **METERING CIRCUIT**

In the receive mode, the meter functions as an S-meter. The source voltage of Q24 drops according to the AGC voltage applied to the second gate of each IF amplifier. The voltage drop controls the base of Q27 for S-meter operation.

In the transmit mode, the meter functions as a relative RF power meter. The detected traveling wave voltage of D1 in the low-pass filter unit is fed to the meter through R19 and R20. R19 is the meter sensitivity adjust trimmer.

#### **SQUELCH STOP CIRCUIT**

This circuit provides signals to stop the scan operation by use of the squelch signal in the FM mode and the S-meter signals in the SSB, AM or CW mode. In the SSB, AM or CW mode, the S-meter signals are fed from the collector of Q27 through R198 to Pin 2 of IC6/2. The voltage set by SQL control R7-2 on the front panel is applied to Pin 3. IC6/2 functions as a comparator. When the voltage at Pin 2 becomes higher than the voltage set at Pin 3 the level at Pin 1 is changed to ground level (L-level), and that of Pin 7 of IC6/2 is switched to the H-level, which is sent to the Driver Unit as the stop signal. During the scan operation, the voltage at Pin 3 stays below the set voltage so that Pin 1 is at the H-level, which turns ON Q33 through D43. Q33 grounds the center tap of AF control resistor R1-1 on the front panel so that IC4 is cut off to quiet the audio signals. When the unit is set in the transmit mode during the scan operation, the voltage from the RF-level detector is supplied to Pin 2 of IC6/2 through R198, Pin 1 is switched to the ground level, and Pin 7 of IC6/2 puts out the H-level to the Driver Unit to stop the scan operation.

## **POWER SUPPLY CIRCUIT**

Regardless of whether the transceiver is switched to the receive mode or not, power is always supplied from a constantly activated source to the receiver AF amplifier, the transmitter microphone amplifier circuits and VOX circuit BFO and CW monitor circuits are supplied through the mode switch. This power source supplied current through R143 and zener diode D38, producing a regulated voltage of about 9.2V. This corresponds to the reference voltage of D32's cathode, and is applied to the base of Q29, resulting in a regulated voltage of about 9V which is taken out at the emitter of Q29.

The power source which is operative during reception supplies voltage to the RF amplifier, mixers, 1st stage of the IF amplifier, and SSB IF, Pass Band Tuning, and FM IF (In the optional FM unit) circuits through the mode switch. Similar to the constantly activated source in the receive mode power circuit, current flows through R142, D37 and D38. A reference voltage is supplied to the base of Q28 and regulated voltage is taken from the emitter of Q28.

The power source which is in operation during transmit supplies power to the 9MHz oscillator (In the optional FM unit), transmit mixer, IF amplifier, pre-driver and driver bias circuits, and exciting amplifier circuit.

Similar to the receive mode power circuit, in the transmit mode power circuit current flows through R146, D39, and D38. A reference voltage is supplied to the base of Q30, and regulated voltage is taken out from the emitter of Q30.

The ALC control circuit, driver amplifier, power amplifier, AF power amplifier and noise blanker circuits are supplied directly with 13.8V DC.

If the DC power supply is connected with polarity reversed, the equipment is protected. Since D4 and D5 become forward biased, a large current flows and causes the fuse in the external DC power supply cord to blow.

During reception, since the microphone push-to-talk (PTT) switch is OFF, there is no flow of current through D35, D36 and D41, receive power supply becomes operative, and receive +9V is obtained. A voltage is supplied through R148 and D40 to the base of Q32 and turns Q32 ON. The base of Q30 is connected to ground through Q32, and so the transmit power supply is inoperative, and the transceiver is set in the receive mode.

During transmission, the PTT switch is ON, Q28's base is connected to ground through D36, and the output voltage of the receive power supply becomes zero. D35 connected to the emitter of Q28 rapidly discharge voltage stored in the receive circuit capacitor to prevent receiver and transmitter from functioning simultaneously during switching. At the same time, Q32 is turned OFF, as its base is connected to ground through D41, and so the D32 reference voltage is applied to the base of Q35 through D39, +9V is obtained from the transmit power supply, and the transceiver will transmit.

## **PLL (PHASE LOCKED LOOP) UNIT**

### **LOCAL OSCILLATOR CIRCUIT**

This circuit is for the oscillation, in 100Hz steps, of the lowest two digits (0.0~9.9KHz) of the VCO output frequency of the PLL circuit. It consists of Q3 oscillator, and Q4 frequency doubler.



The crystal unit X2, a special VXO (Variable Xtal Oscillator) crystal, is connected to Q3's base and oscillates at about 18.010MHz. The oscillating frequency is altered in 100Hz steps by the voltage supplied to the anodes of D3 and D4 from the D/A (Digital to Analog) converter through IC6/2 operational amplifier. The 18MHz signal is doubled at Q4, thus the local oscillator output between 36.0185MHz and 36.0284MHz is obtained. The cathodes of D3 and D4 are connected to the RIT switch control Q13 and Q14 through the bias network R68 ~ R71.

When the set is in the transmit mode or the RIT is turned OFF, both Q13 and Q14 are turned ON and R68 is connected to ground through Q14. Thus a fixed voltage divided by R71, R69 and R68, is applied to D3 and D4.

When the set is in the receive mode and the RIT is turned ON, both Q13 and Q14 are turned OFF, and R68 is connected to the RIT control. A DC voltage from the RIT control is applied to D3 and D4, and the oscillating frequency will be shifted approximately  $\pm 800\text{Hz}$ . Q13 prevents Q14 from reverse flow caused by the diode phenomenon between the base and collector when negative voltage is supplied to the collector of Q14.

### MIXER, LOW PASS FILTER, AND AMPLIFIER CIRCUIT

The output signals from the local oscillator circuit and the VCO signals are mixed by the double balanced mixer IC5. The output signals are fed to the low-pass filters to filter out only the signals below 15MHz. The output signals from the filter are amplified to the proper drive level (more than 3Vp-p) of the programmable divider IC1 by IC4 and Q5. Then the signals are fed to Pin 2 of IC1 through C14.

### PROGRAMMABLE DIVIDER CIRCUIT

The input signals at Pin 2 of the programmable divider IC1 are divided by the BCD input signals at Pins 3 ~ 14.

The programmable divider is also called the 1/N counter and the BCD input is N. The relationship between the display frequency and the divide number N is as follows:

$$\text{BCD code (N)} = (\text{display frequency of 10KHz and above}) - 5000 + 497$$

Example: 50.3239MHz       $N = 5032 - 5000 + 497 = 529$

The output signals (10KHz signals) from Pin 17 of the programmable divider are sent to phase detector IC2.

### REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator IC3 consists of a crystal oscillator and a highspeed divider. X1 oscillates at 10.24MHz, which is divided by 1024. The 10KHz reference frequency is fed from Pin 17 to Pin 8 of phase detector IC2. This 10KHz reference frequency decides the variation step of the PLL output frequency and the divide number N decides the PLL output frequency.

$$\text{PLL output freq.} = \text{local oscillator freq. (MHz)} + 0.01\text{MHz (the reference freq.)} \times N \text{ (divide number of programmable divider)}$$

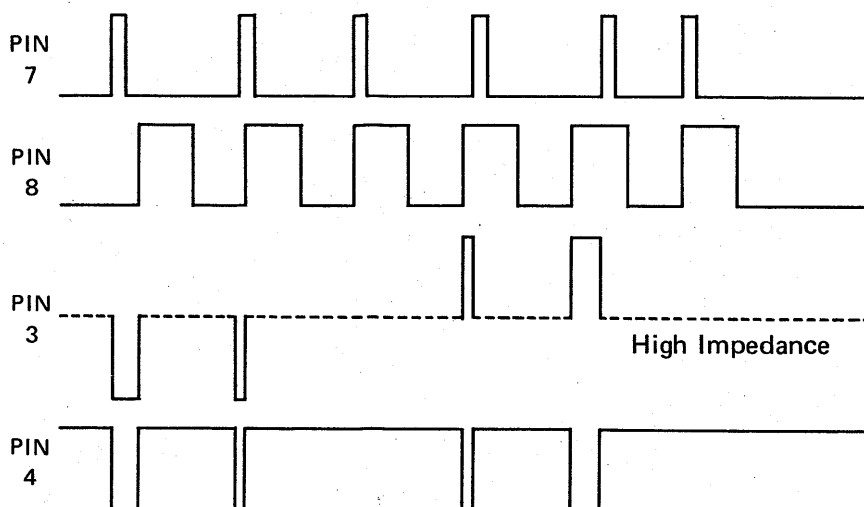
When the last two digits of the display frequency are changed from 0 to 9.9KHz, the local oscillator frequency is changed from 36.0185 to 36.0284MHz. When the display frequency reaches 10.0KHz, the local oscillator frequency is set back to 36.0185 and 1 is added to N. Thus the frequency change by 10KHz steps is set by the divide number N and the frequency change below 10KHz

steps is set by the 100Hz-step variation of the local oscillator (VXO) frequency.

### PHASE DETECTOR AND LOOP FILTER CIRCUIT

Digital phase detector IC2 detects the phase difference of the pulse signals at Pin 7, the 10KHz reference frequency, signal and Pin 8, the output signal of the programmable divider, and proportionately puts out positive/negative pulse signals at Pin 3, which become high impedance when the PLL is locked. Pin 4 is for detecting the lock failures and changes to ground level according to the phase difference of the two pulse signals.

#### INPUT/OUTPUT WAVE FORMS OF PHASE DETECTOR IC2



The loop filter, consisting of R21, R22 and C26, converts the pulse signal from Pin 3 into a DC voltage and decides the response time of the whole loop. (R22 is for dumping adjustment.) The output signals are fed to tuning diode D1 of the VCO unit as the control voltage for the VCO frequency set.

A part of the output voltage of the loop filter is fed to noninverting amplifier IC6/1 and amplified. The output signal is fed to D2 of the VCO unit to preset the VCO frequency near the desired frequency.

### BUFFER AMPLIFIER CIRCUIT

The VCO output signals are fed to buffer amplifier Q8. They are then fed to Pin 11 of mixer IC5, and to buffer amplifiers Q6 and Q7, of which the output signals are fed through the low pass filter, consisting of L2, C51, C52 and C53, to the transmit and receive mixers in the Main Unit.

### LOCK FAILURE DETECTOR AND MUTE CONTROL CIRCUIT

When the lock fails, the pulse signal from Pin 4 is integrated by R18 and C18. When the integrated signal level exceeds the junction voltage of Q1's base, Q1 is turned ON and then Q2 is turned ON. The collector of Q2 is connected to the base of Q6, so the base voltage of Q6 becomes ground level, and Q6 and Q7 are shut OFF to prevent transmitting unwanted signals.

### POWER CIRCUIT

The PLL Unit has +8V and -8V regulated power circuits. When the power is turned ON, a current flow charges C61 through the emitter and the base of Q9. This turns Q9 ON, and regulator IC7 puts out a regulated 8V, which is then divided by R52 and R53 and fed to the base of Q10 to turn

Q10 ON. The voltage at the emitter of Q10 becomes approximately 0.6V below the voltage at the base of Q10. Thus the input voltage of regulator IC7 is regulated at the total of the zener voltage of D2 and the emitter voltage of Q10. When the input voltage of IC7 varies, the emitter voltage of Q10 varies because the zener voltage is stable. The variation in the voltage controls Q9 by controlling the base current of Q9. Thus the input voltage of IC7 is regulated.

-10V is supplied from IC18 DC-DC converter of the Driver Unit to the emitter of Q12 to obtain a regulated -8V. When the voltage varies from -8V, the collector current of the half of Q11 having R54 and R55 varies. Q11 works as a differential amplifier, so the collector current flows into the other half of Q11 and this flow controls Q12 to regulate -8V.

### VCO UNIT

The VCO (Voltage-Controlled Oscillator) is a Colpitts circuit, using Q1, and oscillates in the 40MHz range. The oscillation frequency is controlled by a DC voltage which is supplied from the loop filter in the PLL unit to varactor diode D1 and from IC6/1 in the PLL unit to varactor diode D2, inserted in parallel with the oscillation coil.

The oscillator output is taken from the source of Q1, and fed to buffer amplifiers in the PLL unit to become the local oscillator signal for the transmitter and receiver, and to get a DC-voltage to control the frequency of the VCO.

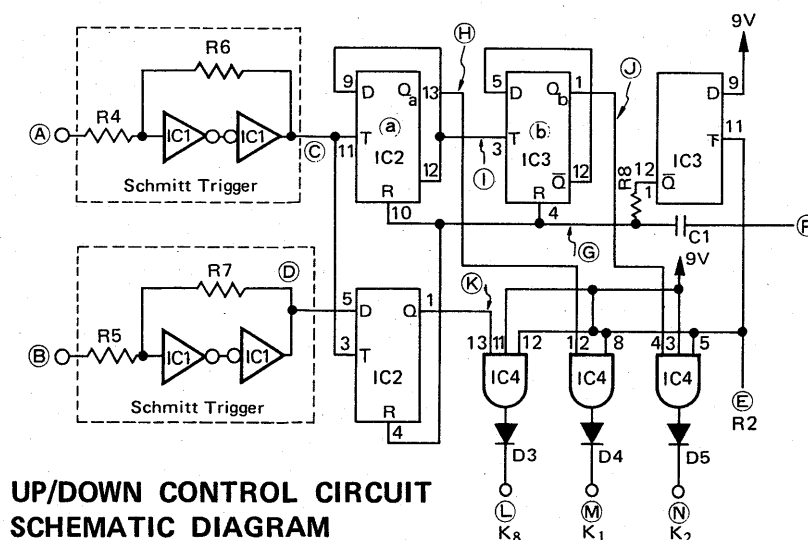
D2 presets the VCO frequency near the desired frequency so that the voltage effect to D1 is reduced insuring a very pure output signal.

### DRIVER UNIT

The frequency control of the set is controlled with a microcomputer which contains ICOM's original programs. The microcomputer provides various operating capabilities.

### CLOCK PULSE GENERATOR AND UP/DOWN CONTROL CIRCUIT

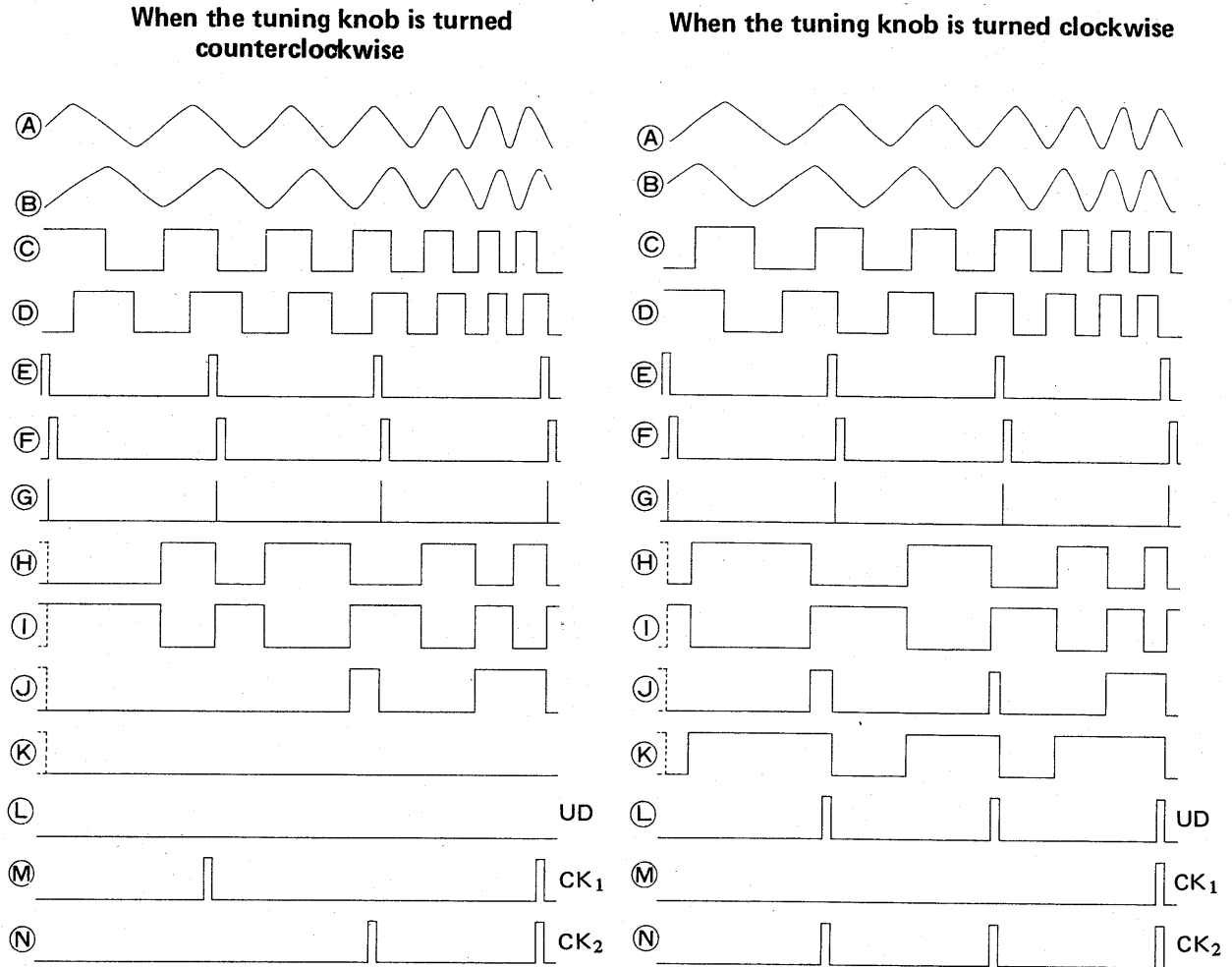
D1 and D2 are infrared LED diodes and Q1 and Q2 are the photo transistors. D1 sends a continuous light source to Q1 and D2 sends it to Q2. Between the diodes and the transistors is a windowed chopper disk which is connected directly to the shaft of the tuning knob. The diodes and photo transistors are set up so that a phase difference of 90 degrees results when the disk revolves.



As these 90 degree out of phase signals are similar to a sine wave, the signals are converted into logic level signals which have very short rise and fall times by the Schmitt trigger circuits of IC1.

With the logic level signals, clock pulse signals (CK1, 2) and UP/DOWN signals (UD) are generated by the UP/DOWN control circuit.

### TIMING CHART



The flip-flop of Ⓐ (1/2 IC2) and Ⓑ (1/2 IC3) functions as a quad counter and stores the data (0-3) according to the dial rotating speed.

Qa	Qb	Data
L	L	0
L	H	1
H	L	2
H	H	3

L = 0V  
H = 9V

When the power is turned ON, the counter programmed in the CPU sets the operating frequency at 50.1MHz in any mode and sets all of the memory channels at 51.0MHz. Then pulse signals are fed to R2 Ⓔ and R7 Ⓕ of the CPU and clear the necessary flip-flop. Also, when data between 0 and 3 is latched by the pulse signal generated by revolving the tuning knob, the gate of IC4 is controlled, synchronizing with the output signal from R2 Ⓔ of the CPU, and the datum between 0 and 3 is

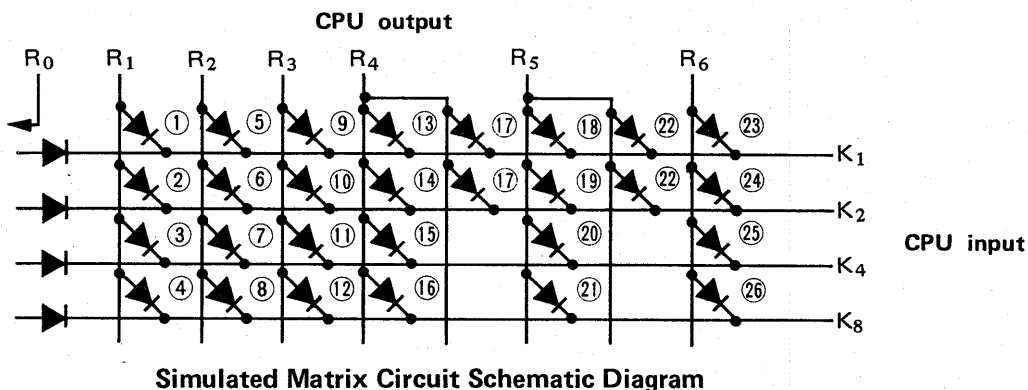
fed through D4 and D5 to the K1 (M) and K2 (N) terminals of the CPU. At the same time, an UP or DOWN signal (UD) is fed through D3 to the K8 (L) terminal. The output of D3 becomes H-level at the UP count and L-level at the DOWN count. K1 and K2 data are added to or subtracted from the preset frequency (50.1MHz) according to the UP/DOWN signal.

In other words, addition or subtraction functions are made according to the data read from the pulse interval of R2 and this operation is repeated after each clearance made by the pulse signals from R7.

### CPU CONTROL CIRCUIT

The CPU in the unit is a 4-bit CPU and the input terminals are K1, K2, K4 and K8 only.

Since the CPU can not make many functions with the small number of K input signals, to increase the functions of the CPU, scanning R output signals (R0 ~ R6) are fed to K input terminals through the matrix circuit as shown in the figure below. The CPU reads the relationship of R output and K input signals to decide the function as follows:



- ① **R1 → K1 (VFO A)**  
This flow occurs when the VFO select switch is set at "A", and the unit operates at the frequency set by "A" VFO.
- ② **R1 → K2 (VFO B)**  
This flow occurs when the VFO select switch is set at "B", and the unit operates at the frequency set by "B" VFO.
- ③ **R1 → K4 (MS)**  
This flow occurs when the VFO select switch is set at "MS". In this setting, when the flow of ⑫ occurs, the three memory channels are scanned in the order of 1, 2, 3, 1, 2, 3, . . . with the flow of ⑰ as a clock.
- ④ **R1 → K8 (A → B)**  
This flow occurs when the VFO select switch is set at "A → B". The data in the "A" VFO is input to the "B" VFO and the "B" VFO frequency becomes equal to that of the "A" VFO.
- ⑤ **R2 → K1 (COUNT 1)**
- ⑥ **R2 → K2 (COUNT 2)**  
The signals of ⑤ and ⑥ express the data between 0 and 3 to add or subtract.

- ⑦ **R2 → K4 (DIAL LOCK)**  
This flow occurs when the dial lock switch is set in the lock position.
- ⑧ **R2 → K8 (Frequency UP)**  
This flow occurs when the frequency is moved up by turning the tuning control knob. When the frequency is moved down, the R2 signal is not fed to K8.
- ⑨ **R3 → K1 (Memory 1)**  
This flow occurs when the VFO select switch is set at "Memory 1".
- ⑩ **R3 → K2 (Memory 2)**  
This flow occurs when the VFO select switch is set at "Memory 2".
- ⑪ **R3 → K4 (Memory 3)**  
This flow occurs when the VFO select switch is set at "Memory 3"  
In the condition of ⑨, ⑩, or ⑪, when the flow of ⑫ occurs, the data in "A" VFO is programmed in Memory Channel 1, 2 or 3, respectively.
- ⑫ **R3 → K8 (MS/MW)**  
This flow occurs when the MS/MW button is pushed.
- ⑬ **R4 → K1 (LSB)**  
This flow occurs when the MODE select switch is set at "LSB".  
When this happens, the display shows "L" and the carrier frequency.
- ⑭ **R4 → K2 (USB)**  
This flow occurs when the MODE select switch is set at "USB".  
When this happens, the display shows "U" and the carrier frequency.
- ⑮ **R4 → K4 (CW)**  
This flow occurs when the MODE select switch is set at "CW".  
When this flow occurs, the display shows "C" and the carrier frequency in the transmit mode and the 800Hz lower frequency in the receive mode.
- ⑯ **R4 → K8 (FM)**  
This flow occurs when the MODE select switch is set at "FM". When this happens, the display shows "F" and the carrier frequency.
- ⑰ **R4 → K1, K2 (AM)**  
This flow occurs when the MODE select switch is set at "AM". The display shows "A" and the carrier frequency.
- ⑱ **R5 → K1 (STOP 1 Mode)**  
This flow occurs when the scan is stopped by use of the MS/MW button.
- ⑲ **R5 → K2 (Clock)**  
The number of pulses from the scan control circuit are counted by use of the R5 pulse signals, and the sample signal is input to the K2 for the scan operation.

⑳ **R5 → K4 (RT)**

㉑ **R5 → K8 (DBC)**

These are used when an external controller is connected to the unit.

㉒ **R5 → K1, K2 (STOP 2 Mode)**

This flow occurs when the scan is stopped automatically. In this condition, the scan starts automatically from the frequency the scan has stopped at with the signal from the scan stop control circuit.

㉓ **R6 → K1 (TS)**

This flow occurs when the TS button is pushed.

㉔ **R6 → K2 (TX)**

This flow occurs when the unit is set in the transmit mode. The scan operation stops automatically.

㉕ **R6 → K4 (RB-TA)**

This flow occurs when the VFO select switch is set at "RB-TA". The "B" VFO operates in the receive mode and the "A" VFO operates in the transmit mode.

㉖ **R6 → K8 (RA-TB)**

This flow occurs when the VFO select switch is set at "RA-TB". The "A" VFO operates in the receive mode and the "B" VFO operates in the transmit mode.

## **FREQUENCY CONTROL, DISPLAY AND I/O CIRCUIT**

The dynamic lighting display functions with the 7-segment data output at the O1~O7 terminals of the CPU and the digit designation output signals at the R0~R6 terminals. The two decimal points are illuminated with the current through diodes D6 and D7 only when the digit designation signals for the 1MHz and 1KHz order are put out. The O0~O3 and R0~R6 terminals are time-shared for the other data output. The O0~O3 terminals also put out the divide number (N) for the PLL divider, and the signals from the R0~R6 terminals are also supplied to the CPU control circuit.

When the power is turned ON, the CPU is initialized and then reads the mode setting and memorizes it. Then the CPU reads the control data from the external controller in the order of the numbers of the matrix and controls the various necessary operations. The data of the display, "A" VFO, "B" VFO, the frequency shift step pitch, Memories 1~3, and the divide number (N) are programmed in each RAM area for the initial presetting.

Then, at the CPU output terminals O0~O3, the divide number and the VXO control data are put out in the BCD code. The data to designate the latch position (digit-position) are output at the CPU output R7~R9 and the signals from R10 are latched as the strobe pulse in the Input/Output port IC10, of which the terminals A1~D2 provide the VXO control data of which terminals A3~D5 provide the divide number (N).

Synchronizing the output of R0~R6, O0~O7 provide the 7-segment display data and by the order pulse of R0~R6, the mode, 10MHz digit, 1MHz digit, . . . . ., 100Hz digit is driven. Thus the CPU outputs are alternately switched between these two operations.

## CPU MALFUNCTION-PREVENT CIRCUIT

This circuit is to prevent the CPU from malfunctioning which may be caused by repeatedly turning the power ON and OFF, or by chattering when the power connector is plugged. The cause of this malfunction is that C7 starts recharging before it discharges completely and the CPU is not initialized. To prevent this, Q4 is turned ON and C7 is shorted when the power is OFF.

## D/A (DIGITAL TO ANALOG) CONVERTER CIRCUIT

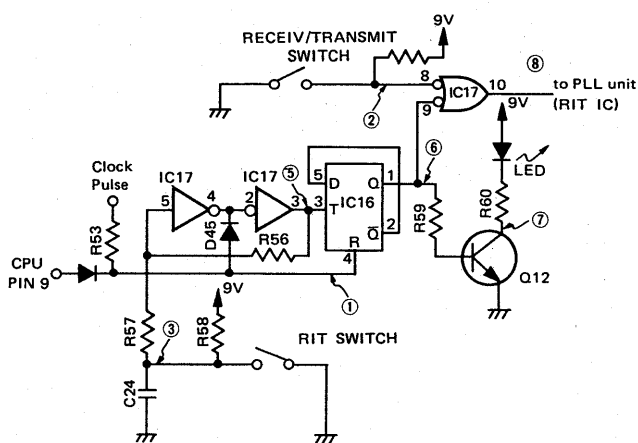
The signals from A1~D2 of IC10 are supplied to R87~R95 for D/A conversion through R82. This D/A converted voltage is fed to the PLL unit and changes in steps to give 100Hz step variation to the VXO frequency.

## RIT CONTROL CIRCUIT

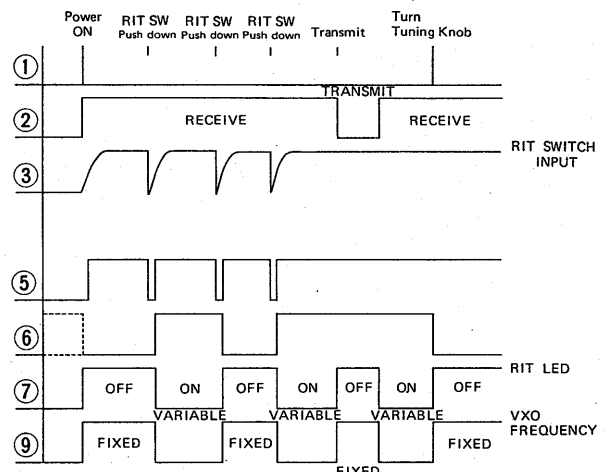
The RIT circuit in the unit is turned ON and OFF by operation of the RIT switch. When the RIT is ON, it may also be turned OFF by rotating the tuning control knob. When the RIT is switched ON, a pulse signal is generated and fed to the Schmitt trigger circuit which consists of two inverters of IC17 and R56. Any chatter is absorbed by R58 and C24. The square pulse achieved by this circuit is fed to flip-flop IC16. Then IC16 puts out an H-level signal at its Pin 1 which is fed to Pin 9 of IC17. Pin 8 of IC17 is H-level in the receive mode and Pin 10 is switched to the L-level, which turns OFF Q13 and Q14 in the PLL unit so that the VXO frequency can be adjusted with the RIT control. When the tuning control knob is rotated, a clock pulse signal through R53 resets the flip-flop IC16 and turns OFF the RIT.

When the unit is switched to the transmit mode while the RIT is ON, Pin 8 of IC17 becomes L-level and Pin 10 becomes H-level, so that Q13 and Q14 in the PLL unit are turned ON. In the receive mode, Q13 and Q14 are turned OFF and the receiving frequency goes back to the previous frequency with the RIT ON.

**RIT CONTROL CIRCUIT  
SCHEMATIC DIAGRAM**



**TIMING CHART**



## SCAN CLOCK GENERATOR AND CONTROL CIRCUIT

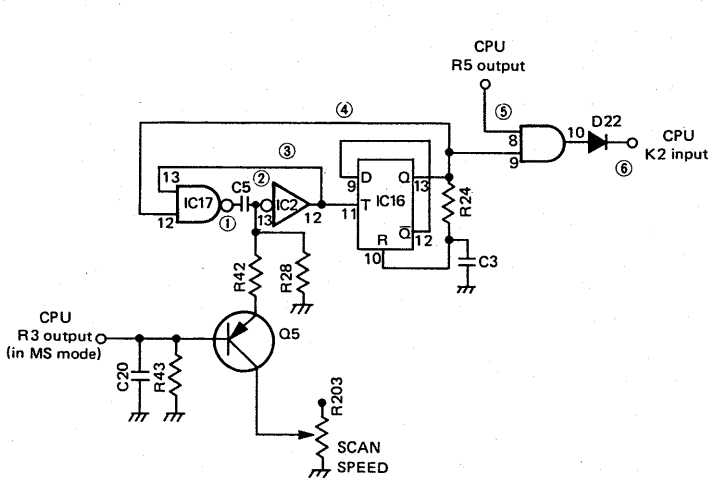
This circuit consists of a monostable multivibrator of 1/4 IC17 and 1/4 IC12, a flip-flop of 1/2 IC16, a sampling gate of 1/4 IC5 and Q5. The circuit samples the scan clock which is fed to Pin 9 of IC5 with the pulse signals from R5 of the CPU, and the sampled signals are fed to the K2 terminals of the CPU. In the Memory Scan (MS) mode, the output signals from the R3 terminal are charged by



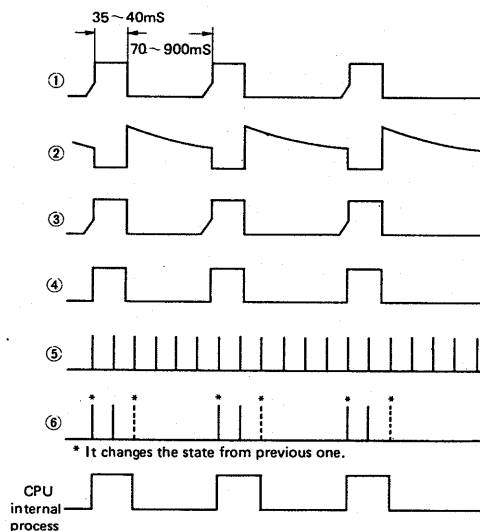
C20 so that Q5 is turned OFF, and the monostable multivibrator, consisting of IC12 and IC17, operates with the time constant set by R28 and C5. In the other scan mode, Q5 is turned ON so that the scan speed is decided by the time constant set by C5, R42, R28 and the scan speed control R203 under the access cover.

The K2 input signal is read and its positive edge and negative edge is detected by the CPU program. The CPU synchronizes to this period and decides the scanning speed.

### SCAN CLOCK GENERATOR AND CONTROL CIRCUIT SCHEMATIC DIAGRAM



### TIMING CHART



### SCAN START/STOP CONTROL CIRCUIT

This circuit consists of three monostable multivibrators and one binary counter. The output signals from the circuit control the gates between the R output terminals of the CPU and the K input terminals to provide the scan START and STOP in the Scan "A", Scan "B" and Memory Scan operations, and the Memory Write operation.

### IN THE SCAN "A" MODE

#### SCAN START

The signal generated by pushing the MS/MW button is differentiated by C8 and R31 and then fed to the monostable multivibrator of 1/4 IC11 and 1/4 IC12.

The output signal of the multivibrator drives the flip-flop of 1/2 IC13. The output signal at Pin 1 switches Pins 8 and 9 of IC11 to an H-level. Then Pin 10 of IC11 is switched to L-level and Q3 is turned ON so that the output from R5 of the CPU is input to the K8 terminal, and the scan operation starts.

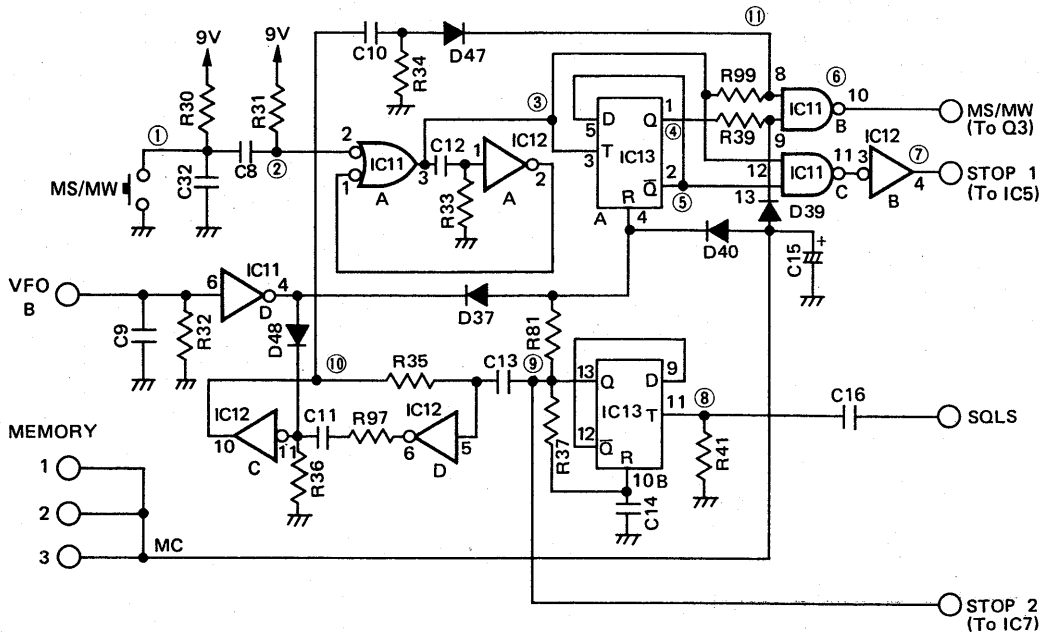
#### SCAN STOP

When the MS/MW button is pushed again, the multivibrator consisting of IC11 and IC12 functions and the signal is fed to IC13, the output signal levels of which are then reversed, and Pin 1 output is L-level and Pin 2 output is H-level. Therefore the output at Pin 10 of IC11 and Pin 7 of IC12 become H-level, which is input to Pin 5 of IC5 as the STOP 1 signal. Then the output signal from the R5 terminal of the CPU is fed to the K1 terminal to stop the scan operation.

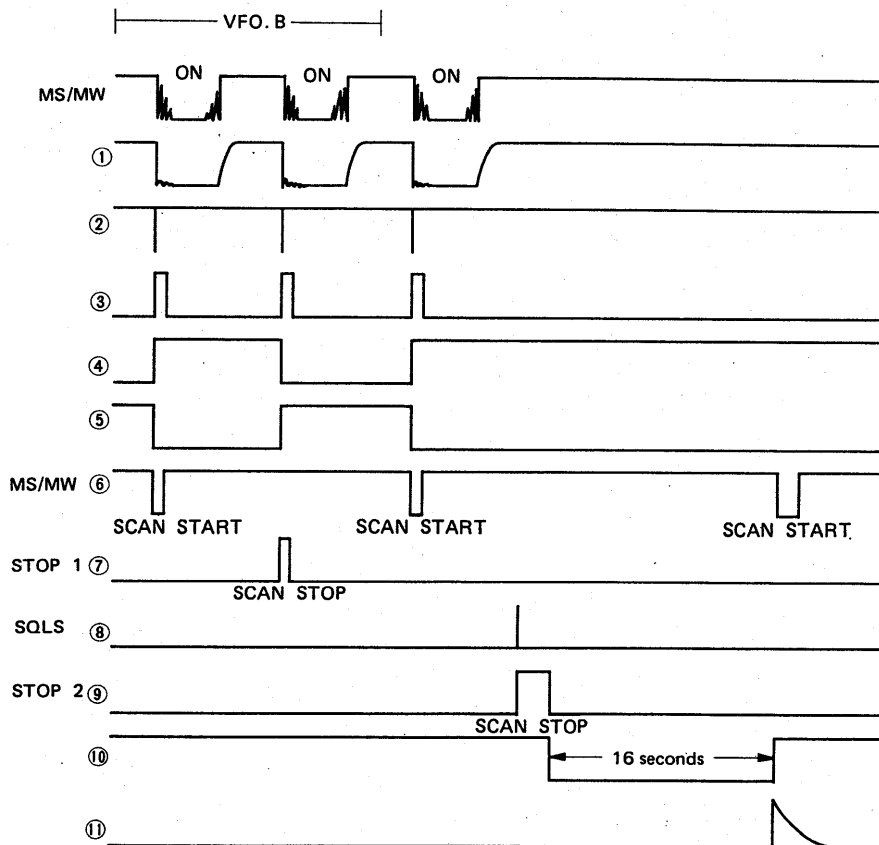
## SCAN STOP BY A RECEIVED SIGNAL

While scanning, when a signal is received, SQL S signal is fed from Pin 7 of IC6 on the Main Unit. After being differentiated, the signal is fed to Pin 11 of IC13. The output signal at Pin 13 is fed to Pin 6 of IC7 as the STOP 2 signal so that the R5 output of the CPU is fed to K1 and K2 to stop the scan. Then, if the MS/MW switch is pushed again, the output signal from Pin 13 of IC13 is input to Pin 4 of IC13 to reset the circuit so that the L-level signal from Pin 10 of IC11 turns Q3 ON, and the R5 output of the CPU is sent to K8 to start the scan again.

### SCAN START/STOP CONTROL CIRCUIT SCHEMATIC DIAGRAM



### TIMING CHART



## **IN THE SCAN "B" MODE**

### **SCAN START/STOP**

The scan START and scan STOP 1 function by use of the MS/MW button, and scan STOP 2 functions by receiving a signal, are the same as the operations for SCAN "A" mode.

### **AUTO SCAN START**

In the SCAN "B" mode, the scanning stops by receiving a signal. After approximately 16 seconds, the scan re-starts automatically.

In SCAN "B" mode, Pin 4 of IC11 is at L-level and Pin 4 of IC13 is shunt to ground through D37 so that the output signal from Pin 13 of IC13 does not reset Pins 1~5 of IC13. As R81 has high resistance against the ground level, the signal from Pin 13 of IC13 through C13 drives the multivibrator consisting of IC12 (Pins 5, 6, 10 and 11), R97, R36, and C11. Approximately 16 seconds later, the multivibrator puts out a signal, which is input to Pin 8 of IC11 after being differentiated by C10 and R34. On the other hand, as Pin 1 of IC13 is not reset to H-level, the output signal at Pin 10 of IC11 becomes L-level, Q3 is turned ON and the output signal from the R5 terminal of the CPU is fed to the K5 terminal to start the scan again.

### **PUSHING THE MS/MW BUTTON DURING 16 SECONDS COUNTING**

During the 16 seconds, as Pins 1~5 of IC13 are not reset, the operations are reversed by pushing the MS/MW button. Pin 1 becomes L-level and Pin 2 becomes H-level so that Pin 12 of IC11 becomes H-level and Pin 13 also becomes H-level. Then the IC12 puts out an H-level signal at Pin 4, which is fed to Pin 5 of IC5 so that the output signal from the R5 terminal of the CPU is fed to the K1 terminal for the Scan STOP 1 operation.

### **MEMORY WRITE**

While the VFO select switch is set at the Memory 1, 2 or 3 position, the MC signal becomes H-level, which resets IC13/1 or IC13/2 and sets Pin 9 of IC11 at H-level. The Memory Write operation is available by pushing the MS/MW button in this condition.

### **POWER CIRCUIT**

This unit has a special power circuit to prevent the CPU from malfunctioning. When the power is turned ON, 13.8V is supplied to zener diode D44 and Q11 is turned ON so that the bases of Q9 and Q10 are shunt to the ground; Q9 is turned OFF and Q10 is turned ON. C22 is charged by the current through D42 and at the same time, a current flows to charge C21 by the diode effect between the emitter and base of Q7. This current turns ON Q7 as the base current of Q7. The current from the collector of Q7 charges C18 and the voltage starts rising. When the base voltage of Q8 becomes approximately 0.6V, Q8 is turned ON, the base current of Q7 flows through R49 and the collector and emitter of Q8, and the output voltage of Q7 keeps rising. When the voltage reaches approximately 7.6V, zener diode D41 is turned ON. By the voltage divided by R44 and R45, Q6 is turned ON and controls the base voltage of Q8 so that the output voltage of Q7 is regulated. When the input voltage of Q7 varies, Q6, Q8 and Q7, in this order, are controlled to regulate the output voltage. When the voltage drops suddenly, D44 is turned OFF, and the output signals of R3, R6 and R7 of the CPU are fed through IC19 to the base of Q11 so that Q11 is repeatedly turned ON and OFF, and Q9 and Q10 are alternately turned ON. By this operation, C22 is charged through D42 when Q10 is ON; and when Q9 is ON, the power voltage is added to the charged voltage of C22. Thus enough voltage is supplied to the emitter of Q7 to put out the regulated voltage.

## SECTION VIII TROUBLE SHOOTING

Your IC-551D has been tested very carefully at the factory before shipping. The chart below has been designed to help you correct any problems which are not equipment malfunctions. If you are not able to locate the problem and/or solve it through use of this chart, please contact your dealer or ICOM distributor for assistance.

Problem	Possible Cause	Solution
1. Power does not come ON when the switch is pushed.	<p>Power cord is improperly connected.</p> <p>Power cord is connected with the polarity reversed. (When using DC power source)</p> <p>Blown fuse.</p> <p>IC-PS20's MAIN switch is in the OFF position.</p>	<p>Carefully reconnect power cord.</p> <p>Disconnect the power cord, replace the blown fuse, then reconnect the power cord observing proper polarity.</p> <p>Check for the cause, then replace the fuse with a new one.</p> <p>If using an IC-PS20, also check its fuse.</p> <p>Place MAIN switch in the ON position.</p>
2. No sound comes from the speaker.	<p>AF GAIN Control knob is completely counterclockwise.</p> <p>The unit is in the transmit mode, either by the T/R switch or the PTT switch on the microphone.</p> <p>SQUELCH setting is turned too far clockwise.</p> <p>External speaker is in use.</p> <p>The internal speaker cable is not connected.</p> <p>A headphone is connected to the PHONES jack.</p>	<p>Turn the knob clockwise to a suitable level.</p> <p>Put the unit in the receive mode.</p> <p>Turn the SQUELCH control counterclockwise until noise can be heard and reset it just below the threshold.</p> <p>Check if the external speaker plug is inserted properly or if the external speaker cable is cut.</p> <p>Connect the speaker connection.</p> <p>Unplug the headphone.</p>
3. Sensitivity is low and only strong signals are audible.	<p>RF GAIN Control knob is turned fully counterclockwise.</p> <p>The antenna feed line is cut or shorted.</p>	<p>Turn the RF Gain control knob fully clockwise.</p> <p>Check the feed line and correct any improper condition.</p>
4. During receive, the "S" meter is higher than the "0" position even when there is no signal.	<p>Mode select switch is in the FM-C position.</p>	<p>Set the Mode select switch in the FM-S position. (When the optional FM unit is installed)</p>
5. Only incomprehensible voices are heard during SSB reception.	<p>Receiving the wrong sideband.</p> <p>Receiving FM signals.</p>	<p>Set the MODE switch to the sideband other than the one you are using, either USB or LSB.</p> <p>Set the MODE switch to the FM position. (When the optional FM unit is installed.)</p>

Problem	Possible Cause	Solution
<p>6. No output power or low output power.</p>	<p>RF POWER setting is turned too far counterclockwise.</p> <p>MIC GAIN setting is too low. (in SSB mode)</p> <p>When SSB, AM or FM is desired, but the MODE switch is in the CW position. (FM is when the optional FM unit is installed only.)</p> <p>PTT switch is not functioning due to improper connection of the mic connector.</p> <p>The antenna feed line is cut or shorted, or excessive antenna SWR.</p>	<p>Turn the RF POWER control fully counterclockwise to the COMP OFF position, or turn the RF POWER control clockwise while watching the multi-function meter, to obtain the proper output power.</p> <p>Turn the MIC GAIN Control clockwise to the center (12 o'clock) position.</p> <p>Set the MODE switch to the USB, LSB, AM or FM position.</p> <p>Using a flat screw driver, slightly spread the prongs of the mic connector for better contact.</p> <p>Check the antenna feed line and correct any improper connection.</p>
<p>7. No modulation. (No RF output in SSB mode.)</p>	<p>Bad connection of the MIC connector.</p> <p>The MIC cable is cut.</p> <p>MIC GAIN control is fully counterclockwise.</p>	<p>Make the gap of each pin wider.</p> <p>Repair the disconnected or cut wire.</p> <p>Turn the MIC GAIN control clockwise to obtain the proper modulation.</p>
<p>8. The receive mode functions properly and your signals are transmitted, but you are unable to make contact with another station. (When desiring SIMPLEX mode.)</p> <p>(When desiring DUPLEX mode.)</p>	<p>The VFO Select is in the RA-TB or RB-TA position.</p> <p>The receive frequency is off set from the transmit frequency by the RIT control.</p> <p>The VFO Select switch is in the A,B or Memory position.</p> <p>Improper frequency split or input/output frequency of the repeater.</p>	<p>Set the VFO Select switch to the A, B or Memory position.</p> <p>Turn OFF the RIT, or set the RIT control knob to the center (12 o'clock) position.</p> <p>Set the VFO Select switch to the RA-TB or RB-TA position.</p> <p>Set the proper frequency split and turn the VFO Select switch to the RA-TB or RB-TA position according to repeater input/output frequency.</p>
<p>9. Left side of the unit case become a little hot.</p>	<p>As left side of the case is used as heat sink for the transmitter driver transistor even during normal operation, it may get as hot as 35°C (63°F) above room temperature.</p>	<p>Make sure that the area around the unit has as much ventilation as possible.</p>
<p>10. Buzzer beeps suddenly.</p>	<p>The warning buzzer has been beeped due to a high temperature of the final transistors.</p>	<p>When the buzzer beeps, discontinue transmission immediately, set the FAN switch in the R-ON position, allow the heat sink to cool and check to see that you have the best ventilation possible, or correct a high SWR condition, etc.</p>

Problem	Possible Cause	Solution
11. The heat sink on the rear panel becomes hot.	The heat sink on the rear panel is for the final transistors and may become as hot as 40°C (72°F) above room temperature.	Make sure the area around the unit has as much ventilation as possible.
12. The RIT LED goes out even though you did not depress the RIT ON/OFF switch to turn it OFF.	The RIT is automatically turned OFF when the Tuning knob is rotated.	Depress the RIT ON/OFF switch again to turn ON the RIT.
13. The frequency does not change by rotating the Tuning knob.	DIAL LOCK is engaged.	Disengage the DIAL LOCK by moving the DIAL LOCK switch.
14. The scale on the Tuning knob is not in calibration with the displayed frequency.	The TUNING SPEED button was depressed when the Tuning knob was set with one of the small increments at the center point, the Tuning knob was rotated when the DIAL LOCK was engaged.	Set the Tuning dial so that one of the large increments is at the center point, and push the TUNING SPEED button, and the scale will be calibrated.
15. The last digit of the memorized or displayed frequency has changed to 0.	The TUNING SPEED button was pressed, or the VFO Select switch was turned while pressing the TUNING SPEED button.	Release the TUNING SPEED button, and set the unit to the desired frequency with the Tuning knob.
16. An abnormal figure is displayed on the display, or the display fails to illuminate.	The Power switch was turned OFF and ON too quickly.	Turn the Power switch and the memory switch OFF, wait a few seconds, and then turn them ON again.
17. The memorized frequencies are lost and the display shows 51.000.0 when the power switch is turned ON.	The main switch of the power source was turned OFF or the power plug was unplugged. The power failed (when using the AC power source).	Use the optional memory power source.
18. Unable to key when using an electronic keyer.	The Switching circuit of the electronic keyer does not close completely.  Polarity of the connection wires from the keyer is reversed.  The MODE switch is not in the CW position.	Replace the keyer with one having a voltage of less than 0.4V between the two keying lines at the key down position, or modify your keyer so that the voltage is less than 0.4 Volts.  Connect the keyer wires observing proper polarity.  Place the MODE switch in the CW position.
19. The scan operation does not function when the MS/MW switch is pushed.	No frequency is programmed in the memory channels or the same frequency is programmed in all the memory channels.	Program the required frequencies in the memory channels following the instructions for "MEMORY-WRITE" on page 19.

## SECTION IX VOLTAGE CHARTS

**NOTE:** Measuring instrument is a 50K $\Omega$ /V multimeter.

### MAIN UNIT TRANSISTORS (In the USB mode and RF POWER control in the COMP OFF position.)

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1									Deleted
Q 2	0.7		13.8	GND	0		13.8	GND	
Q 3	0.7		13.8	GND	0		13.8	GND	
Q 4	0.7		6.8	GND	0		0	GND	
Q 5	0	0.2	9.0	0.5	0	0.2	0	0.5	
Q 6	0		7.5	4.0	0		0	0	
Q 7	0		7.5	4.0	0		0	0	
Q 8	13.8		13.8	13.8	13.8		13.8	13.8	
Q 9	0.6		0	GND	0.6		0	GND	
Q10	0		1.2	GND	0		1.2	GND	
Q11	0		0	0	0		0	0	
Q12	0		1.7	0	0		0	0	
Q13	0		0	0	0		6.6	0	
Q14	10.4		0	0	10.2		10.2	0	
Q15	0		10.2	0	0		10.2	0	
Q16	0	0	0	0	0	0.7	9.8	0.6	
Q17	0		0	0	0		9.8	0.4	
Q18	0		0	0	0		9.8	0	
Q19	GND		0	0	GND		7.8	0.5	
Q20	1.6		8.0	1.4	1.6		8.0	1.4	
Q21	1.9		8.0	1.6	1.9		8.0	1.6	
Q22	-10.1		4.0	-10.6	-10.1		4.0	-10.6	
Q28	0		13.5	0	10.4		13.5	9.8	
Q29	9.6		13.5	9.0	9.6		13.5	9.0	
Q30	10.3		13.5	9.7	0		13.5	0	
Q31	0.7		0	GND	0.2		10.4	GND	
Q32	0.2		10.3	GND	0.7		0	GND	
Q33	0.7		0	GND	0.3		0	GND	
Q34	1.5		5.2	0.9	1.5		5.2	0.9	CW Key opened
Q35	0.7		0	GND	0.7		0	GND	CW Key opened
Q36									Deleted
Q37	0		0	GND	0.6		3.0	GND	FM SQL opened
Q38	0.7		0	GND	0.7		0	GND	
Q39	0		9.8	GND	0.7		0	GND	
Q40	0		0	GND	0.7		0	GND	
Q 1	0.75		13.8	GND	0		13.8	GND	in PA UNIT
Q 2	0.75		13.8	GND	0		13.8	GND	in PA UNIT
Q 3	1.25		13.8	0.75	0		13.8	0	in PA UNIT

### MAIN UNIT IC IN TRANSMIT MODE (USB)

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC1	4.8	0.4	4.4	GND	7.3	7.1	8.2	9.0							
IC2	3.1	3.1	0	GND	10.3	13.5	13.5								
IC3	7.0	6.2	5.6	GND	3.2	3.2	3.2								
IC4	0.4	2.7	GND	0.7	13.8										
IC5	4.9	3.0	4.5	GND	4.5	4.9	2.6	8.9							
IC6	0.1	0	0	GND	0	0	0	0							
IC2	3.0	0.7	0.5	-10	0	0	8.6	9.2							in PA UNIT

### MAIN UNIT IC IN RECEIVE MODE (USB, Squelch opened)

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC1	4.8	0.4	4.4	GND	7.3	7.1	8.2	9.0							
IC2	3.1	3.1	0	GND	10.3	13.5	13.5								
IC3	7.0	6.2	5.6	GND	3.2	3.2	3.2								
IC4	0.4	0.7	GND	7.0	13.8										
IC5	4.9	3.0	4.5	GND	4.5	4.9	2.6	8.9							
IC6	1.3	0.6	0.7	GND	1.3	1.3	7.9	9.7							
IC2	0	0	0	-10	0	0	0	0							in PA UNIT

### VCO UNIT TRANSISTORS

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q1	0		6.5	2.3	0		6.5	2.3	

### PLL UNIT TRANSISTORS

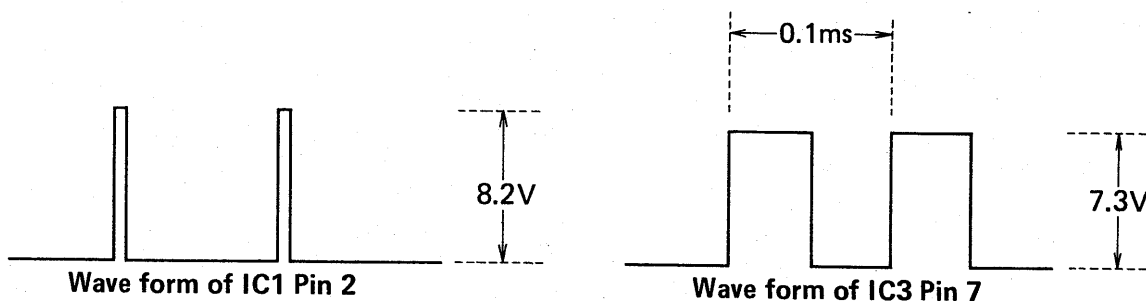
TR No.	Specified Mode in REMARKS								REMARKS
	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1	8.0		0	8.0	7.2		7.8	7.8	Lock fails
Q 2	0		7.8	GND	0.7		0	GND	Lock fails
Q 3	2.0		6.7	1.3					
Q 4	1.3		7.8	1.0					
Q 5	0.9		4.6	0.1					
Q 6	5.4		8.0	4.7	0		8.0	0	Lock fails
Q 7	4.7		8.0	4.2	0		8.0	0	Lock fails
Q 8	3.3		7.4	2.6					
Q 9	13.0		11.3	13.8					
Q10	5.1		12.8	4.5					
Q11	-0.1 GND		-8.2 -9.2	0.5					
Q12	-9.2		-8.2	-9.8					
Q13	GND		0.6	0.7	GND		0~-2.0	0	RIT ON
Q14	0.6		0	GND	0~-2.0		4.3~-4.4	GND	RIT ON



## PLL UNIT IC

IC No.	PIN No.																	REMARKS	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18
IC1	8.0	2.7	*	*	*	*	*	*	*	*	*	*	*	*	NC	NC	0	GND	
IC2	8.0	GND	3.2	8.0	8.0	0	0	3.6	GND										
IC3	2.6	3.2	3.2	0	7.1	0	0	3.5	GND										
IC4	1.4	1.4	GND	7.0	7.5														
IC5	0	7.6	6.8	3.9	2.5	GND	0	0	2.5	3.9	3.9	3.9	6.8	0					
IC6	1~ 3	0~ 1	0~ 1	-8.1	3~ 4	3~ 4	-5~ -3	8.0											
IC7	11.2	GND	8.0																

\* : 7.4V or 0V according to operating frequency.



## DRIVER UNIT TRANSISTORS

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE1	GATÈ2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 4	9.2		0	8.4	9.2		0	8.4	
Q 5	6.3		0	5.0	6.3		0	5.0	
Q 6	0.65		0.65	0	0.65		0.65	0	
Q 7	13.8		8.6	13.8	13.8		8.6	13.8	
Q 8	0.65		13.8	0	0.65		13.8	0	
Q 9	0		13.8	0	0		13.8	0	
Q10	0		0	0	0		0	0	
Q11	0.75		0	0	0.75		0	0	
Q12	0.7		0	0	0.7		0	0	RIT ON
Q12	0		7.0	0	0		7.0	0	RIT OFF

### NOTE:

Other devices work in C-MOS level and with pulse signals, so the voltages can not be measured with a 50KΩ/V multimeter.

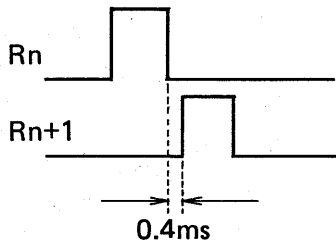
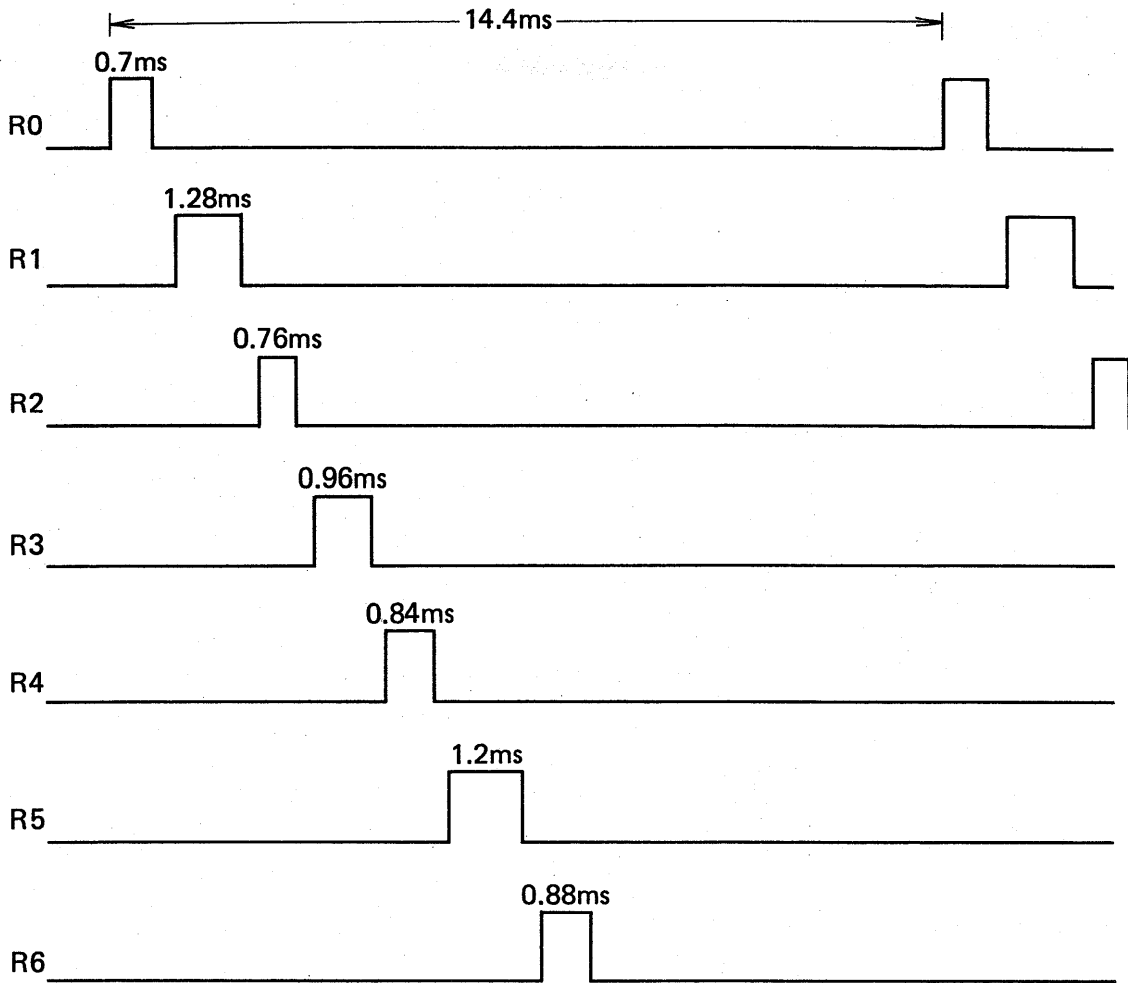
The function of the CPU is identified with reading the relationship between the R output and the K input signals.

Refer the matrix chart on page 43 and the timing chart of the R output signals on the next page. The relationship between the R output and the K input signals can be checked with a dual trace oscilloscope, and also the level of these signals can be measured with the scope.

The driver unit consists of several C-MOS IC's and P-MOS IC's. P-MOS IC's are IC9 TMS1099 CPU and IC10 TMS1025 I/O port, and the others are C-MOS IC's.

Refer to the threshold level chart on next page for measuring these levels.

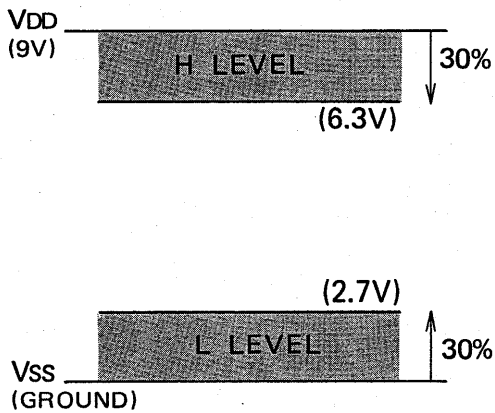
### R OUTPUT TIMING CHART



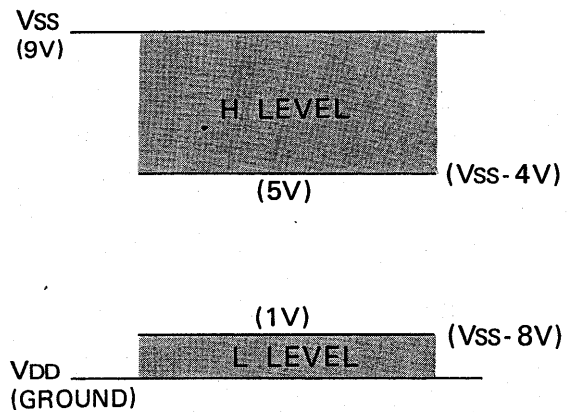
Each R output has a 0.4 milliseconds interval.

### THRESHOLD LEVEL CHART

#### C-MOS IC



#### P-MOS IC



**PBT UNIT TRANSISTORS (In the USB mode and RF POWER control in click ON position.)**

TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1	0	0.2	8.0	0	0	0.2	8.0	0	
Q 2	0	1.2	8.0	0	0	1.2	8.0	0	
Q 3	0	0.2	8.0	0	0	4.0	8.0	0	
Q 4	0	0.2	0	0	1.2	4.0	8.0	1.5	
Q 5	-0.2 -0.5		-9.6 -10.6	-0.3	-0.2 -0.5		-9.6 -10.2	0	
Q 6	-9.6		0.2	-10.2	-9.6		4.0	-10.2	
Q 7	0		0	0	1.5		0	1.8	
Q 8	2.3		7.2	1.6	2.4		7.2	1.8	
Q 9	0.6		6.2	GND	0.6		6.4	GND	
Q10	0.6		6.7	GND	0.6		6.6	GND	
Q11	0.6		6.7	GND	0.6		6.6	GND	
Q12	0.7		0	GND	0		0	GND	
Q13	0		4.4	GND	0.7		0	GND	
Q14	0		6.0	-0.1	0		6.0	-0.6	
Q15	0		8.2	0	0		0	0	

**VOX UNIT TRANSISTORS**

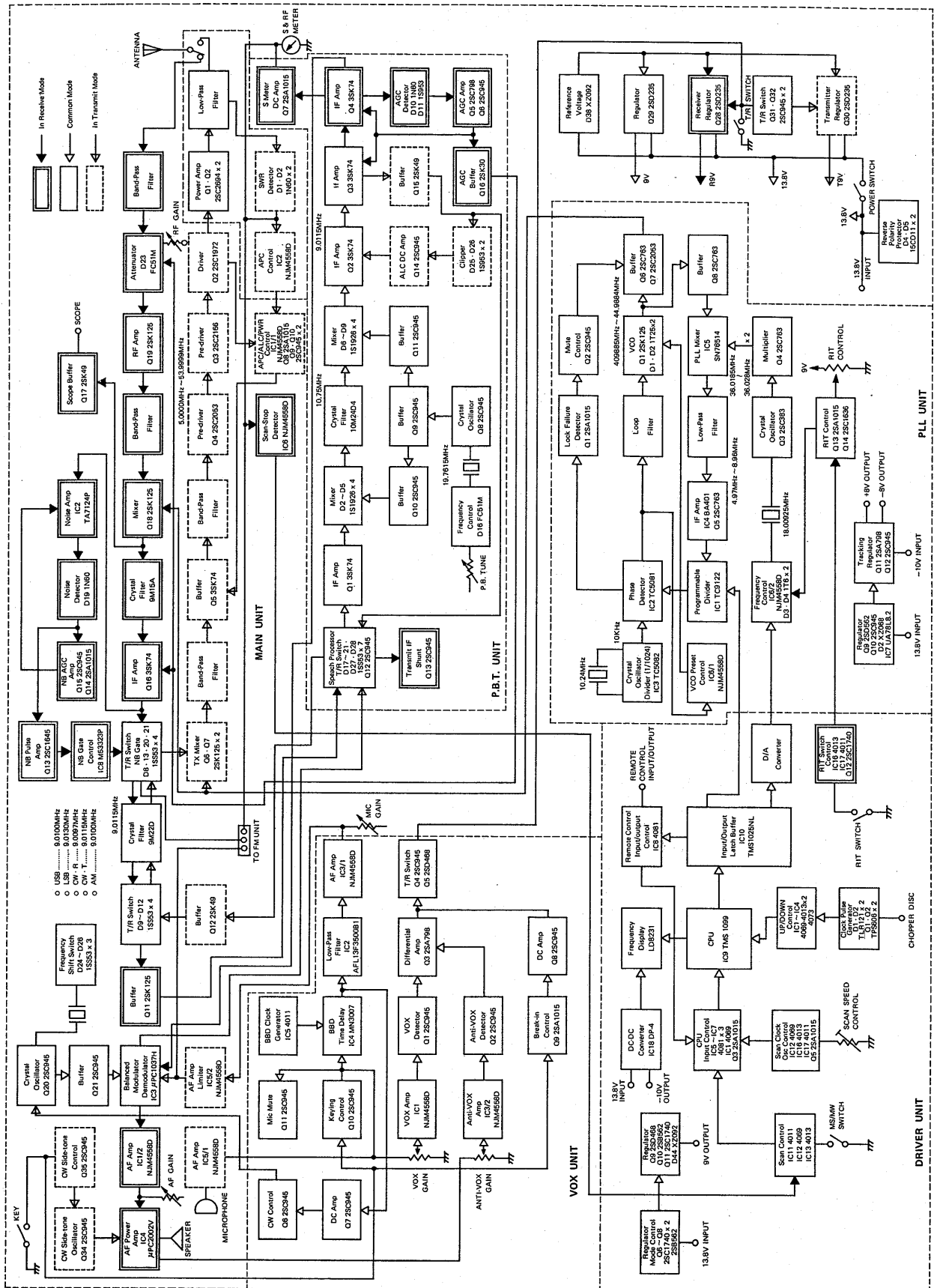
TR No.	TRANSMIT				RECEIVE				REMARKS
	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	BASE OR GATE1	GATE2	COLLECTOR OR DRAIN	EMITTER OR SOURCE	
Q 1	4.0		7.8	3.0	4.0		7.8	3.0	USB
Q 2	4.2		7.8	3.6	4.2		7.8	3.6	USB
Q 3	0.8 1.0		0.7 GND	4.9	0.8 1.0		0.7 GND	4.9	USB
Q 4	0.7		0.1	GND	0.7		0.1	GND	USB
Q 5	0.1		9.5	GND	0.1		9.5	GND	USB
Q 6	-		-	-	0.7		0	GND	CW Key down
Q 7	-		-	-	0.7		4.0	4.0	CW Key down
Q 8	-		-	-	0.7		0	GND	CW Key down
Q 9	-		-	-	8.0		8.8	8.5	CW Key down
Q10	-		-	-	0		8.0	GND	CW Key down

**VOX UNIT IC (In the USB mode.)**

IC No.	PIN No.														REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
IC1	4.0	4.0	4.0	GND	4.0	4.0	4.0	7.8							
IC2	3.8	GND	4.2	8.0											
IC3	5.2	4.0	4.0	GND	4.0	4.0	4.0	8.0							
IC4	8.0	4.0*	3.6	0.7	GND	4.1*	4.0	4.0							
IC5	8.0	*	*	*	8.0	*	GND	8.0	*	*	*	*	8.0	8.0	

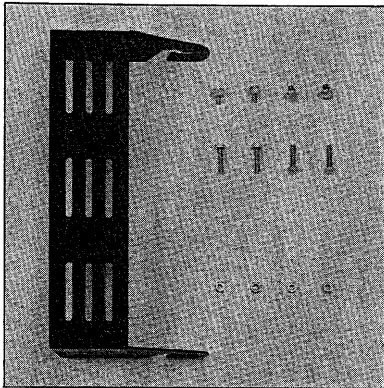
\* : Pulse activated

# SECTION X BLOCK DIAGRAM



## SECTION XI OPTIONS

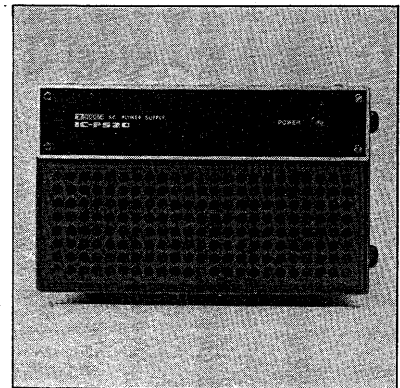
We have prepared a variety of options for the transceiver IC-551D in order to enlarge its use.



**MOBILE MOUNTING  
BRACKET IC-MB5  
FOR IC-551D**



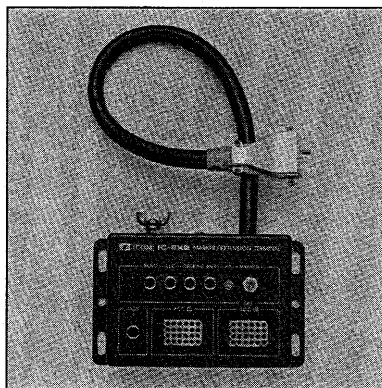
**IC-SM2  
DESK MICROPHONE  
ELECTRET CONDENSER  
TYPE**



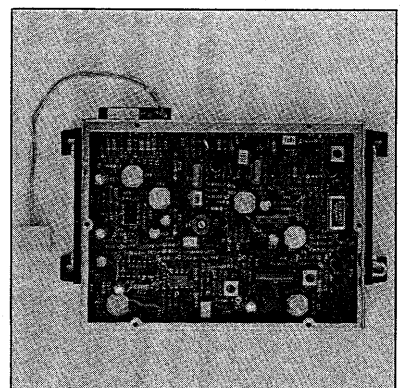
**IC-PS20  
AC POWER SUPPLY  
13.8V 20A**



**IC-HP1  
HEADPHONES**

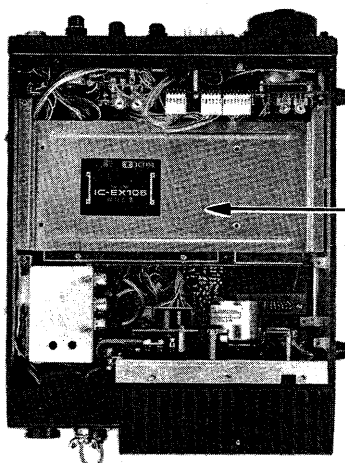


**IC-EX1  
EXTENTION TERMINAL  
IC-EX2  
EXTENTION TERMINAL  
WITH 25KHz MARKER**

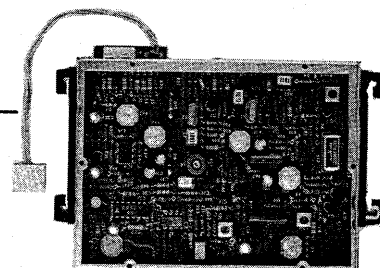


**IC-EX106  
FM UNIT**

### OPTIONAL UNIT INSTALLATION



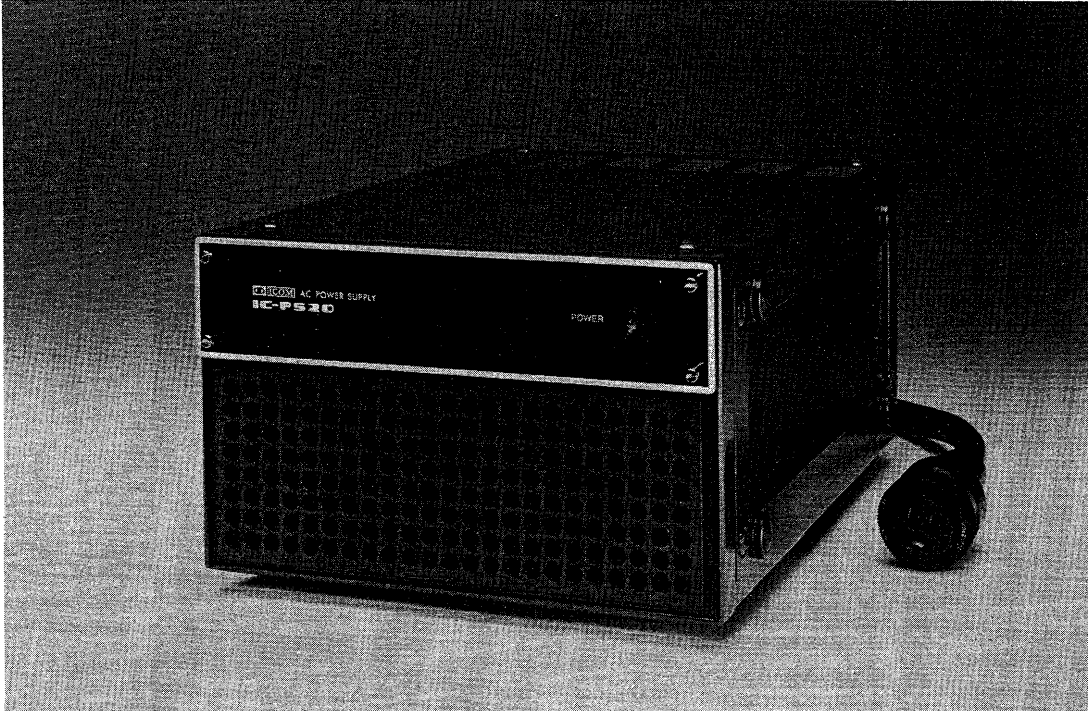
Attach this unit to  
the upper mounting  
plate.



**IC-EX106 FM UNIT**

## OPTIONAL AC POWER SUPPLY IC-PS20

This set is designed to operate on 13.8 Volts DC. However, a special AC power supply the IC-PS20 is available for AC operation. The IC-PS20 provides 13.8 Volts at 20 Amps. When connected to the IC-551D transceiver, the power supply ON-OFF operation is remotely controlled by the power ON-OFF switch on the IC-551D.



### ■ SPECIFICATIONS

- Number of Semiconductors:

Transistors	7
IC	1
Diodes	9
- Input Voltage (suitable voltage): 117/240V AC (50/60Hz)
- Allowable Voltage Fluction:  $\pm 10\%$  of input voltage (suitable line voltage)
- Input Capacity: 550VA (at 20A load)
- Output Voltage: DC 13.8V (regulated)
- Max. Load Current: 20A (10 minutes ON/10 minutes OFF 50% duty cycle)
- Polarization: Negative ground
- Internal Speaker:

125 x 77 mm
2 watt nominal input
4 watt maximum
- Dimensions: 110(H) x 180(W) x 260(D) mm
- Weight: Approximately 4.2 kg
- Accessories included:

AC power cord	1
Spare fuse	2
Speaker cord	1



**ICOM INCORPORATED**

1-6-19, KAMI KURATSUKURI, HIRANO-KU,  
OSAKA JAPAN