HF ALL BAND TRANSCEIVER

IC-740

MAINTENANCE MANUAL

ICOM

ICOM INCORPORATED

For Service Manuals Contact
MAURITRON TECHNICAL SERVICES
8 Cherry Tree Rd, Chinnor
Oxon OX9 4QY
Tel:- 01844-351694 Fax:- 01844-352554
Email:- enquiries@mauritron.co.uk

TABLE OF CONTENTS

SECTION 1 SPECIFICATIONS

GENERAL

Number of Semiconductors:

Transistors	85
FET	18
IC (Includes CPU)	48
Diodes	247

Frequency Coverage:

1.8MHz ~ 2.0 MHz
3.5MHz ~ 4.0 MHz
7.0MHz ~ 7.3 MHz
10.0MHz ~ 10.5 MHz
14.0MHz ~ 14.35MHz
18.0MHz ~ 18.5 MHz (Receive Only)
21.0MHz ~ 21.45MHz
24.5MHz ~ 25.0 MHz (Receive Only)
28.0MHz ~ 29.7 MHz

Frequency Control:
CPU based 10Hz step PLL synthesizer.
Independent Transmit-Receive Frequency Available on same band.

Frequency Readout:
6 digit 100Hz readout.

Frequency Stability:
Less than 500Hz after switch on 1 min to 60 mins, and less than 100Hz after 1 hour. Less than 1KHz in the range of −10°C to +60°C.

Power Supply Requirements:
DC 13.8V ±15% Negative ground Current drain 20A max. (at 200W input)
AC power supply is available for AC operation.

Antenna Impedance:
50 ohms Unbalanced

Weight:
8.0 Kg

Dimensions:
111mm(H) x 286mm (W) x 374mm(D)

TRANSMITTER

RF Power:
SSB (A_3J) 200 Watts PEP input
CW (A_1), RTTY (F_1), FM (F_3)* 200 Watts input
Continuously Adjustable Output power 10 Watts ~ Max.

Emission Mode:

A_3J	SSB (Upper sideband and Lower sideband)
A_1	CW
F_1	RTTY (FSK)
F_3*	FM

*When optional FM unit is installed.

Harmonic Output:
More than 50dB below peak power output

Spurious Output:
More than 50dB below peak power output

Carrier Suppression:
More than 50dB below peak power output

Unwanted Sideband:
More than 55dB down at 1000Hz AF input

Microphone:
Impedance 1300 ohms
Input Level 120 millivolts typical
Dynamic or Electret Condenser Microphone with Preamplifier

RECEIVER

Receiving System:
Triple Conversion Superheterodyne with continuous Pass-Band Shift Control.

Receiving Mode:
A_1, A_3J (USB, LSB), F_1, F_3*

IF Frequencies:

1st	39.7315MHz
2nd	9.0115MHz
3rd	455KHz

with continuous Pass-Band Shift Control.

Sensitivity:
SSB, CW, RTTY
Less than 0.3 microvolts for 10dB S+N/N
(preamp ON)
Less than 0.15 microvolts for 10dB S+N/N
FM* (preamp ON)
Less than 0.3 microvolts for 20dB noise quieting

Selectivity:

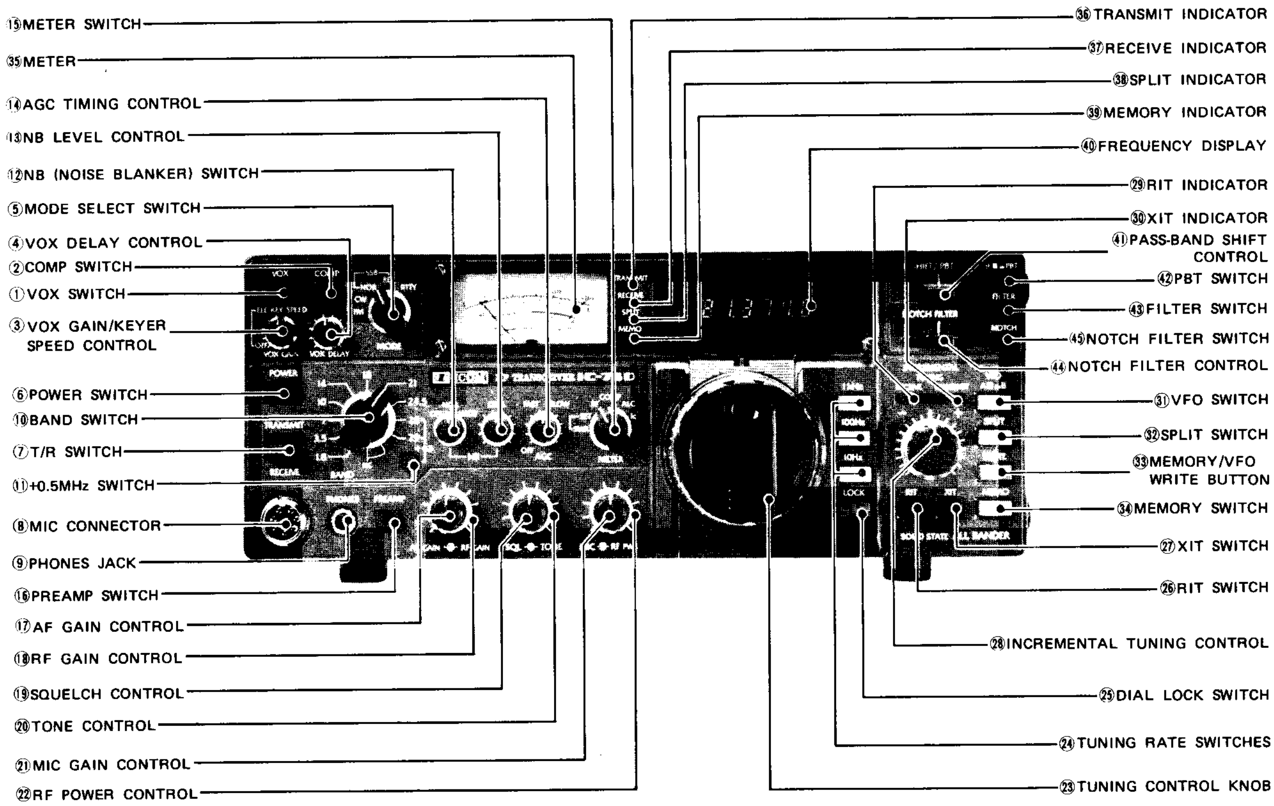
SSB, RTTY	2.4KHz at −6dB
	4.5KHz at −60dB
(PBT max.)	2.2KHz at −6dB
	4.2KHz at −60dB
(PBT min)	700Hz at −6dB
	2.0KHz at −60dB
CW (AF Filter)	300Hz at −6dB
FM*	15KHz at −6dB
	30KHz at −60dB

Spurious Response Rejection Ratio:
More than 60dB

Audio Output:
More than 2.6 Watts

Audio Output Impedance:
8 ohms

2-1 FRONT PANEL



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

2. COMP (SPEECH PROCESSOR) SWITCH
Switches the speech processor circuit ON and OFF. This circuit enables greater talk power and better results in DX operation.

3. VOX GAIN/KEYER SPEED CONTROL
This control adjusts input signal level via the microphone to the VOX circuit. For VOX operation in SSB and FM, adjust the control so that the VOX circuit will operate with normal speech.

When the optional electronic keyer unit is installed and the set is in CW mode, this control adjusts keying speed of the keyer.

4. VOX DELAY (VOX time constant) CONTROL
This controls the transmit to receive switching time. Adjust it so transmit to receive switching will not occur during short pauses in normal speech.

5. MODE SELECT SWITCH
Selects any one of four operating modes (FM is option). There are two modes in SSB mode as follows:

SSB-NOR: For normal SSB operation, upper sideband (USB) for 10MHz band and above, and lower sideband (LSB) for 7MHz band and below.

SSB-REV: For reverse SSB operation, lower sideband (LSB) for 10MHz band and above, and upper sideband (USB) for 7MHz band and below.

6. POWER SWITCH
The POWER SWITCH is a push-lock type switch which controls the input DC power to the IC-740. When the external AC power supply (IC-PS15) or optional built-in

AC power supply (IC-PS740) is used, the switch also acts as the AC power supply switch. 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 PA unit. When the BC-10A is used, power will also be supplied to the CPU.

7. T/R (TRANSMIT/RECEIVE) SWITCH

This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (down) and the IC-740 is in the receive mode. Set the switch to TRANSMIT (up) 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.

8. MIC CONNECTOR

Connect the supplied microphone or optional microphone, IC-SM5 or scanning microphone IC-HM10 to this jack.

9. PHONES JACK

Accepts a standard 1/4 inch headphone plug for headphones of 4 ~ 16 ohms. Stereo phones can be used without modification.

10. BAND SWITCH

The BAND SWITCH is a 10 position rotary switch used for selecting one of the 500KHz segments. The selectable bands are 1.8MHz, 3.5MHz, 7MHz, 10MHz, 14MHz, 18MHz, 21MHz, 24MHz and 28MHz. (28MHz band is separated to four 500KHz segments, and use ⑪ + 0.5MHz switch for upper 500KHz segments on 28MHz and 29MHz.)

11. +0.5MHz SWITCH

This switch is for selecting upper 500KHz segment on 28MHz or 29MHz band. This switch is negated when the other band is selected.

12. NB (NOISE BLANKER) SWITCH

When pulse type noise such as automobile ignition noise is present, set this switch to the NOR or WIDE position. The noise will be reduced to provide comfortable reception.

The blanking time can be selected NORMAL and WIDE by this switch. It will be effective against any type noises.

13. NB LEVEL CONTROL

Controls the threshold level of the noise blanker. Adjust the control so that incoming noises will be disappeared.

14. AGC TIMING CONTROL

For changing the time-constant of the AGC (Automatic Gain Control) circuit. By turning the control clockwise, the AGC voltage is released more slowly. Adjust the control to provide comfortable reception.

When the control is in the OFF position, the AGC function is turned OFF and the S-meter does not swing even if a signal has being received. (The AGC does not actuate on the FM mode.)

15. METER SWITCH

In the transmit mode, the meter has five functions.

1. Ic	Indicates the collector current of the final transistors.
2. ALC	Indicates the ALC level. The meter begins to function when the RF output power reaches a certain level.
3. COMP	Indicates the compression level when the speech processer is in use.
4. RF	Indicates an approximate RF output power.
5. SET/SWR	SWR can be measured by setting this switch to the SET position and calibrating the meter needle to the "SET" position with the RF POWER control, then setting this switch to the SWR position.

16. PREAMP SWITCH

Switches the preamplifier for the receiver.

17. AF GAIN CONTROL

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

18. RF GAIN CONTROL

Controls the gain of the RF section in the receive mode. Clockwise rotation gives the maximum gain. As the control is rotated counterclockwise, the needle of the METER rises, and only signals stronger than the level indicated by the needle will be heard.

19. 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.

20. TONE CONTROL

Controls the receiver audio tone. Ajust the control to provide comfortable reception.

21. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. Clockwise rotation increases the microphones gain. As the input will vary with different microphones and different voices, the knob should be turned until the Meter needle, in the ALC mode, begins to move slightly within the ALC zone. In the SSB mode when the speech processor is in use, the MIC GAIN CONTROL sets a clipping limit, while the RF POWER CONTROL sets the RF drive level to the maximum power level, where ALC starts at the saturation point of the amplifiers.

22. RF POWER CONTROL

Controls the RF output power 10 Watts to maximum (SSB: 100 Watts PEP, CW, RTTY: 100 Watts). Clockwise rotation increases the output power.

23. TUNING CONTROL KNOB
Rotating the TUNING CONTROL KNOB clockwise increases the frequency, while rotating it counterclockwise decreases the frequency. The frequency is changed in 10Hz, 100Hz or 1KHz steps which is according to the TUNING RATE switches. One complete rotation of the tuning knob results in a 1KHz frequency increase or decrease in 10Hz steps, 10KHz in 100Hz steps and 100KHz in 1KHz steps.

When the 10Hz steps tuning rate is selected, by turning the tuning control knob faster, the 100Hz steps tuning rate is automatically selected. This makes it very convenient to make a QSY over a wide frequency range.

24. TUNING RATE SWITCHES
The small vernier marks on the tuning knob are changed to correspond to 10Hz, 100Hz or 1KHz steps which is selected by pushing the switch either 10Hz, 100Hz or 1KHz.

25. DIAL LOCK SWITCH
After the IC-740 is set to a certain frequency for rag chewing, mobile operation, etc., by pushing the DIAL LOCK switch, the VFO is electronically locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change frequency, the dial lock must first be disengaged by pushing and releasing the DIAL LOCK switch again.

26. RIT SWITCH
Switches the RIT (Receiver Incremental Tuning) circuit ON and OFF.

27. XIT SWITCH
Switches the XIT (Transmitter Incremental Tuning) circuit ON and OFF.

28. INCREMENTAL TUNING CONTROL
Shifts the receive frequency ±1.5KHz to either side of the transmit frequency when the RIT is ON, and shifts the transmit frequency to either side of the receive frequency when the XIT is ON. Rotating the control to the (+) side raises the receive or transmit frequency, and rotating to the (−) side lowers the receive or transmit frequency. The frequency shift by turning the control is not indicated on the frequency display.

When both the RIT and XIT switches are ON, the receive and transmit frequencies are the same, and this frequency can be shifted either side from the displayed frequency by the control.

29. RIT INDICATOR
Illuminates when RIT is turned ON.

30. XIT INDICATOR
Illuminates when XIT is turned ON.

31. VFO SWITCH
You can select either of the two built-in VFO's with this switch. It also selects the relationship of the two VFO's with the SPLIT switch. The switch performs the following operations according to its position.

A. (NORMAL)	Selects the "A" VFO for both transmit and receive.
A. (SPLIT)	Selects "A" VFO for receive and "B" VFO for transmit.
B. (NORMAL)	Selects the "B" VFO in both transmit and receive.
B. (SPLIT)	Selects "B" VFO for receive and "A" VFO for transmit.

32. SPLIT (TRANSCEIVE/SPLIT) SWITCH
Selects the relationship of the two VFO's. In the NORMAL (out) position, one VFO is for both transmit and receive. In the SPLIT (in) position, one VFO is for transmit and the other is for receive.

33. MEMORY/VFO WRITE BUTTON
By pushing this button, A VFO's frequency is written into Memory, or one VFO's frequency is transferred to the other VFO.

34. MEMORY SWITCH
Push this switch when you wish to write a frequency into a memory, or to call a memorized frequency.

35. METER
When in the receive mode the meter acts as an S-meter regardless of the position of the meter select switch. Signal strength is indicated on a scale of S1-S9, and S9 to S9+60dB.

In the transmit mode the meter has five functions which are selected by the Meter Switch (15).

36. TRANSMIT INDICATOR
Illuminates when the transceiver is in the transmit mode.

37. RECEIVE INDICATOR
Illuminates when the squelch is opened in the receive mode.

38. SPLIT INDICATOR
Illuminates when the transceiver is in the split frequency operation.

39. MEMORY INDICATOR
Illuminates when the memory switch is pushed ON.

40. FREQUENCY DISPLAY
The frequency of the IC-740 is displayed on a luminescent display tube. Since the 1MHz and 1KHz decimal points are displayed, the frequency can easily be read. The frequencies indicated are the carrier frequencies of each mode in, USB, LSB and CW, and the mark frequency in RTTY.

Remember, if you turn the RIT or XIT SWITCH ON to change the frequency and rotate the INCREMENTAL

TUNING CONTROL knob, the frequency displayed will not change.

41. PASS-BAND SHIFT (TUNING) CONTROL

Allows continuous shifting of the pass-band from upper or lower side in SSB, CW and RTTY. This will reduce interference by a nearby signal. When the PBT switch is pushed ON, this control allows continuous tuning of the pass-band selectivity by moving the filter up to 800Hz from the upper or lower side in SSB, CW and RTTY. This not only improves selectivity, but also can improve the audio tone. Normal position is in the center position and is 2.4KHz wide in SSB.

42. PBT SWITCH

Switches the IF SHIFT function and PASS-BAND TUNING function.

43. FILTER SWITCH

Selects the combination of the second IF (9MHz) filter and the third IF (455KHz) filter to improve the selectivity.

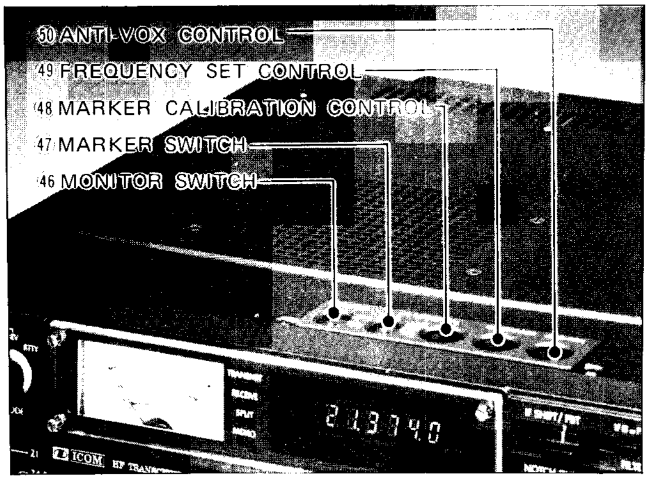
44. NOTCH FILTER CONTROL

Shifts the notch filter frequency. Adjust the control so that the interference is reduced.

45. NOTCH FILTER SWITCH

Switches the notch filter function ON and OFF.

2-2 TOP COVER



46. MONITOR SWITCH

In the SSB transmit mode, the transmitting IF signals can be monitored by turning this switch ON. At this time, use headphones or reduce receiver audio volume to prevent howling.

47. MARKER SWITCH

When an optional marker oscillator unit is installed, this switch turns the marker oscillator ON or OFF.

The marker frequency is available on every 25KHz or 100KHz step.

48. MARKER CALIBRATION CONTROL

Calibrates the marker frequency with a standard frequency such as WWV.

49. FREQUENCY SET CONTROL

This control is for fine adjustment of the reference frequency of the PLL unit, which is local oscillator frequency. Do not turn it unless you want to change the frequency.

50. ANTI-VOX CONTROL

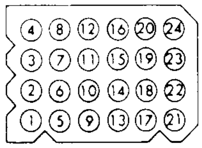
In VOX (SSB) operation, the VOX circuit may be operated by sound from the speaker causing a switch to transmit. This trouble can be prevented by adjusting the input level of the ANTI-VOX circuit with this control along with the VOX gain control so that the VOX circuit only operates by the operator's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

2-3 REAR PANEL CONNECTIONS

51. ACCESSORY (ACC) SOCKET

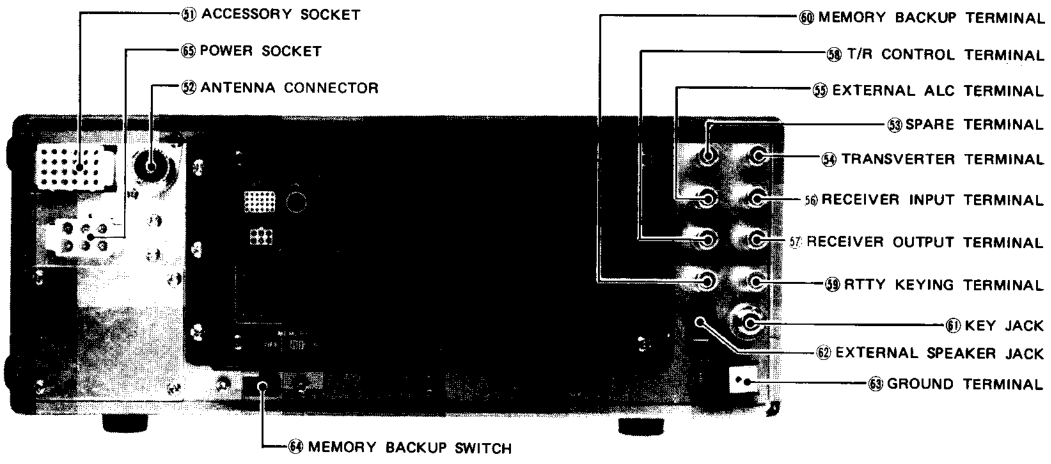
Various functions are available through the accessory socket such as modulation output, receiver output, T/R change-over, and so forth. The table below shows those terminals.

ACC SOCKET CONNECTIONS



Outside view

PIN No.	FUNCTION
1.	Output from the discriminator circuit (When optional FM unit is installed).
2.	13.8 Volts DC in conjunction with the power switch operation.
3.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
4.	Output from the receive detector stage. Fixed output regardless of AF output or AF gain.
5.	Output from Transmitter MIC amplifier stage. (Input for MIC gain control 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.	NC (no connection)
10.	8 Volts DC available when the 28MHz band is selected.
11.	Input for TRANSVERTER control. When 8 Volts DC is applied, the set can operate with a transverter.
12.	Output reference voltage for band switching.
13.	Output for external band switching.
14.~24.	NC



52. ANTENNA (ANT) CONNECTOR
This is used to connect an antenna to the set. Its impedance is 50 ohms and connect with a PL-259 connector.

53. SPARE TERMINAL
This terminal is available for your personal use, such as for adding accessory circuit, etc., if desired.

54. TRANSVERTER TERMINAL
VHF and UHF operation using a suitable transverter with the IC-740 is possible. This terminal is for Transverter connection. The output is a few milliwatts.

55. EXTERNAL ALC TERMINAL
This terminal can be used for input terminal of external ALC signal from a linear amplifier or transverter.
The ALC voltage should be in 0V ~ –4V.

56. RECEIVER INPUT TERMINAL
This is an input terminal which is connected directly to the receiver.

57. RECEIVER ANTENNA OUTPUT TERMINAL
This is a terminal to which received signals from the antenna connector are conducted 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-740.

58. T/R CONTROL TERMINAL
Controls Transmit/Receive for an external linear amplifier or transverter. This terminal can be used to switch 24V 1A DC. Don't exceed this limit.

59. RTTY KEYING TERMINAL
This terminal is for RTTY keying (Frequency Shift Keying). The keying signals should be H-level (+5V) for the MARK and L-level (0V) for the SPACE.

60. MEMORY BACKUP TERMINAL
For connection of a 9 ~ 12V DC power supply. For mobile installation the current drain is low, so connection to the vehicle's battery can be made. For fixed installation use of the BC-10A is recommended.

61. KEY JACK
For CW operation, connect a key here using a standard 1/4 inch 3-P plug. For electronic keying the terminal voltage must be less than 0.4V DC.

When an optional electronic keyer unit is installed, an iambic keyer paddle can be used with a 1/4 inch 3-P plug.

62. 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.

63. 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.

64. MEMORY BACKUP SWITCH
When this switch is in the ON position, the power to the CPU of the set is supplied continuously, if you use the optional built-in power supply or memory backup power source, even when the POWER switch on the front panel is turned OFF. At this time, the programmed frequencies in the memory channels, the operating frequencies of the two VFO's are also retained.

When this switch is set at the OFF position, all the power, including that to the CPU, is turned OFF by turning the POWER switch OFF, so that all frequencies are erased.

65. POWER SOCKET
This is for connection of the IC-PS15's DC power cord, or other suitable power supply.

3-1 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.

3-1-1 FREQUENCY DISPLAY ON EACH MODE

When the set is first turned ON, the following readouts will appear on the FREQUENCY DISPLAY.

Band	Displayed Frequency (MHz)		
	CW·RTTY·FM	LSB	USB
1.8MHz	1.600.0	1.601.5	1.598.5
3.5 〃	3.600.0	3.601.5	3.598.5
7 〃	7.100.0	7.101.5	7.098.5
10 〃	10.100.0	10.101.5	10.098.5
14 〃	14.100.0	14.101.5	14.098.5
18 〃	18.100.0	18.101.5	18.098.5
21 〃	21.100.0	21.101.5	21.098.5
24.5 〃	24.600.0	24.601.5	24.598.5
28 〃	28.100.0	28.101.5	28.098.5
28.5 〃	28.600.0	28.601.5	28.598.5
29 〃	29.100.0	29.101.5	29.098.5
29.5 〃	29.600.0	29.601.5	29.598.5

EXAMPLE:
When the 7MHz band and LSB are selected, the display will be as follow:

When changing to other modes, the display will be as follows:

USB:

CW:

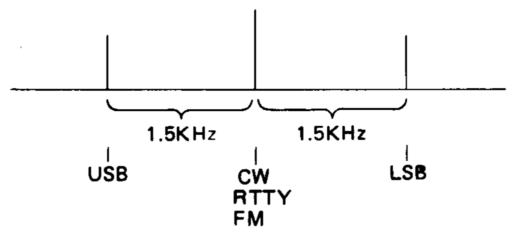
RTTY:

FM:

The displayed frequency shows the carrier frequency. 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 frequency shifts of the various modes, refer to the following figure.

When changing to other bands, 100KHz and lower digits of the frequency display will remain as it had in the previous display.

The differences of the frequency of the various modes



EXAMPLE:
When the frequency display shows 14.255.5MHz, and if you switch to the 21MHz band, and the frequency display will show 21.255.5MHz. (When you switch to the 3.5MHz band, it will show 3.755.5MHz.)

3-1-2 TUNING CONTROL KNOB

The transmit or receive frequency is displayed on a 7 segment Electroluminescent display down to 100Hz digits. Rotating the tuning knob clockwise increases the frequency, while turning counterclockwise decreases the frequency in which stops are selected by the TUNING RATE switches, i.e., 10Hz, 100Hz or 1KHz steps.

When the 10Hz steps tuning rate is selected, by turning the tuning control knob faster, the 100Hz steps tuning rate is automatically selected.

One complete rotation of the tuning knob results in 1KHz with 10Hz steps, 10KHz with 100Hz steps, or 100KHz with 1KHz steps with a frequency increase or decrease.

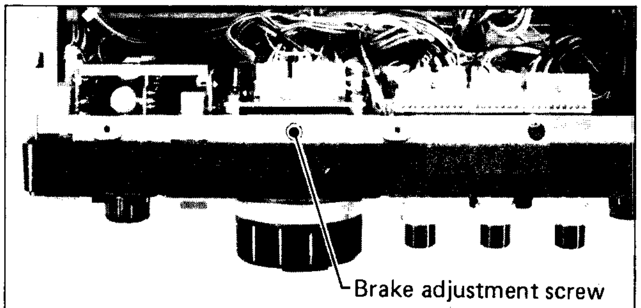
Exact calibration is not necessary as the displayed frequency will always be correct but you may calibrate the scale on the tuning knob for use as an analog type frequency display.

If you want to calibrate the scale during operation, set the frequency readout to 0.0KHz, push the dial lock switch, then set the large increment on the tuning scale to line up with the indicator arrow and then push the dial lock switch again.

The tuning knob scale may require recalibration if you:

1. Turn the knob while the frequency is locked by use of the Dial Lock switch.
2. Turn the knob beyond the band edge.

Brake Adjustment
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.



(It is unnecessary to remove the bottom cover for the 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.

The displayed frequency will not go beyond the highest band edge even by turning the tuning knob clockwise, or beyond the lowest band edge by turning the knob counterclockwise.

The frequency range of each band is shown in the following chart.

Band	Frequency Range (MHz)
1.8	1.400.0 ~ 2.099.9*
3.5	3.400.0 ~ 4.099.9
7.0	6.900.0 ~ 7.599.9
10.0	9.900.0 ~ 10.599.9
14.0	13.900.0 ~ 14.599.9
18.0	17.900.0 ~ 18.599.9
21.0	20.900.0 ~ 21.599.9
24.0	24.400.0 ~ 25.099.9
28.0	27.900.0 ~ 28.599.9
28.5	28.400.0 ~ 29.099.9
29.0	28.900.0 ~ 29.599.9
29.5	29.400.0 ~ 29.999.9

***NOTE:** In the range of 2.000.0 ~ 2.099.9, the frequency display will show as 1.000.0 ~ 1.099.9.

3-1-3 TUNING RATE SWITCHES

Pushing one of the Tuning Rate switches will change the basic tuning rate of the set.

When the 10Hz switch is pushed, the tuning rate becomes 10Hz. The 10Hz may be read from the increments on the tuning knob.

When the 100Hz switch is pushed, the tuning rate becomes 100Hz.

When the 1KHz switch is pushed, the tuning rate is changed to correspond to 1KHz steps. The last significant-digit on the display will remain as the previous one. This position will allow you to quickly QSY over a great frequency range.

3-1-4 DIAL LOCK SWITCH

After the IC-740 is set at a certain frequency for rag chewing, mobile operation, etc., by pushing the Dial Lock switch 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 pushing and releasing the Dial Lock switch again.

3-1-5 VFO SWITCH

The CPU in the IC-740 contains two "VFO's" for both receiving and transmitting. The VFO's are labeled "A" VFO and "B" VFO and are selectible with the VFO Switch. This dual VFO system gives the IC-740 many very convenient features. Please read this section very carefully and perform the operation several times until you are comfortable with the system.

1. "A" VFO is for both transmitting and receiving and is selected by placing the VFO switch in the "A" position. The transmit and receive frequency will be controlled by "A" VFO, displayed on the frequency readout, and stored in "A" memory.

2. "B" VFO is for both transmitting and receiving and is selected by placing the VFO switch in the "B" position. The transmit and receive frequency will be controlled by "B" VFO, displayed on the frequency readout, and stored in "B" memory.

EXAMPLE:
When the set is turned ON (7MHz and LSB are selected), 7.101.5 will be displayed on the readout.
This will occur whether the VFO switch is in either the "A" or "B". Rotating the tuning knob clockwise will increase the frequency in 100Hz (10Hz or 1KHz) steps. Rotating the tuning knob counterclockwise will decrease the frequency in 100Hz (10Hz or 1KHz) steps.

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

EXAMPLE:
If 14.125.0MHz is set with "A" VFO, and the VFO switch is set to "B" VFO, the frequency readout will show "B" VFO's frequency, but 14.125.0MHz is still stored in "A" VFO's memory. Returning the VFO switch to "A" VFO position, and 14.125.0 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!

3-1-6 SPLIT SWITCH

Pushing the SPLIT switch will change the relationship of the two VFO's. In the NORMAL (out) position, one VFO is for both transmit and receive. In the SPLIT (in) position, one VFO is for transmit and the other is for receive, so that this will allow you to operate split transmit/receive frequencies on the same band.

EXAMPLE:

Set "A" VFO to 7.085.0MHz and "B" VFO to 7.255.0 MHz.

Return the VFO Switch to "A" VFO then set the SPLIT Switch to the SPLIT position. 7.085.0MHz will be shown on the readout during receive ("A" VFO) and 7.255.0MHz during transmit ("B" VFO). You are now receiving on 7.085.0MHz and transmitting on 7.255.0MHz. Setting the VFO switch to "B" VFO to reverse the above.

5-1-7 RIT (RECEIVE INCREMENTAL TUNING)

By using the RIT circuit, you can shift the receive frequency ±1.5KHz 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 frequency without disturbing the transmitting frequency. By pushing the RIT switch the RIT circuit is turned ON and the RIT Indicator is lit.
The receive frequency can be shifted with the INCREMENTAL TUNING Control knob.

When the Control 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 function, again push and release the RIT switch and the RIT Indicator will go OFF. When the RIT circuit is OFF, the transmit and receive frequencies are the same regardless of the setting of the control knob.

NOTE: The RIT circuit is operational when the frequency is locked with the dial lock switch. The frequency shifted by turning the INCREMENTAL TUNING control is not indicated on the frequency display. When the transmitting and receiving frequencies differ by more than 1.5KHz, use "A" and "B" VFOs.

3-1-8 XIT (XMITTER INCREMENTAL TUNING)

You can shift the transmit frequency ±1.5KHz on either side of the receive frequency without moving the receive frequency the same function as the RIT by using the XIT circuit.

By pushing the XIT switch, the XIT circuit is turned ON and the XIT Indicator is lit.
The transmit frequency can be shifted with the INCREMENTAL TUNING Control.

NOTE: When both the RIT and XIT switches are pushed, the receive frequency and transmit frequency become the same frequency, and it can be shifted to either side from the displayed frequency by the INCREMENTAL TUNING control.

3-1-9 MEMORY/VFO WRITE BUTTON

This button allows desired frequencies to be written into the memories for each band, and allows either VFO's to be brought to the exact frequency of the other VFO without turning the tuning knob. Therefore, it is very easy to make a few KHz split transmit/receive frequencies.

EXAMPLE:

When "A" VFO is 14.255.5MHz and "B" VFO is 14.355.0 MHz, pushing the VFO switch to select "B" VFO, then the MEMORY/VFO WRITE button, "B" VFO's frequency becomes the same as "A" VFO's (14.255.5MHz). Now the "A" VFO's frequency is memorized in the "B" VFO, and you can operate anywhere with "A" VFO or "B" VFO. When you want to return to the previous frequency (14.255.5MHz), switch back to the other VFO. It's very easy. Also, you can make several KHz split frequency operations with "A" VFO and "B" VFO, within a few moments. To reverse this (A the same as B), select "A" VFO first, then push the MEMORY/VFO WRITE button.

3-1-10 MEMORY OPERATION

MEMORY-WRITING

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

1. Set the TUNING CONTROL knob to the desired frequency, using "A" VFO. For example, set it for 14.255.5MHz on the display (when 14MHz and USB are selected).
2. Push the MEMORY Switch. If no frequency has been programmed since turning the power of the unit ON, 14.098.5 (14MHz, USB) will be shown on the display and the unit will receive on this frequency.
3. One push of the MEMORY/VFO WRITE Button erases the previous programmed frequency (14.098.5) and programs the new frequency (14.255.5) into memory.
4. Program any desired frequency into memory for each band in the same manner.
5. There is a memory for each band. The 28MHz band consists of four segments, and there is a memory for each one. However, the memory can be used for all segments. For example when 28.055.0 is written in the memory, it can be used for 28.555.0, 29.055.0 and 29.555.0MHz also.

Also, there is only one memory for 1.8MHz and 3.5MHz bands. However the memory can be used for the both bands. For example, when 1.805.5 is written in the memory, it can be used for 3.805.5 as well.

MEMORY-READING

Just push the MEMORY Switch. At whichever frequency the "A" or "B" VFO has been set, that previously programmed frequency is recalled. When the MEMORY Switch is pushed again and released, the previous operating frequency of that VFO will again be shown on the display.

The programmed frequencies in the memories are maintained as long as the power, including MEMORY BACKUP power, of the set is not turned OFF, or new frequency reprogrammed. When a MEMORY BACKUP power source is connected, all programmed frequencies in the memories and the operating frequencies of both "A" and "B" VFO's are retained even when the POWER Switch is turned OFF.

3-2 SSB OPERATION

3-2-1 RECEIVING

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

POWER SWITCH	OFF (OUT)
T/R SWITCH	RECEIVE (DOWN)
VOX SWITCH	OFF (OUT)
NOISE BLANKER (NB) SWITCH	OFF
NB LEVEL CONTROL	Completely Counterclockwise
AGC CONTROL	Center (12 o'clock)
PREAMP SWITCH	OFF (OUT)
VFO SWITCH	A (OUT)
TUNING RATE SWITCHES	Desired Rate
MODE SWITCH	SSB-NOR
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
SQUELCH CONTROL	Completely Counterclockwise
TONE CONTROL	Center (12 o'clock)
P.B. SHIFT CONTROL	Center position
BAND SWITCH	Desired Band
RIT SWITCH	OFF
XIT SWITCH	OFF
SPLIT SWITCH	OFF (OUT)
DIAL LOCK SWITCH	OFF (OUT)
MEMORY SWITCH	OFF (OUT)
PBT SWITCH	IF SHIFT (OUT)
FILTER SWITCH	OFF (OUT)
NOTCH FILTER SWITCH	OFF (OUT)

Now turn ON the power switch. The meter lamp will be illuminated and [7.101.5] will be shown on the FREQUENCY display (when 7MHz and LSB are selected).

In SSB operation there is both a USB (upper side band) and an LSB (lower side band). LSB is usually used on the 3.5 and 7MHz bands, while USB is usually used on the 10MHz band and above.

Slowly turn the AF GAIN control clockwise to a comfortable level. Rotate the tuning knob until a signal is received. The 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 to the proper sideband.

3-2-2 NB (NOISE BLANKER)

Set the NB (noise blanker) switch in the NOR position when there is pulse type noise, such as ignition noise from automobile motors, and turn the NB LEVEL control clockwise so that noise will be suppressed and even weak signals will be received comfortably.

When the NB switch is set in the WIDE position, the noise blanker will effectively work for "woodpecker's noise", however, if the receiving signal is too strong, the noise blanker may work with the receiving signal itself, and some distortion may cause in the receiving audio or keying form. At this time, set the N.B. Switch in the NOR position, or turn the NB switch OFF.

3-2-3 AGC (AUTOMATIC GAIN CONTROL)

The IC-740 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 meter indicates the peak value for a certain period, facilitating reading of the meter "S" function.

For normal SSB reception, turn the AGC control clockwise to the SLOW position. Turn the AGC control counterclockwise to the FAST position, when tuning or receiving signals with short interval fading. When in the FAST position, the time constant is shortened.

When this control is set at the OFF position, the AGC circuit is turned OFF, and the S-meter does not work even if a signal is received. However the RF GAIN control is still active and the needle of the meter moves depending on the control position.

3-2-4 PREAMP SWITCH

Turn the PREAMP Switch ON (in) when receiving weak signals. In the ON position, an RF preamplifier is inserted into the receiving antenna circuit, increasing sensitivity and giving easy reception.

3-2-5 PASS-BAND SHIFT CONTROL

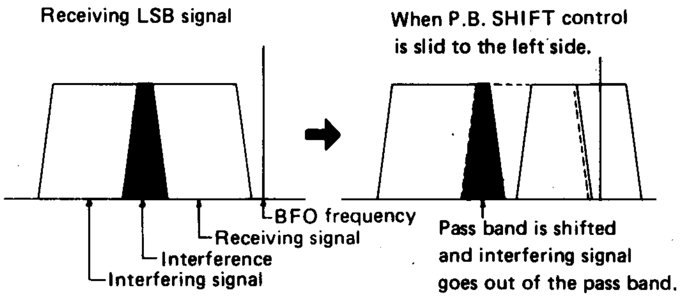
Pass-Band Shift Control is a system in the receive mode to shift the pass-band of the IF upper or lower side continuously. This is very effective in reducing interference from nearby signals.

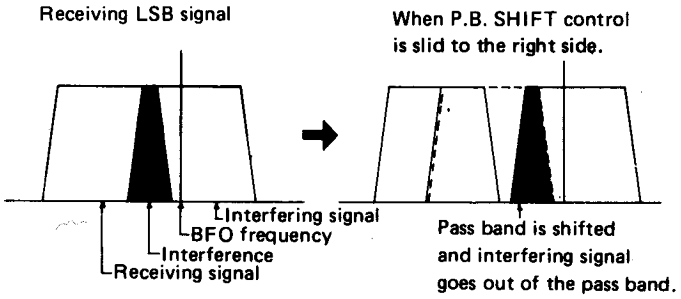
To use the Pass-Band (IF) Shift system, set the PBT switch in the IF (out) position and slide the control toward right or left side. The center position is the normal pass-band condition.

For example, while receiving in the LSB mode, if you get interference from a lower frequency (interfering signals are high pitched tones), shift the pass-band by sliding the P.B. SHIFT control to the left side. When the interfering signals are low-pitched tones, they are from a higher frequency, and you should shift the pass-band by sliding the P.B. SHIFT control to the right side.

When receiving in the USB mode, the pass-band is shifted in the opposite manner. Interference from a higher frequency will be high-pitched tones, and the P.B. SHIFT control should be slid to the right side. Interference from a lower frequency will be low-pitched tones and the P.B. SHIFT control is slid to the left side.

This control can also be used for audio tone adjustment, so it may be set for the most comfortable reception.

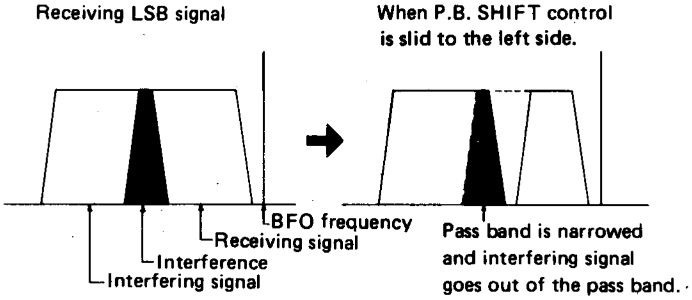


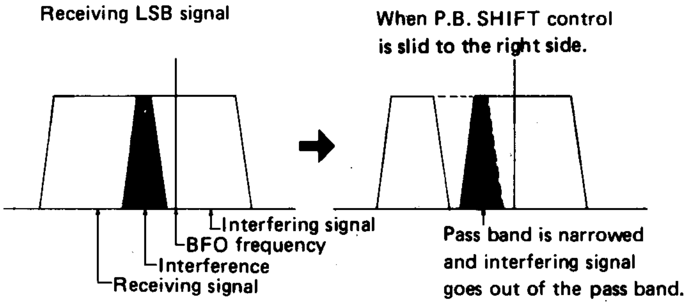


When the PBT switch is set in the PBT (in) position, the Pass-Band Shift system will be changed to the Pass-Band Tuning system.

The Pass-Band Tuning (PBT) is a system in the receive mode to narrow the band width (selectivity) of the frequencies that will pass through the crystal filter electronically from either the upper or lower side continuously by up to 800Hz. This is very effective in reducing interference from nearby signals.

To use the PBT system, slide the control the same as the Pass-Band Shift system.
The center position is the widest position and is equivalent to the normal SSB band width.





3-2-6 FILTER SWITCH

This switch selects the combination of the internal filters. When an optional filter is installed, this function will be more effective. Select and install the optional filter(s) to suit your favorite mode(s).

3-2-7 NOTCH FILTER

This circuit notches a frequency in the IF pass-band, so this is effective to reduce interference such as a beat-tone signal.

To use this function, push the NOTCH FILTER switch ON and slide the NOTCH FILTER control so that the interference is reduced.

3-2-8 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 knobs and switches as follows.

MIC GAIN	CENTER (12 o'clock) position
RF POWER CONTROL	FULLY COUNTERCLOCKWISE
METER SWITCH	ALC

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 Indicator 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. Set the MIC GAIN control so that the meter needle stays well within the ALC zone at voice peaks. If you wish to increase the output power, turn the RF POWER Control clockwise and adjust to obtain the desired RF output power of between 10 watts and 100 watts (approximately).

Change to the receive mode by moving the T/R switch to receive, or release the microphone PTT switch.

3-2-9 HOW TO USE THE SPEECH PROCESSOR

The IC-740 has a low distortion AF speech processor which enables greater talk power and better results in DX operation. Follow the steps below for use of the Speech Processor:

MIC GAIN CONTROL	CENTER (12 o'clock)
RF POWER CONTROL	Fully Counterclockwise
COMP SWITCH	ON
METER SWITCH	COMP

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 10 watts and 100 watts (approximately).

Adjust the MIC GAIN CONTROL to a point where the meter needle just begins to move.

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.

3-2-10 HOW TO USE THE VOX CIRCUIT

The IC-740 has a built-in VOX (voice operated relay) which allows automatic T/R switching by voice signals into the microphone. For VOX use, set the knobs and switch as follows:

VOX GAIN CONTROL
FULLY COUNTERCLOCKWISE
VOX DELAY CONTROL
FULLY CLOCKWISE
ANTI VOX CONTROL (on the top)
FULLY COUNTERCLOCKWIS

Push the VOX switch on the front panel to the ON (in) 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 the 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.

3-2-11 MONITOR

The transmitting IF signals can be monitored in the SSB mode. So you can check the quality of the transmitting signals and conditions of the speech processor and so on.

To use this function, turn the MONITOR switch on the top cover ON and adjust the AF GAIN control to a comfortable audio level. At this time, use headphones to prevent howling which will be caused by picking up sounds from the speaker.

3-3 CW OPERATION

3-3-1 RECEIVING

For CW reception, set the MODE Switch for CW mode.

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

In addition to the crystal band-pass filter, Narrow filters are optional for this unit. When the FILTER Switch is set at the ON (in) position, this filter is activated and the total selectivity of CW reception is improved. With these filters, internal noise is reduced for comfortable CW reception and an improved signal to noise ratio (S/N).

Also, use the Noise Blanker, AGC switch and/or PREAMP Switch depending on the receiving conditions, the same as SSB reception.

3-3-2 TRANSMITTING

Insert the keyer plug into the KEY Jack on the rear panel of the unit, and set knobs and switches as follows:

RF POWER CONTROL	Fully counterclockwise
METER SWITCH	RF
VOX GAIN/KEYER SPEED CONTROL	OFF

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

By setting the T/R switch to TRANSMIT, the TRANSMIT indicator 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 increase the transmitting power, turn the RF POWER Control clockwise to adjust while watching the meter needle on the Po scale for the desired output power.

When the optional keyer unit is installed, connect an iambic paddle with the supplied 3-P key plug to the KEY jack on the rear panel.

Then adjust keying speed by turning the VOX GAIN/ KEYER SPEED CONTROL clockwise for your favorite keying speed.

The other procedures are the same when using a hand keyer or an external electronic keyer.

3-3-3 CW SIDE-TONE (MONITOR)

When keying the side-tone oscillator is activated and an 800Hz tone will be heard. The loudness of the tone is controlled by the CW MONI Control located under the top cover. Rotating the control clockwise will increase the loudness. This tone is also audible in the receive mode and can be used for code practice, adjustment of the keyer, etc.

3-3-4 SEMI BREAK-IN OPERATION

The IC-740 has Semi Break-In CW capability when using the VOX function. 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 (IN) position.

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

3-4 RTTY OPERATION

For RTTY operation, a teletypewriter and a demodulator (terminal unit) which is operational with audio input are required. Any demodulator with 2125/2295Hz filters (narrow, 170Hz shift) can be used with the IC-740.

3-4-1 RECEIVING

Audio signals for the demodulator can be supplied from Pin 4 of the ACC socket on the rear panel, or from the PHONES jack on the front panel. The level of the audio signals from Pin 4 of the ACC socket does not vary by turning the AF GAIN Control, and the level is about 300mV P-P maximum.

Set the operating mode for RTTY, by setting the MODE SELECT switch to "RTTY". The other controls are the same as those for SSB reception. When tuning a RTTY signal, set the TUNING RATE SELECT switch in the 10Hz position, and tune to get audio signals of 2125Hz for MARK and 2295Hz for SPACE. (Use the tuning indicator of the terminal unit for easy tuning.) Also slide the P.B. Tune control for clear reception.

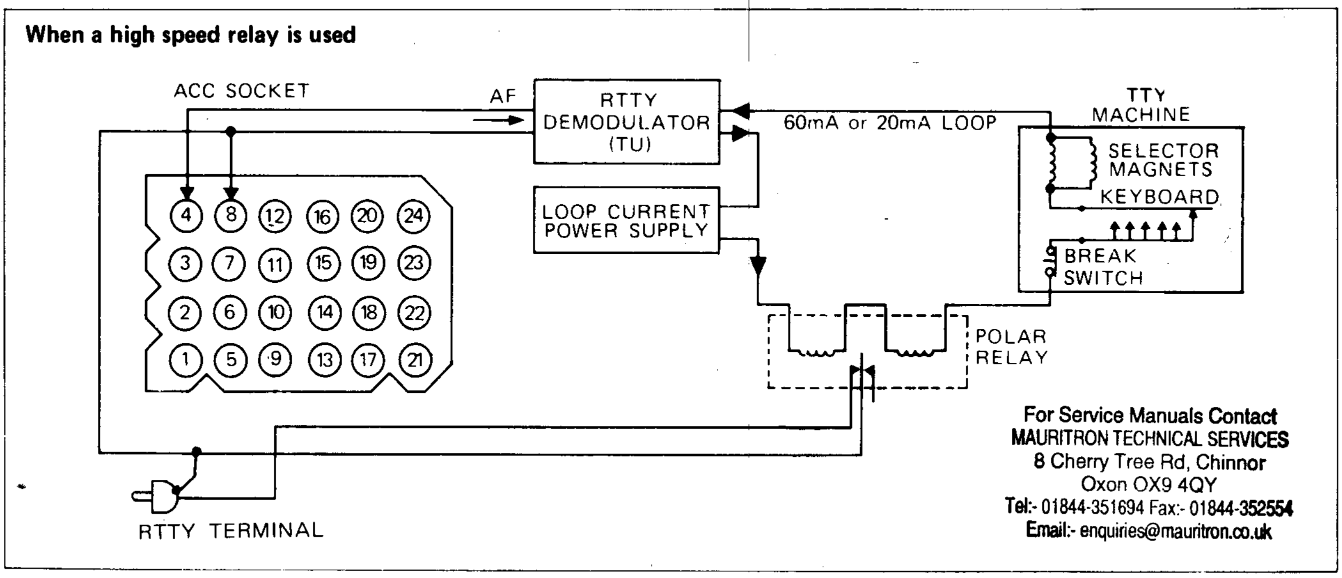
3-4-2 TRANSMITTING

For keying of the Frequency Shift Keying (FSK) circuit insert a high speed relay's coil into the loop current circuit of the teletypewriter, and connect the relay contacts to the RTTY keying terminal on the rear panel. The relay contacts make during the Space and break during the Mark, as shown in the drawing. Fine adjustment of the MARK and SPACE frequencies can be done by adjusting the coil cores in the MAIN unit.

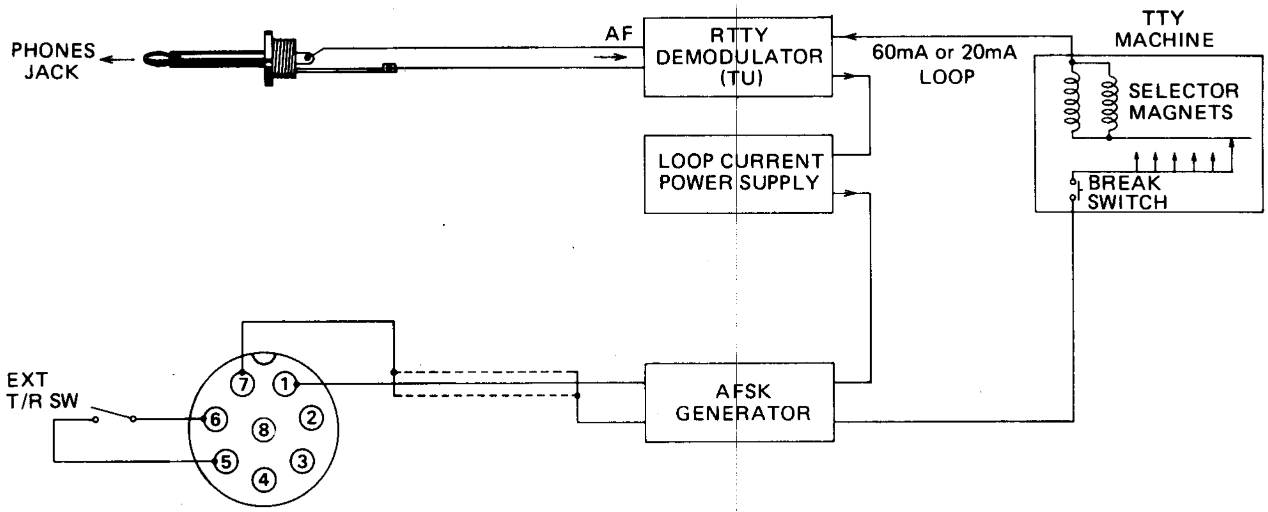
When a level converter for TTL level signals is used, connect the output of the converter to the RTTY keying terminal apply High level (5V) signals for the Mark, and Low (0V) for the Space.

When using an AFSK generator that has 2125Hz for Mark and 2295Hz for Space, connect the output signals for the AFSK to the Mic connector on the front panel and set the Mode to LSB. (See Other Operations chapter.) Doing this, you can use the VOX operation available in this mode, and receive/transmit changeover is very easy.

If you wish to transmit continuously 10 minutes or more, reduce the output power to less than 70% of the full power, by rotating the RF POWER control on the front panel.



When a AFSK generator is used



3-5 FM OPERATION (OPTION)

3-5-1 RECEIVING

Set the operating mode for FM, by setting the MODE SELECT switch to "FM". The other controls are the same as those for SSB reception, however, the Pass Band Shift (Tune) control, Notch Filter, Noise Blanker and AGC circuits do not work in this mode.

When tuning an FM signal, tune for maximum signal strength as indicated on the meter and the clearest audio.

3-5-2 TRANSMITTING

Transmitting FM signals is essentially the same as SSB transmission.
Set knobs and switches the same as for SSB operation. However the speech processor can not be used on this mode.

When transmitting the FM signals, the meter (in RF position) will indicate the carrier power, but the meter needle does not move according to your voice such as SSB transmitting.

3-6 OTHER OPERATIONS

3-6-1 VSWR READING

The IC-740 has a built-in VSWR meter for checking antenna matching in order to avoid problems caused by VSWR. Set the METER SELECT switch to the SET position. Set the operating mode to RTTY, and turn the TRANSMIT/RECEIVE switch to TRANSMIT.

Adjust the RF POWER control so that the meter needle points to "SET" on the meter scale. Set the METER SELECT switch to the SWR position. With the switch in the SWR position, SWR reading can be seen on the meter. Although this unit is built to handle VSWR of up to 2:1, it is recommended that the antenna(s) be adjusted for the lowest possible VSWR. After taking the reading, return the switch to the other position. ALSO BE SURE THAT THE ANTENNA IMPEDANCE IS 50 OHMS OR THERE MAY NOT BE ANY OUTPUT. OTHERWISE THERE WILL BE DAMAGE TO THE TRANSCEIVER.

The final transistors used in the IC-740 are of good design and are protected to a reasonable extent by circuits incorporated in the set. These devices can be expected to have an indefinite lifetime since there are no cathodes to burn out. Under some conditions, however, they can be abused beyond tolerance and may have to be replaced.

When in doubt about antenna systems, use the lowest power setting possible to achieve meaningful readings. Use a good tuner or transmatch when necessary. Always use caution and exercise judgement when testing RF power generators.

3-6-2 WWV RECEPTION

To receive WWV (or other standard frequency station), set the operating band to 10MHz in the HAM band, and the MODE to any mode. Tune to 10.000.0MHz on the frequency display.

The WWV signal can be used for alignment of a frequency counter, marker oscillator, or the frequency display.

3-6-3 SIMPLE FREQUENCY ALIGNMENT

A very accurate frequency counter is necessary to align the frequency of the IC-740. However, the frequency can be aligned simply by receiving the WWV signal.

1. Set the frequency display to 10.000.0MHz and be sure that you are receiving the WWV signal.
2. Set the operating mode to CW. A 800Hz beat can be heard.
3. Short the KEY Jack on the rear panel so that the CW side-tone also becomes audible.
4. Rotate the CALIBRATOR Control, located on the top cover, so that the two tones are of the same pitch (in zero beat). If the tones are difficult to adjust because of a difference in their strengths, adjust the CW side-tone level with the CW MONI control, located on the MAIN unit (under the top cover), until the strengths are the same.

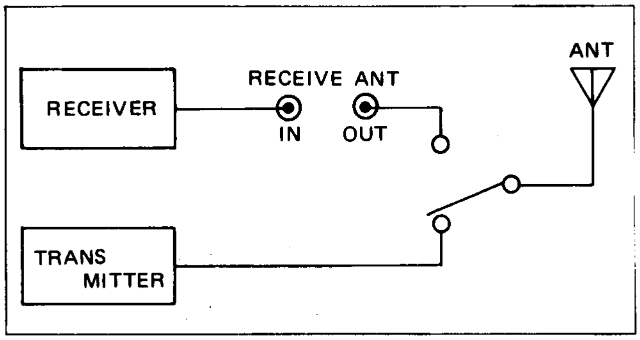
When the optional marker unit, IC-EX241 is installed, operating frequency can be calibrated each 25KHz or 100KHz on the all bands.

WHEN ALIGNING THE FREQUENCY, DO NOT PUT THE UNIT IN THE TRANSMIT MODE.

Be sure the T/R switch is in the Receive position, the VOX switch is OFF, and that you do not touch the PTT switch on the microphone.

3-6-4 RECEIVE ANTENNA TERMINALS

The RECEIVE ANT IN jack is connected to the input terminal of the receiving section, and the RECEIVE ANT OUT jack is connected to the antenna connector through the internal T/R antenna switching circuit.



These two jacks are normally jumpered with a cable, but can be used for:

1. A receiving preamplifier.
2. A separate receiver.
3. Separate receiver and transmitter antennas.

If you wish to use a receiver preamplifier, connect it between the receiver input and antenna output terminals.

If a separate receiver is used, connect it to the receiver antenna output terminal. For a separate receive antenna connect it to the receiver input terminal.

3-6-5 TRANSVERTER CONNECTION

When a transverter control signal (+8V) is applied to Pin 11 of the ACCESSORY socket, the TRANSVERTER terminal can be used for a VHF/UHF transverter INPUT/OUTPUT terminal.

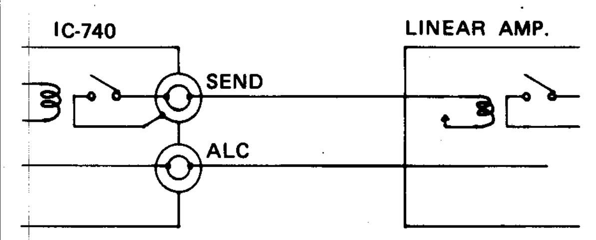
The transverter's input/output frequency and signal level should be as follows:

- Transverter INPUT/OUTPUT Frequency
  28 ~ 30MHz
- Input/Output Level
  Transmit (Output) : Max. 150mV across a 50 ohm load
  Receive (Input) : 1μV for S/N 10dB

3-6-6 LINEAR AMPLIFIER CONNECTION

The jacks on the rear panel marked "ALC" and "SEND" are a relay built-in for keying a linear amplifier, and the input for ALC from the linear amplifier. For linear amplifier hookup the SEND jack is for an internal relay and the ALC jack is for ALC input.

Internal Connections for Linear Amplifier



The optional linear amplifier IC-2KL and automatic antenna tuner IC-AT100/AT500 can be connected to the IC-740 with their accessory cables as same as other ICOM HF transceivers. Refer to their instruction manuals for detail.

The IC-740 puts out the band control voltage to change operating band automatically for external equipment such as linear amplifier and antenna tuner. The voltage is put out from Pin 13 of the accessory socket. (Refer to page 10.)

Band Control Voltage Chart

BAND (MHz)	Band Control Voltage
1.8	7.0 ~ 8.0V
3.5	6.0 ~ 6.5V
7	5.0 ~ 5.5V
14	4.0 ~ 4.5V
18 - 21	3.0 ~ 3.5V
24 - 28	2.0 ~ 2.5V
10	0 ~ 1.2V

4-1 RECEIVER CIRCUITS

4-1-1 RF SECTION (RF Unit)

A receive signal from the antenna connector is fed to the RF unit through the FILTER unit.

The receive signal passes through a high-pass filter, consisting of L34, L35 and C80 - C84, which attenuates strong radio signals from the medium wave BC band. It then goes to one of the nine bandpass filters for various frequency ranges through contacts of RL1, C74 and D34.
When the PREAMP switch on the front panel is on, the emitter of Q9 is grounded which turns on RL1, and an RF preamplifier, Q6 and Q7.
When a transverter is in use, TRV8V is supplied to the base of Q10 and the base of Q9 is grounded to turn off RL1.
The gain of this preamplifier is greater than 8dB and the intercept point is +26dBm.
D34 is turned on by the bias voltages R8V and TRV8V through D38 and D39. In the transmit mode, Q5 is turned on to improve the isolation from transmit RF output signals.

The signal is fed to the first mixer.

4-1-2 IF SECTION (RF Unit)

The received signal is converted to a 39.7315MHz first IF signal in a double-balanced mixer. The first LO output signal from the VCO unit is amplified by Q1 to more than +10dBm before being applied to the mixer.
The image rejection ratio and spurious response rejection ratio are improved by use of the up-conversion mixer.
Q4 and Q3 comprise a two-stage first IF amplifier with about 20dB gain. The first IF signal is filtered by monolithic crystal filters FI1 and FI2 (39M1B) to improve the second image characteristics by removing strong signals in the same band. The 1st IF signal is then fed to the second mixer.
The second LO signal (30.71901 - 30.72000MHz) is fed to the second mixer to convert the 1st IF signal to a 9.0115 MHz second IF signal, which is fed through the noise blanker gate to J11 of the IF unit.

The 2nd local oscillator consisting of Q12, X1 and D41 oscillates at 30.7190MHz - 30.7200MHz with 10Hz steps. D41 varactor diode provides this frequency variation. A control voltage generated in the LOGIC unit and DC-amplified by IC9 in the MAIN unit is applied to D41. The oscillation frequency can be adjusted by L38.

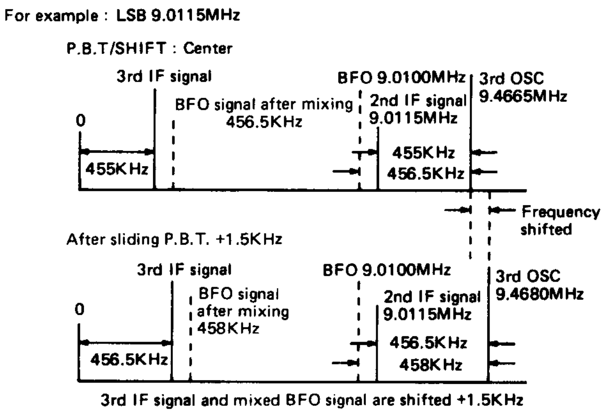
(a) Noise Blanker Circuit (RF Unit)

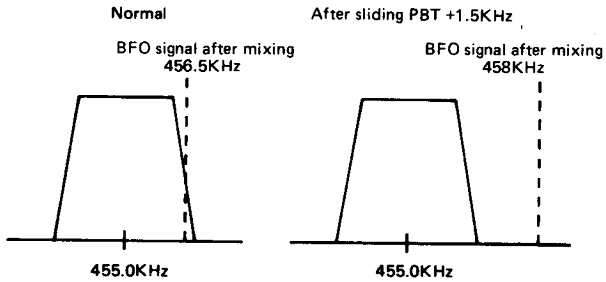
The output signal from the second mixer fed through D47 and C106 is amplified by Q14 and IC1, and then rectified by D51. When the output voltage exceeds 0.6V RMS, the AGC voltage is supplied to Pin 3 of IC1 through Q16 and Q15. The AGC attack time constant is determined by R78 and C116 when the NB switch on the front panel is at WIDE and by R77 and C116 at NORMAL. The release time constant is determined by R77, R79, R80 and C116.
The output signal from D51 is also supplied to Pin 2 of IC2. When a pulse noise is received, IC2 outputs a high-level signal to drive Q17 which grounds R72.
The source voltage of Q14 is adjusted by the NB LEVEL control on the front panel to control the gain of the noise amplifier. L42 and L43 at the noise blanking gate comprise a dual-tuned circuit to suppress the spurious output from the second mixer.
A receive signal without noise components passes through D48 and D49, which are turned on by R69 - R71, and D50 is turned off by a bias voltage. However, a signal with noise passes through D50, which is turned on by R69, and D48 and D49 are turned off by a bias voltage.
The signal from the noise blanking gate is output at J6.

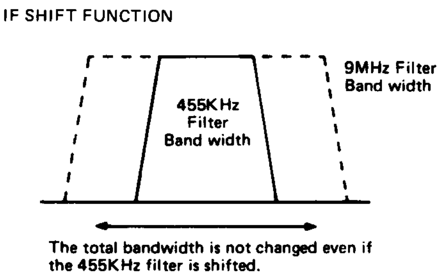
(b) PBT, IF SHIFT, NOTCH FILTER (IF Unit)

The second IF signal from J11 of the IF unit passes through D45. The appropriate filter is selected by the MODE and the PBT/IF SHIFT switches on the front panel.
When the IF SHIFT function is selected or when in the FM mode, 8V is applied to pin 4 of J9. This turns on D17 - D19 and the signal is fed to FI3 (9M15A ± 7.5kHz/—3dB). When the PBT function is chosen, 8V is applied to J1 - J5 or J6 - J8, depending on the selection of the filter selecting pins (P2 - P13).
When 8V is applied to J1 - J5, Q4 is turned on. D20 and D22 are also on to select FI1 (9M22D2 2.2kHz/—6dB). When 8V is applied to J6 - J8, Q5 is turned on, and D23 and D24 are on to select the optional filter installed.

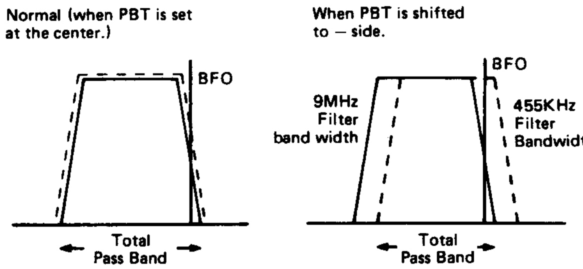
The signal from the filter is amplified by Q7, and the secondary coil L8 is used for a notch filter circuit. The notch frequency is shifted by the voltage change at the cathode of D31 controlled by the NOTCH FILTER CONTROL on the front panel. The frequency variation is 9.0115MHz ± 1.52kHz and the attenuation is more than 25dB.
To obtain stable notch operation, the output impedance of Q7 is held high by use of the source follower Q8, and the signal is supplied to the third mixer IC2.
The LO signal which passes from Q10 to Pin 7 of the mixer IC2 can be varied by ± 1.5kHz from 9.4665MHz, thus the receive signal from Q8 is converted to a 455kHz third IF signal. The frequency of the converted signal is varied according to the frequency shift of the LO signal. The signal from Q10 is also applied to the BFO, and when the LO frequency is varied, the IF SHIFT is effected.
When the bandwidth of the 9MHz filter is wide enough for the bandwidth of the 455kHz filter and the SHIFT frequency, this system functions as an IF SHIFT circuit.







When the bandwidth of the 9MHz filter is as wide (narrow) as that of the 455kHz filter, the total bandwidth becomes narrower as the LO frequency is shifted, and the system functions as a PASS BAND TUNING circuit.

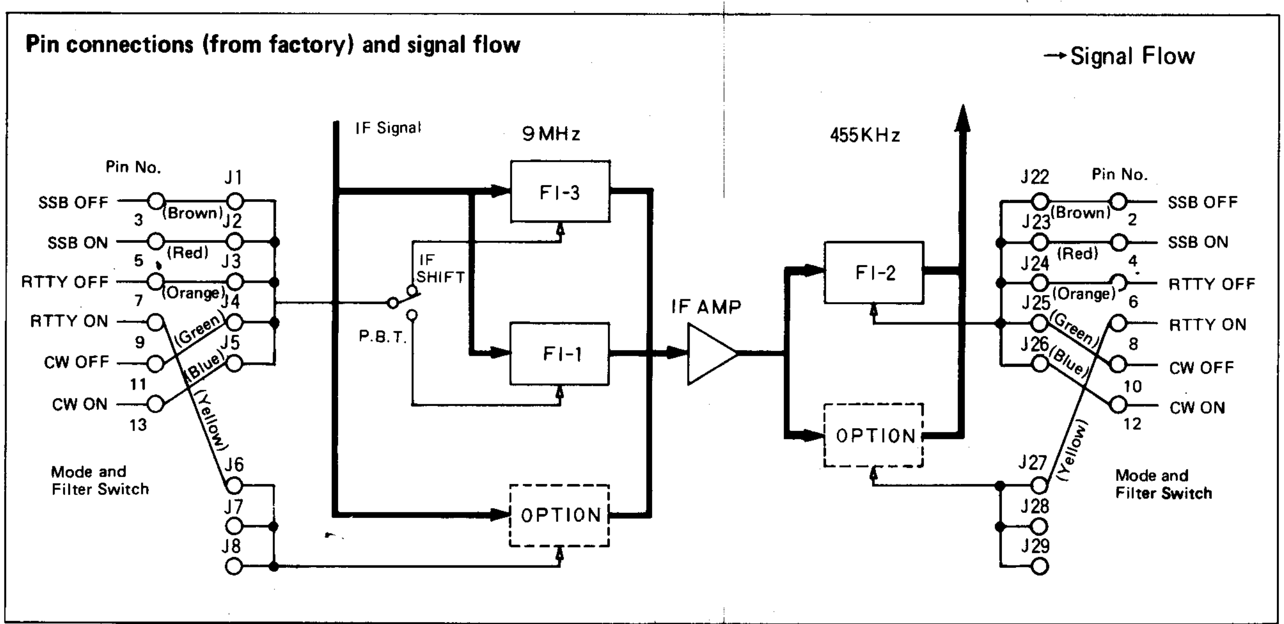


The receive signal from IC2 is fed through D32 to a 455kHz filter, which determines the selectivity, and then through an emitter follower Q1, for a low impedance output, to the MAIN unit through J2.

The following figure shows the connector connection when shipping; P18 is inserted to J20. In this condition, the FILTER SWITCH is effective for SSB and CW modes, but not for RTTY.
If P18 is inserted to J31, the FILTER SWITCH is effective for CW and RTTY, but not for SSB. Select the appropriate position for your requirements.

4-1-3 AF SECTION (MAIN Unit)

The 455kHz IF signal from the IF unit is input to J3 of the MAIN unit, amplified by IF amplifiers Q1 and Q2, and fed to Pin 5 of the double-balanced demodulator IC1.
The SSB, CW or RTTY signal is demodulated by the BFO signal fed into Pin 7 of IC1.



The detected signal passes through squelch circuit Q6 to the AF GAIN control on the front panel, which also controls the CW side-tone and SSB monitor audio levels. Q6 is turned on when the gate level is high and off when it is low.

The audio signal controlled by the AF GAIN control is amplified by Q18 in the CW mode and by Q19 in other modes. The output signal from the amplifier is selected by D16 and D17 and fed to Pin 1 of the AF power amplifier IC10 to drive a speaker. Q18 comprising a phase oscillator circuit functions as an active filter with the center frequency of about 800Hz.

Part of the demodulator output signal is amplified by Q7 and output to the ACC connector on the rear panel. It is unaffected by the AF GAIN control (Impedance: Approximately 5kohm and 0.4V p-p.)

(a) BFO Circuit (MAIN Unit)

The BFO signal is generated by Q13 with X1, X2 or X3; bufferd by Q14 and fed to Pin 5 of IC2, where the signal is mixed with the PBT LO (9.4665MHz) for the 455kHz (± SHIFT frequency) BFO signal. L8 and C53 comprise a low-pass filter.

In the USB mode, D9 is turned on by 8V supplied through R66, X2 oscillates at 9.0130MHz with C45, and the output signal is mixed at IC2 for the 453.5kHz ± PBT SHIFT frequency. At this time, D8 and D10 are reverse biased.

In the LSB mode, D10 is turned on by 8V supplied through R73, X3 oscillates at 9.0100MHz with C48, and the output signal is mixed at IC2 for the 456.5kHz ± PBT SHIFT frequency. At this time, D8 and D9 are reverse biased.

In the RTTY mode, for the space signal transmission, Q33 is turned on, Q12 is off, and Q11 is on. Thus C37 is grounded to oscillate with X1 at 9.01167MHz. The output frequency of IC2 is 454.83kHz ± PBT SHIFT frequency.

For the mark signal in the RTTY mode and for CW-T mode, Q33 is turned on and Q11 is off to turn D7 on by supplying 8V through R55. Thus, L7 is grounded to shift the oscillating frequency of X1 to 9.01150MHz. The output frequency of IC2 is 455.00kHz ± PBT SHIFT frequency.

In CW-R, Q12 is on and Q11 is off to supply 8V to turn on D6 through R54. Thus, L6 is grounded, as well as L7, to shift the X1 frequency to 9.01070MHz. The IC2 output frequency is 455.70kHz ± PBT SHIFT frequency.

In the RTTY-R mode, Q12 is on and Q11 is off while Q10 is turned on by 8V supplied to its base through R53. Thus, the frequency of X1 as determined by L5, L6 and L7 is 9.009375MHz. At this time D9 and D10 are reverse biased. The output frequency of IC2 is 457.125kHz ± PBT SHIFT frequency.

(b) Squelch Circuit (MAIN Unit)

The AGC voltage is supplied to Pin 6 of IC6 and the voltage controlled by the SQUELCH control on the front panel is supplied to Pin 5. IC5 comprises a comparator for the voltages at Pins 5 and 6. The output voltage of IC5 turns on Q22 and Q23, making the gate level of Q6 high to drive the squelch circuit.

(c) AGC Circuit (MAIN Unit)

The output signal from Q2 is buffer-amplified by Q3 and rectified by D1 and D2. The rectified signal charges the peak-hold circuit of R14 and C13. The delay time constant can be varied by adjusting the AGC TIMING control on the front panel.

The resulting voltage is combined with the voltage set by the RF GAIN control, and then output to the MAIN, IF and RF units as the AGC voltage.

(d) S-meter

The AGC voltage is input to Pin 2 of IC5 through R122 for inverting amplification, and its output signal is fed through the SW-C unit to the meter after the level is adjusted by R127 and R128. These controls set the S9 and full-scale levels respectively.

4-2 TRANSMITTER CIRCUITS

4-2-1 AF SECTION (MAIN Unit)

AF signal from the mic connector is amplified by IC3, and then fed to the VOX GAIN control and the MIC GAIN control.

For use with microphones without built-in amplifiers, such as the IC-SM6, the gain of the amplifier (IC3) can be increased to approximately 32dB by removing R77.

The signal through the MIC GAIN control is amplified by Q15 and fed to Pin 5 of the balanced modulator IC1. Pin 7 of IC1 is for the BFO input and Pin 5 is for the DSB output to the IF unit through J8.

The output is muted by Q4 in the receive mode or in the CW or RTTY mode. In CW or RTTY mode, a voltage is supplied to Pin 5 of IC1 through R17 and D3. Thus, the modulator is unbalanced and outputs the BFO signal as the carrier signal.

(a) VOX Circuit (MAIN Unit)

The signal from IC3 is adjusted by the VOX GAIN control and fed to IC4. The IC4 output is rectified by D11 and charges C63.

A portion of the output signal from the AF power amplifier passes through the ANTI VOX GAIN control and is amplified by amplifier IC4 (Pins 1, 2 and 3) and rectified by D13 and charges C65. Approximately 4V is applied to C65 by R97 and R98, and 3.3V to C63 when there is no signal.

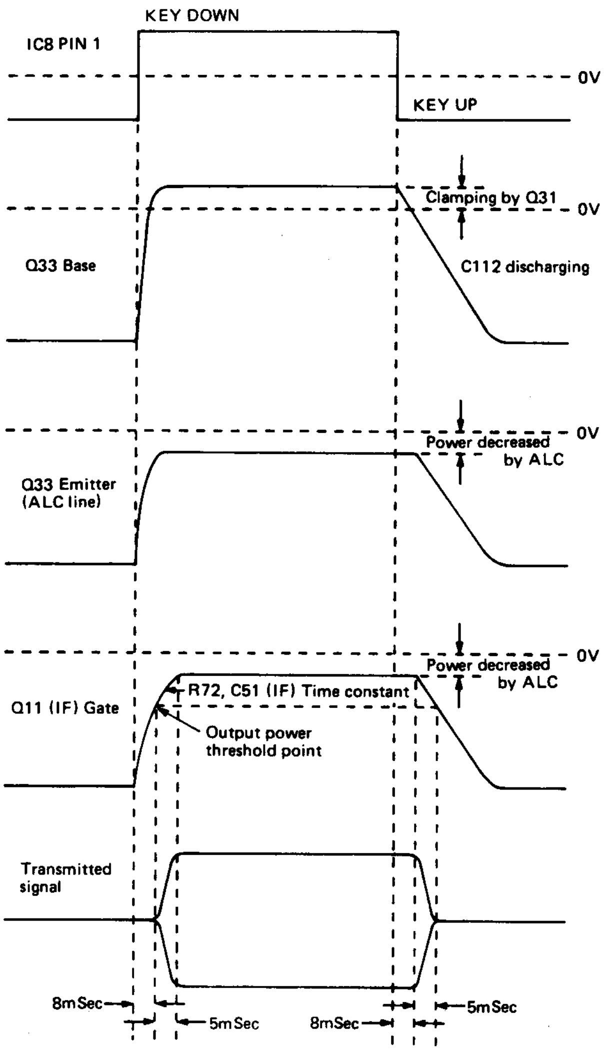
IC3 is a comparator to compare the output voltages of the VOX and ANTI VOX amplifiers. At no signal, the ANTI VOX output voltage becomes higher than that of the VOX, and the level of IC3 Pin 7 becomes low. While both of the signals from the mic and AF amplifier vary, when the voltage at Pin 5 (VOX) of IC3 becomes higher than that of Pin 6 (ANTI VOX), Pin 7 becomes high to turn Q16 and Q17 on. When the VOX switch is on, the SEND line is

grounded for the transmit mode.
In the CW mode, when key is down, pin 1 of IC9 becomes high level and it charges C64 through D14.
The delay time constant is to be adjusted by the VOX DELAY control on the front panel.

(b) Keying Circuit

The voltage at Pin 2 of comparator IC9 is higher than that of Pin 3 when the CW key is up, and the output voltage at Pin 1 is negative. The output feeds into the base of Q29 to set the ALC voltage negative. This operation suppresses the carrier signal more than 100dB.
When the key is down, Pin 2 becomes low and the output from Pin 1 becomes high to drive the side-tone oscillator circuit, to charge C116 to operate the break-in circuit, and to set the base of Q29 positive. When the base of Q29 is positive, the ALC voltage immediately becomes 0V. However, the delay time constant of the ALC circuit for the IF and RF stages is set by R197 and C116, and provides a proper attack time for CW transmission.

Keying Timing Chart



When the key is up, Pin 1 of IC9 becomes negative to turn off Q24 which stops the oscillation of the side-tone and the charging of C116. The base of Q29 becomes negative with some delay caused by the discharge of C116. In all modes but CW, Q28 turns off the ALC keying and prevents the ALC from excessive delay caused by high voltage at the base of Q29. By use of the base voltage of Q29, the voltage of Pin 3 of IC6 is kept negative to prevent the ALC meter from moving out of the scale when the CW key is up.
C116 and R197 are to set the time constant, and R223 is to determine the carrier suppression.

(c) Ic meter

The collector current of the PA transistors Q4 and Q5 flow through R27. The voltage across R27 is fed to pins 5 and 6 of IC6 on the MAIN unit and inverting amplified.
The amplified voltage is adjusted in level by R146 and R147, and fed to the meter when the METER switch is set to the Ic position. R146 is for meter deflection adjustment and R147 is for APC threshold adjustment.

(d) RF, SWR meter

The forward (FOR) and reflected (REF) voltages detected by the FILTER unit are fed to IC9.
For the RF meter and the SWR set, the forward voltage is fed to Pin 3 of IC7 and its output voltage is adjusted by R23 of the SW-C unit and fed through the METER switch to the meter.
For the SWR, the reflected voltage is input to Pin 5 of IC7 and its output voltage is fed through the SW-C unit and the METER switch to the meter.

(e) ALC meter

The ALC voltage is fed to Pin 2 of IC6. The amplified output voltage is adjusted by R180, and supplied to the meter through the METER switch on the SW-C unit.

(f) ALC circuit (MAIN Unit)

The forward and reflected voltages detected by L17 in the FILTER unit are supplied to J18 on the MAIN unit.
The forward voltage is compared with the voltage set by the RF POWER control on the front panel by IC8 (Pins 5, 6 and 7), and then fed to the IF and RF units as ALC voltage.
Both forward and reflected voltages are input to IC8 (Pins 1, 2 and 3) to protect the final transistors by reducing the RF output power when the VSWR of the antenna load exceeds 3-to-1. A portion of the output for the Ic meter is adjusted by R147 and input to Pin 2 of IC8 to control the ALC voltage through the increase of the final transistor collector current.
When the temperature of the final transistors rises, Q30 is turned on by D29 - D31 to control the power control voltage. R206 is for HIGH POWER adjustment and R164 is for LOW POWER.

4-2-2 IF SECTION

(a) IF Unit

The carrier frequency from the MAIN unit varies depending on the mode: DSB for LSB, 456.5kHz: DSB for USB, 453.5kHz: CW, 455kHz: RTTY (mark), 455kHz: and RTTY (space), 454.83kHz.

The DSB signal output from J17 of the IF unit passes through D33 and FI2 to remove the unwanted sideband resulting in an SSB signal.

After going through the emitter follower Q1, when the COMP switch on the front panel is off, the signal passes through C3 to the RF POWER control on the front panel.

When the COMP switch is on, the signal is fed to an amplifier Q2, and then clipped by D1 and D2. To remove the distortion in the clipped signal, a 9MHz filter is provided before the adjustment of the output level by the RF POWER control on the front panel.

The output signal is mixed with the 9.4665MHz local oscillator signal to 9.0115MHz, and fed through D16 to FI3 when the COMP switch is off and to FI1 when it is on. The signal is amplified by Q6 and fed to the RF unit through J16. The ALC voltage is supplied to the gate of Q6, and the attack time constant is determined by R34 and C33 in the CW mode.

A receive IF amplifier Q7 functions as a monitor amplifier during the transmit mode, and the amplified signal is converted into 455kHz by IC2, then fed to the monitor circuit.

(b) RF Unit

The signal from the IF unit is passed through D46 to the second mixer. Q13 is turned on to prevent the IF signal from being fed back to the noise blanker gate.

The input signal to the double-balanced mixer D42 - D45 is mixed with the 30.71901 - 30.7200MHz second LO signal for a 39.7305 - 39.7315MHz signal, which passes through a switching diode D1 and a dual-tuned filter L2 and L3 to eliminate spurious components. It is then fed to a 20dB amplifier Q2.

The output signal from Q2 is fed through D2 to the first mixer, which converts the signal to the desired frequency. The converted signal is fed through a band-pass filter for the band of operation and D40 to a 20dB amplifier Q11. The Q11 output, approximately +13dBm, is passed to the PA unit through J8.

The ALC voltage is supplied to the gate of Q2, and the ALC attack time constant is determined by R6 and C9.

4-2-3 RF SECTION (PA Unit)

The RF signal input from the RF unit through P1 is amplified by class A amplifier Q1. The output from Q1 is converted to a balanced output by L2 and amplified by the class AB push-pull amplifier Q2 and Q3. The negative feedback circuit, consisting of R10, C5, R11 and C6 inserted between the collectors and the bases of Q2 and Q3, prevents the amplification factor from changing for various frequencies.

The idling current of Q2 and Q3 is controlled by the junction voltage of D1. The current is set at about 100mA by R6. D1 senses the heat of Q3 for temperature compensation by Q2 and Q3.

The output of Q2 and Q3 is fed to the impedance-matching section L4 and amplified by the class AB push-pull amplifier Q4 and Q5 to provide 100 watts of output power.

Q6 comprises the bias circuit for Q4 and Q5 using the regulated voltage. The idling current is set at about 600mA by R21.

A portion of the output power from Q4 and Q5 is applied to the bases of these transistors through the negative feedback transformer L7 to reduce the variations in the gain factor over the frequency range from 1.9MHz to 30MHz.

The output from Q4 and Q5 is then fed to L8 for impedance conversion and output to the FILTER unit from P2.

Thermal switches S1 and S2 detect the Q4 and Q5 temperatures and control the cooling fan and the output power reduction circuit.

If the temperature increases, S1 is turned on at about 70 deg. C which places the cooling fan in the high-speed mode. When the temperature reaches about 80 deg. C, S2 is turned on and sends a signal to the MAIN unit to reduce the transmit power to 50 watts.

In the transmit mode, a voltage is applied to the base of Q7 which turns it on, and a voltage is also applied to the fan motor through R23 which places the fan in the low-speed mode.

4-2-4 FILTER UNIT

The RF output from the PA unit is fed to the FILTER unit to eliminate harmonic components. The desired filter is selected by the BAND switch on the front panel.

The filtered output signal passes through the SWR detecting transformer L17 to the antenna connector on the rear panel.

4-3 PLL CIRCUITS

4-3-1 PLL CIRCUIT

This unit contains a down conversion type PLL circuit.

Q1 oscillates at 13.666MHz, which is multiplied 9 times by two triplers Q2 and Q3, and is then fed to the mixer Q4. The signal from the VCO, Q6, is input to Q4 through the buffer amplifiers Q7 and Q8. The output signal (9 – 16MHz) from Q4 is amplified by Q5 and fed to IC1, which is a PLL IC consisting of a programmable divider, reference frequency oscillator, divider, and phase detector.

A 9MHz signal generated by crystal X1 at Pins 2 and 3 is divided by the internal divider for a 10kHz reference frequency signal, which is then input to the phase detector. The signal applied through Pin 9 is fed to the programmable divider, and the frequency data are fed through Pins 4 – 8 from the CPU. The output signal is input to the phase detector.

The output signal from the phase detector is fed through Pin 14 to a loop-filter of R29, R30, and C36, where the

signal is converted to a DC signal and fed to a varactor diode D2.
The VCO puts out a 10kHz step signal between 132 – 139 MHz from Q7 to IC2, where the signal is divided by 10 to make 1kHz-step signals between 13.2 – 13.9MHz.
This unit controls the frequency between the 100kHz digit and the 1kHz digit of the operating frequency. 13.2MHz is for the bottom of the 700kHz band and 13.9MHz is for the top.

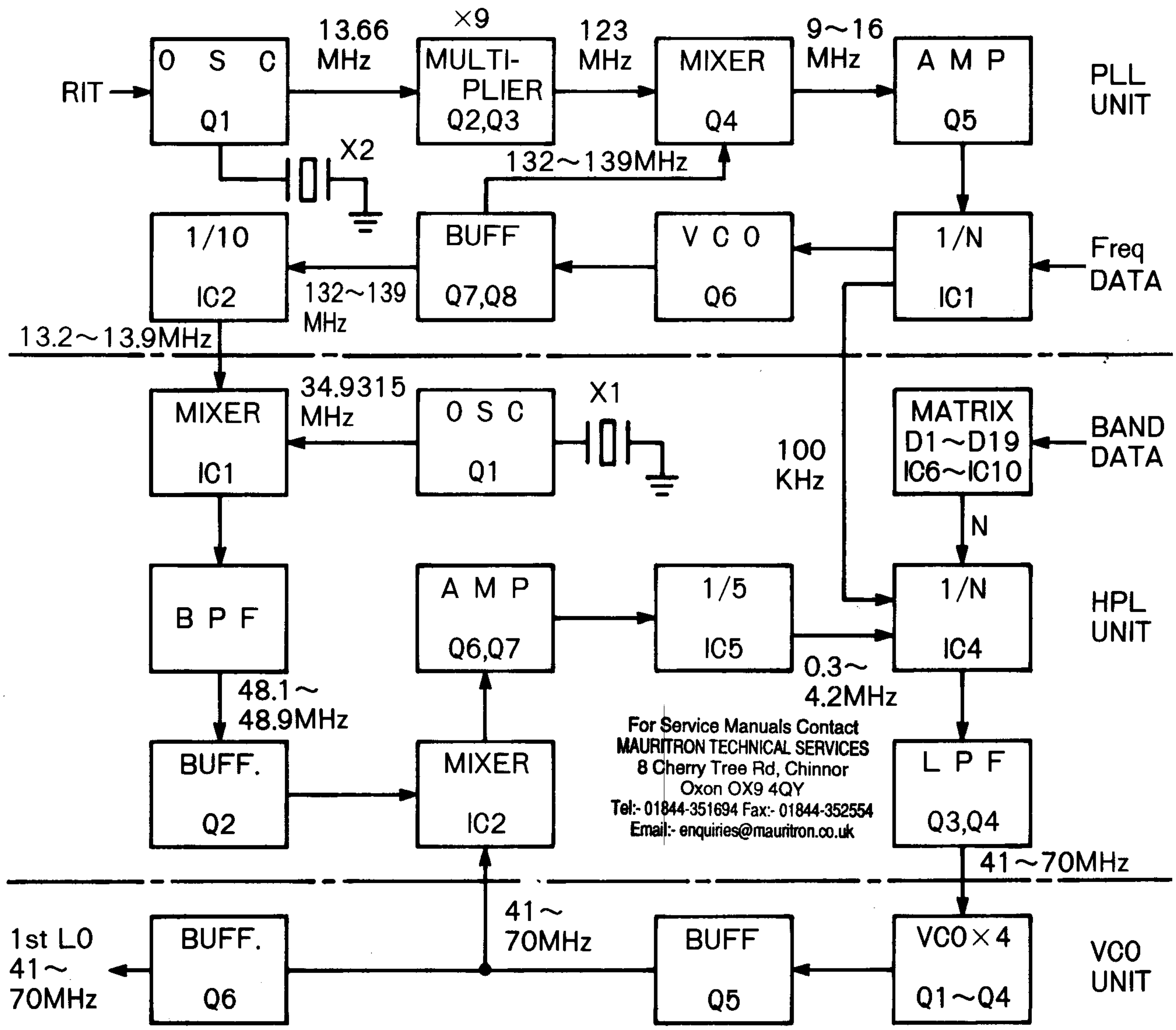
4-3-2 VCO CIRCUITS

This unit is the last stage of the local oscillator section and is very important to keep the output signal clean from spurious and sideband noise.
The VCO circuit is divided into four segments: Q1 controls the local oscillator for the 1.8, 3.5 and 7MHz bands, Q2 is for 10 and 14MHz, Q3 is for 18 and 21MHz, and Q4 is 24.5, 28, and 29MHz. To cover a wide frequency range, C5 is switched by applying a voltage to Q1 through D3.
Diodes D4, D6, D8 and D10 switch the signal from each segment. The signal is fed through an emitter follower Q5, for impedance matching, to Q6. The emitter follower allows stable VCO operation against external impedance variation.
The output signal from Q6 passes through an HPF and LPF L12 – L14, C46 – C52, and C58 to suppress spurious radiation.
A portion of the output signal from Q5 is fed through C57 to the HPL unit.

4-3-3 HPL UNIT

The PLL output signal which passes through J1 to Pin 3 of IC1 and the offset oscillator signal from Q1 to Pin 7 are mixed in IC1. A 48MHz signal is filtered by BPF L2 – L4, C9, C11, C15 – C17, and is fed through Q2 and C19 to Pin 3 of IC2.
The VCO output signal through J2 is amplified by Q5 and fed through C20 to Pin 7 of mixer IC2, from which the mixed signal passes through matching transformer L6 to an LPF to suppress unwanted spurious signals. The signal is fed to IC5, through amplifier Q7 and level converter Q6, where the signal is divided by five and output to Pin 11 of IC4.

BLOCK DIAGRAM



IC4 is a PLL IC with a programmable divider, reference frequency oscillator, divider and phase detector. In this circuit, the reference frequency oscillator and divider are not used. The signal divided by the programmable divider is fed to the phase detector.
The signal from the band switch is input through P2 and P3 from the matrix unit, converted to the desired divider data for the band of operation by D7 – D19 and IC6 – IC10, and fed to Pin 13 – 19 of IC4.

As the reference frequency signal, a 100kHz signal is obtained from Pin 12 of IC1 in the PLL unit and input to P1 on the HPL unit. The signal is fed through voltage divider R42 and R43 to the phase detector from Pin 5 of IC4. The phase detector output signal from Pin 2 is smoothed by a loop filter comprised of Q3, Q4, R12, R13, R15 and C27, and fed to a varactor diode of the VCO unit through J3.
D1 through D6 are encoders to set the VCO division for each band.

FREQUENCY CHART

BAND (MHz)	HPL IC4N-DATA	VCO	VCO FREQUENCY	HPL IC2 OUTPUT
1.8	14	Q1	41.1315MHz ~ 41.8315MHz	7.0MHz
3.5	10		43.1315MHz ~ 43.8315MHz	5.0MHz
7	3		46.6315MHz ~ 47.3315MHz	1.5MHz
10	3	Q2	49.6315MHz ~ 50.3315MHz	1.5MHz
14	11		53.6315MHz ~ 54.3315MHz	5.5MHz
18	19	Q3	57.6315MHz ~ 58.3315MHz	9.5MHz
21	25		60.6315MHz ~ 61.3315MHz	12.5MHz
24.5	32	Q4	64.1315MHz ~ 64.8315MHz	16.0MHz
28	39		67.6315MHz ~ 68.3315MHz	19.5MHz
28.5	40		68.1315MHz ~ 68.8315MHz	20.0MHz
29	41		68.6315MHz ~ 69.3315MHz	20.5MHz
29.5	42		69.1315MHz ~ 69.8315MHz	21.0MHz

4-4 LOGIC CIRCUIT

This unit provides frequency control, output of the band signal, PLL data, and display data. For lower power consumption and higher speed operation, a 4-bit C MOS CPU is employed.

4-4-1 CPU

The 42-pin plastic package IC1 is a CPU with a 400kHz cera-lock (ceramic oscillator unit) connected to clock terminals CL0, Pin 1, and CL1, Pin 42.

Port A: a 4-bit input port from the matrix circuit
Port B: a 4-bit input port from the rotary encoder
Port C: a 4-bit port for the D/A outputs
Port D: a 4-bit port for the D/A outputs
Port E: a 4-bit output port for various applications
Port F: a 2-bit port for the strobe output
Port G: not used
Port H: not used
Port I: an output port for the rotary encoder reset

When the power is turned on, the regulated 5V is applied by voltage regulator IC10 to IC1. The voltage integrated by C20 and R35 is fed to Pin 13 of IC9 to generate an initial reset signal for the CPU. On receiving the reset signal, the CPU outputs the necessary signals to initialize all the ports, and then starts the main routine.

4-4-2 ROTARY ENCODER CIRCUIT

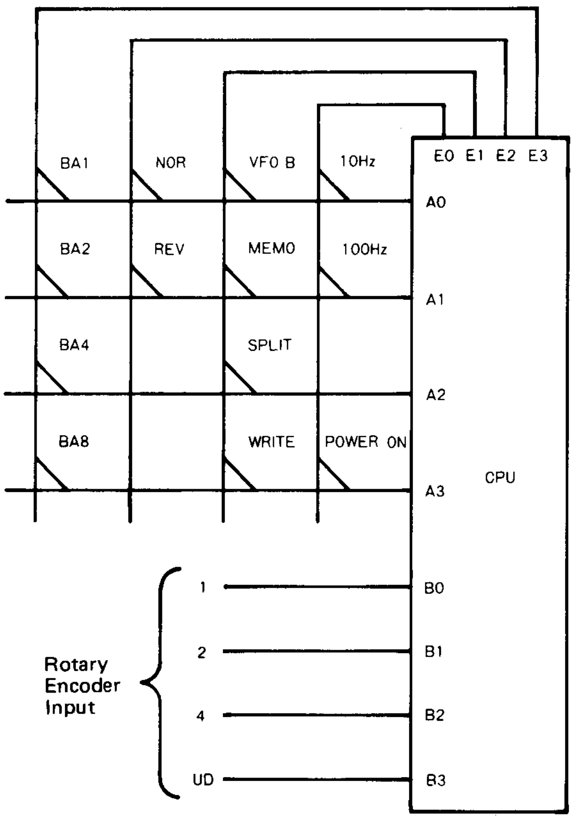
Two signals from the rotary encoder are input to SENS1 and SENS2 terminals, then waveform shaped by the two Schmitt trigger circuits consisting of IC2, R2, R3, R5 and R6. One of the two signals is fed to pin 5 of IC3 and the other signal is time delayed by R7 and C1, then fed to pin 6. IC3 puts out two pulses at the leading edge and the trailing edge. The circuit, consisting of an IC3 gate pins 1, 2, 3, and R8 and C2, works the same as above. Chattering that appears on the output signals of IC3 pins 3 and 4 is removed by IC4.
The leading edge and trailing edge of the signal is detected by C3 and R9, and C4 and R10, then fed to an OR gate consisting of IC3 pins 12 and 13. This output is fed to a three bit counter consisting of IC6 and IC7, then IC9 pin 8 through an OR gate consisting of D16, D17 and D18. The signal is inverted at IC9 and fed to the CPU pin 6 (INT terminal).

The INT terminal of the CPU is an interrupt terminal. The CPU works prior to other functions with the I/O port inputs of B0 – B3. It puts a reset signal for resetting the three bit counter and the up/down latch.

4-4-3 INPUT MATRIX CIRCUIT

BA1–BA8 are used to send a band select signal in hexadecimal to the CPU. This signal is input to J10 on the LOGIC unit through the matrix circuit board. The level of the signal is converted from 13.8V to 5V by R23 through R26 and by D1 through D4, and the signal is fed to A0 through A3 terminals of the CPU.

NOR and REV matrices select USB or LSB automatically according to the band setting. When the mode switch on the front panel is at NOR, LSB is selected below 10MHz; when it is at REV, USB is selected.



BAND DATA

BAND (MHz)	FREQUENCY RANGE	CPU INPUT				
		BCD				HEX
1.8	1.4000 ~ 2.0999	0	1	0	0	2
3.5	3.4000 ~ 4.0999	0	1	0	0	2
7	6.9000 ~ 7.5999	1	1	0	0	3
10	9.9000 ~ 10.5999	0	0	1	0	4
14	13.9000 ~ 14.5999	1	0	1	0	5
18	17.9000 ~ 18.5999	0	1	1	0	6
21	20.9000 ~ 21.5999	1	1	1	0	7
24.5	24.4000 ~ 25.0999	0	0	0	1	8
28	27.9000 ~ 28.5999	1	0	0	1	9
28(28.5)	28.4000 ~ 29.0999	0	1	0	1	A
28(29)	28.9000 ~ 29.5999	1	1	0	1	B
28(29.5)	29.4000 ~ 30.0999	0	0	1	1	C

4-4-4 TUNING RATE CIRCUIT

The tuning rate signal from the front panel is fed through J3 to IC11. When the generation speed of the signals from the rotary encoder is slow, R31 and D23 keep the voltage of C26 from becoming high enough to drive the Schmitt trigger circuit of Pins 4 – 6 of IC12, R30 and R32. For this reason, the tuning rate signal passes through Pins 4 – 6 or Pins 1 – 3 of IC11 for the selected tuning rate (10Hz or 1kHz). When the tuning control knob is rotated quickly while the tuning rate of 10Hz is selected, the signal frequency at D23 becomes high so that the voltage at C26 becomes high enough to drive the Schmitt trigger circuit of IC12. The level at Pin 4 of IC12 becomes high and drives Pins 2, 5, 12 and 13 of IC11. An edge trigger, Pins 11 – 13 of IC11, detect leading edges to stop the interrupt operation temporarily through D12. The sensor signal is read by interrupts so that no other signals are accepted during this operation. At the same time, the level of Pin 4 of IC11 is changed to low by the signal at Pin 5 and the rate is set at 1kHz for the fast tuning speed.

4-4-5 SPLIT FREQUENCY CIRCUIT

T8V from Pin 5 of J10 is divided by R27 and R18 and input to Pin 8 of IC5. The VFO select signal is read through Pin 35 (A2) of the CPU, and the VFO is switched between A and B according to the T/R switch.

4-4-6 CPU RESET CIRCUIT

When the power switch is turned on, the power voltage rise is delayed by R38 and C16 and input to Pin 9 of IC12 through a Schmitt trigger of Pins 4 – 6 of IC9. IC12 outputs a signal with the proper timing as a power-on signal for the CPU through D11.

The output signal from Pin 4 of IC9 is input to Pin 2, and then its output signal from Pin 3 is used as a reset signal for the display IC.

4-6-7 MIC UP/DOWN CONTROL CIRCUIT

The voltage at the UD terminal is about the same as the power voltage level when neither the UP nor DOWN switch is pushed; it becomes ground level when the UP switch is pushed; and mid-level when DOWN is pushed. When the UP or DOWN switch is pushed, a multi-vibrator Q2 outputs signals which are fed through a differentiator comprised of C11 and R46 to Pin 6 of IC7 in a like manner as when the CPU reads the signals from the tuning control encoder.

When the UD terminal becomes high or medium level, Q1 is turned on and its output becomes low. When the UD terminal becomes low, the output of Q1 becomes high to drive Pin 8 of IC7 to obtain the UD signal to the CPU through B3.

R17, C9 and D14 change the frequency shift timing rate between the first shift and following shifts.

Pins 8 – 10 of IC7 connect to a malfunction protection circuit for the end of the Mic Up/Down operations. When the collector of Q1 is switched from high to low, the signal